Default Guideline Values (DGVs) for Aquatic Ecosystems of the Lower Derwent Catchment

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Introduction

Water quality management, determination of water quality guideline values, and the setting of water quality objectives is guided by the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018* (ANZG 2018) and the *National Water Quality Management Strategy 1994* (NWQMS).

The *State Policy on Water Quality Management 1997 (*SPWQM*)* establishes a framework that is compatible and consistent with these national guidelines.

The default guideline values (DGVs) for aquatic ecosystems presented herein have been derived for the Lower Derwent Catchment in accordance with the NWQMS.

Protected Environmental Values (PEVs) – Community Values

As part of the implementation of the State Policy, protected environmental values for inland waters were determined through extensive stakeholder consultation and identification of community values and uses. The PEVs for inland waters were set for 22 areas on the basis of catchment boundary or municipal boundary. These are available via the EPA website.

The current PEVs for inland waters for the protection of aquatic ecosystems provide options for both pristine and modified systems:

A: Protection of Aquatic Ecosystems

(i) Pristine or nearly pristine ecosystems

(Having regard for the management objectives for nature recreation areas, conservation areas and game reserves outlined in Schedule 4 of the *National Parks and Wildlife Act 1970*.)

OR

(ii) Modified (not pristine) ecosystems

(i) from which edible fish, shellfish and crustacea are harvested

OR

(ii) from which edible fish, shellfish and/or crustacea are not harvested

B. Recreational Water Quality & Aesthetics

(i) Primary contact water quality (specify sites)

(ii) Secondary contact water quality

(iii) Aesthetic water quality

C. Raw Water for Drinking Water Supply

(i) Subject to coarse screening plus disinfection

D. Agricultural Water Uses

(i) Irrigation

(ii) Stock watering

E. Industrial Water Supply

That is, as a minimum, water quality management strategies should seek to provide water of a physical and chemical nature to support a pristine/modified aquatic ecosystem from which edible fish, crustacea and shellfish may be harvested; that is suitable as a raw water for drinking water supply subject to coarse screening plus disinfection; that is acceptable for irrigation and stock watering purposes; which will allow people to safely engage in primary contact recreation activities such as swimming at specific sites (refer to Appendix B) and secondary contact recreation activities such as paddling or fishing in aesthetically pleasing waters; and which is suitable for industrial water supply, e.g., use by aquaculture (shellfish farms) in marine farming zones.

For a detailed explanation on the PEVs as they relate to land tenure and a spatial presentation of the land tenure refer to the Environmental Management Goals for Tasmanian Waters Derwent River Catchment April, 2003 and PEVs map, respectively.

Default Guideline Values

Guideline values apply to key indicators and are numerical concentrations or descriptive statements recommended for the support and maintenance of the designated water use or value, i.e. the Protected Environmental Value (PEV).

Tasmania refers to the following national level guideline values for the relevant key indicators.

- Water Quality management Framework
- Toxicant DGVs in freshwater and marine water
- Water quality for primary industries
- Australian guidelines for water recycling
- Australian Drinking Water guidelines
- Guidelines for Managing Risks in Recreational water
- Cultural and spiritual values of waterways
- Food Standards

The primary focus within Tasmania has been the derivation of guideline values for Aquatic Ecosystems based on Tasmanian data for key indicators of interest. This is as the protection of aquatic ecosystems is a PEV common to all water types. In addition, the trigger values for aquatic ecosystems from the ANZECC 2000 water quality guidelines were based on a very limited quantity of Tasmanian data.

Ecosystem Condition

The ANZG 2018 provides a framework for developing water quality guideline values based on the water type, health of aquatic ecosystems or ecosystem condition. Ecosystem condition can be viewed as a continuum ranging from natural to highly disturbed or artificial. The ANZG 2018 identifies three broad categories of ecosystem: High Ecological Value (HEV), Slightly to Moderately Disturbed (SMD) and Highly Disturbed (HD). To better characterise Tasmanian ecosystems the SMD category has been further divided into Slightly Modified Ecological Value (SMEV) and Moderately Disturbed (MD) (Figure 1).

For the decision process and selection criteria for identifying ecosystem condition refer to the EPA document, Technical Guidance for Water Quality Objectives (WQOs) Setting for Tasmania.

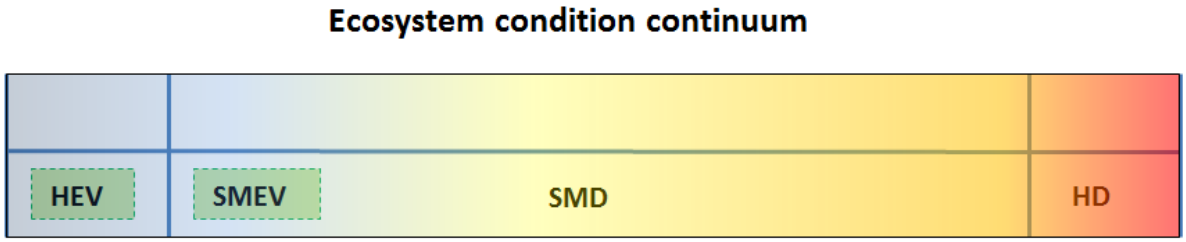

Figure 1. Ecosystem condition continuum showing HEV and SMEV reference categories.

