Department of Environment
and Resource Management

Environmental Protection (Water) Policy 2009

Pine Rivers and Redcliffe Creeks environmental values and water quality objectives

Basin No. 142 (part), including Hays Inlet and all tributaries of the North Pine and South Pine rivers

July 2010

Queensland Government

Prepared by:
Water Quality & Ecosystem Health Policy Unit
Department of Environment and Resource Management

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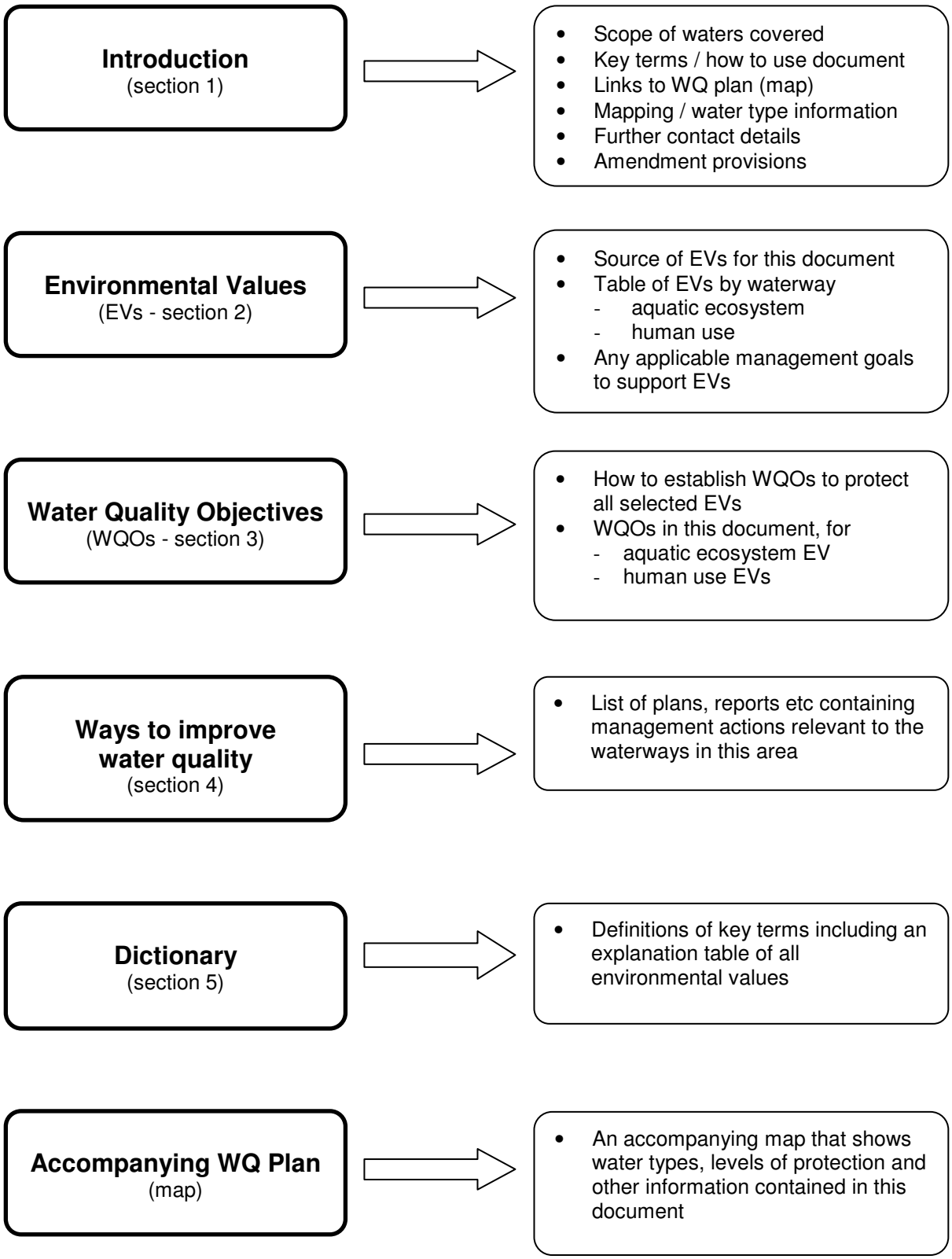
Main parts of this document and what they contain



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1 Introduction

This document is made pursuant to the provisions of the *Environmental Protection (Water) Policy 2009* (the EPP [Water]), which is subordinate legislation under the *Environmental Protection Act 1994*. The EPP (Water) provides a framework for:

- identifying environmental values for Queensland waters, and deciding the water quality objectives to protect or enhance those environmental values; and
- including the identified environmental values and water quality objectives under Schedule 1 of the EPP (Water).

This document contains environmental values and water quality objectives for waters in the Pine Rivers and Redcliffe Creeks catchment, and is listed under schedule 1 of the EPP (Water).

1.1 Waters to which this document applies

This document applies to fresh, estuarine and marine surface waters and ground waters draining the catchment of Pine Rivers and Redcliffe Creeks, as indicated in the accompanying plan (WQ1421)[1]. These waters fall within the broader Pine basin (basin 142)[2]. Waters covered by this document include:

- North and South Pine Rivers;
- Lake Samsonvale and Lake Kurwongbah;
- One Mile, Four Mile, Saltwater and Freshwater Creeks;
- Hay's Inlet;
- Redcliffe Peninsula creeks (including constructed channels);
- other fresh and estuarine waters within the Pine Rivers and Redcliffe Creeks catchment;
- tidal canals, constructed estuaries, marinas and boat harbours;
- wetlands; and
- groundwaters.

The geographical extent of waters addressed by this document is shown in the plan (WQ1421), and is broadly:

- north to the boundary of the Pine Rivers and Redcliffe Creeks catchment with the Caboolture River catchment;
- west to the boundary of the Brisbane basin (basin 143);
- south to the boundary of the of the Pine Rivers and Redcliffe Creeks catchment with the boundary of the Brisbane River estuary catchment and the Brisbane Creeks – Bramble Bay catchment (excluding a small area of upper South Pine waters within Brisbane City, which is included in the scheduling document for Brisbane Creeks – Bramble Bay catchment); and
- east to the waters of western Moreton Bay.

[1]This document and the accompanying plan are available in electronic form from the Environmental Values web page on the Department of Environment and Resource Management (DERM) website: http://www.derm.qld.gov.au/. The boundaries in the accompanying plan WQ1421 are indicative only. The water types and management intent (level of protection) depicted in the accompanying plan are stored in electronic form as part of the SEQ Environmental Values Schedule 1 Database July 2010 and held at the DERM offices at 41 George Street Brisbane. Database regions are based on the regions established in the Queensland water quality guidelines. For further information on accessing the database, please contact DERM by email at epa.ev@derm.qld.gov.au.

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

1.2 Guidance on using this document

1.2.1 Key terms

Key terms used in this document are explained below. Additional detail is provided in the dictionary at the end of the document:

ADWG: means the Australian drinking water guidelines (2004), prepared by the National Health and Medical Research Council (NHMRC) in collaboration with the Natural Resource Management Ministerial Council (NRMMC)[3].

AWQG: means the Australian and New Zealand guidelines for fresh and marine water quality (October 2000), prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)[4].

Environmental Values (EVs) for water: means the EVs specified in Table 1 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 they can potentially apply to are listed below, and further details are provided in the dictionary (refer Section 5).

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; and • Highly disturbed waters. [suitability for seagrass and wildlife habitat have also been specifically identified for some waters as a component of this EV]	✓	✓
EVs other than aquatic ecosystem EV (called human use EVs)		
Suitability for human consumers of wild or stocked fish, shellfish or crustaceans [suitability for oystering has also been specifically identified for some waters]	✓	✓
Suitability for primary contact recreation (eg swimming)	✓	✓
Suitability for secondary contact recreation (eg boating)	✓	✓
Suitability for visual (no contact) recreation	✓	✓

[3] The Australian drinking water guidelines (2004) can be downloaded from the following website: http://www.nhmrc.gov.au/publications/synopses/eh19syn.htm

[4] The AWQG (2000) can be downloaded from the following website: http://www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality

Environmental Value (EV)	Potentially applicable to:	
	Tidal waters	Fresh (non-tidal) waters
Protection of cultural and spiritual values, including Traditional Owner values of water	✓	✓
Suitability for industrial use (including manufacturing plants, power generation)	✓	✓
Suitability for aquaculture (eg red claw, barramundi)	✓	✓
Suitability for drinking water supplies		✓
Suitability for crop irrigation		✓
Suitability for stock watering		✓
Suitability for farm supply/use		✓

Level of protection for a water (aquatic ecosystem EV): means the level of aquatic ecosystem condition specified in Table 2 of this document that the corresponding water quality objectives for that water are intended to achieve (refer to management intent definition below for further information).

Management goal: means the goals (if any) stated in section 2 of this document to support the EVs for waters identified in Table 1.

Management intent (level of protection) for a water (aquatic ecosystem EV): means the level of aquatic ecosystem condition specified in Table 2 of this document that the corresponding water quality objectives for that water are intended to achieve. For example, the intent for high ecological value waters is that their effectively unmodified condition is maintained.

QWQG: means the Queensland water quality guidelines, prepared by the Department of Environment and Resource Management (2009)[5].

Water quality guidelines (defined in the EPP [Water]): are numerical concentration levels or statements for indicators that protect a stated environmental value. Under the EVs setting process contained in the EPP (Water), water quality guidelines are used as an input to the development of water quality objectives.

Water quality indicator (for an EV): 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 2–14 of this document to support the EVs for waters identified in Table 1.

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. They are based on scientific criteria or water quality guidelines but may be modified by other (eg social, cultural, economic) inputs.

Examples of WQOs include:
- total phosphorus concentration <20 micrograms per litre (µg/L);
- chlorophyll a concentration <1 µg/L;
- dissolved oxygen between 95% and 105% saturation;
- family richness of macroinvertebrate > 12 families; and
- exotic individuals of fish < 5%.

