Default Guideline Values (DGVs) for Aquatic Ecosystems of Tasmanian Inland Waters

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Enquiries:
Environment Protection Authority
GPO Box 1550
Hobart, Tasmania 7001
Telephone: (03) 6165 4599
Email: Enquiries@epa.tas.gov.au
Web: www.epa.tas.gov.au

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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 state default guideline values (DGVs) for aquatic ecosystems presented herein have been derived for Tasmanian inland waters 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 C) 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.

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 either a very limited quantity of Tasmanian data or are based solely on data from other jurisdictions within the South-east zone.

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).

High Ecological Value Ecosystems

High Ecological Value ecosystems (HEVs) are unmodified and highly valued ecosystems, typically (but not always) occurring in national parks, conservation reserves or in remote and/or inaccessible locations. Their ecological integrity is regarded as intact.

Slightly to Moderately Disturbed Ecosystems

Slightly to moderately disturbed ecosystems (SMD) are ecosystems where aquatic biological diversity may have been adversely affected ranging from a relatively small but measurable impact to a more significant one by human activity. The biological communities however remain in a healthy condition and ecosystem integrity is largely retained. This category has been further divided as follows

Slightly Modified Ecological Value

The Slightly Modified Ecological Value (SMEV) ecosystems are the least impacted ecosystems within the SMD category. Ecosystems within this category only show a slight deviation from natural condition.

Moderately Disturbed Ecosystems

These are ecosystems within the SMD category that have been subject to a moderate degree of departure from natural conditions.

Highly Disturbed Ecosystem

Highly disturbed ecosystems (HD) are measurably degraded ecosystems of lower ecological condition.

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.

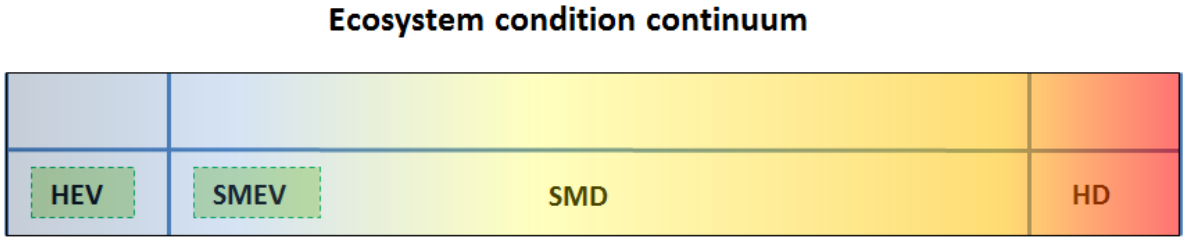

Figure 1. Ecosystem condition continuum showing HEV and SMEV reference categories.

Deriving DGVs for inland aquatic ecosystems

The state water quality DGVs for aquatic ecosystems are based on data from 139 sites. Of these 77 sites were HEV ecosystem category and 62 were SMD ecosystem category. A suite of biological indicators has also been used to derive biological DGVs for the HEV and SMD ecosystem categories. Biological information was used from 245 sites. Of these 175 sites were HEV ecosystem category and 70 were SMD ecosystem category.

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 1.).

Table 1. 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*

*For details of the biological indicators for inland waters Refer to Appendix B.

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 outputs have been used to generate percentile values to provide a level of statistical robustness for biological DGVs. A summary of the DGVs for HEV and SMD aquatic ecosystems is provided in Appendix A.

HEV DGVs for aquatic ecosystems of inland waters

The HEV water quality DGVs (Tables 2 to 6 shaded values) have been derived from 77 HEV sites.