Regionalisation of inland waters by Surface Water Catchment

The state water quality DGVs for aquatic ecosystems are based on data from across the entire state. To refine this a hydrologcial regionalisation approach as been adotped that is based on river flow information (Hughes, 1987). This has been further refined by regionalisation based on surface water catchment. The hydrologically distinct groupings (Figure 2). Links to regional documents are provided in and the associated surface water catchments are listed in Table 1.

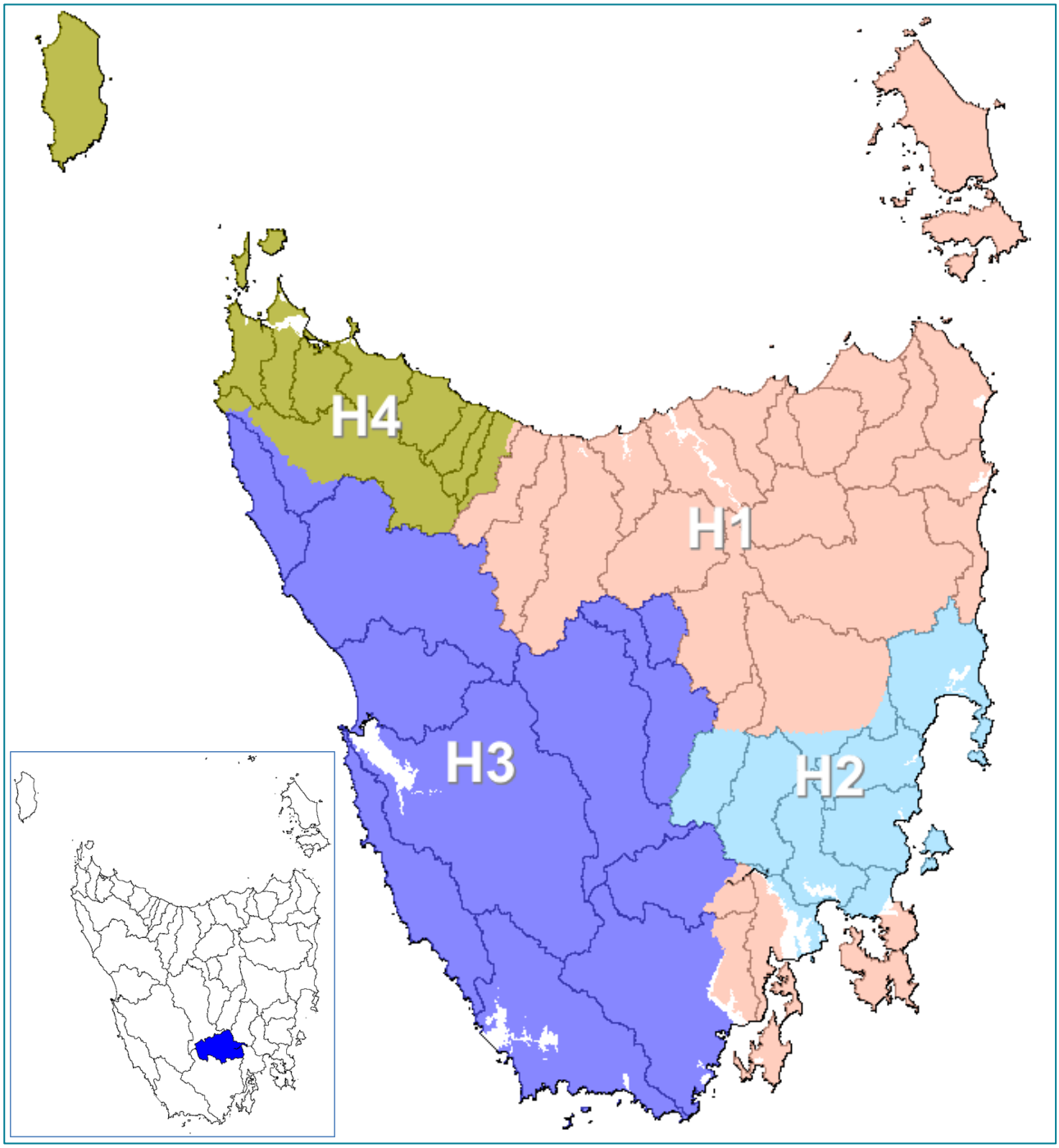

Figure 2. Hydrological regions (Hughes, 1987) and topographic catchments (Lower Derwent highlighted on inset).

