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

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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 interim default guideline values (DGVs) for aquatic ecosystems presented herein have been derived for Tasmanian estuarine 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 estuarine waters are:

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

(ii) Secondary contact water quality

(iii) Aesthetic water quality

C: Industrial Water Supply (Selected areas of aquaculture in Marine Farming Zones)

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 ecosystem from which edible fish, shellfish and crustacea are harvested; which will allow people to safely engage in recreation activities such as swimming, paddling (Refer to Appendix B) or fishing in aesthetically pleasing waters; and which is suitable for the farming of shellfish 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.

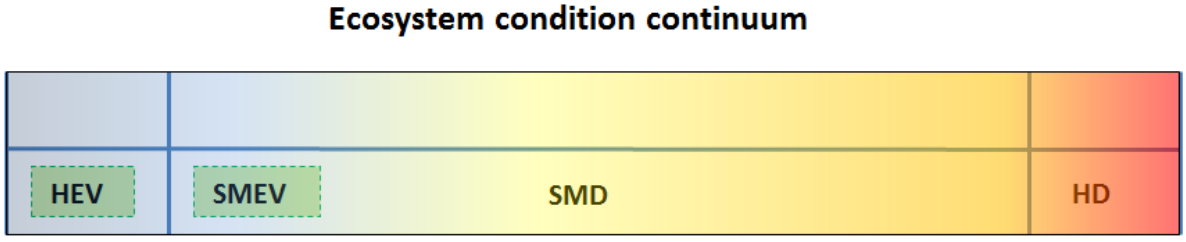

Figure 1. Ecosystem condition continuum showing HEV and SMEV reference categories.

Deriving DGVs for aquatic ecosystems of estuarine waters

Three classes of estuary have been identified for Tasmania (Figure 1). The classes highlight the ability of an estuary to dilute or flush pollutants and consequently the estuaries susceptibility to degradation. Well flushed estuaries are the least susceptible to degradation; poorly flushed estuaries are moderately susceptible, whilst open/closed estuaries are the most susceptible.

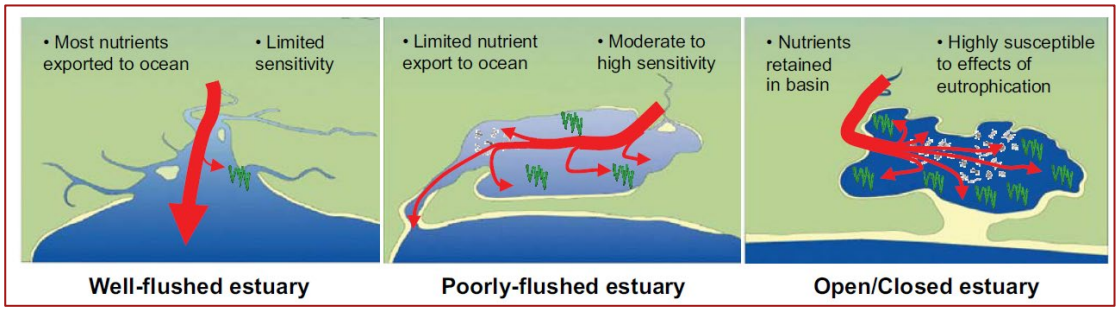

Figure 1: Tasmanian estuary classes (image from Landscape Logic)

The estuarine decision tree (Figure 2) for monitoring and management of Tasmanian estuaries was developed by Landscape Logic and is based on the vulnerability of estuaries to human induced change. The variation between the estuary classes results in each class being susceptible to different critical events. Location within an estuary has also been found to play a role in each flushing class to overall susceptibility to water quality perturbations. The interim DGVs for HEV and SMD estuaries have subsequently been developed based on the estuarine decision tree (Figure 2).

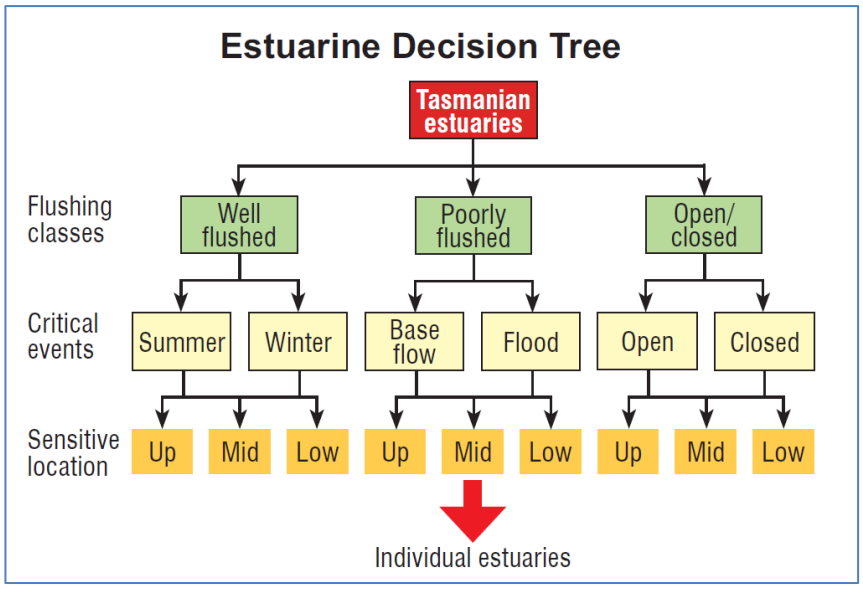

Figure 2. Estuarine decision tree for Tasmanian estuaries (image from Landscape Logic)

HEV and SMD estuaries were identified based on the naturalness scores assigned to estuaries by the Conservation of Freshwater Ecosystem Values (CFEV) project. The estuary class for the estuaries of interest was then determined. Data from HEV and the least modified SMD estuaries for each flushing class was then analysed to derive the interim DGVs (Table 1). Interim DGVs have also been developed that apply to all HEV and or SMD estuaries throughout Tasmania. These have been derived by combining the data used to generate the interim DGVs for the three estuary classes.

For well flushed estuaries data sourced from the Institute of Marine and Antarctic Studies (IMAS) and the Department of Health and Human Services (DHHS) that allowed for the determination of seasonal information was used. For poorly flushed and open/closed estuaries only the IMAS data was used as this dataset included critical event information.

Table 1. Estuaries incorporated in the DGVs for aquatic ecosystems

Estuary	HEV	SMD	Flushing class	Sampling occasions
Bathurst Harbour	√		P	1
Catamaran	√		W	6
Payne Bay	√		W	1
Nelson Bay	√		O/C	5
Ansons Bay		√	P	15
Moulting		√	P	21
Arthur		√	P	13
Cockle		√	P	8
Little Musselroe		√	P	8
Cloudy		√	P	7
Black/Dip		√	W	20
East Inlet		√	W	5
Ringarooma		√	W	9
Earlham		√	O/C	7
Douglas		√	O/C	8

W=Well flushed, P=Poorly flushed, O/C= Open/Closed

Table 2. Flushing Classes and associated estuaries.