Table 2 Full year

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.4	8.2	9.0	10.1	11.2	11.8	12.2	1491
Dissolved Oxygen % Saturation	72.5	81.1	87.9	96.5	103.0	106.0	108.9	637
Field Cond @ TRef25 µS/cm	33.9	38.4	43.6	57.0	89.1	124.0	185.0	8025
pH field - sensor TC	5.0	5.4	5.8	6.4	6.9	7.2	7.4	7886
Turbidity NTU	0.4	0.6	1.0	2.2	5.0	8.5	13.8	7236
Temperature (Celsius)	4.5	5.0	6.0	9.0	12.1	14.0	16.0	7514
TAN as N mg/L	0.003	0.004	0.005	0.010	0.017	0.024	0.031	552
Nitrate as N mg/L	0.001	0.001	0.001	0.016	0.084	0.147	0.199	593
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.005	0.007	0.009	552
Total Nitrogen as N mg/L	0.078	0.100	0.140	0.236	0.476	0.629	0.751	919
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.003	0.004	0.005	0.006	546
Total Phosphorus as P mg/L	0.003	0.003	0.003	0.007	0.013	0.019	0.024	1032
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

Table 3 Summer

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	6.4	7.2	7.9	9.1	10.0	10.3	10.7	412
Dissolved Oxygen % Saturation	69.0	76.1	83.0	96.0	102.5	107.8	113.1	176
Field Cond @ TRef25 µS/cm	35.7	40.4	45.8	62.9	97.5	136.5	189.9	2141
pH field - sensor TC	5.1	5.6	5.9	6.5	7.0	7.3	7.5	2115
Turbidity NTU	0.3	0.5	0.8	2.0	4.6	7.4	12.5	1966
Temperature (Celsius)	6.0	8.0	9.8	12.0	15.0	17.0	19.0	2008
TAN as N mg/L	0.002	0.003	0.006	0.011	0.018	0.025	0.030	149
Nitrate as N mg/L	0.001	0.001	0.001	0.005	0.076	0.148	0.191	162
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.005	0.007	0.009	149
Total Nitrogen as N mg/L	0.080	0.102	0.140	0.250	0.494	0.634	0.731	257
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.002	0.003	0.004	0.005	0.006	145
Total Phosphorus as P mg/L	0.003	0.003	0.003	0.008	0.015	0.020	0.025	280
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

Table 4 Autumn

Parameter	5th %ile	10th %ile	10th %ile	Median	80th %ile	80th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.4	8.2	9.1	10.1	11.0	11.5	11.9	384
Dissolved Oxygen % Saturation	65.1	81.2	86.2	95.7	103.0	105.8	107.6	169
Field Cond @ TRef25 µS/cm	36.0	40.1	45.7	59.4	96.0	134.7	191.0	2077
pH field - sensor TC	5.1	5.5	5.9	6.5	7.0	7.2	7.4	2031
Turbidity NTU	0.3	0.5	0.9	1.9	4.1	6.2	10.2	1788
Temperature (Celsius)	5.0	6.0	7.0	9.0	12.0	13.0	14.7	1962
TAN as N mg/l	0.003	0.004	0.005	0.010	0.016	0.020	0.026	157
Nitrate as N mg/L	0.001	0.001	0.001	0.013	0.076	0.131	0.176	168
Nitrite as N mg/l	0.001	0.001	0.001	0.001	0.004	0.007	0.009	157
Total Nitrogen as N mg/l	0.057	0.095	0.142	0.230	0.470	0.592	0.714	271
Phosphorus, Dissolved Reactive as P mg/l	0.001	0.001	0.001	0.003	0.004	0.005	0.006	157
Total Phosphorus as P mg/l	0.003	0.003	0.003	0.007	0.014	0.020	0.026	302
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

Table 5 Winter

Parameter	5th %ile	10th %ile	10th %ile	Median	80th %ile	80th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	9.4	9.6	10.1	11.2	12.0	12.5	12.9	361
Dissolved Oxygen % Saturation	79.3	86.6	89.9	96.5	103.6	106.0	108.7	142
Field Cond @ TRef25 µS/cm	32.0	36.3	41.5	52.0	79.2	111.3	170.2	1865
pH field - sensor TC	4.9	5.2	5.7	6.2	6.7	6.9	7.2	1834
Turbidity NTU	0.4	0.7	1.0	2.7	6.2	10.9	16.4	1690
Temperature (Celsius)	3.0	4.0	5.0	6.0	8.0	8.8	9.5	1724
TAN as N mg/L	0.003	0.003	0.005	0.010	0.017	0.025	0.037	121
Nitrate as N mg/L	0.001	0.005	0.012	0.040	0.094	0.194	0.245	124
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.004	0.007	0.010	121
Total Nitrogen as N mg/L	0.048	0.104	0.146	0.230	0.505	0.700	0.844	191
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.002	0.003	0.004	0.005	0.005	121
Total Phosphorus as P mg/L	0.003	0.003	0.003	0.006	0.012	0.017	0.028	222
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