Table 1. Hydrological region and associated catchments

Hydrological Region	Catchment
Hydrological Region 1 (H1)	The Leven, Mersey, Meander, Rubicon, Tamar Estuary, Brumbys-Lake, South Esk, North Esk, Pipers, Little Forester, Great Forester-Brid, Ringarooma, Boobyalla-Tomahawk, George, Great Musselroe-Ansons, and Scamander-Douglas catchments are entirely within the H1 hydrological region. The Macquarie, Tasman, Huon, Clyde, Lower Derwent and Derwent Estuary-Bruny catchments are deemed to be partly within the H1 and partly within the H3 or H2 Hydrological regions.
Hydrological Region 2 (H2)	The Swan-Apsley, Little Swanport, Prosser, Pitt water-Coal and Jordan catchments are entirely within the hydrological region. The Tasman, Derwent Estuary – Bruny, Clyde and Macquarie catchments are deemed to be partly within the H2 and partly within the H1 Hydrological region. The Lower Derwent catchment is predominantly within the H3 region, but also has river sections that have been deemed to belong to the H1 and H2 hydrological regions. The river sections of the Lower Derwent catchment belonging to the H2 region are from Upper Dromedary to Bridgewater.
Hydrological Region 3 (H3)	The Ouse, Great Lake, Upper Derwent, Gordon-Franklin, Port Davey, Wanderer-Giblin, King-Henty and Pieman catchments are entirely within the hydrological region. The Huon and Lower Derwent catchments are predominately within H3 but also partly within the H1 hydrological region. While the Arthur catchment is only partly within H3 and predominantly within the H4 hydrological region.
Hydrological Region 4 (H4)	The Blythe, Emu, Cam, Inglis-Flowerdale, Black-Detention, Duck, Montagu, Welcome and King Island catchments are entirely within the hydrological region. The Arthur catchment is deemed to be predominantly within the H4 and only partly within the H3 hydrological region.

Deriving DGVs for aquatic ecosystems of the Lower Derwent Catchment

For the development of water quality DGVs one site was available within the Lower Derwent Catchment. No sites were available within the HEV ecosystem category and for this reason the 44 HEV sites within the H3 hydrological region were used.The site within the catchment was within the SMD ecosystem category (Table 2). For the development of biological DGVs 12 sites were available within the Lower Derwent Catchment. These were within the HEV ecosystem category (Table 2). No sites were available within the SMD ecosystem category therfore the 13 SMD sites within the H3 hydrological region were used.

Table 2. Sites used to develop water quality and biological DGVs within the Lower Derwent Catchment

Site	HEV WQ	HEV BIOL	SMD WQ	SMD BIOL
Plenty River at Leesons Road		√		
Plenty River upstream of Stony Creek		√		
Puzzle River north of Russel Bridge		√		
Stony Creek at Plenty Valley Road		√		
Plenty River tributary at Plenty Valley Road		√		
Styx River at Cataract Road		√		
Styx River at Styx Road		√		
Cataract River upstream of Styx River confluence		√		
South Styx upstream of Styx River confluence		√		
Tyenna River at Florentine Road		√		
Humboldt River at Newbury Road		√		
Junee River at Junee Road		√		
Tyenna River at Newbury Road			√	

The parameters or indicators measured at a site are dependent on the water type and the question being asked by the monitoring program. For inland water the indicators that were widely monitored (spatially and temporally) were selected for the derivation of DGVs for aquatic ecosystems (Table 3.).

Table 3. Indicators for which DGVs were derived for inland waters

Water Type	Indicator
Inland	• Physico-chemical: Dissolved Oxygen, Conductivity pH, Turbidity and, Water Temperature. • Nutrients: TAN (NH_3 and NH_4^+), Nitrate, Nitrite, Total Nitrogen, Dissolved Reactive Phosphorus, Total Phosphorus and, Total Suspended Solids (TSS). • Biological: AUSRIVSA Band, OE50, OE50Signal, Signal Index, Taxon Diversity, EPT Diversity, and Macroinvertebrate Composition, Fish O/E, Fish O/P, Proportion native fish abundance, proportion native fish species, proportion native biomass, Chlorophyll a, algal cover and riparian shading*

Where possible water quality data collected at times of no flow or during times of flood (over bank full) have been excluded in the derivation of the water quality DGVs. On this basis it can be taken that the WQ DGVs represent base flow conditions**,** i.e. flow conditions that occur 98 percent of the time within waterways. For the decision process and selection criteria for identifying flow conditions refer to the EPA document, Technical Guidance for Water Quality Objectives (WQOs) Setting for Tasmania.

