Proposed Statewide Waterwatch Water Quality Levels For Rivers And Streams

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Aim

With the release of the policy SEPP (Waters) in 2018, with revised water quality objectives, there is a need to develop water quality levels for Waterwatch to help the interpretation of water quality data. It should be noted that with the commencement of the new Environment Protection Act (2018) in July 2021, SEPPs were no longer to exist. However, the same water quality indicators and objectives transitioned to the Environmental Reference Standard (ERS) (Govt Vic 2022) under the new Act.

There are currently some Waterwatch indicator levels in the Data Interpretation Manual (Waterwatch Victoria 2009) but mostly there to indicate harmful levels. These were based on the Index of Stream Condition and professional judgement.

In 2022 water quality levels were developed by the authors for North Central CMA Waterwatch using the approach below. These have been used by the North Central Waterwatch team and have proven to be very useful in the interpretation of water quality data. The approach, therefore, has been repeated to develop statewide water quality levels.

Water quality levels are a guide only and are not meant to be definitive as local conditions will vary. A knowledge and understanding of the local environment will also be important in interpreting water quality results.

Approach

ERS Approach for setting water quality objectives

The ERS divides the state into five river and stream segments (and seventeen sub-segments) which are geographic areas that have common environmental and ecological conditions and natural characteristics. There is a sixth urban segment but that is not included here.

The ERS method for determining new water quality objectives was initially based on tiers (levels) that reflected levels of modification. Although the use of tiers was not adopted in the final policy, the development of tiers strongly informed the final objectives in SEPP (Waters).

The tiers were taken from the DELWP Healthy Waterways Strategy 2013 and are:

- Near Natural/Ecologically Healthy.
- Sustainable Working.
- Highly Modified.

In deriving new water quality objectives for SEPP (Waters), EPA:

- Accessed data from all sites within both of DELWPs (now DEECA) and Melbourne Waters monitoring networks;

- Used data from 1990 – 2013 for the six key indicators – dissolved oxygen, pH, turbidity, electrical conductivity, total nitrogen and total phosphorus;
- Identified water quality monitoring 'reference' sites within each segment based on measures of disturbance, with 'reference' sites identified for each segment and tier; and,
- Used a percentile approach to set objectives based on the data from these reference sites.

This approach was endorsed by an independent Scientific Advisory Panel convened by EPA and DELWP to review the science input to the policy.

The ERS objectives in effect used the Ecologically Healthy tier for the Highlands and Uplands segments and Sustainable Working tier for the Central Foothills and Coastal Plains and the Murray and Western Plains segments. The previous SEPP objectives were based on reference sites of mixed quality. In the most recent review, the reference sites are acceptable (ie in ecologically healthy condition) in the Highlands and Uplands segments but are only the 'best available sites' in the Central Foothills and Coastal Plains and the Murray and Western Plains segments. In reality, a tiered framework has been in place, albeit not formally or transparently.

Waterwatch approach for setting water quality levels

ERS objectives and the tier values were used as a starting point for developing more practical levels which distinguished between the condition levels (ie good, moderate, poor and very poor) used by Waterwatch. Known cause-effect relationships and professional judgement were used in addition to the tiers to determine the levels where they differed to the levels derived under the SEPP (Waters) development. This was done for pH, turbidity and dissolved oxygen.

Setting pH levels, in particular, using the tiers developed by EPA were not appropriate as range of the tiers are very narrow. This is largely because monitoring data for pH shows very little variability over time at most sites, therefore the upper and lower limits are very close. The tiered objectives do not necessarily represent different ecological condition levels but reflect the water quality data from the sites. For the determination of pH levels, the "ecologically heathy" tier was used for the good levels and then cause-effect relationships and professional judgement were used to determine the moderate, poor and very poor levels.

Similarly with turbidity, the tiered objectives would have resulted in the poor and very poor levels being well below the levels that are indicative of biological effects. Cause-effect relationships and the use of professional judgment were, therefore, used to set the moderate, poor and very poor levels.

For dissolved oxygen saturation, moderate, poor and very poor levels again used cause-effect relationships and professional judgement. Cause-effect data generally suggest that in upland rivers and streams, harmful effects are likely to happen when dissolved oxygen levels are less than 60% saturation, and in lowland rivers and streams at less than 40% saturation.