Flushing Class	Estuary
Well Flushed	The Mosquito Inlet, Welcome, Duck Bay, West Inlet, East Inlet, Black / Dip, Detention, Inglis, Leven, Forth, Don, Mersey, Port Sorell, Tamar, Tomahawk, Boobyalla Inlet, Spring Bay, Derwent, North West Bay, Crooks, Port Cygnet, Esperance, D`Entrecasteaux, Catamaran, Lewis, Mainwaring, Montagu, Brid, Huon, and Payne Bay estuaries.
Poorly flushed	The Yarra, Cam, Emu, Blythe, Piper, Great Musselroe, Little Musselroe, Lee, Dover, Thirsty Lagoon, North East Inlet, Ansons Bay, Georges Bay, Moulting Lagoon, Buxton, Prosser, Blackman Bay, Carlton, Pittwater, Pipeclay Lagoon, Garden Island, Cloudy Bay, Cockle Creek, Southport, Southport Lagoon, New River lagoon, Lousia River, Louisa Creek, Bathurst Harbour, Mulcahy, Giblin, Macquarie Harbour, Pieman, Arthur, and Little Swanport estuaries.
Open / Closed	The Yellow Rock, Sea Elephant, Ettrick, Seal, Crayfish, Curries, Little Forester, , Rices, Rocky Head, Modder, Shack Rock, Pats, Foochow Inlet,_ Patriarch, Sellars Lagoon, Cameron Inlet, Logans Lagoon, Big Lagoon, Sloop Lagoon, Grants Lagoon, Scamander, Hendersons Lagoon, Templestowe, Denison, Saltwater Lagoon, Freshwater Lagoon, Bryans Lagoon, Meredith, Stoney, Lisdillon, Earlham Lagoon, Grindstone, Browns, South Cape Rivulet, Freney, Wanderer, Spero, Hibbs Lagoon, Henty, Little Henty, Lagoon, Pedder, Nelson Bay, Mines, Middle Inlet, Douglas, Dianas Basin, and Wrinklers Lagoon estuaries.

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

Water Type	Indicator
Estuarine	• Physico-chemical: Dissolved Oxygen, Salinity, pH, Turbidity and, Water Temperature. • Nutrients: Ammonia/TAN (NH_3 and NH_4^+), Nitrate, Nitrate, Nitrate and Nitrite, Total Nitrogen, Dissolved Reactive Phosphorus, Total Phosphorus, Silicate, and Dissolved Organic Carbon. • Biological: Chlorophyll a.

The tables overleaf of physico-chemical indicators report the Interim DGVs for aquatic ecosystems of estuarine waters (shaded values) for the state, for various flushing classes, relevant critical event and location for HEV and SMD estuaries (summarized in Appendix A). Additional percentile values have been included for comparative purposes. The state interim DGVs apply when site-specific guideline values consistent with the NWQMS are not available.

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.

DGVs for aquatic ecosystems of estuarine waters

The interim DGVs below are provided for the state, for various flushing classes, relevant critical event and location for HEV and SMD estuaries.

Interim DGVs (Tables 4 to 6 shaded values) for HEV estuarine water of Tasmania.

Table 4 Tasmanian HEV estuaries

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.7	7.7	8.0	9.6	10.8	11.3	11.7	53
Dissolved Oxygen % Sat	82.8	89.8	91.0	93.6	98.6	100.6	102.7	43
Salinity (PPT)	0.0	0.0	0.7	7.3	22.2	26.4	31.4	58
pH	7.7	7.7	7.9	8.1	8.1	8.1	8.1	12
Turbidity NTU	0.8	0.9	1.1	2.1	4.7	8.1	9.0	48
Temperature (Celsius)	6.9	7.9	9.1	11.7	16.2	17.2	17.2	58
Ammonia as N (µg/L)					ND			
Nitrate as N (µg/L)	1.0	2.0	3.0	7.0	9.8	12.6	19.3	60
Nitrite as N (µg/L)	0.4	0.6	3.6	13.5	34.2	41.1	43.1	60
NOx as N (µg/L)	7.3	11.2	14.0	33.0	49.8	53.0	55.0	43
Total Nitrogen as N (µg/L)					ND			
SRP as P (µg/L)	1.0	1.0	1.0	4.0	7.0	7.3	8.7	48
Total P as P (µg/L)					ND			
Silicate as Si (µg/L)	88.3	167.2	250.0	250.0	825.8	1048.5	1120.9	60
Chl a (µg/L)	0.1	0.1	0.2	0.7	1.2	2.3	2.4	20
DOC as C (mg/L)					ID			

Table 5 Tasmanian HEV estuaries based on critical event data only

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.6	7.7	7.7	8.1	11.5	11.7	11.7	23
Dissolved Oxygen % Sat	79.3	80.0	85.9	94.7	98.2	102.0	104.8	13
Salinity (PPT)	0.0	0.0	0.0	3.9	26.0	30.6	32.2	28
pH[#]	7.7	7.7	7.9	8.1	8.1	8.1	8.1	12
Turbidity NTU	1.4	1.6	2.7	3.2	4.7	7.3	11.1	18
Temperature (Celsius)	6.4	6.8	8.5	12.9	17.2	17.2	17.2	28
Ammonia as N (µg/L)					ND			
Nitrate as N (µg/L)	2.5	3.0	4.8	7.0	9.8	10.3	19.4	30
Nitrite as N (µg/L)	0.4	0.4	0.6	8.0	29.2	38.1	40.1	30
NOx as N (µg/L)	6.9	9.1	12.2	35.0	46.6	48.0	48.5	18
Total Nitrogen as N (µg/L)					ND			
SRP as P (µg/L)	1.0	1.0	1.0	1.5	5.6	7.3	8.5	18
Total P as P (µg/L)					ND			
Silicate as Si (µg/L)	64.4	87.1	166.3	250.0	748.3	928.9	1131.8	30
Chl a (µg/L)	0.3	0.5	1.0	1.8	2.3	3.4	3.9	6
DOC as C (mg/L)					ID			