The minimum sample number required to determine percentile values with at least 95% confidence for WQ DGVs are as follows: 6 samples for 50th percentile; 14 samples for 20th and 80th percentiles; 29 samples for 10th and 90th percentiles; and 35 samples for 5th and 95th percentiles. In instances where there is insufficient data for a given key indicator the national WQ DGVs can be used.

For biological indicators a minimum of six combined season AUSRIVAS outputs have been used to generate percentile values to provide a level of statistical robustness for biological DGVs. For details on biological indicators for inland waters refer to the EPA document, Technical Guidance for Water Quality Objectives (WQOs) Setting for Tasmania

The tables overleaf of physico-chemical indicators report the DGVs for aquatic ecosystems of the Lower Derwent Catchment (shaded values) for HEV and SMD ecosystem categories on an annual and seasonal basis. Additional percentile values have been included for comparative purposes. The DGVs are summarised in Appendix A.

HEV DGVs for aquatic ecosystems of the Lower Derwent Catchment

The HEV water quality DGVs (Tables 4 to 8 shaded values) have been derived from 44 HEV sites across the H3 region.

Table 4 Full year

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L^	7.4	8.3	9.0	10.1	11.2	11.7	12.1	422
Dissolved Oxygen % Saturation^	66.9	73.3	80.9	96.4	101.9	105.5	108.5	90
Field Cond @ TRef25 µS/cm^	33.6	37.7	42.7	53.5	76.6	97.5	134.8	6567
pH field - sensor TC^	5.0	5.4	5.8	6.3	6.8	7.0	7.1	6555
Turbidity NTU^	0.3	0.5	1.0	2.1	4.8	8.2	13.3	6017
Temperature (Celsius)^	4.0	5.0	6.0	8.5	12.0	14.0	15.0	6061
TAN as N mg/L^	0.005	0.007	0.009	0.017	0.023	0.027	0.033	92
Nitrate as N mg/L^	0.001	0.001	0.001	0.001	0.003	0.006	0.009	107
Nitrite as N mg/L^	0.001	0.001	0.003	0.006	0.010	0.011	0.013	92
Total Nitrogen as N mg/L^	0.091	0.120	0.152	0.216	0.412	0.600	0.690	383
Phosphorus, Dissolved Reactive as P mg/L^	0.001	0.001	0.001	0.003	0.004	0.004	0.006	91
Total Phosphorus as P mg/L^	0.003	0.003	0.003	0.007	0.011	0.016	0.023	498
Total Suspended Solids (1.5µm) mg/L*	5.000	5.000	5.000	5.000	5.000	5.000	5.000	15
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	0.500	3.000	7.000	10.150	358

* State derived values, ^ hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

Table 5 Summer

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L^	6.4	7.3	8.0	9.1	10.1	10.4	10.6	130
Dissolved Oxygen % Saturation^	61.3	67.1	72.0	86.2	101.0	104.4	110.4	31
Field Cond @ TRef25 µS/cm^	34.7	39.6	44.7	59.3	84.2	110.2	152.0	1770
pH field - sensor TC^	5.1	5.5	5.9	6.5	6.9	7.1	7.3	1769
Turbidity NTU^	0.3	0.5	0.8	2.0	4.4	7.3	12.5	1657
Temperature (Celsius)^	5.6	7.0	9.0	12.0	14.5	16.0	18.0	1642
TAN as N mg/L^	0.004	0.004	0.009	0.017	0.020	0.025	0.028	31
Nitrate as N mg/L^	0.001	0.001	0.001	0.001	0.003	0.004	0.007	36
Nitrite as N mg/L^	0.001	0.001	0.002	0.006	0.009	0.010	0.011	31
Total Nitrogen as N mg/L^	0.086	0.110	0.140	0.224	0.407	0.603	0.678	118
Phosphorus, Dissolved Reactive as P mg/L^	0.001	0.001	0.001	0.003	0.004	0.005	0.005	31
Total Phosphorus as P mg/L^	0.003	0.003	0.003	0.007	0.014	0.018	0.021	145
Total Suspended Solids (1.5µm) mg/L*	5.000	5.000	5.000	5.000	5.000	5.000	5.000	4
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	0.500	3.000	7.000	8.000	101