The ERS uses total phosphorus (which is a better indicator of potential nutrient enrichment and plant growth) though Waterwatch can only measure reactive phosphorus. There is no absolute relationship between total and reactive phosphorus, but reactive phosphorus is usually the major component of the total. In the absence of alternative objectives for reactive phosphorus, the recommendation is to use the ERS total phosphorus for the reactive phosphorus levels. This approach will tend to somewhat overestimate the risk due of phosphorus, but not by an excessive amount.

The ERS for the Central Foothills and Coastal Plains Segment and the Murray and Wester Plains Segment employed the Sustainable Working tier for the objectives in recognition that these regions were not ecologically healthy like the upland forested segments but were nonetheless in reasonable ecological condition given the generally agricultural nature of the catchments.

In the Highland Segment there were no highly modified tier values developed. Largely this is due to the clearly ecological healthy condition of the streams in the highlands. Cause-effect data and professional judgement have been used to set the poor and very poor levels. Nonetheless, these reflect the high quality of the segment.

Four levels of river and stream health have been chosen:

- The ERS objectives indicates “good”.
- For the Highlands and Uplands A and B segments, between the Ecologically Healthy tier and the Sustainable Working tier is “moderate” and for the other segments between Sustainable Working and Highly Modified is “moderate”.
- For the Uplands A and B segments, between the Sustainable Working tier and Highly Modified tier is “poor”, and for the other segments, greater than Highly Modified is “poor”. There is no Highly Modified tier for the Highlands
- For the Uplands A and B segments greater or less (dissolved oxygen and the pH lower) than Highly Modified is “very poor” and for the other segments cause effect data and professional judgement were used to determine “very poor”. There is no Highly Modified tier for the Highlands
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Segments

The policy divides Victoria into a series of segments (Figure 1) for the water environment, including marine, estuarine and inland (rivers and streams) waters.

The levels reported here are only for the inland, river and stream, segments. Levels for the urban segment have not been developed.

Generally:

Highlands are alpine and sub-alpine environments above 1,000 metres in altitude.

Uplands A are forested and above 400 metres in altitude but also include some coastal areas (eg the Otways).

Uplands B are forested and above 400 metres in altitude.

Central Foothills are largely cleared and above 200 metres in altitude and the Coastal Plains below 200 metres in altitude.

Murray and Western Plains are cleared and are below 200 metres in altitude.