[#] Tasmanian HEV estuaries derived data

Table 6 Well flushed HEV estuaries

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.8	8.3	8.6	10.1	11.1	11.6	11.7	38
Dissolved Oxygen % Sat	90.0	90.7	91.2	93.8	98.7	100.3	102.1	36
Salinity (PPT)	0.0	0.6	2.4	6.7	13.0	20.7	27.4	39
pH[#]	7.7	7.7	7.9	8.1	8.1	8.1	8.1	12
Turbidity NTU	0.8	0.9	1.0	1.6	3.4	7.2	8.3	36
Temperature (Celsius)	6.6	7.3	8.5	10.4	14.8	15.8	16.0	39
Ammonia as N (µg/L)					ND			
Nitrate as N (µg/L)	1.0	1.0	2.6	7.0	10.0	15.0	25.0	39
Nitrite as N (µg/L)	1.1	4.0	4.0	16.0	34.4	42.2	45.1	39
NOx as N (µg/L)	12.5	14.0	15.0	33.0	52.0	55.0	55.0	31
Total Nitrogen as N (µg/L)					ND			
SRP as P (µg/L)	1.0	1.0	2.0	4.5	7.0	7.5	8.3	36
Total P as P (µg/L)					ND			
Silicate as Si (µg/L)	242.6	250.0	250.0	566.9	890.8	1048.7	1070.5	39
Chl a (µg/L)	0.1	0.2	0.2	0.4	1.0	1.1	1.2	14
DOC as C (mg/L)					ID			

[#] Tasmanian HEV estuaries derived data

Interim DGVs (shaded) for SMD estuaries of Tasmania (Table 7 to 26).

Table 7 Tasmanian SMD estuaries

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	6.2	7.1	7.7	8.8	10.1	10.9	11.4	336
Dissolved Oxygen % Sat	1.6	59.4	78.2	94.5	102.2	110.3	118.2	542
Salinity (PPT)	0.0	0.2	1.8	22.3	34.6	35.2	35.7	674
pH	6.6	6.9	7.3	8.0	8.5	8.6	8.7	125
Turbidity NTU	0.8	0.9	1.2	2.5	5.1	7.8	9.8	560
Temperature (Celsius)	7.8	8.8	10.1	13.5	18.8	20.5	21.9	604
Ammonia as N (µg/L)	2.0	5.0	7.0	17.0	30.0	48.4	76.8	237
Nitrate as N (µg/L)	1.0	1.0	1.0	8.0	41.0	88.5	145.3	576
Nitrite as N (µg/L)	1.0	1.0	1.0	5.0	14.0	20.0	26.3	576
NOx as N (µg/L)	3.0	5.0	8.0	28.0	77.0	125.5	178.0	476
Total Nitrogen as N (µg/L)	290.0	300.0	330.0	385.0	568.0	979.0	1300.0	108
SRP as P (µg/L)	1.0	1.0	2.0	4.0	8.0	10.0	12.0	673
Total P as P (µg/L)	17.0	20.0	23.0	28.0	35.0	41.0	45.0	93
Silicate as Si (µg/L)	250.0	250.0	250.0	947.7	4100.0	6700.0	9600.0	641
Chl a (µg/L)	0.1	0.2	0.4	0.9	3.2	5.3	8.5	531
DOC as C (mg/L)	1.3	1.7	2.9	6.6	20.6	37.9	41.5	92

Table 8 Well flushed SMD estuaries

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	5.8	7.2	7.6	8.7	9.5	9.9	10.5	63
Dissolved Oxygen % Sat	71.0	75.6	78.7	88.4	98.8	103.8	108.5	97
Salinity (PPT)	0.0	0.1	2.2	10.6	26.1	33.2	35.1	143
pH	6.7	6.9	7.4	7.7	7.9	8.0	8.2	25
Turbidity NTU	1.2	1.9	2.4	3.7	6.4	11.1	15.2	125
Temperature (Celsius)	8.8	9.1	10.1	13.5	17.6	19.3	20.7	116
Ammonia as N (µg/L)	2.0	2.0	13.2	21.0	29.0	31.2	35.0	69
Nitrate as N (µg/L)	1.0	2.0	9.2	70.0	145.4	175.6	295.1	139
Nitrite as N (µg/L)	1.0	1.0	2.0	5.0	13.0	15.6	29.6	135
NOx as N (µg/L)	6.5	22.3	45.0	89.5	176.8	191.9	310.6	124
Total Nitrogen as N (µg/L)	276.5	293.0	316.0	350.0	384.0	431.0	604.5	34
SRP as P (µg/L)	1.0	2.0	2.6	4.0	9.0	11.0	14.0	149
Total P as P (µg/L)	16.7	17.0	20.2	24.0	27.4	29.0	29.3	19
Silicate as Si (µg/L)	250.0	250.0	500.0	1790.0	3767.4	4735.1	6520.0	130
Chl a (µg/L)	0.1	0.2	0.4	0.9	1.8	3.3	4.8	130
DOC as C (mg/L)	1.4	1.6	2.9	5.0	8.2	11.0	11.3	19

Table 9 Well flushed SMD estuaries for summer and winter combined

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	5.0	5.3	6.8	8.8	9.5	9.7	9.8	19
Dissolved Oxygen % Sat	64.9	73.4	82.6	88.5	94.1	102.2	105.4	33
Salinity (PPT)	0.0	0.8	5.4	12.6	28.0	35.1	35.2	48
pH	7.6	7.7	7.8	7.9	8.0	8.1	8.2	6
Turbidity NTU	1.2	1.5	2.0	2.9	4.2	15.2	17.4	49
Temperature (Celsius)	7.6	7.8	9.0	13.2	18.8	19.6	22.8	41
Ammonia as N (µg/L)	15.0	15.3	16.6	23.0	31.0	31.0	31.9	24
Nitrate as N (µg/L)	1.0	1.0	3.0	61.0	145.0	173.0	296.0	51
Nitrite as N (µg/L)	1.0	2.0	2.0	4.0	14.0	15.0	17.5	51
NOx as N (µg/L)	7.2	21.0	43.4	84.0	161.6	186.8	311.0	47
Total Nitrogen as N (µg/L)	310.5	321.0	342.0	370.0	508.0	601.0	625.5	8
SRP as P (µg/L)	1.0	2.0	3.0	5.0	9.8	11.0	15.2	57
Total P as P (µg/L)	15.1	16.1	17.8	23.0	24.0	24.9	26.0	8
Silicate as Si (µg/L)	250.0	250.0	250.0	947.7	2650.6	4140.0	6400.0	47
Chl a (µg/L)	0.1	0.2	0.3	1.0	1.6	5.1	5.4	56
DOC as C (mg/L)	2.7	3.0	3.9	6.7	11.0	11.9	13.0	8