* State derived values, ^ hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

Table 6 Autumn

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L^	8.1	8.5	9.2	10.2	11.0	11.4	11.7	111
Dissolved Oxygen % Saturation^	62.8	77.1	84.3	94.5	101.1	104.2	107.2	27
Field Cond @ TRef25 µS/cm^	35.7	40.0	44.9	55.8	80.1	105.5	140.8	1685
pH field - sensor TC^	5.1	5.4	5.8	6.4	6.9	7.0	7.2	1681
Turbidity NTU^	0.3	0.5	0.8	1.8	4.0	6.1	10.2	1462
Temperature (Celsius)^	5.0	6.0	7.0	9.0	11.0	12.5	14.0	1575
TAN as N mg/L^	0.006	0.007	0.010	0.014	0.020	0.024	0.025	27
Nitrate as N mg/L^	0.001	0.001	0.001	0.001	0.002	0.006	0.008	32
Nitrite as N mg/L^	0.001	0.001	0.003	0.006	0.009	0.010	0.010	27
Total Nitrogen as N mg/L^	0.025	0.141	0.166	0.231	0.446	0.626	0.716	112
Phosphorus, Dissolved Reactive as P mg/L^	0.001	0.001	0.001	0.003	0.004	0.005	0.006	27
Total Phosphorus as P mg/L^	0.003	0.003	0.003	0.007	0.012	0.015	0.025	141
Total Suspended Solids (1.5µm) mg/L*	5.000	5.000	5.000	5.000	5.000	5.000	5.000	3
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	0.500	5.000	7.600	17.300	95

* State derived values, ^ hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

Table 7 Winter

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L^	9.3	9.5	10.0	11.0	12.0	12.4	12.8	95
Dissolved Oxygen % Saturation^	91.5	92.0	93.8	99.0	105.1	107.2	111.0	13
Field Cond @ TRef25 µS/cm^	31.9	35.5	40.5	49.4	69.2	85.3	110.8	1505
pH field - sensor TC^	4.9	5.2	5.6	6.2	6.6	6.7	6.9	1505
Turbidity NTU^	0.4	0.6	1.0	2.4	5.9	10.2	15.3	1388
Temperature (Celsius)^	3.0	4.0	5.0	6.0	7.5	8.0	9.0	1363
TAN as N mg/L^	0.009	0.009	0.012	0.021	0.030	0.036	0.041	14
Nitrate as N mg/L^	0.001	0.001	0.001	0.002	0.006	0.008	0.010	14
Nitrite as N mg/L^	0.002	0.003	0.004	0.007	0.013	0.016	0.017	14
Total Nitrogen as N mg/L^	0.144	0.160	0.184	0.220	0.298	0.588	0.769	67
Phosphorus, Dissolved Reactive as P mg/L^	0.001	0.001	0.002	0.003	0.003	0.004	0.005	14
Total Phosphorus as P mg/L^	0.003	0.003	0.003	0.006	0.008	0.013	0.021	97
Total Suspended Solids (1.5µm) mg/L*	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	0.500	3.000	4.700	8.350	74

* State derived values, ^ hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

Table 8 Spring

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L^	8.7	9.0	9.4	10.4	11.4	11.7	11.8	86
Dissolved Oxygen % Saturation^	84.1	85.6	88.9	96.4	101.4	104.7	105.7	19
Field Cond @ TRef25 µS/cm^	32.5	36.6	41.0	50.6	70.9	88.9	120.3	1607
pH field - sensor TC^	4.9	5.3	5.7	6.3	6.7	6.9	7.0	1600
Turbidity NTU^	0.4	0.6	1.0	2.3	5.3	8.7	14.7	1510
Temperature (Celsius)^	5.0	5.0	6.0	8.0	10.0	11.0	13.0	1481
TAN as N mg/L^	0.005	0.007	0.008	0.019	0.028	0.030	0.032	20
Nitrate as N mg/L^	0.001	0.001	0.001	0.001	0.001	0.003	0.006	25
Nitrite as N mg/L^	0.001	0.002	0.003	0.007	0.010	0.012	0.013	20
Total Nitrogen as N mg/L^	0.113	0.122	0.136	0.178	0.407	0.512	0.615	86
Phosphorus, Dissolved Reactive as P mg/L^	0.001	0.001	0.001	0.003	0.004	0.004	0.004	19
Total Phosphorus as P mg/L^	0.003	0.003	0.003	0.007	0.010	0.015	0.018	115
Total Suspended Solids (1.5µm) mg/L*	5.000	5.000	5.000	5.000	5.000	5.000	5.000	3
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	0.500	3.000	6.000	9.650	88

* State derived values, ^ hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

The HEV biological DGVs detailed in Table 9 have been derived from 12 HEV sites within the catchment.

Table 9 Data Summary and biological DGVs (shaded) for HEV ecosystems of the Lower Derwent Catchment

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
AUSRIVAS Band#	B	B	A	A	A	A	A	22
OE50#	0.85	0.87	0.91	1.00	1.08	1.10	1.12	22
OE50Signal#	0.96	0.96	0.96	0.99	1.00	1.01	1.01	22
Signal Index	5.9	6.0	6.0	6.2	6.4	6.5	6.6	22
Taxon Diversity	19	24	25	29	31	31	31	22
EPT Diversity	9	9	10	13	15	15	16	22
Macroinvertebrate composition	0.39	0.40	0.40	0.45	0.48	0.52	0.55	22

Based on combined season AUSRIVAS outputs.