[5] The Queensland water quality guidelines can be downloaded from the DERM website at: http://www.derm.qld.gov.au/environmental_management/water/queensland_water_quality_guidelines/

Water type: groupings of waters with similar characteristics, as shown in the accompanying plan. The water types covered by this document are based on mapping and definitional rules for water types established in the QWQG and, where available, other site-specific documents. Water types can include coastal marine waters (open coastal, enclosed coastal), estuarine waters (lower, middle and upper estuaries), tidal canals, constructed estuaries, marinas and boat harbours, freshwaters (lowland, upland, lakes/reservoirs), wetlands and groundwaters. WQOs applying to different water types are outlined in this document. More detail on water types is provided in section 1.4.

1.2.2 Main parts of this document

The main components of this document are:

- Plan WQ1423 – showing the spatial extent and boundaries of water types covered by this document;
- Section 1 – introduction and guidance on how to use the document;
- Section 2 (Table 1) – environmental values (EVs) applying to waters covered by this document;
- Section 3 (Tables 2–14) – water quality objectives (WQOs) applying to different EVs:
  - Tables 2 to 3 and 14 provide WQOs to protect the aquatic ecosystem EV, and closely link to the water types shown on Plan WQ1423;
  - Tables 4 to 13 provide WQOs to protect human use EVs;
- Section 4 – ways to improve water quality: containing a list of relevant documents, provided for information purposes only; and
- Section 5 – a dictionary of other terms relevant to EVs and WQOs.

1.2.3 Use of this document

Section 2 (Table 1) lists the identified EVs for protection for particular waters. The aquatic ecosystem EV is a default applying to all waters. Reference to section 3 (Tables 2–3 and 14) provides the corresponding WQOs to protect the aquatic ecosystem EV. Where relevant, different WQOs are specified to protect the aquatic ecosystem EV in different water types (refer to the tables and the accompanying plan). For the human use EVs specified for a water in Table 1, Tables 4–13 provide the corresponding WQOs to support these EVs.

Where reference to Table 1 indicates 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. Further detail on selection of most stringent WQOs is provided in section 3.

This document also refers to a number of guidelines, codes and other reference sources on water quality. In particular, the Queensland water quality guidelines (QWQG) prepared by DERM provide a technical basis for the water quality objectives contained in this document. The QWQG also provide more detailed information on water types, water quality indicators, derivation of local water quality guidelines, application during flood events, monitoring, predicting and assessing compliance.

1.3 Information about mapped areas and boundaries

The boundaries in the accompanying plan WQ1423 are indicative only. The water types and management intent (level of protection) depicted in the accompanying plan are stored in electronic form as part of the South East Queensland Environmental Values Schedule 1 Database July 2010 and held at the offices of DERM at 41 George Street Brisbane. Database regions are based on the regions established in the Queensland water quality guidelines. For further information on accessing the accompanying plan and database, please contact the Department by email at epa.ev@derm.qld.gov.au.

1.4 Water types and basis for boundaries

1.4.1 Water types

Waters in this document have been classified into different water types from the list below. The water types are based on the AWQG (2000) and mapping and definitional rules contained in the QWQG (2009). Further detail on water types is contained in these sources.

- open coastal: waters extending to the seaward limits of Queensland waters;
- enclosed coastal/lower estuary: waters occurring at the downstream end of estuaries and including shallow coastal waters in adjacent enclosed bays;
- 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;
- upper estuary: waters in the upper reaches of estuaries, with limited flushing. This water type is absent from short estuaries, less than 15km total estuary length;
- tidal canals, constructed estuaries, marinas and boat harbours;
- lowland freshwaters: larger slow flowing freshwater streams and rivers, shown on the accompanying plan as freshwaters under 150 metres altitude. This water type has been further divided into three sub types in south east Queensland, derived from work carried out for the Ecosystem Health Monitoring Program[6]:
  - **lowland freshwaters**: Larger (third, fourth and fifth order), slow flowing and meandering streams and rivers. Gradient very slight. Substrates sometimes cobble and gravel but more often silt, sand or mud.
  - **wallum/tannin-stained freshwaters:** Tannin-stained**,** generally low gradient, small to mid-sized streams, many with sandy substrates and low pH, tea-coloured water draining through wallum vegetation.
  - **coastal freshwaters**: Mix of small and large slow-flowing lowland rivers and creeks between Caboolture and the NSW border, that flow across the coastal plain. Substrates are often cobble despite the low gradient. Does not include steeper upland streams that feed these systems.
- upland freshwaters: small upland streams, moderate – fast flowing with steeper gradients than lowland freshwaters. Shown on the accompanying plan as freshwaters above 150 metres altitude;
- freshwater lakes/reservoirs;
- groundwaters; and
- wetlands.

Water types identified in this document are shown in Tables 2–3 and the accompanying plan (WQ1423).

1.4.2 Water type boundaries

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

1) geographic coordinates;
2) catchment or sub-catchment boundaries;
3) highest/lowest astronomical tide;
4) tidal limiting structure (weirs);
5) maritime mapping conventions;
6) coastline;
7) surveyed terrestrial boundaries; and
8) altitude.

The basis of different boundaries is shown in the plan. The boundaries of water types may be confirmed or revised by site investigations. Refer section 1.3 above.

[6] Refer Queensland Water Quality Guidelines (DERM, 2009) and EHMP (2004) Ecosystem Health Monitoring Program 2003-2004 Annual Technical Report. Moreton Bay Waterways and Catchments Partnership.

1.5 Matters for Amendment

Amendments of the following type may be made to this schedule 1 document for the purposes of replacement under section 12(2)(b) of the EPP (Water):

- 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; and
- Updates to information/data sources, web sites and email contact details, agency/departmental names, other institutional names, references.

2 Environmental values (EVs)

2.1 Environmental Values

Table 1 outlines the environmental values (EVs) for waters in the Pine Rivers and Redcliffe Creeks catchment. These are based on a combination of:

- EVs in the *South East Queensland Regional Water Quality Management Strategy*, 2001;
- *Environmental Values and Water Quality Objectives for Wivenhoe, Somerset and North Pine Dam, SEQ Water*, 2005;
- Pine Rivers Shire Council Stream Health Manual (May, 2004); and
- Work carried out by DERM as part of the EVs/WQOs scheduling process.

The dictionary to this document provides further explanation of EVs - refer section 5.

2.2 Management Goals to support EVs

There are no management goals specified under this document.

Table 1 Environmental values (EVs) for Pine Rivers and Redcliffe Creeks catchment waters

	Environmental values [1, 2, 3, 4, 5]													
Water	**Aquatic ecosystems**	**Seagrass**	**Irrigation**	**Farm Supply/use**	**Stock water**	**Aquaculture**	**Human consumer**	**Oystering**	**Primary recreation**	**Secondary recreation**	**Visual recreation**	**Drinking water**	**Industrial use**	**Cultural and spiritual values**
North Pine River Upstream of Lake Samsonvale Laceys Creek Terrors Creek Kobble Creek	✓		✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
Lake Samsonvale (North Pine Dam)	✓		✓				✓			✓	✓	✓		✓
North Pine River Freshwater downstream of dam	✓		✓		✓					✓	✓	✓	✓	✓
North Pine River Tidal	✓	✓					✓		✓	✓	✓			✓
Kurwongbah Catchment Mosquito Creek	✓								✓	✓	✓	✓		✓
Lake Kurwongbah	✓									✓	✓	✓		✓
One Mile Creek Freshwater	✓								✓	✓	✓			✓
One Mile Creek Tidal	✓									✓	✓			✓
Cedar Creek	✓								✓	✓	✓			✓
Four Mile Creek Freshwater	✓		✓						✓	✓	✓			✓
Four Mile Creek Tidal	✓									✓	✓			✓
South Pine River Freshwater	✓		✓		✓		✓		✓	✓	✓			✓

Water	Environmental values [1, 2, 3, 4, 5]													
	Aquatic ecosystems	Seagrass	Irrigation	Farm Supply/use	Stock water	Aquaculture	Human consumer	Oystering	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural and spiritual values
South Pine River Tidal	✓						✓		✓	✓	✓			✓
Albany Creek - freshwater	✓									✓	✓			✓
Bald Hills Creek - freshwater	✓						✓			✓	✓			✓
Bald Hills Creek - including Tinchi Tamba Wetland - estuarine	✓						✓			✓	✓			✓
Saltwater Creek Freshwater	✓								✓	✓	✓			✓
Saltwater Creek Tidal	✓						✓			✓	✓			✓
Freshwater Creek Freshwater	✓								✓	✓	✓			✓
Freshwater Creek Tidal	✓						✓			✓	✓			✓
Griffin	✓	✓					✓			✓	✓			✓
Hay's Inlet	✓	✓					✓		✓	✓	✓			✓
Redcliffe Peninsula Creeks (including constructed channels) - freshwater	✓									✓	✓			✓
Redcliffe Peninsula Creeks (including constructed channels) - estuarine	✓									✓	✓			✓

	Environmental values [1, 2, 3, 4, 5]													
Water	**Aquatic ecosystems**	**Seagrass**	**Irrigation**	**Farm Supply/use**	**Stock water**	**Aquaculture**	**Human consumer**	**Oystering**	**Primary recreation**	**Secondary recreation**	**Visual recreation**	**Drinking water**	**Industrial use**	**Cultural and spiritual values**
Other tidal canals, constructed estuaries, marinas and boat harbours (not included in above waters)	✓						✓			✓	✓			✓
Other estuarine tributaries (not included in above waters)	✓						✓			✓	✓			✓
Other freshwater tributaries (not included in above waters)	✓		✓	✓	✓		✓			✓	✓			✓
Other wetlands, lakes and reservoirs (not included in above waters)	✓						✓			✓	✓			✓
Groundwaters	✓		✓	✓	✓							✓		

Notes:
1. ✓ means the EV is selected for protection.
2. Blank indicates that the EV is not chosen for protection.
3. Refer dictionary for further explanation of environmental values.
4. Refer to section 3 for water quality objectives applying to the EVs in this table.
5. Seagrass is a component of the aquatic ecosystem EV. Oystering is a component of the human consumer EV.

3 Water quality objectives (WQOs) to protect environmental values

This section provides water quality objectives (WQOs) to support and protect different environmental values identified for waters within the Pine Rivers and Redcliffe Creeks catchment in Table 1.

This section is in two main parts:

- Section 3.1 (Tables 2 to 3 and 14) outlines WQOs to protect the aquatic ecosystem EV. The aquatic ecosystem EV is a default applying to all 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; and

- Section 3.2 (Tables 4 to 13) provides WQOs for EVs other than aquatic ecosystem ('human use EVs') such as recreational water use, irrigating crops, and aquaculture.