Table 10 Well flushed SMD estuaries during summer

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	5.0	5.0	5.2	8.3	8.9	9.2	9.3	9
Dissolved Oxygen % Sat	60.3	65.6	75.9	89.8	102.2	105.3	106.9	18
Salinity (PPT)	7.4	8.7	12.3	19.6	29.5	35.1	35.7	24
pH	7.6	7.47	7.8	7.9	8.0	8.1	8.2	6
Turbidity NTU	1.1	1.2	1.9	2.6	3.4	4.3	4.5	29
Temperature (Celsius)	13.9	16.1	16.4	18.6	19.6	22.8	23.2	21
Ammonia as N (µg/L)	21.0	21.8	23.0	30.0	31.0	31.6	32.9	15
Nitrate as N (µg/L)	1.0	1.0	1.0	35.0	80.8	109.2	139.6	27
Nitrite as N (µg/L)	1.0	1.0	2.0	4.0	8.8	12.8	14.0	27
NOx as N (µg/L)	24.4	37.0	42.4	72.0	116.4	151.0	162.8	23
Total Nitrogen as N (µg/L)^	276.5	293.0	316.0	350.0	384.0	431.0	604.5	34
SRP as P (µg/L)	2.6	3.0	4.0	6.0	9.0	10.0	11.0	33
Total P as P (µg/L)^	16.7	17.0	20.2	24.0	27.4	29.0	29.3	19
Silicate as Si (µg/L)	250.0	250.0	250.0	1093.2	1893.0	2493.7	3795.0	28
Chl a (µg/L)	0.6	0.6	0.7	1.1	4.0	5.3	5.6	33
DOC as C (mg/L)^	1.4	1.6	2.9	5.0	8.2	11.0	11.3	19

^ Well flushed SMD estuaries derived data

Table 11 Well flushed SMD estuaries during winter

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.6	7.7	7.8	9.4	9.7	9.8	9.9	10
Dissolved Oxygen % Sat	81.2	82.3	84.3	85.9	93.8	93.8	94.0	15
Salinity (PPT)	0.0	0.0	0.8	5.9	16.4	34.8	35.1	24
pH^	6.7	6.9	7.4	7.7	7.9	8.0	8.2	25
Turbidity NTU	1.7	2.2	2.8	3.2	15.6	17.5	17.7	20
Temperature (Celsius)	7.4	7.6	7.8	9.3	10.2	10.5	10.5	20
Ammonia as N (µg/L)	13.2	14.4	15.0	16.0	17.4	18.6	19.8	9
Nitrate as N (µg/L)	3.0	3.3	49.8	115.5	175.8	296.0	300.3	24
Nitrite as N (µg/L)	2.0	2.0	2.6	5.0	15.0	16.7	32.3	24
NOx as N (µg/L)	6.0	7.2	58.2	119.5	186.8	311.0	316.1	24
Total Nitrogen as N (µg/L)^	276.5	293.0	316.0	350.0	384.0	431.0	604.5	34
SRP as P (µg/L)	1.0	1.0	2.0	4.0	11.0	15.0	15.9	24
Total P as P (µg/L)^	16.7	17.0	20.2	24.0	27.4	29.0	29.3	19
Silicate as Si (µg/L)	250.0	250.0	450.4	947.7	3816.3	7100.0	7600.0	19
Chl a (µg/L)	0.1	0.1	0.1	0.3	1.4	1.5	1.5	23
DOC as C (mg/L)^	1.4	1.6	2.9	5.0	8.2	11.0	11.3	19

^ Well flushed SMD estuaries derived data

Table 12 Poorly flushed SMD estuaries

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	6.0	6.7	7.6	8.7	9.9	10.8	11.4	210
Dissolved Oxygen % Sat	1.4	1.9	72.1	94.6	101.9	106.8	114.9	358
Salinity (PPT)	0.0	0.1	2.4	27.4	34.9	35.3	36.6	429
pH	6.1	6.9	7.3	8.1	8.5	8.7	8.8	100
Turbidity NTU	0.7	0.8	1.1	2.1	4.7	6.8	9.5	327
Temperature (Celsius)	7.7	8.8	10.2	13.3	19.1	20.8	22.1	410
Ammonia as N (µg/L)	1.7	5.0	7.0	12.0	31.6	63.0	100.6	155
Nitrate as N (µg/L)	1.0	1.0	1.0	3.0	13.0	19.7	31.4	334
Nitrite as N (µg/L)	1.0	1.0	1.0	5.0	16.0	23.0	27.9	344
NOx as N (µg/L)	2.0	3.0	6.0	15.0	33.0	58.0	69.0	275
Total Nitrogen as N (µg/L)	290.0	306.0	350.0	440.0	664.0	1100.0	1300.0	74
SRP as P (µg/L)	1.0	1.0	2.0	4.0	7.0	10.0	12.0	417
Total P as P (µg/L)	19.0	21.3	24.0	29.5	38.0	41.7	45.4	74
Silicate as Si (µg/L)	250.0	250.0	250.0	658.9	3580.0	6400.0	8530.0	427
Chl a (µg/L)	0.1	0.2	0.4	1.1	3.9	7.1	12.9	351
DOC as C (mg/L)	1.3	1.9	2.9	7.9	23.0	40.0	42.0	73

Table 13 Poorly flushed SMD estuaries during base flows

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	5.9	6.6	7.6	8.6	9.5	10.2	11.3	186
Dissolved Oxygen % Sat	1.3	1.7	68.5	93.7	101.6	106.5	114.5	326
Salinity (PPT)	0.1	0.9	6.7	28.6	34.9	35.3	36.6	376
pH	6.0	6.9	7.4	8.1	8.5	8.7	8.8	89
Turbidity NTU	0.7	0.8	1.0	1.9	4.0	5.8	8.1	287
Temperature (Celsius)	8.0	9.0	10.5	13.2	18.9	20.5	21.9	369
Ammonia as N (µg/L)	1.0	5.0	7.0	12.0	32.8	68.6	102.8	133
Nitrate as N (µg/L)	1.0	1.0	1.0	2.0	9.0	16.0	20.0	293
Nitrite as N (µg/L)	1.0	1.0	1.0	5.0	14.0	19.0	23.0	303
NOx as N (µg/L)	2.0	3.0	5.0	13.0	29.0	34.0	43.0	231
Total Nitrogen as N (µg/L)	290.0	300.0	340.0	425.0	510.0	599.0	669.5	62
SRP as P (µg/L)	1.0	2.0	2.0	4.0	7.0	9.0	11.0	366
Total P as P (µg/L)	19.0	20.1	23.2	28.5	37.4	41.0	45.0	62
Silicate as Si (µg/L)	250.0	250.0	250.0	627.9	2700.0	6200.0	7725.0	376
Chl a (µg/L)	0.2	0.3	0.5	1.2	3.9	6.5	10.0	301
DOC as C (mg/L)	1.3	1.8	2.7	6.5	16.0	27.9	39.9	62