Table 6 Spring

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	8.5	9.0	9.4	10.4	11.2	11.7	11.9	334
Dissolved Oxygen % Saturation	80.8	87.0	91.8	98.1	102.5	106.0	108.6	150
Field Cond @ TRef25 µS/cm	32.5	37.0	42.0	53.6	82.1	113.5	176.0	1942
pH field - sensor TC	4.9	5.3	5.7	6.4	6.8	7.1	7.4	1906
Turbidity NTU	0.4	0.6	1.0	2.4	5.5	9.4	15.3	1792
Temperature (Celsius)	5.0	5.5	6.5	8.0	10.6	12.2	14.0	1820
TAN as N mg/L	0.003	0.004	0.006	0.009	0.017	0.023	0.031	125
Nitrate as N mg/L	0.001	0.001	0.001	0.015	0.085	0.147	0.192	139
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.005	0.007	0.010	125
Total Nitrogen as N mg/L	0.089	0.110	0.136	0.217	0.463	0.621	0.700	200
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.003	0.004	0.005	0.005	123
Total Phosphorus as P mg/L	0.003	0.003	0.005	0.008	0.013	0.017	0.022	228
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

The HEV biological DGVs detailed in Table 7 have been derived from 175 HEV sites.

Table 7 Data Summary and biological DGVs (shaded) for HEV ecosystems of inland waters

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
AUSRIVAS Band[#]	B	B	A	A	A	A	X	598
OE50[#]	0.77	0.83	0.91	1.02	1.10	1.13	1.15	598
OE50Signal[#]	0.95	0.96	0.98	1.00	1.02	1.03	1.04	598
Signal Index	5.7	5.9	6.1	6.3	6.5	6.7	6.7	615
Taxon Diversity	19	21	23	27	31	32	33	615
EPT Diversity	8	9	10	12	14	15	16	615
Macroinvertebrate composition	0.35	0.38	0.41	0.45	0.50	0.52	0.54	615

[#] Based on combined season AUSRIVAS outputs

SMD DGVs for aquatic ecosystems of inland waters

The SMD water quality DGVs (Tables 8 to 12 shaded values) have been derived from 62 SMEV sites.

Table 8 Full year

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.8	8.4	9.0	10.2	11.2	11.8	12.2	1823
Dissolved Oxygen % Saturation	79.0	84.5	89.0	96.1	101.6	105.7	108.8	1125
Field Cond @ TRef25 µS/cm	39.0	47.0	56.0	79.0	143.1	229.0	366.3	2976
pH field - sensor TC	5.8	6.1	6.4	6.9	7.5	7.7	7.9	2871
Turbidity NTU	0.7	1.0	1.5	3.3	7.5	12.4	22.3	2638
Temperature (Celsius)	5.0	5.9	7.1	10.6	15.0	17.3	19.2	2943
TAN as N mg/L	0.003	0.003	0.005	0.010	0.020	0.042	0.066	1011
Nitrate as N mg/L	0.001	0.001	0.002	0.028	0.160	0.259	0.328	1037
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.003	0.004	0.005	1005
Total Nitrogen as N mg/L	0.100	0.130	0.188	0.350	0.609	0.911	1.500	1059
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.003	0.004	0.005	0.007	930
Total Phosphorus as P mg/L	0.003	0.003	0.006	0.012	0.025	0.042	0.092	1204
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

Table 9 Summer

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	6.9	7.6	8.3	9.1	9.9	10.5	11.0	454
Dissolved Oxygen % Saturation	78.0	82.2	88.0	96.2	103.9	108.5	114.7	302
Field Cond @ TRef25 µS/cm	43.0	51.1	60.0	84.3	146.0	225.2	335.2	733
pH field - sensor TC	6.1	6.3	6.6	7.1	7.5	7.8	8.1	710
Turbidity NTU	0.6	0.9	1.3	2.7	6.0	9.7	17.2	629
Temperature (Celsius)	11.0	12.0	13.1	15.5	18.7	20.6	22.1	715
TAN as N mg/L	0.003	0.003	0.006	0.011	0.025	0.041	0.055	261
Nitrate as N mg/L	0.001	0.001	0.001	0.014	0.143	0.223	0.265	269
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.003	0.004	0.006	257
Total Nitrogen as N mg/L	0.099	0.114	0.172	0.350	0.605	1.000	1.460	270
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.003	0.004	0.006	0.007	240
Total Phosphorus as P mg/L	0.003	0.003	0.006	0.012	0.025	0.044	0.090	299
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