Sources used in deriving WQOs are provided after the tables.

Reference to the identified EVs in Table 1 of this document provides guidance on the EVs applying to waters within the catchment. Where reference to Table 1 indicates more than one EV applies to a given water (for example aquatic ecosystem and recreational use), the most stringent WQO for each water quality indicator applies, which will then protect all identified EVs. Refer to the two following examples on selection of most stringent WQOs. Note that these are examples only and should not be directly adopted for use.

Example 1:
For lowland freshwater streams with aquatic ecosystem and drinking water EVs, the respective turbidity WQOs are:

- aquatic ecosystem lowland freshwater stream: <10 NTU; and
- drinking water: <25 NTU.

In this case the aquatic ecosystem WQO (<10 NTU) is the more stringent, and its adoption therefore supports both the aquatic ecosystem and drinking water EVs.

Example 2:

In the following situation there are stock watering and irrigation EVs, with differing WQOs for thermotolerant (faecal) coliforms (measured as median number of organisms per 100 mL):

- stock watering: <100 organisms per 100 mL;
- raw human food crops in direct contact with irrigation water: <10 organisms per 100 mL; and
- pasture and fodder for dairy animals: <100 organisms per 100 mL

The most stringent WQO is that for direct irrigation of raw human food crops (<10 organisms per 100 mL) and its adoption would in turn provide faecal coliform WQOs that protect all the above-identified human use EVs.

3.1 Water quality objectives (WQOs) to protect aquatic ecosystems

This section provides physico-chemical (section 3.1.1), biological (section 3.1.2) and riparian (section 3.1.3) WQOs to support the aquatic ecosystem EV. Sources used in deriving locally relevant WQOs are provided after the tables in each of these sections. Table 14 provides WQOs for waters within the former Pine Rivers Shire, based on the Pine Rivers Shire Council Stream Health Manual.

Section 5 of the *Queensland Water Quality Guidelines 2009* addresses procedures for the application of guidelines for aquatic ecosystem protection. For the comparison of test site monitoring data against water quality objectives, the median concentration of n independent samples at a particular monitoring site should be compared against the water quality objective of the same indicator, water type and level of aquatic ecosystems protection; as listed in Tables 2-14 below.

3.1.1 Physico-chemical WQOs

Table 2 below includes the following information:

- water area or water type (column 1) (for boundaries of specified areas, refer to the accompanying plan),
- the corresponding management intent (level of protection) for the identified waters (column 2),
- the corresponding physico-chemical WQOs to achieve the management intent for the identified waters.

The EPP (Water) identifies the management intent (level of protection) for different waters (s 14). In summary:

- It identifies some waters for which the management intent is to maintain or achieve an effectively unmodified waterway condition (high ecological value - HEV). These may include waters that are currently HEV, slightly disturbed, or potentially, more modified waters which can be progressively improved to achieve HEV condition. Any such waters are identified in Columns 1 and 2 of Table 2 and are identified and labelled on the accompanying plan in cross-hatching.
- The management intent (level of protection) for most waters is to achieve a moderately disturbed condition, for which corresponding WQOs have been derived.
- The management intent (level of protection) for highly disturbed waters is that they be progressively improved. Some highly disturbed waters may require a long time frame to return to a moderately disturbed condition level. In some circumstances, interim WOQs that reflect a more highly disturbed condition level (which is an improvement on current condition) may be determined for such waters. Any such locations and their corresponding management intent (level of protection) are also identified in the table and accompanying plan.

Some objectives apply to specific areas or water types as indicated in Table 2 and shown on Plan WQ1423, while others apply to more than one water type, as indicated in the Table.

Table 2 Water quality objectives to protect aquatic ecosystem environmental value (refer to Plan WQ1423 for location of waters)

Water area/type (refer Plan WQ1423)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV [1-11]
MARINE AND ESTUARINE WATERS		**For full coverage of Moreton Bay waters, refer to the Moreton Bay scheduling document**
Area HEVa1282 and HEVa1283 – Western Bay (part)	Aquatic ecosystem – high ecological value	Achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. (Refer to Appendix D in Queensland Water Quality Guidelines for details.) The 20th, 50th and 80th percentiles to be achieved are: ▪ turbidity: 2 – 4 – 6 NTU ▪ chlorophyll a: 0.5 – 1.0 – 2.0 µg/L ▪ total nitrogen: 120 – 150 – 200 µg/L ▪ oxidised N: 2 – 2 – 2 µg/L ▪ ammonia N: 2 – 3 – 5 µg/L ▪ organic N: 110 – 150 – 190 µg/L ▪ total phosphorus: 15 – 22 – 30 µg/L ▪ filterable reactive phosphorus (FRP): 6 – 10 – 14 µg/L ▪ dissolved oxygen: 95 – 100 – 105% saturation ▪ pH: 8.1 – 8.2 – 8.4 ▪ secchi depth: 1.3 – 2.0 – 3.0m (note: minimum secchi depth needed to restore seagrass to areas where it has been lost is 1.7m) Maintain the existing seagrass depth limit for *Zostera muelleri* of -1.9m AHD (50th percentile)
Area HEVa1341 – Hays Inlet	Aquatic ecosystem – high ecological value	Achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. (Refer to Appendix D in Queensland Water Quality Guidelines for details.) Note: there is insufficient information available to establish WQOs for these waters. Refer to Appendix D in Queensland Water Quality Guidelines for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.
Area HEVa1342 – Tinchi Tamba Wetlands	Aquatic ecosystem – high ecological value	Achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. (Refer to Appendix D in Queensland Water Quality Guidelines for details.) Note: there is insufficient information available to establish WQOs for these waters. Refer to Appendix D in Queensland Water Quality Guidelines for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.
Area W2 – Western Bay, including: ▪ Hays Inlet / Bramble Bay	Aquatic ecosystem – moderately disturbed	• turbidity: <6 NTU • chlorophyll a: <2.0 µg/L • total nitrogen: <200 µg/L • oxidised N: <2 µg/L • ammonia N: <5 µg/L • organic N: <190 µg/L • total phosphorus: <30 µg/L • filterable reactive phosphorus (FRP): <14 µg/L • dissolved oxygen: 95 – 105% saturation

Water area/type (refer Plan WQ1423)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV [1-11]
		• pH: 8.1 – 8.4 • secchi depth: >1.3m (note: minimum secchi depth needed to restore seagrass to areas where it has been lost is 1.7m) Maintain the existing seagrass depth limit for *Zostera muelleri* of -1.9m AHD (50th percentile) for Waterloo Bay and -3.0m AHD (50th percentile) for Deception Bay
Enclosed coastal	Aquatic ecosystem – moderately disturbed	• turbidity: <6 NTU • suspended solids: <15 mg/L • chlorophyll a: <2 µg/L • total nitrogen: <200 µg/L • oxidised N: <3 µg/L • ammonia N: <8 µg/L • organic N: <180 µg/L • total phosphorus: <20 µg/L • filterable reactive phosphorus (FRP): <6 µg/L • dissolved oxygen: 90 – 105% saturation • pH: 8.0 – 8.4 • secchi depth: >1.5m (note: minimum secchi depth needed to restore seagrass to areas where it has been lost is 1.7m)
Mid estuary – within/adjoining bay, strait or passage	Aquatic ecosystem – moderately disturbed	For waters shown on the plan as being mid estuary and occurring within/adjoining bay, strait, or passage: These waters may have water quality characteristics more in common with the adjacent downstream Western Bay (W2) water area. Under such circumstances, reference should be made to WQOs for the W2 water area (listed above). For mid estuary waters within/adjoining channels, refer below.
Mid estuary	Aquatic ecosystem – moderately disturbed	• turbidity: <8 NTU • suspended solids: <20 mg/L • chlorophyll a: <4 µg/L • total nitrogen: <300 µg/L • oxidised N: <10 µg/L • ammonia N: <10 µg/L • organic N: <280 µg/L • total phosphorus: <25 µg/L • filterable reactive phosphorus (FRP): <6 µg/L • dissolved oxygen: 85 – 105% saturation • pH: 7.0 – 8.4 • secchi depth: >1.0m

Water area/type (refer Plan WQ1423)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV [1-11]
Tidal canals, constructed estuaries, marinas and boat harbours	Aquatic ecosystem – moderately disturbed	• turbidity: <8 NTU • suspended solids: <20 mg/L • chlorophyll a: <4 µg/L • total nitrogen: <300 µg/L • oxidised N: <10 µg/L • ammonia N: <10 µg/L • organic N: <280 µg/L • total phosphorus: <25 µg/L • filterable reactive phosphorus (FRP): <6 µg/L • dissolved oxygen: 85 – 105% saturation • pH: 7.0 – 8.4 • secchi depth: >1.0m
Upper estuary	Aquatic ecosystem – moderately disturbed	• turbidity: <25 NTU • suspended solids: <25 mg/L • chlorophyll a: <8.0 µg/L • total nitrogen: <450 µg/L • oxidised N: <15 µg/L • ammonia N: <30 µg/L • organic N: <400 µg/L • total phosphorus: <30 µg/L • filterable reactive phosphorus (FRP): <10 µg/L • dissolved oxygen: 85 – 105% saturation • pH: 7.0 – 8.4 • secchi depth: >0.5m
For ALL marine and estuarine waters within this Table	All	Toxicants in water and sediment as per AWQG (2000): • Toxicants in water: refer to AWQG section 3.4 - 'water quality guidelines for toxicants' (including Tables 3.4.1, 3.4.2, and Figure 3.4.1) • Toxicants in sediments: refer to AWQG section 3.5 - 'sediment quality guidelines' (including Table 3.5.1, Figure 3.5.1) Release of sewage from vessels to be controlled in accordance with requirements of the *Transport Operations (Marine Pollution) Act and Regulations.* Comply with Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC.

Marine/estuarine waters with seagrass component chosen	Aquatic ecosystem - moderately disturbed	The minimum WQOs needed to restore seagrass to areas where it has been lost are:
		• median total suspended solids: <10 mg/L;
		• median secchi depth: >1.7 m; and
		• light attenuation coefficient: >0.9.
		