Table 14 Poorly flushed SMD estuaries during base flows (upper estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	5.1	5.9	6.9	8.0	10.0	10.2	10.9	49
Dissolved Oxygen % Sat	16.2	58.3	68.9	87.7	98.6	102.4	110.5	107
Salinity (PPT)	0.1	0.9	3.5	18.6	29.5	34.4	38.0	123
pH	6.3	7.2	7.3	8.0	8.4	8.9	8.9	30
Turbidity NTU	0.8	0.9	1.3	2.7	5.0	6.8	13.3	83
Temperature (Celsius)	7.6	9.4	10.5	13.6	18.8	21.4	22.2	120
Ammonia as N (µg/L)	1.3	4.6	8.0	13.0	39.6	74.4	123.6	67
Nitrate as N (µg/L)	1.0	1.0	1.0	3.0	8.8	14.6	22.6	92
Nitrite as N (µg/L)	1.0	1.0	1.0	5.0	14.2	20.6	22.3	95
NOx as N (µg/L)	2.0	3.7	5.0	9.0	23.6	29.6	37.7	88
Total Nitrogen as N (µg/L)	316.0	330.0	360.0	450.0	582.0	664.0	696.0	37
SRP as P (µg/L)	1.0	2.0	3.0	4.0	7.0	10.0	13.0	125
Total P as P (µg/L)	15.4	19.6	22.0	29.0	35.0	41.0	41.4	37
Silicate as Si (µg/L)	250.0	500.0	700.0	1717.9	6080.0	8800.0	12800.0	125
Chl a (µg/L)	0.5	0.6	1.0	2.8	6.5	8.9	15.8	107
DOC as C (mg/L)	3.3	4.0	5.9	9.1	18.8	30.0	38.4	37

Table 15 Poorly flushed SMD estuaries during base flows (mid estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	6.5	7.4	7.7	8.6	9.2	10.1	11.3	95
Dissolved Oxygen % Sat	1.3	1.5	62.6	96.5	100.6	106.6	111.8	164
Salinity (PPT)	0.0	0.8	15.6	31.6	35.1	35.5	36.6	185
pH	6.4	7.0	7.8	8.1	8.5	8.7	8.7	54
Turbidity NTU	0.7	0.7	1.0	1.7	3.5	4.6	7.0	147
Temperature (Celsius)	8.1	8.8	10.1	13.0	19.1	20.6	21.9	183
Ammonia as N (µg/L)	3.0	5.0	6.2	12.0	24.0	56.8	98.9	52
Nitrate as N (µg/L)	1.0	1.0	1.0	2.0	8.8	16.9	19.0	132
Nitrite as N (µg/L)	1.0	1.0	1.0	5.0	13.0	18.3	24.0	138
NOx as N (µg/L)	2.0	2.9	5.0	13.0	31.0	35.1	43.1	100
Total Nitrogen as N (µg/L)	280.0	290.0	290.0	380.0	440.0	450.0	450.0	16
SRP as P (µg/L)	1.0	2.0	2.0	4.0	7.0	9.0	10.0	168
Total P as P (µg/L)	24.5	25.5	27.0	28.5	31.0	47.0	50.0	16
Silicate as Si (µg/L)	250.0	250.0	250.0	500.0	1400.0	4171.7	6324.2	176
Chl a (µg/L)	0.2	0.2	0.4	0.8	2.8	3.9	6.6	140
DOC as C (mg/L)	1.5	1.9	2.6	3.0	3.3	25.3	42.8	16

Table 16 Poorly flushed SMD estuaries during base flows (lower estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	6.1	7.1	7.9	8.8	9.4	10.1	11.2	42
Dissolved Oxygen % Sat	1.2	1.3	71.3	95.7	105.1	116.6	125.6	55
Salinity (PPT)	0.4	1.2	17.2	32.1	35.1	35.2	35.4	68
pH*	6.0	6.9	7.4	8.1	8.5	8.7	8.8	89
Turbidity NTU	0.8	0.9	1.0	2.0	3.8	5.2	7.4	57
Temperature (Celsius)	8.6	9.1	10.8	13.5	18.6	19.3	20.3	66
Ammonia as N (µg/L)	1.0	2.5	6.0	7.5	11.0	15.9	19.4	14
Nitrate as N (µg/L)	1.0	1.0	1.0	4.0	12.0	14.6	23.0	69
Nitrite as N (µg/L)	1.0	1.0	1.0	5.5	15.2	19.0	19.0	70
NOx as N (µg/L)	4.3	8.0	11.0	21.0	32.6	34.8	45.1	43
Total Nitrogen as N (µg/L)	294.0	298.0	312.0	350.0	414.0	426.0	438.0	9
SRP as P (µg/L)	1.0	1.0	2.0	5.0	8.0	9.0	10.0	73
Total P as P (µg/L)	21.0	23.0	24.6	28.0	41.0	42.2	44.6	9
Silicate as Si (µg/L)	250.0	250.0	250.0	250.0	971.9	2760.0	5280.0	75
Chl a (µg/L)	0.2	0.3	0.4	0.8	1.9	2.5	3.4	54
DOC as C (mg/L)	0.8	0.9	1.1	2.6	5.0	8.1	8.4	9

* Poorly flushed SMD base flow derived value

Table 17 Poorly flushed SMD estuaries during flood flows

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.7	7.9	8.6	10.8	11.3	11.8	12.2	24
Dissolved Oxygen % Sat	87.7	89.8	94.5	98.3	105.0	110.4	114.7	34
Salinity (PPT)	0.0	0.0	0.0	1.3	33.1	34.1	35.8	53
pH	7.0	7.1	7.1	7.9	8.6	8.6	8.9	11
Turbidity NTU	0.8	1.2	1.6	5.9	8.3	10.4	11.0	40
Temperature (Celsius)	6.7	6.9	8.8	17.9	20.8	22.2	22.7	41
Ammonia as N (µg/L)	6.0	6.1	7.0	20.5	30.6	51.5	54.9	22
Nitrate as N (µg/L)	1.0	1.0	3.0	19.0	39.0	41.0	41.0	41
Nitrite as N (µg/L)	1.0	1.0	6.0	12.0	30.0	47.0	47.0	41
NOx as N (µg/L)	2.0	5.9	23.4	55.5	69.4	101.0	104.9	44
Total Nitrogen as N (µg/L)	689.0	952.0	996.0	1300.0	1300.0	1300.0	1300.0	12
SRP as P (µg/L)	1.0	1.0	1.0	4.0	10.0	12.0	19.5	51
Total P as P (µg/L)	27.2	29.1	30.0	31.5	37.6	41.6	43.8	12
Silicate as Si (µg/L)	250.0	250.0	250.0	1131.7	6100	12000	12000	51
Chl a (µg/L)	0.0	0.0	0.0	0.7	5.2	12.9	33.0	50
DOC as C (mg/L)	10.9	21.0	21.0	37.0	41.0	42.0	42.0	11