SMD DGVs for aquatic ecosystems of the Lower Derwent Catchment

The SMD water quality DGVs (Tables 10 to 14 shaded values) have been derived from 1 SMEV site within the catchment.

Table 10 Full year

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	9.6	9.7	10.2	11.4	12.1	12.6	13.2	53
Dissolved Oxygen % Saturation	88.1	91.5	95.2	101.6	107.0	108.0	109.6	53
Field Cond @ TRef25 µS/cm	78.9	85.1	105.4	152.0	201.2	233.2	245.7	55
pH field - sensor TC	7.0	7.2	7.4	7.8	8.1	8.3	8.4	53
Turbidity NTU	1.2	1.3	1.5	2.9	4.8	8.3	13.0	55
Temperature (Celsius)	5.0	6.0	6.7	8.9	11.9	13.0	13.6	55
TAN as N mg/L	0.003	0.003	0.004	0.006	0.010	0.012	0.019	54
Nitrate as N mg/L	0.001	0.003	0.015	0.035	0.064	0.076	0.083	54
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.001	0.002	0.003	54
Total Nitrogen as N mg/L	0.074	0.079	0.100	0.144	0.283	0.434	0.537	54
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.003	0.004	0.004	0.004	53
Total Phosphorus as P mg/L	0.003	0.003	0.003	0.008	0.013	0.019	0.025	54
Total Suspended Solids (1.5µm) mg/L*	0.900	3.000	5.000	5.000	5.000	10.000	14.000	137
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	3.000	11.000	20.700	33.750	134

* State derived values, ^Hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

Table 11 Summer

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	9.4	9.6	10.0	10.3	11.0	11.5	11.8	16
Dissolved Oxygen % Saturation	91.5	93.0	97.0	102.3	107.0	108.3	109.9	16
Field Cond @ TRef25 µS/cm	129.3	149.4	153.4	208.3	239.4	249.5	268.0	16
pH field - sensor TC	7.3	7.5	7.8	8.1	8.4	8.4	8.4	16
Turbidity NTU	1.1	1.3	1.4	1.9	2.0	6.5	11.0	16
Temperature (Celsius)	9.5	10.7	10.9	12.1	13.2	13.7	13.9	16
TAN as N mg/L	0.001	0.002	0.004	0.006	0.010	0.010	0.013	16
Nitrate as N mg/L	0.001	0.001	0.003	0.018	0.030	0.038	0.042	16
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.001	0.001	0.002	16
Total Nitrogen as N mg/L	0.073	0.079	0.083	0.100	0.130	0.295	0.397	16
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.002	0.003	0.003	0.003	16
Total Phosphorus as P mg/L	0.003	0.003	0.003	0.004	0.006	0.015	0.021	16
Total Suspended Solids (1.5µm) mg/L*	0.500	2.000	5.000	5.000	5.000	6.000	10.000	31
Total Suspended Solids (0.45µm) mg/L^	0.650	1.600	3.000	9.000	15.200	20.400	42.900	27

* State derived values, ^Hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

Table 12 Autumn

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	9.6	9.6	10.5	11.5	12.0	12.1	12.3	16
Dissolved Oxygen % Saturation	85.0	90.7	94.8	99.6	107.0	108.7	111.4	16
Field Cond @ TRef25 µS/cm	90.4	94.6	107.6	135.0	186.2	225.4	238.4	17
pH field - sensor TC	7.0	7.3	7.6	7.8	8.0	8.1	8.2	15
Turbidity NTU	1.2	1.3	1.7	3.0	4.6	8.1	12.7	17
Temperature (Celsius)	6.6	7.2	8.1	8.9	10.3	11.3	12.1	17
TAN as N mg/L	0.003	0.003	0.005	0.006	0.008	0.009	0.010	17
Nitrate as N mg/L	0.001	0.002	0.019	0.045	0.061	0.064	0.067	17
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.001	0.002	0.002	17
Total Nitrogen as N mg/L	0.070	0.074	0.111	0.175	0.264	0.310	0.360	17
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.003	0.003	0.003	0.004	17
Total Phosphorus as P mg/L	0.003	0.004	0.005	0.008	0.011	0.019	0.029	17
Total Suspended Solids (1.5µm) mg/L*	0.825	2.300	4.600	5.000	5.000	5.000	8.150	34
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	5.000	12.000	16.600	25.650	28