		However, in areas where seagrass is intact, it is more important to maintain existing water quality. Therefore the WQOs are:
		• local total suspended solids, turbidity, secchi and light attenuation is maintained; and
		• local seagrass distribution and composition is maintained, as measured by:
		  • extent of seagrass;
		  • species diversity; and

Water area/type (refer Plan WQ1423)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV [1-11]
		• seagrass depth limit.
Marine/estuarine riparian areas	Aquatic ecosystem – moderately disturbed	Protect or restore riparian areas. Refer section 3.1.3 – riparian area water quality objectives.
FRESHWATERS		
Area PR1 – Pine Rivers (part)	Aquatic ecosystem – high ecological value	Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. For PR1 waters in the former Pine Rivers Shire, refer to Pine Rivers Shire Council Stream Health Manual (May, 2004). Table 14 and Map 1 provide extracts from the manual.
Freshwaters (within former Pine Rivers Shire)	Aquatic ecosystem – moderately disturbed	For slightly-moderately disturbed freshwaters in the former Pine Rivers Shire, refer to Pine Rivers Shire Council Stream Health Manual (May, 2004). Table 14 and Map 1 provide extracts from the manual.
Lowland freshwater (comprising lowland streams, wallum/tannin-stained streams and coastal streams)	Aquatic ecosystem – moderately disturbed	For moderately disturbed upland freshwaters outside the former Pine Rivers Shire, the following apply: • turbidity: <50 NTU • suspended solids: <6 mg/L • chlorophyll a: <5 µg/L • total nitrogen: <500 µg/L • oxidised N: <60 µg/L • ammonia N: <20 µg/L • organic N: <420 µg/L • total phosphorus: <50 µg/L • filterable reactive phosphorus (FRP): <20 µg/L • dissolved oxygen: 85 – 110% saturation • pH: 6.5 – 8.0 • secchi depth: n/a
Upland freshwater	Aquatic ecosystem – moderately disturbed	For moderately disturbed lowland freshwaters in the former Pine Rivers Shire, refer to Pine Rivers Shire Council Stream Health Manual (May, 2004). Table 14 and Map 1 provide extracts from the manual. For moderately disturbed lowland freshwaters outside the former Pine Rivers Shire, the following apply: • turbidity: <25 NT • suspended solids: <6 mg/L • chlorophyll a: <2 µg/L • total nitrogen: <250 µg/L • oxidised N: <40 µg/L • ammonia N: <10 µg/L • organic N: <200 µg/L

Water area/type (refer Plan WQ1423)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV [1-11]
		• total phosphorus: <30 µg/L • filterable reactive phosphorus (FRP): <15 µg/L • dissolved oxygen: 90 – 110% saturation • pH: 6.5 – 8.2 • secchi depth: n/a
Conductivity: refer to Appendix G in Queensland water quality guidelines	conductivity: refer to Appendix G in Queensland water quality guidelines	conductivity: refer to Appendix G in Queensland water quality guidelines
Freshwater lakes/reservoirs	Aquatic ecosystem – moderately disturbed	▪ turbidity range: 1 – 20 NTU ▪ suspended solids: n/d ▪ median chlorophyll a: <5 µg/L ▪ total nitrogen: <350 µg/L ▪ oxidised N: <10 µg/L ▪ ammonia N: <10 µg/L ▪ organic N: <330 µg/L ▪ total phosphorus: <10 µg/L ▪ filterable reactive phosphorus (FRP): <5 µg/L • dissolved oxygen: 90 – 110% saturation • pH: 6.5 – 8.0 • secchi depth: n/d

Redcliffe Peninsula constructed channels - freshwater	Aquatic ecosystem – moderately disturbed	Physico-chemical:
		• pH [(1)] - 6.5 to 8.5
		• Dissolved oxygen [(1)] - 80 to 105 percent saturation
		• Organic matter - NR
		• Total phosphorus [(1)] - 70 µg/L
		• Total nitrogen [(1)] - 650 µg/L
		• Chlorophyll-a [(1)] - 8 µg/L
		• Turbidity [(1)] - 20 NTU
		• Secchi depth [(1)] - >0.2 m
		• Suspended solids:
		  • 15 mg/L for combined wet and dry periods [(1)]
		  • 90%ile <100 mg/L for wet weather periods [(2)]

For ALL freshwaters within this Table	All	For additional biological WQOs, see Table 3. Toxicants in water and sediment as per AWQG (2000): • Toxicants in water: refer to AWQG section 3.4 - 'water quality guidelines for toxicants' (including Tables 3.4.1, 3.4.2, and Figure 3.4.1) • Toxicants in sediments: refer to AWQG section 3.5 - 'sediment quality guidelines' (including Table 3.5.1, Figure 3.5.1) Comply with Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC.
Freshwater riparian areas	Aquatic ecosystem – moderately disturbed	Protect or restore riparian areas. Refer section 3.1.3– riparian area water quality objectives.

Water area/type (refer Plan WQ1423)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV [1-11]
Groundwaters	Aquatic ecosystem – high ecological value	Where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters. Note: the AWQG [2000] recommends that that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. Where groundwaters are in good condition the intent is to maintain existing water quality (20th, 50th and 80th percentiles). There is insufficient information available to establish current water quality for groundwaters. Refer to Appendix D in Queensland water quality guidelines for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.
Wetlands	Aquatic ecosystem – moderately disturbed	Objectives as per AWQG (2000) and section 3.1.3.

Notes:

1. Oxidised N = NO_2 + NO_3. Units for nitrogen indicators are micrograms per litre (µg/L) N.
2. Units for phosphorus indicators are micrograms per litre (µg/L) P.
3. n/d = no data, n/a = not applicable for this indicator and water type.
4. DO objectives apply to daytime conditions. Lower values may occur at night but these should not be more than 10%–15% less than daytime values. DO values as low as 40% may occur in estuaries for short periods following material inflow events after rainfall. DO values <50% are likely to significantly impact on the ongoing ability of fish to persist in a waterbody. DO values <30% saturation are toxic to some fish species. These DO values should be applied as absolute lower limit objectives for DO. – see also section 4.2 of the QWQG. Very high DO (supersaturation) values can be toxic to some fish as they cause gas bubble disease.
5. DO values for freshwaters should only be applied to flowing waters. Stagnant pools in intermittent streams naturally experience values of DO below 50% saturation.
6. Wallum/tannin-stained waters contain naturally high levels of humic acids (and have a characteristic brown ti-tree stain). In these types of waters, natural pH values may range from 3.6 to 6.
7. During flood events or nil flow periods, pH values should not fall below 5.5 (except in wallum/tannin waters) or exceed 9.
8. Nutrient objectives do not apply during high flow events. See QWQG Section 5 and Appendix D for more information on applying guidelines under high flow conditions.
9. 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.
10. **Conductivity**. Under natural conditions, conductivity is highly dependent on local geology and soil types. The *Queensland Water Quality Guidelines 2009* (Appendix G) provides information on conductivity values in a set of 18 defined salinity zones throughout Queensland. For each zone, the *Queensland Water Quality Guidelines 2009* provide a range of percentile values based on data from all the sites within that zone. This provides a useful first estimate of background conductivity within a zone. However, even within zones there is a degree of variation between streams and therefore the values for the zone would still need to be ground truthed against local values.
11. **Temperature** varies both daily and seasonally, it is depth dependent and is also highly site specific. It is therefore not possible to provide simple generic water quality objectives (WQOs) for this indicator. The recommended approach is that local WQOs be developed. Thus, WQOs for potentially impacted streams should be based on measurements from nearby streams that have similar morphology and which are thought not to be impacted by anthropogenic thermal influences.
    From an ecological effects perspective, the most important aspects of temperature are the daily maximum temperature and the daily variation in temperature. Therefore measurements of temperature should be designed to collect information on these indicators of temperature and, similarly, local WQOs should be expressed in terms of these indicators. Clearly, there will be an annual cycle in the values of these indicators and therefore a full seasonal cycle of measurements is required to develop guideline values.

Sources:
The water quality objectives were determined from a combination of documents (and supporting data), including:

- Pine Rivers Shire Council Stream Health Manual (May, 2004)
- Queensland Water Quality Guidelines (2009);
- Australian Water Quality Guidelines (2000);
- water quality guidelines in the *Ecosystem Health Monitoring Program* (EHMP);
- water quality objectives in local studies and the *South East Queensland Regional Water Quality Management Strategy*, 2001 (SEQRWQMS);
- *Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance*, Australian and New Zealand Environment and Conservation Council (1997); and
- *Transport Operations (Marine Pollution) Act 1995* *and* *Regulations 2008*, Queensland Transport.

3.1.2 Biological WQOs

Table 3 provides biological water quality objectives for freshwaters (lowland streams, wallum/tannin-stained streams and coastal streams, upland streams) throughout the catchment, as shown on the plan.

Table 3 Aquatic ecosystem EV: Biological water quality objectives for freshwater streams (refer to Plan WQ1423 for location of streams) [1, 2, 3, 4, 5]

Indicator [4]	Percentile used	Wallum /tannin-stained freshwater	Lowland freshwater	Upland freshwater	Coastal freshwater	Operant [5]	Units
Fish [4]							
Percent of native species expected (PONSE*)	original guideline	100	100	100	100	>=	%
Observed to expected species ratio (O/E*)	used for all	1	1	1	1	>=	ratio (number)
Percent Alien individuals	fish indices	0	0	0	0	=	%
Invertebrates [4]							
Richness (family)	20th	11	22	22	22	>=	number
PET taxa (taxa sensitive to human disturbance)	20th	3	4	5	4	>=	number
SIGNAL score (stream invertebrate grade number average level) 1 = most tolerant 10 = most sensitive	20th	4	4	4.6	4	>=	number
Ecological processes [4]							
Gross primary production (GPP)	80th	0.5	0.5	0.25	0.5	<=	$gC/m^2/day$
Respiration (R24)	80th	0.35	0.35	0.15	0.35	<=	$gC/m^2/day$
Carbon isotope ratio measure (Del ^{13}C)	20th	-28	-28	-28	-28	>=	delta units
Chl a	80th	12	12	8	12	<=	mg Chl a/m^2 /day
Nutrient cycling [4]							
Algal bioassay (N+P)/C	80th	4	4	4	4	<=	ratio (number)
Nitrogen isotope ratio measure (Del ^{15}N)	80th	5	5	5	5	<=	delta units

Notes:
1. Unless otherwise stated, objectives apply to support waters at a moderately disturbed level, and do not apply to high ecological value waters.
2. Refer to Plan WQ1423 for locations of streams.
3. Refer to section 1 of this document for definitions of stream types.