Table 18 Poorly flushed SMD estuaries during flood flows (upper estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.4	7.5	7.7	7.9	8.6	8.7	8.8	6
Dissolved Oxygen % Sat	83.9	86.2	88.1	97.4	102.7	111.0	112.1	10
Salinity (PPT)	0.0	0.0	0.1	0.2	25.4	33.4	34.0	19
pH*	7.0	7.1	7.1	7.9	8.6	8.6	8.9	11
Turbidity NTU	1.3	1.4	2.4	6.6	8.2	8.4	12.4	12
Temperature (Celsius)	6.7	7.8	17.8	20.1	21.2	22.1	22.4	12
Ammonia as N (µg/L)	5.5	6.0	13.0	21.0	24.0	29.0	30.0	11
Nitrate as N (µg/L)	2.4	3.0	3.8	15.0	19.4	21.6	22.3	15
Nitrite as N (µg/L)	1.7	5.2	10.8	12.0	44.6	48.8	50.6	15
NOx as N (µg/L)	2.0	4.1	20.8	32.0	59.2	78.6	10.6	18
Total Nitrogen as N (µg/L)	1300.0	1300.0	1300.0	1300.0	1300.0	1300.0	1300.0	7
SRP as P (µg/L)	1.0	1.0	1.0	4.0	12.4	20.6	23.5	19
Total P as P (µg/L)	26.2	27.4	29.2	30.0	31.0	31.4	31.7	7
Silicate as Si (µg/L)	619.9	816.8	1447.5	4300.0	12000.0	12200.0	13000.0	19
Chl a (µg/L)	0.1	0.1	0.3	0.9	10.9	38.3	70.4	19
DOC as C (mg/L)	37.8	38.5	40.0	40.5	42.0	42.0	42.0	6

* Poorly flushed SMD flood flow derived value

Table 19 Poorly flushed SMD estuaries during flood flows (mid estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	8.8	8.9	9.0	10.8	11.7	11.9	12.1	13
Dissolved Oxygen % Sat	94.0	94.4	94.9	100.1	103.8	108.0	116.9	19
Salinity (PPT)	0.0	0.0	0.0	5.3	32.2	35.0	36.3	24
pH	7.1	7.1	7.1	7.9	8.6	8.6	8.6	6
Turbidity NTU	0.4	0.8	1.6	5.9	7.0	9.8	10.4	20
Temperature (Celsius)	6.7	6.9	8.7	9.7	19.9	20.7	22.6	21
Ammonia as N (µg/L)	6.4	6.7	7.0	16.0	50.0	52.9	54.0	8
Nitrate as N (µg/L)	1.0	1.0	6.2	27.0	40.6	42.6	45.0	17
Nitrite as N (µg/L)	1.0	4.0	8.0	25.0	28.0	36.8	47.0	17
NOx as N (µg/L)	2.0	17.2	34.2	66.0	70.2	104.4	106.0	19
Total Nitrogen as N (µg/L)*	689.0	952.0	996.0	1300.0	1300.0	1300.0	1300.0	12
SRP as P (µg/L)	1.0	1.0	1.0	2.5	4.8	9.9	10.0	22
Total P as P (µg/L)*	27.2	29.1	30.0	31.5	37.6	41.6	43.8	12
Silicate as Si (µg/L)	250.0	250.0	250.0	375.0	5660.0	6170.0	6390.0	22
Chl a (µg/L)	0.0	0.0	0.0	0.1	3.6	9.6	13.0	22
DOC as C (mg/L)*	10.9	21.0	21.0	37.0	41.0	42.0	42.0	11

* Poorly flushed SMD flood flow derived value

Table 20 Poorly flushed SMD estuaries during flood flows (lower estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L*	7.7	7.9	8.6	10.8	11.3	11.8	12.2	24
Dissolved Oxygen % Sat*	87.7	89.8	94.5	98.3	105.0	110.4	114.7	32
Salinity (PPT)	0.0	0.0	0.1	22.1	33.9	34.1	34.2	10
pH*	7.0	7.1	7.1	7.9	8.6	8.6	8.9	11
Turbidity NTU	1.3	1.4	1.8	4.4	9.1	11.1	11.2	8
Temperature (Celsius)	7.7	8.3	8.9	14.3	20.8	22.5	22.9	8
Ammonia as N (µg/L)*	6.0	6.1	7.0	20.5	30.6	51.5	54.9	22
Nitrate as N (µg/L)	1.0	1.0	1.0	14.0	38.0	38.6	39.8	9
Nitrite as N (µg/L)	1.0	1.0	1.6	6.0	30.4	31.2	31.6	9
NOx as N (µg/L)	10.4	12.8	19.6	68.0	71.6	83.6	92.3	7
Total Nitrogen as N (µg/L)*	689.0	952.0	996.0	1300.0	1300.0	1300.0	1300.0	12
SRP as P (µg/L)	1.9	2.8	3.8	5.0	9.4	11.1	11.6	10
Total P as P (µg/L)*	27.2	29.1	30.0	31.5	37.6	41.6	43.8	12
Silicate as Si (µg/L)	250.0	250.0	250.0	250.0	1260.0	5330.0	5465.0	10
Chl a (µg/L)	0.0	0.0	0.0	0.2	3.8	5.2	5.7	9
DOC as C (mg/L)*	10.9	21.0	21.0	37.0	41.0	42.0	42.0	11

* Poorly flushed SMD flood flow derived value

Table 21 Open/Closed SMD estuaries

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.4	7.8	8.3	9.4	11.0	11.2	11.9	63
Dissolved Oxygen % Sat	83.6	87.3	89.9	97.9	111.4	117.6	122.8	63
Salinity (PPT)	0.3	0.4	0.5	12.0	34.0	34.9	35.5	78
pH#	6.6	6.9	7.3	8.0	8.5	8.6	8.7	125
Turbidity NTU	0.8	1.0	1.2	1.8	3.2	4.5	7.8	84
Temperature (Celsius)	7.7	8.7	9.5	14.2	16.5	18.9	20.5	78
Ammonia as N (µg/L)#	2.0	5.0	7.0	17.0	30.0	48.4	76.8	237
Nitrate as N (µg/L)	1.0	1.0	1.0	11.0	36.8	68.0	73.6	83
Nitrite as N (µg/L)	1.0	1.0	2.0	5.0	13.4	17.7	21.0	84
NOx as N (µg/L)	5.8	9.6	15.0	33.0	59.8	81.8	94.6	57
Total Nitrogen as N (µg/L)#	290.0	300.0	330.0	385.0	568.0	979.0	1300.0	108
SRP as P (µg/L)	1.0	1.0	2.0	5.0	8.0	10.0	10.9	84
Total P as P (µg/L)#	17.0	20.0	23.0	28.0	35.0	41.0	45.0	93
Silicate as Si (µg/L)	250.0	556.0	894.7	2201.4	8809.8	10874.2	12792.3	84
Chl a (µg/L)	0.1	0.1	0.3	0.5	0.9	1.5	1.6	50
DOC as C (mg/L)#	1.3	1.7	2.9	6.6	20.6	37.9	41.5	92