Table 10 Autumn

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.8	8.5	9.2	10.2	11.0	11.5	11.8	498
Dissolved Oxygen % Saturation	78.2	84.1	88.4	95.9	101.2	104.6	107.7	309
Field Cond @ TRef25 µS/cm	39.5	49.0	58.0	80.0	143.5	222.0	370.5	810
pH field - sensor TC	6.0	6.2	6.5	7.0	7.5	7.8	7.9	774
Turbidity NTU	0.5	0.9	1.3	3.0	6.8	11.0	22.0	717
Temperature (Celsius)	6.6	7.4	8.6	10.9	13.7	15.7	16.9	783
TAN as N mg/L	0.003	0.003	0.005	0.010	0.021	0.055	0.073	292
Nitrate as N mg/L	0.001	0.001	0.001	0.016	0.119	0.172	0.207	297
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.003	0.004	0.005	291
Total Nitrogen as N mg/L	0.078	0.125	0.188	0.312	0.562	0.797	1.800	306
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.003	0.004	0.005	0.006	273
Total Phosphorus as P mg/L	0.003	0.003	0.006	0.011	0.025	0.047	0.114	346
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

Table 11 Winter

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	9.6	10.0	10.5	11.2	12.0	12.6	12.9	442
Dissolved Oxygen % Saturation	78.0	85.0	88.7	95.3	100.6	104.2	106.6	249
Field Cond @ TRef25 µS/cm	33.0	43.0	54.0	73.0	143.4	238.0	392.0	731
pH field - sensor TC	5.6	5.9	6.2	6.7	7.3	7.6	7.8	713
Turbidity NTU	0.9	1.3	2.0	4.0	9.2	16.0	28.9	660
Temperature (Celsius)	3.9	4.4	5.2	6.6	8.5	9.4	10.1	731
TAN as N mg/L	0.003	0.003	0.005	0.010	0.018	0.029	0.071	233
Nitrate as N mg/L	0.001	0.004	0.008	0.075	0.280	0.359	0.424	239
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.003	0.004	0.006	233
Total Nitrogen as N mg/L	0.114	0.145	0.231	0.423	0.667	0.954	1.485	244
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.002	0.003	0.005	0.006	0.008	212
Total Phosphorus as P mg/L	0.003	0.003	0.005	0.011	0.027	0.041	0.064	286
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

Table 12 Spring

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	8.5	8.8	9.4	10.3	11.0	11.5	11.9	429
Dissolved Oxygen % Saturation	83.7	88.1	91.1	97.1	101.0	104.0	107.1	265
Field Cond @ TRef25 µS/cm	39.1	45.0	54.0	76.0	140.7	232.5	367.0	702
pH field - sensor TC	5.8	6.0	6.4	6.9	7.4	7.7	7.9	674
Turbidity NTU	0.7	1.0	1.6	3.6	8.0	12.7	22.1	632
Temperature (Celsius)	6.4	7.0	8.0	10.5	13.6	15.6	17.2	714
TAN as N mg/L	0.003	0.003	0.005	0.011	0.019	0.040	0.055	225
Nitrate as N mg/L	0.001	0.001	0.002	0.033	0.182	0.270	0.314	232
Nitrite as N mg/L	0.001	0.001	0.001	0.001	0.003	0.004	0.004	224
Total Nitrogen as N mg/L	0.120	0.142	0.192	0.340	0.597	0.863	1.300	239
Phosphorus, Dissolved Reactive as P mg/L	0.001	0.001	0.001	0.003	0.004	0.005	0.006	205
Total Phosphorus as P mg/L	0.003	0.005	0.007	0.012	0.023	0.039	0.077	273
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

TAN=Total Ammonia Nitrogen (NH_3 and NH_4^+)

The SMD biological DGVs detailed in Table 13 have been derived from 70 SMEV sites.