4. More details on the indicators in this table are provided in Appendix E of the QWQG (2009), and the Ecosystem Health Monitoring Program (EHMP) annual technical reports (2002–03, 2003–04).
5. For each indicator the 'operant' denotes whether test-site values should be higher than or lower than the specified number to achieve compliance.

* Denotes values for these indices derived from predictive computer models.

n/a - model not built using this stream type.

Source: Updated based on water quality guidelines in the *Ecosystem Health Monitoring Program* (EHMP).

3.1.3 Riparian WQOs

For vegetation management relating to waterways, reference should be made to the relevant regional vegetation management codes under the Vegetation Management Act. These codes include performance requirements relating to watercourses and wetlands, aimed at maintaining water quality, bank stability, aquatic and terrestrial habitat. Codes include vegetation clearing controls that vary according to stream order.

To review the latest applicable VM code (and other explanatory information) for waters for this area, refer to the vegetation management page on the DERM website.

Planning schemes under the Sustainable Planning Act may also specify riparian buffers (for example under catchment protection or waterway codes). The latest planning schemes are accessible from http://www.dip.qld.gov.au/local-area-planning/local-government-planning-schemes.html.

3.1.4 Stormwater design objectives

Stormwater design objectives for urban development are contained in "Urban Stormwater Quality Planning Guidelines 2010" DERM (2010, as amended). Design objectives are specified for both the construction and operational phases of development in accordance with landscape features and the regional location of proposed development. The latest guidelines are available from the DERM website: http://www.derm.qld.gov.au/water/index.html.

3.2 Water quality objectives (WQOs) for human use EVs

This section outlines WQOs to protect human use EVs, which comprise those EVs other than the aquatic ecosystem EV (eg recreation, stock watering, aquaculture and crop irrigation). Table 1 of this document outlines the EVs that have been identified for different waters in the catchment. Where a human use EV has been identified, the following tables can be used to identify the WQOs to support that EV. Where Table 1 indicates 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 AWQG (2000) and the Australian drinking water guidelines (2004)[7]. Table 4 outlines human use EVs, applicable water types, and a selection of more commonly used WQOs to support those EVs. Tables 5 to 13 provide further WQOs to protect particular human use EVs (based on national guidelines or other more local studies). *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.*

Table 4 Water quality objectives to protect human use environmental values

Environmental value	Water type/ area (refer Table 1 and Plan WQ1423)	Water quality objectives to protect EV (refer to specified codes and guidelines for full details)
Protection of the human consumer for oystering	coastal and estuarine waters	Objectives as per AWQG (2000) and *Australia New Zealand Food Standards Code*[8], Food Standards Australia New Zealand, 2007 and updates.
Protection of the human consumer	coastal, estuarine and freshwaters	Objectives as per AWQG (2000) and *Australia New Zealand Food Standards Code*, Food Standards Australia New Zealand, 2007 and updates.

[7] For further details on the AWQG click on:
http://www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality
For further details on the Australian drinking water guidelines click on:
http://www.nhmrc.gov.au/publications/synopses/eh19syn.htm

[8] For further details on the Australian New Zealand Food Standards Code click on:
http://www.foodstandards.gov.au/foodstandards/foodstandardscode/

Environmental value	Water type/ area (refer Table 1 and Plan WQ1423)	Water quality objectives to protect EV (refer to specified codes and guidelines for full details)
Suitability for primary contact recreation	coastal, estuarine and freshwaters	Objectives as per NHMRC (2008)[9], including: • Water free of physical (floating and submerged) hazards • Temperature: 16–34°C • pH: 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; and • counts of suitable faecal indicator bacteria (usually enterococci). These two components are combined to produce an overall microbial classification of the recreational water body. • Intestinal enterococci: 95th %ile ≤40 organisms per 100mL (for healthy adults) (NHMRC, 2008; Table 5.7) • Direct contact with venomous or dangerous aquatic organisms should be avoided. Recreational water bodies should be reasonably free of, or protected from, venomous organisms (eg box jellyfish and bluebottles). • Cyanobacteria/algae - coastal/estuarine: recreational water bodies should not contain ≥ 10 cells/mL *Karenia brevis* and/or have *Lyngbya majuscula* and/or *Pfiesteria* present in high numbers. • Cyanobacteria/algae – fresh water: recreational water bodies should not contain ≥10 µg/L total microcystins; ≥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 ≥10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present; OR• cyanobacterial scums consistently present. Further details contained in Table 5. Waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes.
Suitability for secondary contact recreation	coastal, estuarine and freshwaters	Objectives as per NHMRC (2008), including: • Intestinal enterococci: 95th %ile ≤40 organisms per 100mL (for healthy adults) (NHMRC, 2008; Table 5.7)
Suitability for visual recreation	coastal, estuarine and freshwaters	Objectives 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.
Protection of cultural and spiritual values	coastal, estuarine and freshwaters, groundwaters	Protect or restore indigenous and non-indigenous cultural heritage consistent with relevant policies and plans.

[9] The National Health and Medical Research Council (NHMRC) has updated the recreational water quality guidelines established in the AWQG (2000). These are available from the NHMRC website at: http://www.nhmrc.gov.au/_files_nhmrc/file/publications/synopses/eh38.pdf

Environmental value	Water type/ area (refer Table 1 and Plan WQ1423)	Water quality objectives to protect EV (refer to specified codes and guidelines for full details)
Suitability for industrial use	coastal, estuarine and freshwaters	No WQOs are provided in this scheduling document for industrial uses. Water quality requirements for industry vary within and between industries. The AWQG (2000) 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	coastal, estuarine and freshwaters	Objectives as per: • Tables 6-8; and • AWQG (2000) and *Australia New Zealand Food Standards Code* , Food Standards Australia New Zealand, 2007 and updates.
Suitability for irrigation	All freshwaters including groundwaters	ANZECC objectives for pathogens and metals are provided in Tables 9 and 10. For other indicators, such as salinity, sodicity and herbicides, see AWQG (2000).
Suitability for stock watering	All freshwaters including groundwaters	Objectives as per AWQG (2000), including median faecal coliforms <100 organisms per 100 mL. WQOs for total dissolved solids and metals are provided in Tables 11 and 12, based on AWQG (2000). For other objectives, such as cyanobacteria and pathogens, see AWQG (2000).
Suitability for farm supply/use	All freshwaters including groundwaters	Objectives as per AWQG (2000).
Suitability for drinking water supply	All freshwaters including groundwaters	Local WQOs for drinking water supply are provided in Table 13. Also refer to AWQG (2000) and Australian drinking water guidelines (ADWG) that discuss how to manage the catchment to minimise the risks to drinking water supply. ADWG also provides health guideline values for potable water at the tap.

Table 5 Primary contact recreation EV: Water quality objectives for management of cyanobacteria in contact recreation areas

When cyanobacteria are present in large numbers they can present a significant hazard, particularly to primary contact users of waters.

Green level surveillance mode	Amber level alert mode	Red level action mode
≥ 500 to <500 cells mL^{-1} *Microsystis aeruginosa* or biovolume equivalent of >0.04 to <0.4mm^3 L^{-1} for the combined total of all cyanobacteria.	≥ 5000 to <50 000 cells mL^{-1} *Microsystis aeruginosa* Or ≥ 0.4 to <4 mm^3 L^{-1} for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume Or ≥ 0.5 to <10 mm mm^3 L^{-1} for the combined total of all cyanobacteria where known toxin producers are not present.	Level 1 guideline: ≥ 10 µg L^{-1} total microsystins Or ≥ 50 000 cells mL^{-1} toxic *Microsystis aeruginosa* Or biovolume equivalent of ≥ 4 mm^3 L^{-1} for the combined total of all cyanobacteria where a known toxin producer is dominant[1] in the total biovolume Or[2] Level 2 guideline: ≥ 10 mm^3 L^{-1} for total biovolume of all cyanobacterial material where known toxins are not present Or Cyanobacteria scums are consistently present[3].

Source: NHMRC Guideline for Managing Risks in Recreational Water – Cyanobacteria and algae in freshwater (NHMRC, 2008).

Notes:

1. The definition of "dominant" is where the known toxin producer comprises 75% or more of the total biovolume of cyanobacteria in a representative sample
2. 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).
3. 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.

Table 6 Aquaculture EV: Water quality objectives for tropical aquaculture

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

Source: Department of Primary Industries and Fisheries - Water Quality in Aquaculture—DPI Notes April 2004.

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

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

Source: Department of Primary Industries and Fisheries - Water Quality in Aquaculture—DPI Notes April 2004.

Table 8 Aquaculture EV: Water quality objectives for optimal growth of particular marine species

Water parameter	Barramundi		Tiger prawn		Kuruma prawn
	Hatchery	Grow out	Hatchery	Grow out	Grow out
Dissolved oxygen	Saturation	>4.0mg/L	>4.0mg/L	>3.5mg/L	>4.0mg/L
Temperature ^{0}C	28–30 optimum 25–31 range	28–30 optimum		26–32	24
pH	~ 8	~ 8	~ 8	7.5–8.5	7.5–8.5
Ammonia (TAN, total ammonia-nitrogen)		0.1–0.5 mg/L			
Ammonia (NH_3, un-ionized form)	<0.1mg/L	<0.1mg/L	<0.1mg/L	<0.1mg/L	<0.1mg/L
Nitrate (NO_3)	<1.0mg/L	<1.0mg/L	<1.0mg/L	<1.0mg/L	<1.0mg/L
Nitrite (NO_2)	<0.2mg/L	<20mg/L	<0.2mg/L	<0.2mg/L	<0.2mg/L
Salinity	28–31ppt	0–35ppt		10–25ppt optimum	30–35 ppt optimum
Alkalinity		105–125mg/L $CaCO_3$			
Clarity				30–40cm Secchi disk	30–40cm Secchi disk
Hydrogen sulphide		<0.3mg/L			
Iron		<0.02mg/L		<1.0mg/L	
Spawning temperature		28–32 *strain dependent		27–32	

Source: Department of Primary Industries and Fisheries - Water Quality in Aquaculture—DPI Notes April 2004.