Tasmanian SMD estuaries derived data

Table 22 Open/Closed SMD estuaries during open phase

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.3	7.8	8.4	9.8	11.0	11.2	12.1	57
Dissolved Oxygen % Sat	82.9	86.8	89.4	97.2	109.0	112.3	116.2	57
Salinity (PPT)	0.2	0.3	0.5	6.8	33.5	34.6	35.4	66
pH#	6.6	6.9	7.3	8.0	8.5	8.6	8.7	125
Turbidity NTU	0.7	0.9	1.2	1.7	3.2	4.6	7.9	72
Temperature (Celsius)	8.8	9.2	10.3	14.2	15.9	17.0	18.9	66
Ammonia as N (µg/L)#	2.0	5.0	7.0	17.0	30.0	48.4	76.8	237
Nitrate as N (µg/L)	1.0	1.0	1.0	11.0	28.0	45.0	70.0	71
Nitrite as N (µg/L)	1.0	1.0	2.0	5.5	13.2	18.9	21.9	72
NOx as N (µg/L)	5.9	9.9	15.0	29.0	48.0	68.7	88.0	50
Total Nitrogen as N (µg/L)#	290.0	300.0	330.0	385.0	568.0	979.0	1300.0	108
SRP as P (µg/L)	1.0	1.0	2.0	5.0	8.0	9.9	10.0	72
Total P as P (µg/L)#	17.0	20.0	23.0	28.0	35.0	41.0	45.0	93
Silicate as Si (µg/L)	250.0	638.2	909.6	2201.4	7328.9	11120.7	12995.4	72
Chl a (µg/L)	0.1	0.1	0.3	0.5	0.9	1.4	1.6	44
DOC as C (mg/L)#	1.3	1.7	2.9	6.6	20.6	37.9	41.5	92

Tasmanian SMD estuaries derived data

Table 23 Open/Closed SMD estuaries during open phase (upper estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.8	8.1	8.3	8.8	9.7	10.1	10.4	10
Dissolved Oxygen % Sat	85.8	88.2	89.5	96.3	99.0	100.6	100.5	10
Salinity (PPT)	6.1	8.9	11.9	31.7	33.3	33.5	34.2	12
pH#	6.6	6.9	7.3	8.0	8.5	8.6	8.7	125
Turbidity NTU	1.2	1.3	1.6	1.9	3.1	3.6	3.7	13
Temperature (Celsius)	9.2	9.4	10.1	13.8	14.8	18.5	18.9	12
Ammonia as N (µg/L)#	2.0	5.0	7.0	17.0	30.0	48.4	76.8	237
Nitrate as N (µg/L)	1.0	1.0	1.0	8.0	13.6	23.6	26.8	13
Nitrite as N (µg/L)	1.0	1.4	3.0	9.0	21.0	22.6	23.4	13
NOx as N (µg/L)	12.6	14.2	18.6	33.0	39.8	44.2	44.6	9
Total Nitrogen as N (µg/L)#	290.0	300.0	330.0	385.0	568.0	979.0	1300.0	108
SRP as P (µg/L)	4.6	5.0	5.0	8.0	8.6	9.8	10.4	13
Total P as P (µg/L)#	17.0	20.0	23.0	28.0	35.0	41.0	45.0	93
Silicate as Si (µg/L)	840.3	946.9	961.4	1189.5	1650.3	2114.1	2237.7	13
Chl a (µg/L)	0.1	0.1	0.3	0.5	0.9	1.4	1.5	11
DOC as C (mg/L)#	1.3	1.7	2.9	6.6	20.6	37.9	41.5	92

Tasmanian SMD estuaries derived data

Table 24 Open/Closed SMD estuaries during open phase (mid estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.3	7.7	8.6	10.2	11.2	11.9	12.8	33
Dissolved Oxygen % Sat	80.3	87.3	93.1	98.6	109.2	112.9	126.9	33
Salinity (PPT)	0.1	0.2	0.3	3.7	33.7	34.3	35.5	37
pH[#]	6.6	6.9	7.3	8.0	8.5	8.6	8.7	125
Turbidity NTU	0.7	0.9	1.1	1.7	3.9	4.8	7.7	39
Temperature (Celsius)	8.8	9.9	10.5	14.2	15.8	16.7	18.9	37
Ammonia as N (µg/L)[#]	2.0	5.0	7.0	17.0	30.0	48.4	76.8	237
Nitrate as N (µg/L)	1.0	1.0	1.0	11.5	40.6	63.0	91.5	38
Nitrite as N (µg/L)	1.0	1.0	1.6	5.0	8.0	14.4	18.2	39
NOx as N (µg/L)	5.4	9.4	16.6	35.0	60.8	88.2	102.6	25
Total Nitrogen as N (µg/L)[#]	290.0	300.0	330.0	385.0	568.0	979.0	1300.0	108
SRP as P (µg/L)	1.0	1.0	2.0	3.0	7.0	8.2	9.0	39
Total P as P (µg/L)[#]	17.0	20.0	23.0	28.0	35.0	41.0	45.0	93
Silicate as Si (µg/L)	250.0	657.6	894.7	2441.0	9430.2	11953.7	14656.6	39
Chl a (µg/L)	0.1	0.1	0.3	0.6	0.9	1.2	1.5	23
DOC as C (mg/L)[#]	1.3	1.7	2.9	6.6	20.6	37.9	41.5	92

[#] Tasmanian SMD estuaries derived data

Table 25 Open/Closed SMD estuaries during open phase (lower estuary)