* State derived values, ^Hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

Table 13 Winter

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	10.6	10.9	11.4	12.4	13.5	13.6	13.7	11
Dissolved Oxygen % Saturation	89.4	91.2	95.9	104.0	107.0	107.6	107.7	11
Field Cond @ TRef25 µS/cm	82.0	84.3	89.0	116.8	157.0	185.7	189.5	12
pH field - sensor TC	7.1	7.2	7.3	7.5	7.8	7.9	8.0	12
Turbidity NTU	1.9	1.9	2.1	3.6	5.5	8.1	19.6	12
Temperature (Celsius)	4.1	4.5	4.9	6.4	7.1	7.3	7.4	12
TAN as N mg/L	0.003	0.003	0.004	0.006	0.016	0.023	0.024	12
Nitrate as N mg/L	0.036	0.041	0.048	0.070	0.083	0.125	0.155	12
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.001	0.003	0.003	12
Total Nitrogen as N mg/L	0.135	0.140	0.141	0.220	0.517	0.614	0.692	12
Phosphorus, Dissolved Reactive as P mg/L	0.002	0.002	0.003	0.004	0.005	0.005	0.005	12
Total Phosphorus as P mg/L	0.004	0.006	0.008	0.011	0.017	0.018	0.027	12
Total Suspended Solids (1.5µm) mg/L*	3.000	4.500	5.000	5.000	10.000	10.000	18.500	46
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	3.000	7.000	15.200	22.100	39

* State derived values, ^Hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

Table 14 Spring

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	10.1	10.3	10.4	11.7	11.9	12.0	12.1	10
Dissolved Oxygen % Saturation	91.8	92.5	97.3	101.6	103.8	104.5	106.8	10
Field Cond @ TRef25 µS/cm	73.4	78.8	100.1	143.4	152.4	155.1	160.2	10
pH field - sensor TC	7.0	7.2	7.3	7.6	8.0	8.2	8.4	10
Turbidity NTU	1.3	1.3	1.5	3.6	4.2	5.1	6.6	10
Temperature (Celsius)	6.2	6.5	6.7	8.5	9.5	11.9	13.0	10
TAN as N mg/L	0.003	0.004	0.005	0.007	0.010	0.012	0.013	9
Nitrate as N mg/L	0.011	0.014	0.020	0.032	0.068	0.078	0.080	9
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.001	0.002	0.002	9
Total Nitrogen as N mg/L	0.084	0.091	0.108	0.183	0.252	0.284	0.344	9
Phosphorus, Dissolved Reactive as P mg/L	0.002	0.002	0.003	0.004	0.004	0.004	0.004	8
Total Phosphorus as P mg/L	0.003	0.003	0.005	0.010	0.015	0.018	0.019	9
Total Suspended Solids (1.5µm) mg/L*	1.500	3.500	5.000	5.000	5.000	11.500	12.000	26
Total Suspended Solids (0.45µm) mg/L^	0.500	0.500	0.500	2.250	8.200	22.100	41.400	40

* State derived values, ^Hydrological region values, TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+).

The SMD biological DGVs detailed in Table 15 have been derived from 13 SMEV sites across the H3 region.

Table 15 Data Summary and biological DGVs (shaded) for SMD ecosystems of the Lower Derwent Catchment

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
AUSRIVAS Band#	B	B	B	B	A	A	A	8
OE50#	0.78	0.78	0.79	0.83	0.90	0.95	1.02	8
OE50Signal#	0.96	0.96	0.97	0.98	0.99	1.01	1.03	8
Signal Index	5.3	5.4	5.5	5.6	5.9	6.0	6.0	9
Taxon Diversity	25	25	27	28	30	31	31	9
EPT Diversity	10	11	11	11	12	13	13	9
Macroinvertebrate composition	0.38	0.39	0.39	0.39	0.43	0.44	0.45	9

Based on combined season AUSRIVAS outputs.

The SMD DGVs may represent aspirational DGVs for moderately disturbed ecosystems but apply when site-specific guideline values consistent with the NWQMS are not available.

Information from the Tasmanian River Condition Index (TRCI) project has been incorporated into the biological DGVs in order to provide guideline values for key biological indicators relating to invertebrate abundance, native fish, and algae. Details are provided in the EPA document, Technical Guidance for Water Quality Objectives (WQOs) Setting for Tasmania.

A summary of the HEV and SMD DGVs from Table 4 to Table 15 are provided in Appendix A.

Appendix A: DGVs summary for aquatic ecosystems of the Lower Derwent Catchment.