Table 9 Irrigation EV: Water quality objectives for thermotolerant (faecal) coliforms in irrigation waters used for food and non-food crops

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 5 days)	<1000 cfu / 100 mL
Pasture and fodder (for grazing animals except pigs and dairy animals, i.e. cattle, sheep and goats)	<1000 cfu / 100 mL
Silviculture, turf, cotton, etc. (restricted public access)	<10 000 cfu / 100 mL

Source: AWQG (2000), Volume 1, Section 4.2.3.3, Table 4.2.2.

Notes:
1. Adapted from ARMCANZ, ANZECC and NHMRC (1999)
2. Refer to AWQG (2000) Volume 1, Section 4.2.3.3 for advice on testing protocols

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Table 10 Irrigation EV: Water quality objectives for heavy metals and metalloids in agricultural irrigation water[1] – long-term trigger value (LTV), short-term trigger value (STV) and soil cumulative contamination loading limit (CCL)

Element	Soil cumulative contaminant loading limit (CCL - kg/ha) [2]	Long-term trigger value (LTV) in irrigation water (up to 100 yrs) (mg/L)	Short-term trigger value (STV) in irrigation water (up to 20 yrs) (mg/L)
Aluminium	ND	5	20
Arsenic	20	0.1	2.0
Beryllium	ND	0.1	0.5
Boron	ND	0.5	Refer to AWQG (2000) Vol 3,Table 9.2.18
Cadmium	2	0.01	0.05
Chromium	ND	0.1	1
Cobalt	ND	0.05	0.1
Copper	140	0.2	5
Fluoride	ND	1	2
Iron	ND	0.2	10
Lead	260	2	5
Lithium	ND	2.5 (0.075 for Citrus crops)	2.5 (0.075 for Citrus crops)
Manganese	ND	0.2	10
Mercury	2	0.002	0.002
Molybdenum	ND	0.01	0.05
Nickel	85	0.2	2
Selenium	10	0.02	0.05
Uranium	ND	0.01	0.1
Vanadium	ND	0.1	0.5
Zinc	300	2	5

Source: AWQG (2000), Volume 1, Section 4.2.6, Table 4.2.10

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 [2000], Volume 3, Section 9.2.5)
2. ND = Not determined; insufficient background data to calculate CCL

Table 11 Stock watering EV: Water quality objectives for tolerances of livestock to total dissolved solids (salinity) in drinking water[1]

Livestock	Total dissolved solids (TDS) (mg/L)		
	No adverse effects on animals expected.	Animals may have initial reluctance to drink or there may be some scouring, but stock should adapt without loss of production	Loss of production and 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

Source: AWQG (2000), Volume 1, Section 4.3.3.5, Table 4.3.1

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

Table 12 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

Source: AWQG (2000), Volume 1, Section 4.3.4, Table 4.3.2

Notes:
1. Higher concentrations may be tolerated in some situations (further details provided in AWQG [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.

Table 13 Drinking water EV: Priority water quality objectives for drinking water supply in the vicinity of off-takes, including groundwater, before treatment

Indicator	Water quality objectives
Hardness	60-200 mg/L (as CaCO3) Refer ADWG (treated water guideline)
Taste and odour	5 µg/L Geosmin or 10 µg/L MIB or 10 µg/L combined Geosmin & MIB
Cyanotoxins (specific assessment of treatment step efficiencies for each toxin is required)	Saxitoxin 3 µg/L (ADWG health alert value for acute exposure; and SEQWater Toxic Cyanobacteria Risk Assessment 2006) Mycrocystin 1.3 µg/L (ADWG treated water guideline) Cylindrospermopsin 1 µg/L
Cryptosporidium	0 oocyst
Giardia	0 cyst
E. *coli*	100 cfu/100mL (ensure sufficient turbidity reduction and chlorine contact:dose)
Manganese (soluble)	50 µg/L
Iron (soluble)	50 µg/L
Turbidity	25 NTU for WTP designed for offtakes from open water storages 50 NTU for WTP designed for offtakes in riverine (weir) systems
Colour	50 Hazen Units
Conductivity/TDS	See ADWG (no treatment options to remove salt) 500 mg/L TDS. Site specific conversion to conductivity required. ADWG recommends average multiplication factor of 2 to derive conductivity (µs/cm): 1000 µs/cm
Dissolved oxygen	4 mg/L at water surface
Pesticides	Presence at detectable levels (detection limits specified by Qld Health Scientific Services)
Dissolved Organic Carbon	10 mg/L

Source: Queensland Bulk Water Supply Authority Trading as: Seqwater

Table 14 Aquatic ecosystem EV: WQOs for freshwaters in Pine Rivers Shire stream health manual (2004)

Performance indicator levels (targets) for individual sub-catchments, Pine Rivers Shire

Sub-catchment (full name)	Sub-catchment (ID)	Stream Health Class (idenfied in 2001-2003)	Management task *	Vision - Stream Health Class in 2006-2011	Abundance of benthic macroinvertebrates	Locally important and rare species (Names given in Table 2)	Condition of stream channel (Categories: see Table 3)	Minimum width of riparian buffer	Suspended solids (SS) (objective)	Suspended solids (SS) (upper limit)	Total phosphorus (TP) (objective)	Total phosphorus (TP) (upper limit)	Total nitrogen (TN) (objective)	Total nitrogen (TN) (upper limit)	Conductivity (EC) (objective)	Conductivity (EC) (upper limit)	pH range (objective)	Faecal coliform bacteria - upper limit (draft, ANZECC 2000)
					[ind./m²]	where applicable		[m]	[mg/L]	[mg/L]	[µg/litre]	[µg/litre]	[µg/litre]	[µg/litre]	[µS/cm]	[µS/cm]	where applicable	[cfu/100 ml]
Greater South Pine River Catchment																		
South Pine River 1	**SP1**	a	pct	a	<2500	3; 8	4	100	<2	3	≤5	10	≤100	200	<120	200		150
South Pine River 2	**SP2**	b	pct	b	<5000	8	4	100	<2	3	≤10	20	≤100	300	<200	300		150
South Pine River 3	**SP3**	d	enh	c	<10000	15; 16	3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Dawson Creek 1	**Dw1**	c	enh	b	<5000		4	100	<2	3	≤10	20	≤100	300	<200	300		150
Dawson Creek 2	**Dw2**	e	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
South Pine River 4	**SP4**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
South Pine River 5	**SP5**	f	rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
South Pine River 6	**SP6**	e	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Samford Creek 1	**Sf1**	e, f	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Samford Creek 2	**Sf2**	e	enh rep	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
South Pine River 7	**SP7**	e	enh rep	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Cedar Creek 1	**Cd1**	a	pct	a	<2500	2; 3; 5	4	100	<2	3	≤5	10	≤100	200	<120	200		150
Cedar Creek 2	**Cd2**	b	pct	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300		150
Stony Creek 1	**St1**	b,c	pct enh	b	<5000		4	100	<2	3	≤10	20	≤100	300	<200	300		150
Stony Creek 2	**St2**	c	prv	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Stony Creek 3	**St3**	d	rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Cedar Creek 3	**Cd3**	c	prv	c	<10000	17	3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Cedar Creek 4	**Cd4**	d	enh	c	<10000	17	3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Branch Creek 1	**Br1**	b	pct	b	<5000		4	100	<2	3	≤10	20	≤100	300	<200	300		150
Branch Creek 2	**Br2**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Cedar Creek 5	**Cd5**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
South Pine River 8	**SP8**	d	prv	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Wongan Creek 1	**Wg1**	b	pct	b	<5000		4	100	<2	3	≤10	20	≤100	300	<200	300		150
Wongan Creek 2	**Wg2**	c	prv	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Wongan Creek 3	**Wg3**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Bergin Creek	**Wg4**	e	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Wongan Creek 5	**Wg5**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
South Pine River 9	**SP9**	d	prv	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Kingfisher Creek 1	**Kf1**	c	prv	c	<10000		4	50	≤2	5	≤20	30	≤200	300	<280	400		150
Kingfisher Creek 2	**Kf2**	e	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
South Pine River 10	**SP10**	d	prv	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Sandy Creek 1	**Sn1**	c	prv	c	<10000		4	50	≤2	5	≤20	30	≤200	300	<280	400		150
Sandy Creek 2	**Sn2**	e	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Albany Creek 1	**Al1**	c	prv	c	<10000		4	50	≤2	5	≤20	30	≤200	300	<280	400		150
Albany Creek 2	**Al2**	d	prv	d	<25000		3	50	<5	10	≤30	70	≤300	750	<400	650		150
Couldharts Creek	**Cl**	e	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Conflagration Creek 1	**Cn1**	d	prv	d	<25000		3	50	<5	10	≤30	70	≤300	750	<400	650		150

Performance indicator levels (targets) for individual sub-catchments, Pine Rivers Shire