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L	7.6	8.0	8.5	10.3	11.0	11.1	11.1	14
Dissolved Oxygen % Sat	86.2	87.1	89.2	95.1	110.1	113.2	113.9	14
Salinity (PPT)	0.4	0.5	0.5	3.8	33.4	34.6	34.9	17
pH[#]	6.6	6.9	7.3	8.0	8.5	8.6	8.7	125
Turbidity NTU	0.7	0.8	1.0	1.4	2.7	8.1	8.2	20
Temperature (Celsius)	8.8	8.9	9.2	14.4	16.0	16.7	17.4	17
Ammonia as N (µg/L)[#]	2.0	5.0	7.0	17.0	30.0	48.4	76.8	237
Nitrate as N (µg/L)	1.0	1.0	3.0	11.0	20.4	46.5	60.5	20
Nitrite as N (µg/L)	1.0	1.0	2.0	5.5	8.0	14.3	17.5	20
NOx as N (µg/L)	8.0	9.5	13.0	18.0	43.0	58.5	67.3	16
Total Nitrogen as N (µg/L)[#]	290.0	300.0	330.0	385.0	568.0	979.0	1300.0	108
SRP as P (µg/L)	1.0	1.0	2.0	3.0	10.0	10.1	12.2	20
Total P as P (µg/L)[#]	17.0	20.0	23.0	28.0	35.0	41.0	45.0	93
Silicate as Si (µg/L)	250.0	250.0	660.6	4128.9	10737.3	10924.9	11462.6	20
Chl a (µg/L)	0.1	0.1	0.2	0.5	0.9	1.6	1.9	10
DOC as C (mg/L)[#]	1.3	1.7	2.9	6.6	20.6	37.9	41.5	92

[#] Tasmanian SMD estuaries derived data

Table 26 Open/Closed SMD estuaries during closed phase

Parameter	5th %ile	10th %ile	20th %ile	Median	80th %ile	90th %ile	95th %ile	Sample Number
Dissolved Oxygen mg/L^	7.4	7.8	8.3	9.4	11.0	11.2	11.9	63
Dissolved Oxygen % Sat^	83.6	87.3	89.9	97.9	111.4	117.6	122.8	63
Salinity (PPT)^	0.3	0.4	0.5	12.0	34.0	34.9	35.5	78
pH#	6.6	6.9	7.3	8.0	8.5	8.6	8.7	125
Turbidity NTU^	0.8	1.0	1.2	1.8	3.2	4.5	7.8	84
Temperature (Celsius)^	7.7	8.7	9.5	14.2	16.5	18.9	20.5	78
Ammonia as N (µg/L)#	2.0	5.0	7.0	17.0	30.0	48.4	76.8	237
Nitrate as N (µg/L)^	1.0	1.0	1.0	11.0	36.8	68.0	73.6	83
Nitrite as N (µg/L)^	1.0	1.0	2.0	5.0	13.4	17.7	21.0	84
NOx as N (µg/L)^	5.8	9.6	15.0	33.0	59.8	81.8	94.6	57
Total Nitrogen as N (µg/L)#	290.0	300.0	330.0	385.0	568.0	979.0	1300.0	108
SRP as P (µg/L)^	1.0	1.0	2.0	5.0	8.0	10.0	10.9	84
Total P as P (µg/L)#	17.0	20.0	23.0	28.0	35.0	41.0	45.0	93
Silicate as Si (µg/L)^	250.0	556.0	894.7	2201.4	8809.8	10874.2	12792.3	84
Chl a (µg/L)^	0.1	0.1	0.3	0.5	0.9	1.5	1.6	50
DOC as C (mg/L)#	1.3	1.7	2.9	6.6	20.6	37.9	41.5	92

^ Open/Closed SMD estuaries, # Tasmanian SMD estuaries derived data

Appendix A: DGVs summary for aquatic ecosystems of estuarine waters

The following tables of physico-chemical indicators report the interim DGVs for aquatic ecosystems for HEV and SMD estuaries on a state wide basis and by flushing class in accordance with the estuarine decision tree shown in Figure 2.

HEV Estuary Annual	Physico-chemical indicators and interim DGVs for Aquatic Ecosystems																		
	DO (mg/L)		DO (% sat)		Salinity	pH		Temp (°C)		Turb	TAN as N	NO_3 as N	NO_2 as N	NO_x as N	Total N as N	DRP as P	Total P as P	SiO_4 as Si	Chl a	DOC as C
	lower	upper	lower	upper	(PPT)	lower	upper	lower	upper	NTU	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	µg/L)	(µg/L)	(mg/L)
State	8.0	10.8	91.0	98.6	22.2	7.9~	8.1~	9.1	16.2	4.7	ND	9.8	34.2	49.8	ND	7.0	ND	825.8	1.2	ID
Well	8.6	11.1	91.2	98.7	13.0	7.9~*	8.1~*	8.5	14.8	3.4	ND	10.0	34.4	52.0	ND	7.0	ND	890.8	1.0	ID
Poorly	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
O/C	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID

NB: DO (dissolved oxygen), Turb (turbidity), TAN (total ammonia nitrogen), NO_3 (Nitrate), NO_2 (Nitrite) NOx (Nitrite and Nitrate), DRP (dissolved reactive Phosphorous), SiO_4 (Silicate), Chl a (Chlorophyll a), DOC (dissolved organic carbon) *State derived values ND = No Data, ID = Insufficient data, ~ <95% confidence. Figures shown above are based on data from the 4 HEV estuaries listed in Table 1.

SMD Estuary Annual	Physico-chemical indicators and interim DGVs for Aquatic Ecosystems																		
	DO (mg/L)		DO (% sat)		Salinity	pH		Temp (°C)		Turb	TAN as N	NO_3 as N	NO_2 as N	NO_x as N	Total N as N	DRP as P	Total P as P	SiO_4 as Si	Chl a	DOC as C
	lower	upper	lower	upper	(PPT)	lower	upper	lower	upper	NTU	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	µg/L)	(µg/L)	(mg/L)
State	7.7	10.1	78.2	102.2	34.6	7.3	8.5	10.1	18.8	5.1	30.0	41.0	14.0	77.0	568.0	8.0	35.0	4100	3.2	20.6
Well	7.6	9.5	78.7	98.8	26.1	7.4	7.9	10.1	17.6	6.4	29.0	145.4	13.0	176.8	384.0	9.0	27.4	3767	1.8	8.2
Poorly	7.6	9.9	72.1	101.9	34.9	7.3	8.5	10.2	19.1	4.7	31.6	13.0	16.0	33.0	664.0	7.0	38.0	3580	3.9	23.0
O/C	8.3	11.0	89.9	111.4	34.0	7.3	8.5	9.5	16.5	3.2	30.0	36.8	13.4	59.8	568.0	8.0	35.0	8810	0.9	20.6

NB: DO (dissolved oxygen), Turb (turbidity), TAN (total ammonia nitrogen), NO_3 (Nitrate), NO_2 (Nitrite) NOx (Nitrite and Nitrate), DRP (dissolved reactive Phosphorous), SiO_4 (Silicate), Chl a (Chlorophyll a), DOC (dissolved organic carbon) *State derived values ND = No Data, ID = Insufficient data, ~ <95% confidence. Figures shown above are based on data from the 11 SMD estuaries listed in Table 1.

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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