Table 13 Data Summary and biological DGVs (shaded) for SMD ecosystems of inland waters

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	213
OE50[#]	0.77	0.81	0.89	0.98	1.05	1.09	1.12	213
OE50Signal[#]	0.94	0.95	0.97	0.99	1.01	1.02	1.03	213
Signal Index	5.4	5.6	5.8	6.1	6.3	6.4	6.5	214
Taxon Diversity	21	22	24	27	30	31	33	214
EPT Diversity	9	9	10	12	13	14	15	214
Macroinvertebrate composition	0.35	0.37	0.40	0.44	0.48	0.50	0.54	214

[#] 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.

A summary of the HEV and SMD DGVs from Table 2 to Table 13 are provided in Appendix A.

Appendix A: DGVs summary for aquatic ecosystems of inland waters

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	87.9	103.0	89.1	5.8	6.9	5.0	6.0	12.1	0.017	0.084	0.005	0.476	0.004	0.013	5.000	3.000
Summer	7.9	10.0	83.0	102.5	97.5	5.9	7.0	4.6	9.8	15.0	0.018	0.076	0.005	0.494	0.004	0.015	5.000~	3.000
Autumn	9.1	11.0	86.2	103.0	96.0	5.9	7.0	4.1	7.0	12.0	0.016	0.076	0.004	0.470	0.004	0.014	5.000~	5.000
Winter	10.1	12.0	89.9	103.6	79.2	5.7	6.7	6.2	5.0	8.0	0.017	0.094	0.004	0.505	0.004	0.012	5.000~	3.000
Spring	9.4	11.2	91.8	102.5	82.1	5.7	6.8	5.5	6.5	10.6	0.017	0.085	0.005	0.463	0.004	0.013	5.000~	3.000

NB: DO (dissolved oxygen), Cond (electrical conductivity), Turb (turbidity), TAN (total ammonia nitrogen (NH_3 and NH_4^+)), DRP (dissolved reactive phosphorus),

TSS (total suspended solids) filtered through, e.g., 1.5 µm. ~ <95% Confidence. Figures shown above are based on data from 77 HEV sites.

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	9.0	11.2	89.0	101.6	143.1	6.4	7.5	7.5	7.1	15.0	0.020	0.160	0.003	0.609	0.004	0.025	5.000	11.000
Summer	8.3	9.9	88.0	103.9	146.0	6.6	7.5	6.0	13.1	18.7	0.025	0.143	0.003	0.605	0.004	0.025	5.000	15.200
Autumn	9.2	11.0	88.4	101.2	143.5	6.5	7.5	6.8	8.6	13.7	0.021	0.119	0.003	0.562	0.004	0.025	5.000	12.000
Winter	10.5	12.0	88.7	100.6	143.4	6.2	7.3	9.2	5.2	8.5	0.018	0.280	0.003	0.667	0.005	0.027	10.00	7.000
Spring	9.4	11.0	91.1	101.0	140.7	6.4	7.4	8.0	8.0	13.6	0.019	0.182	0.003	0.597	0.004	0.023	5.000	8.200

NB: DO (dissolved oxygen), Cond (electrical conductivity), Turb (turbidity), TAN (total ammonia nitrogen (NH_3 and NH_4+)), DRP (dissolved reactive phosphorus),

TSS (total suspended solids) filtered through, e.g., 1.5 µm. Figures shown above are based on data from 62 SMEV sites.

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	1.10	0.98	1.02	6.1	6.5	23	31	10	14	0.41	0.50
SMD	A	A	0.89	1.05	0.97	1.01	5.8	6.3	24	30	10	13	0.40	0.48

Figures shown above are based on data from 175 HEV and 70 SMEV sites.

Appendix B: Biological Indicators for Inland waters

The following benthic macro-invertebrates indices are part of the rapid biological assessment approach. Those noted with "*" are based on combined season riffle AUSRIVAS outputs.