	Sub-catchment (full name)	Sub-catchment (ID)	Stream Health Class (idenfied in 2001-2003)	Management task *	Vision - Stream Health Class in 2006-2011	Abundance of benthic macroinvertebrates	Locally important and rare species (Names given in Table 2)	Condition of stream channel (Categories: see Table 3)	Minimum width of riparian buffer	Suspended solids (SS) (objective)	Suspended solids (SS) (upper limit)	Total phosphorus (TP) (objective)	Total phosphorus (TP) (upper limit)	Total nitrogen (TN) (objective)	Total nitrogen (TN) (upper limit)	Conductivity (EC) (objective)	Conductivity (EC) (upper limit)	pH range (objective)	Faecal coliform bacteria - upper limit (draft, ANZECC 2000)
Conflagration Creek 2	**Cn2**	e	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Four Mile Creek	**FM1**	c	prv	c	<10000		4	50	≤2	5	≤20	30	≤200	300	<280	400		150
Four Mile Creek	**FM2**	b	pct	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300		150
Four Mile Creek	**FM3**	d	pct enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Four Mile Creek	**FM4**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Four Mile Creek	**FM5**	e	enh rep	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Greater North Pine River Catchment																			
Lake Samsonvale Catchment																			
North Pine River 1	**NP1**	a	pct	a	<2500	9; 10	4	100	<2	3	≤5	10	≤100	200	<120	200	7.2 - 8.2	150
North Pine River 2	**NP2**	a	pct	a	<2500	1; 4; 9; 10; 12	4	100	<2	3	≤5	10	≤100	200	<120	200	7.2 - 8.2	150
North Pine River 3	**NP3**	b,c,d	pct rep	b	<5000	9; 10; 11	3	100	<2	3	≤10	20	≤100	300	<200	300		150
North Pine River 4	**NP4**	c	prv	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Pine Creek	**NP5**	d,e	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
North Pine River 6	**NP6**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Laceys Creek 1	**Lc1**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Laceys Creek 2	**Lc2**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Laceys Creek 3	**Lc3**	b,c	pct enh	b,c	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Raynbird Creek 1	**Ry1**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Raynbird Creek 2	**Ry2**	c,d	pct enh	b,c	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Raynbird Creek 3	**Ry3**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Raynbird Creek 4	**Ry4**	b	pct	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Raynbird Creek 5	**Ry5**	c	enh	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Raynbird Creek 6	**Ry6**	c,d	enh	c	<10000	20	3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Laceys Creek 4	**Lc4**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Laceys Creek 5	**Lc5**	c	enh rep+	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Laceys Creek 6	**Lc6**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Laceys Creek 7	**Lc7**	b	pct	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Laceys Creek 8	**Lc8**	c	prv rep+	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Laceys Creek 9	**Lc9**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Laceys Creek 10	**Lc10**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Laceys Creek 11	**Lc11**	b	pct	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Laceys Creek 12	**Lc12**	d	enh rep+	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Laceys Creek 13	**Lc13**	c,d	enh rep+	b,c	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300		150
Laceys Creek 14	**Lc14**	d	enh rep+	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Laceys Creek 15	**Lc15**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200	7.5 - 8.7	150
Laceys Creek 16	**Lc16**	c	enh	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Laceys Creek 17	**Lc17**	d	enh rep+	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
North Pine River 7	**NP7**	d	enh	c	<10000		4	50	≤2	5	≤20	30	≤200	300	<280	400		150
Baxter Creek 1	**Bx1**	c	enh	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300		150
Baxter Creek 2	**Bx2**	d	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
North Pine River 8	**NP8**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Armstrong Creek 1	**Ar1**	b	pct	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300		150
Armstrong Creek 2	**Ar2**	b,c	pct, enh	b,c	<5000		3	100	≤2	3	≤10	20	≤100	300	<200	300		150

Performance indicator levels (targets) for individual sub-catchments, Pine Rivers Shire

Sub-catchment (full name)	Sub-catchment (ID)	Stream Health Class (idenfied in 2001-2003)	Management task *	Vision - Stream Health Class in 2006-2011	Abundance of benthic macroinvertebrates	Locally important and rare species (Names given in Table 2)	Condition of stream channel (Categories: see Table 3)	Minimum width of riparian buffer	Suspended solids (SS) (objective)	Suspended solids (SS) (upper limit)	Total phosphorus (TP) (objective)	Total phosphorus (TP) (upper limit)	Total nitrogen (TN) (objective)	Total nitrogen (TN) (upper limit)	Conductivity (EC) (objective)	Conductivity (EC) (upper limit)	pH range (objective)	Faecal coliform bacteria - upper limit (draft, ANZECC 2000)
Armstrong Creek 3	**Ar3**	d	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Armstrong Creek 4	**Ar4**	e	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
North Pine River 9	**NP9**	e	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Terrors Creek 1	**Tr1**	d	rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Terrors Creek 2	**Tr2**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Terrors Creek 3	**Tr3**	e	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
North Pine River 10	**NP10**	e	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Rush Creek1	**Rs1**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Rush Creek 2	**Rs2**	e	enh, prv	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Forbes Creek 1	**Fb1**	d	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Forbes Creek 2	**Fb2**	e	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Kobble Creek North 1	**KN1**	a	pct	a	<2500	11; 15; 16	4	100	<2	3	≤5	10	≤100	200	<120	200		150
Kobble Creek North 2	**KN2**	b	pct	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300		150
Kobble Creek North 3	**KN3**	c	pct enh	c	<10000	15; 16	3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Kobble Creek South 4	**KS4**	a	pct	a	<2500	6; 7;11;15;16;19	4	100	<2	3	≤5	10	≤100	200	<120	200		150
Kobble Creek South 5	**KS5**	b,c	enh	b,c	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300		150
Kobble Creek 6	**K6**	c	pct enh	c	<10000	16	3	50	≤2	5	≤20	30	≤200	300	<280	400		150
tributary Kobble Creek 7	**K7**	c	enh rep+	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
tributary Kobble Creek 8	**K8**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Mt Samson Creek1	**Sm1**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Lake Kurwongbah Catchment																		
Mosquito Creek 1	**Mq1**	a	pct	a	<2500	9; 16	4	100	<2	3	≤5	10	≤100	200	<120	200		150
Mosquito Creek 2	**Mq2**	b	pct	b	<5000	7; 13; 15; 16	3	100	<2	3	≤10	20	≤100	300	<200	300		150
Mosquito Creek 3	**Mq3**	d	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Browns Creek 1	**Br1**	c	pct enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Browns Creek 2	**Br2**	d	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Browns Creek 3	**Br3**	c	prv	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Browns Creek 4	**Br4**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Browns Creek 5	**Br5**	e	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Sidelings Creek 1	**Sd1**	e	enh rep	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Unnamed creek	**Ck1**	c	pct	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
lower North Pine River Catchment																		
North Pine River 11	**NP11**	e	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
One Mile Creek 1	**OM1**	a	pct	a	<2500		4	100	<2	3	≤5	10	≤100	200	<120	200		150
One Mile Creek 2	**OM2**	b	pct	b	<5000		4	100	<2	3	≤10	20	≤100	300	<200	300		150
One Mile Creek 3	**OM3**	c	prv	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
One Mile Creek 4	**OM4**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Caboolture River Catchment																		
Zillman Creek 1	**Zm1**	b	pct	b	<5000	15	4 & 3	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Zillman Creek 2	**Zm2**	c	enh, rep+	b	<5000		4 & 2	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Caboolture River (South Branch) 1	**CR1**	c	enh, rep+	b	<5000		3 to 1	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150

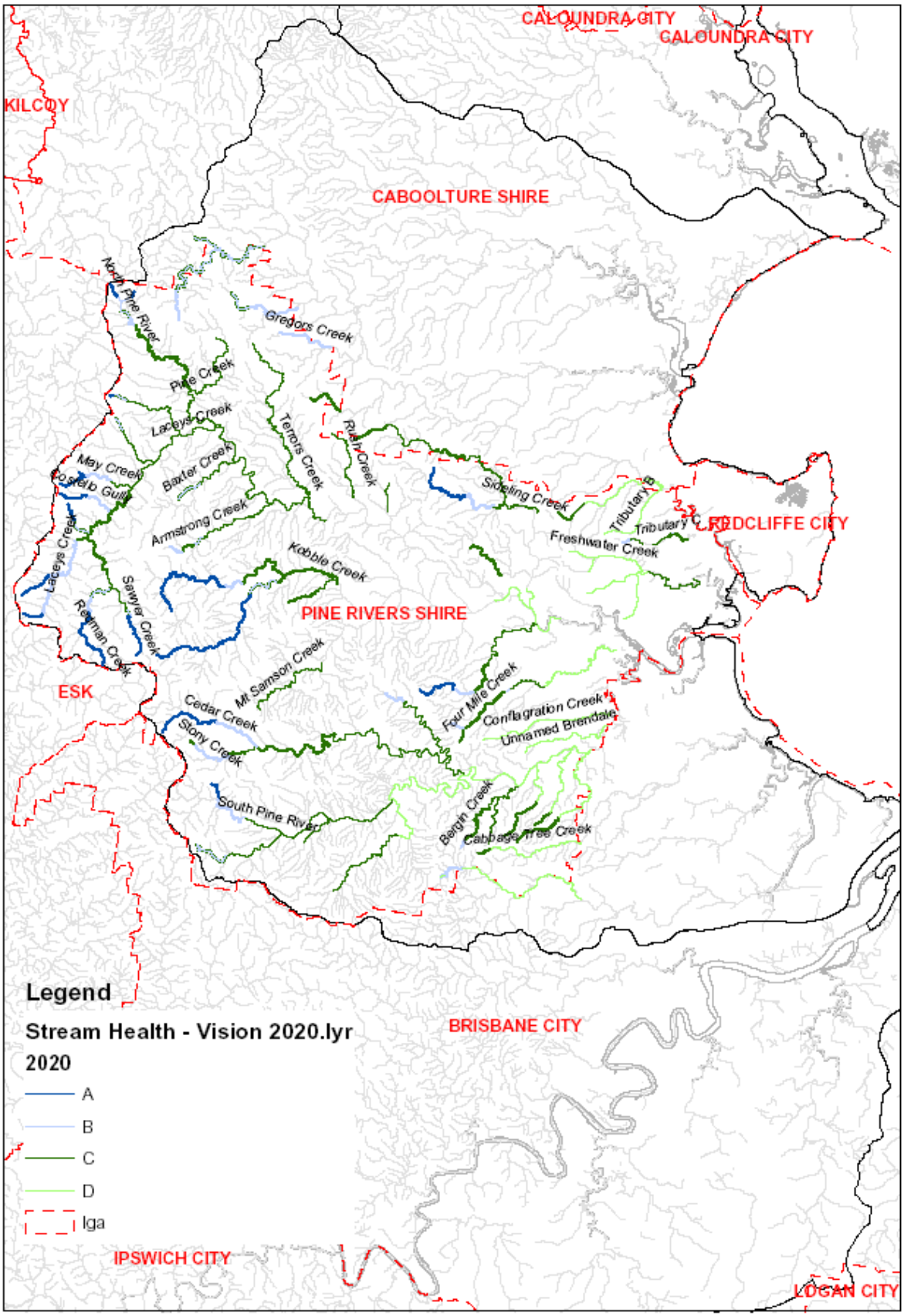
Performance indicator levels (targets) for individual sub-catchments, Pine Rivers Shire