HEV	Physico-chemical indicators and water quality DGVs for Aquatic Ecosystems																
	DO (mg/L)^		DO (% sat)^		Cond^	pH^		Turb^	Temp (°C)^		TAN as N^	NO_3 as N^	NO_2 as N^	Total N as N^	DRP as P^	Total P as P^	TSS* (1.5 µm)	TSS^ (0.45 µm)
	lower	upper	lower	upper	(µs/cm)	lower	upper	NTU	lower	upper	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Annual	9.0	11.2	80.9	101.9	76.6	5.8	6.8	4.8	6.0	12.0	0.023	0.003	0.010	0.412	0.004	0.011	5.00	3.00
Summer	8.0	10.1	72.0	101.0	84.2	5.9	6.9	4.4	9.0	14.5	0.020	0.003	0.009	0.407	0.004	0.014	5.00~	3.00
Autumn	9.2	11.0	84.3	101.1	80.1	5.8	6.9	4.0	7.0	11.0	0.020	0.002	0.009	0.446	0.004	0.012	5.00~	5.00
Winter	10.0	12.0	93.8~	105.1~	69.2	5.6	6.6	5.9	5.0	7.5	0.030	0.006	0.013	0.298	0.003	0.008	5.00~	3.00
Spring	9.4	11.4	88.9	101.4	70.9	5.7	6.7	5.3	6.0	10.0	0.028	0.001	0.010	0.407	0.004	0.010	5.00~	3.00

NB: DO (dissolved oxygen), Cond (electrical conductivity), Turb (turbidity), TAN (total ammonia nitrogen), DRP (dissolved reactive phosphorus), TSS (total suspended solids) filtered through, e.g., 1.5 µm. * State derived values, ^ Hydrological region values, ~ <95% confidence. Figures shown above are based on data from 44 HEV sites from across the H3 hydrological region unless noted otherwise in the table.

SMD	Physico-chemical indicators and water quality DGVs for Aquatic Ecosystems																
	DO (mg/L)		DO (% sat)		Cond	pH		Turb	Temp (°C)		TAN as N	NO_3 as N	NO_2 as N	Total N as N	DRP as P	Total P as P	TSS* (1.5 µm)	TSS^ (0.45 µm)
	lower	upper	lower	upper	(µs/cm)	lower	upper	NTU	lower	upper	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Annual	10.2	12.1	95.2	107.0	201.2	7.4	8.1	4.8	6.7	11.9	0.010	0.064	0.001	0.283	0.004	0.013	5.00	11.00
Summer	10.0	11.0	97.0	107.0	239.4	7.8	8.4	2.0	10.9	13.2	0.010	0.030	0.001	0.130	0.003	0.006	5.00	15.20
Autumn	10.5	12.0	94.8	107.0	186.2	7.6	8.0	4.6	8.1	10.3	0.008	0.061	0.001	0.264	0.003	0.011	5.00	12.00
Winter	11.4~	13.5~	95.9~	107.0~	157.0~	7.3~	7.8~	5.5~	4.9~	7.1~	0.016~	0.083~	0.001~	0.517~	0.005~	0.017~	10.00	7.00
Spring	10.4~	11.9~	97.3~	103.8~	152.4~	7.3~	8.0~	4.2~	6.7~	9.5~	0.010~	0.068~	0.001~	0.252~	0.004~	0.015~	5.00	8.20

NB: DO (dissolved oxygen), Cond (electrical conductivity), Turb (turbidity), TAN (total ammonia nitrogen), DRP (dissolved reactive phosphorus), TSS (total suspended solids) filtered through, e.g., 1.5 µm. * State derived values, ^ Hydrological region values, ~ <95% confidence. Figures shown above are based on data from 1 SMEV site within the Lower Derwent Catchment unless noted otherwise in the table.

Biological Condition	Biological indicators and biological DGVs for Aquatic Ecosystems													
	AUSIVAS band		OE50		OE50 Signal		Signal Index		Taxon Diversity		EPT Diversity		Macroinvertebrate Composition	
	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper	lower	upper
HEV	A	A	0.91	1.08	0.96	1.00	6.0	6.4	25	31	10	15	0.40	0.48
SMD^	B	A	0.80	1.01	0.97	1.01	5.5	6.3	22	30	9	12	0.38	0.45

^ Hydrological region values. Figures shown above are based on data from 12 HEV sites within the Lower Derwent Catchment and 13 SMEV sites across the H3 Hydrological region.

Appendix B: Precautionary approach for recreational waters microorganisms

For recreational waters microorganisms are used as a regulatory parameter of public health significance. The indicator organism used for microbiological water quality assessment is intestinal enterococci and is related to a risk matrix which uses sanitary inspection of potential faecal contamination sources and 95th percentile levels of enterococci/100mL. The Public Health Act 1997 Recreational Water Quality Guidelines (Tasmania 2007) for a general water body (where no sanitary risk assessment has been undertaken) has determined microbial levels for investigation and action to informing the public of the elevated public health risk. These levels are at enterococci counts in a single water sample greater than 140 enterococci/100mL and when two consecutive water samples results are greater than 280 enterococci/100mL.

A precautionary approach is however recommended by the EPA, being that microbial levels should be at 40 enterococci/100mL or less and this should be the DGV for this key indicator. Refer to the Australian Government Guidelines for Managing Risk in Recreational Water for more detail on the classification matrix for faecal pollution of recreational water and other key indicators DGVs.

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