Parameter Name	Description
AUSRIVAS Band *	Band allocation from combined season riffle AUSRIVAS model letter score.
EPT Diversity	number of Ephemeroptera, Plecoptera and Trichoptera families observed in samples for combined season riffle analysis
Macroinvertebrate composition	Proportion of Ephemeroptera, Plecoptera and Trichoptera families observed in samples for combined season riffle analysis
OE50*	Observed versus expected ratio from combined season riffle AUSRIVAS model
OE50Signal *	Sensitivity score for expected taxa from combined season riffle AUSRIVAS model
Signal Index	Average signal score of families/taxa observed in samples for combined season riffle analysis
Taxon Diversity	number of families/taxa observed in samples for combined season riffle analysis
Fish Observed/Expected ratio	Comparison of native fish species predicted to occur in a stream reach by CFEV with species actually observed in the reach by electrofishing
Fish Observed/Predicted ratio	Comparison of native fish species predicted to have occurred (pre-European) in a CFEV sub-catchment with native species observed in the sub-catchment by electrofishing
Proportion native fish abundance	Proportion of individual fish electrofished at a site that are native species
Proportion native fish species	Proportion of fish species electrofished at a site that are native species
Proportion native biomass	Proportion of total biomass electrofished at a site comprised of native species

SIGNAL Index

The SIGNAL (Stream Invertebrate Grade Number Average Level) Index for a pair of samples is calculated by averaging the pollution sensitivity grade numbers (signal scores) of the 'families' collected. Pollution sensitivity grade numbers range from 10 for the most sensitive taxa to 1 for the most tolerant taxa (Chessman 2003). The resultant SIGNAL index provides an indication of water pollution impacts.

SIGNAL Score	Water Quality
>6	Excellent
5-5.9	Clean water
4-4.9	Mild pollution
3-3.9	Moderate pollution
<3	Severe pollution

Derived guidelines for Biological Indicators

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 that are not related to AUSRIVAS assessments, but relate to invertebrate abundance, native fish and algae. The biological indicators and associated values for HEV and SMD ecosystems are outlined in the following section.

Macroinvertebrate abundance

For benthic macroinvertebrate abundance a default total abundance count range of 700-4400 individuals/m^2 has been derived from Tasmanian River Condition Index for moderate to good condition category. This can be applied to HEV and SMD ecosystems.

Native fish indicators

The Tasmanian River Condition Index (TRCI) native fish indicators have been adopted, as follows; ratio of observed to expected fish for the river reach, ratio of observed to predicted fish for the sub-catchment, native fish abundance, native fish biomass, and proportion of fish species that are native.

For HEV ecosystems a default value of greater than (>)0.59 has been adopted for the observed/expected (O/E) biometric. For the observed/predicted (O/P) biometric a default value of >0.29 has been adopted. For native fish abundance, native fish biomass and proportion of native fish species a default value of >0.7 has been adopted. The default ranges for HEV ecosystems have been derived from the good fish condition category.

For SMD ecosystems a default score range of 0.29-0.59 has been adopted for the observed/expected (O/E) and 0.14-0.29 observed/predicted (O/P) biometrics. For native fish abundance and native fish biomass a default range of 0.30-0.69 has been adopted, whilst for proportion of native fish species a default score range of 0.2 to 0.69 has been adopted. The default ranges have been derived from the moderate fish condition category.

Algal indicators

The Tasmanian River Condition Index (TRCI) algal indicators have been adopted as follows; Chlorophyll-a biomass, percent riparian shading, and percent algal cover.

For HEV ecosystems, chlorophyll-a default biomass values of less than (<)4 mg/m^2 of rock surface under greater than (>)80% riparian shading, <6 mg/m^2 of rock surface under 60-80% riparian shading, and <15 mg/m^2 of rock surface under <60% riparian shading have been derived from the TRCI low category for algal biomass. An algal cover of <80% for rock substrate has been adopted as the default value for algal cover based on the low to moderate category for algal cover.

For SMD ecosystems, chlorophyll-a default biomass values <20 mg/m^2 of rock surface under >80% riparian shading, <25 mg/m^2 of rock surface under 60-80% riparian shading, and <60 mg/m^2 of rock surface under <60% riparian shading have been derived from the TRCI moderate category for algal biomass. An algal cover of <80% for rock substrate has been adopted as the default value for algal cover based on the low to moderate category for algal cover.

Appendix C: 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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