Sub-catchment (full name)	Sub-catchment (ID)	Stream Health Class (idenfied in 2001-2003)	Management task *	Vision - Stream Health Class in 2006-2011	Abundance of benthic macroinvertebrates	Locally important and rare species (Names given in Table 2)	Condition of stream channel (Categories: see Table 3)	Minimum width of riparian buffer	Suspended solids (SS) (objective)	Suspended solids (SS) (upper limit)	Total phosphorus (TP) (objective)	Total phosphorus (TP) (upper limit)	Total nitrogen (TN) (objective)	Total nitrogen (TN) (upper limit)	Conductivity (EC) (objective)	Conductivity (EC) (upper limit)	pH range (objective)	Faecal coliform bacteria - upper limit (draft, ANZECC 2000)
Caboolture River (South Branch) 2	**CR2**	b	pct	b	<5000	13	4	100	<2	3	≤10	20	≤100	300	<200	300	7.5 - 8.7	150
Gregors Creek 1	**Gr1**	b	enh	b	<5000	9	3	100	<2	3	≤10	20	≤100	300	<200	300		150
Burpengary Creek	**Bp1**	c	enh, rep+	b	<5000		3	100	<2	3	≤10	20	≤100	300	<200	300		150
Saltwater Creek Catchment																		
Tributary B North 1	**Sw1**	c	prv	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Tributary B North 2	**Sw2**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Tributary B North 3	**Sw3**	f	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Tributary B North 4	**Sw4**	e	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Tributary B South	**Sw5**	e	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Tributary C 1	**Sw6**	b	pct	b	<5000	14	3	100	<2	3	≤10	20	≤100	300	<200	300	5.5-6.6	150
Tributary C 2	**Sw7**	d	enh	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Tributary C 3	**Sw8**	c	pct prv	c	<10000		3	50	≤2	5	≤20	30	≤200	300	<280	400		150
Freshwater Creek Catchment																		
Freshwater Creek North 1	**Fw1**	f	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Freshwater Creek North 2	**Fw2**	e,f	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Freshwater Creek South 3	**Fw3**	d	prv	d	<25000		3	50	<5	10	≤30	70	≤300	750	<400	650		150
Freshwater Creek South 4	**Fw4**	e,f	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150
Black Duck Creek	**Fw5**	d,e	enh pct	d	<25000		3	50	<5	10	≤30	70	≤300	750	<400	650		150
lower Freshwater Creek	**Fw6**	d	enh pct	c	<10000	18	4	50	≤2	5	≤20	30	≤200	300	<280	400		150
Cabbage Tree Creek Catchment																		
Cabbage Tree Creek 1	**CT1**	c	pct prv	c	<10000		4	50	≤2	5	≤20	30	≤200	300	<280	400		150
Cabbage Tree Creek 2	**CT2**	d	prv	d	<25000		3	50	<5	10	≤30	70	≤300	750	<400	650		150
Kedron Brook Catchment																		
Kedron Brook 1	**KB1**	b	pct	b	<5000		4	100	<2	3	≤10	20	≤100	300	<200	300		150
Kedron Brook 2	**KB2**	d	prv	d	<25000		3	50	<5	10	≤30	70	≤300	750	<400	650		150
Kedron Brook 3	**KB3**	e	enh	d	<25000		2	50	<5	10	≤30	70	≤300	750	<400	650		150

* pct = protect, enh = enhance, rep = repair, rep+ = repair riparian vegetation, prv = prevent further degradation

Note: Also refer to Map 1.
Source: Pine Rivers Shire Council Stream Health Manual (May, 2004)

Map 1 Pine Rivers Shire stream health classes



Source: Pine Rivers Shire Council (2004) Stream Health Manual
Notes: Refer Table 14 for further details on water quality objectives

4 Ways to improve water quality

The following documents are relevant in considering ways to improve water quality in the Pine Rivers-Redcliffe catchment. The document list below is additional to the plans, guidelines and other sources referred to in previous sections, and is provided for information only.

- *Council planning scheme and supporting codes, policies*
- *Pine Rivers Catchment Management Strategy*
- *Pine Rivers Shire Council Stream Health Manual (May, 2004)*
- *Saltwater Creek Catchment Management Plan*
- *Freshwater Creek Catchment Management Plan*
- *One Mile Creek Catchment Management Plan*
- *Integrated Catchment Management Strategy for Lake Samsonvale*
- *Guideline on Identifying and Applying Water Quality Objectives in Brisbane City,* 2000, Brisbane City Council
- *Subdivision and Development Guidelines 2000 - Water Quality Management Chapters*, Waterways Program, Brisbane City Council, 2000
- *Natural Channel Design Guidelines,* Waterways Program, Brisbane City Council, 2000
- *Erosion Treatment for Urban Creeks - Guidelines for Selecting Remedial Works,* Department of Works, Brisbane City Council, 1997
- *Design Guidelines for Stormwater Quality Improvement Devices - Final Draft*, City Design and Geo-Eng P/L, Brisbane City Council, 1999
- *Sediment Basin Design, Construction and Maintenance Guidelines*, Waterways Program, Brisbane City Council, 2001
- *Guidelines for Pollutant Export Modelling in Brisbane - Version 7*, Brisbane City Council, 2003
- *Best Practice Guidelines for the Control of Stormwater Pollution from Building Sites,* Brisbane City Council Waterways Program and Gold Coast City Council, Brisbane, 2002
- *Erosion and Sediment Control Standard,* Waterways Program, Brisbane City Council, 2000
- *Development guidelines for water quality management in drinking water catchments* (Seqwater)
- *South East Queensland Regional Plan 2009 - 2031*
- *South East Queensland Natural Resource Management Plan 2009-2031*
- *South East Queensland Healthy Waterways Strategy 2007-2012*
- *South East Queensland Regional Water Quality Management Strategy September 2001*
- *Queensland Water Quality Guidelines 2009 (DERM)*
- *Monitoring and Sampling Manual 2009 (DERM)*
- *Draft Queensland Coastal Plan*
- *Memorandum of Understanding between the Queensland Government and Queensland Farmers' Federation relating to Farm Management Systems 2005*
- *Queensland Water Plan 2005 – 2010 An action plan to meet our future water needs, Queensland Government, August 2005*
- *Managing riparian widths to achieve multiple objectives,* fact sheet 13, Land and Water Australia, Australian Government, 2004.
- *Improving water quality,* fact sheet 3, Land & Water Australia, Australian Government, 2002.
- *Riparian Land Management Technical Guidelines – Volume 1 and 2, November 1999,* Land and Water Resources Research and Development Corporation (LWRRDC)
- *Guidelines for Queensland Streambank Stabilisation with Riparian Vegetation,* CRC for Catchment Hydrology, September 1999
- *Restoration of Fish Habitats – Fisheries Guidelines for Marine Areas,* FHG002, Fisheries Group, Department of Primary Industries, October 1998
- *Fisheries Guidelines for Fish Habitat Buffer Zones,* FHG003, Fisheries Group, Department of Primary Industries, August 2000
- *Guidelines for Riparian Filter Strips for Queensland Irrigators*, CSIRO Land and Water, September 1999

5 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.

Aquatic ecosystems (defined in the AWQG, 2000): comprise the animals, plants and micro-organisms that live in water, and the physical and chemical environment and climatic regime in which they interact. It is predominantly the physical components (eg light, temperature, mixing, flow, habitat) and chemical components (eg organic and inorganic carbon, oxygen, nutrients) of an ecosystem that determine what lives and breeds in it, and therefore the structure of the food web. Biological interactions (eg grazing and predation) can also play a part in structuring many aquatic ecosystems.

ARMCANZ means the Agriculture and Resource Management Council of Australia and New Zealand.

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

Biological integrity, of water, means the water's ability 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 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 health (defined in the AWQG, 2000): means the 'health' or 'condition' of an ecosystem. It is the ability of an ecosystem to support and maintain key ecological processes and organisms so that their species compositions, diversity and functional organisations are as comparable as possible to those occurring in natural habitats within a region (also termed ecological integrity).

Environmental 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 Table 15.

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-catchment means part of a catchment.

Table 15 Suite of environmental values that can be chosen for protection

Environmental values and definitions	ICON
Aquatic ecosystem: "*a community of organisms living within or adjacent to water, including riparian or foreshore areas*". (EPPW, schedule 2) 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 - SEQRWQMS.) See below for more details on aquatic ecosystems, based on the EPP Water.	
High ecological/conservation value waters "W*aters in which the biological integrity of the water is effectively unmodified or highly valued*." (EPPW, 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*" (EPPW, 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."* (EPPW, 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*." (EPPW, schedule 2)	None
Seagrass (Goal within the Aquatic ecosystem EV): Maintenance or rehabilitation of seagrass habitat. (Applies only to tidal waterways.)	
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.	

Environmental values and definitions	ICON
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: Health of humans consuming aquatic foods — such as fish, crustaceans and shellfish from natural waterways. Note that in some areas oystering is a more specific goal identified under the human consumer EV (see below).	
Oystering (Goal within the EV of Human consumers of aquatic foods): Health of humans consuming oysters from natural waterways and commercial ventures. (Applies only to tidal waterways.)	
Primary recreation: Health of humans during recreation which involves direct contact and a high probability of water being swallowed — for example, swimming, surfing, windsurfing, diving and water-skiing. ***Primary recreational use****, of water, means full body contact with the water, including, for example, diving, swimming, surfing, waterskiing and windsurfing.* (EPPW, s6)	
Secondary recreation: Health of humans during recreation which involves indirect contact and a low probability of water being swallowed — for example, wading, boating, rowing and fishing. ***Secondary recreational use****, of water, means contact other than full body contact with the water, including, for example, boating and fishing.* (EPPW, s6)	
Visual recreation: Amenity of waterways for recreation which does not involve any contact with water — for example, walking and picnicking adjacent to a waterway. ***Visual recreational use****, of a water, means viewing the water without contact with it.* (EPPW, s6)	

Environmental values and definitions	ICON
Drinking water supply: Suitability of raw drinking water supply. This assumes minimal treatment of water is required — for example, coarse screening and/or disinfection.	
Industrial use: Suitability of water supply for industrial use — for example, food, beverage, paper, petroleum and power industries. Industries usually treat water supplies to meet their needs.	
Cultural and spiritual values: Indigenous and non-indigenous cultural heritage — for example: • custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities; • symbols, landmarks and icons (such as waterways, turtles and frogs); and • lifestyles (such as agriculture and fishing). ***Cultural and spiritual values****, of water, means its aesthetic, historical, scientific, social or other significance, to the present generation or past or future generations.* (EPPW, s6)