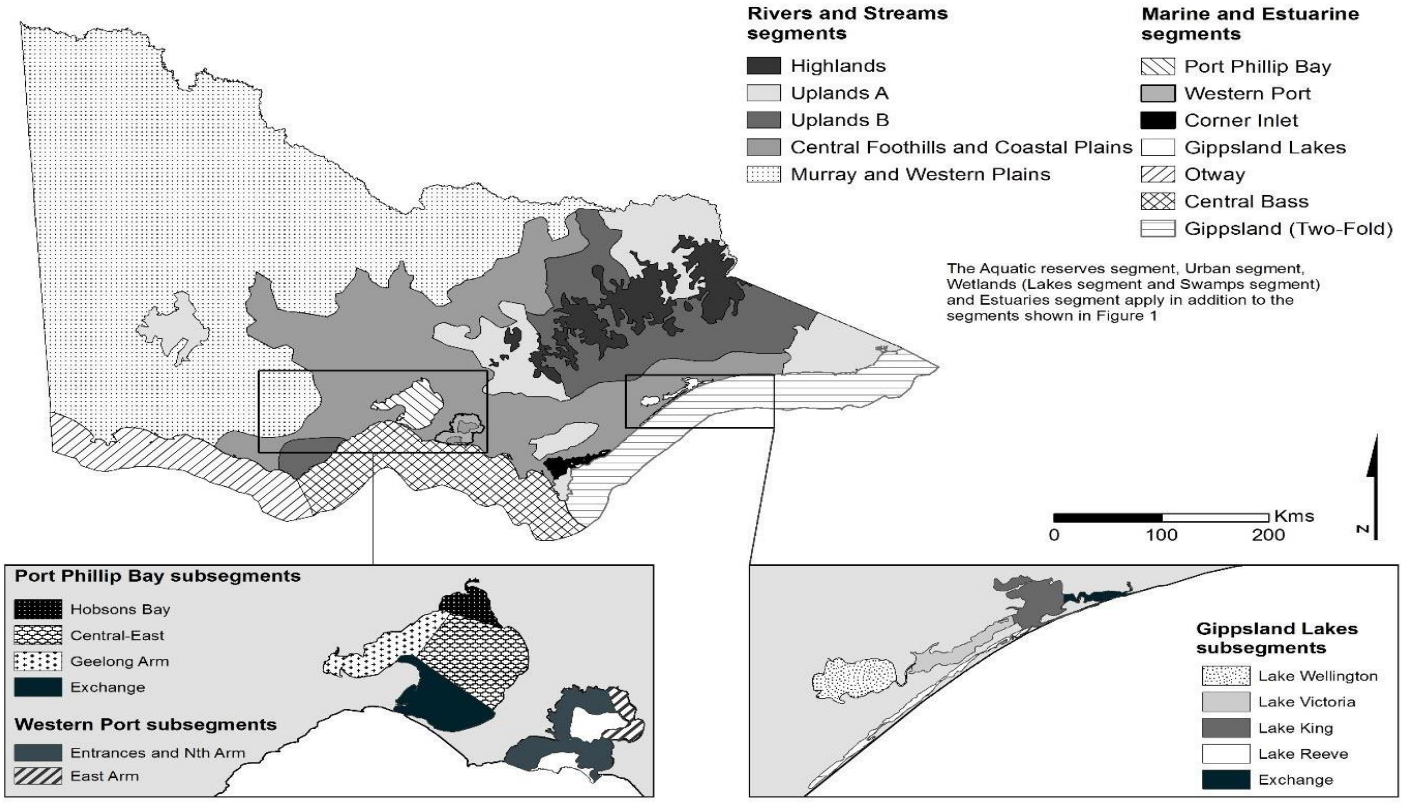

Figure 1. Maps of Environmental Reference Standard segments

Proposed water quality levels

The proposed indicator levels are presented in Table 1 to 16.

The indicator levels are a guide only and are not meant to be definitive as local conditions will vary. A knowledge and understanding of the local environment will also be important in interpreting water quality results.

The assessment of the indicators can be undertaken yearly or over a greater period of time. A minimum number of 6 readings across 18 months is required to give a minimum of 75% confidence level.

Note, for all segments there is an upper limit to dissolved oxygen of 130%. Greater than this is indicative of excessive plant growth, and the site is likely to be in poor or very poor condition.

Highlands Segment

Table 1. Highlands

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥5.9	<5.9 ≥5.5	<5.5 ≥5.0	<5.0
pH upper	pH	75th	≤6.9	>6.9 ≤7.5	>7.5 ≤8.0	>8.0
Electrical conductivity	µS/cm	75th	≤30	> 30 ≤50	>50 ≤500	>500
Turbidity	NTU	75th	≤3	>3 ≤5	> 5 ≤15	>15
Reactive phosphorus	mg/L	75th	≤0.020	>0.020 ≤0.030	>0.030 ≤0.045	>0.045
Dissolved oxygen	% Saturation	25th	≥85	<85 ≥75	<75 ≥60	<60

Uplands A Segment

Table 2. Uplands A – Wilsons Promontory, Strzelecki Ranges and East Gippsland Basin

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.6	<6.6 ≥6.1	<6.1 ≥5.5	<5.5
pH upper	pH	75th	≤7.6	>7.6 ≤8.0	>8.0 ≤8.5	>8.5
Electrical conductivity	µS/cm	75th	≤200	>200 ≤225	>225 ≤500	>500
Turbidity	NTU	75th	≤10	> 10 ≤15	>15 ≤25	>25
Reactive phosphorus	mg/L	75th	≤0.030	>0.030 ≤0.040	>0.040 ≤0.055	>0.055
Dissolved oxygen	% Saturation	25th	≥90	<90 ≥80	<80 ≥60	<60

Table 3. Uplands A – Upper Murray and Kiewa Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.5	< 6.5 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.5	> 7.5 ≤8.0	>8.0 ≤8.5	>8.5
Electrical conductivity	µS/cm	75th	≤100	> 100 ≤125	>125 ≤500	>500
Turbidity	NTU	75th	≤10	>10 ≤15	>15 ≤25	>25
Reactive phosphorus	mg/L	75th	≤0.030	>0.030 ≤0.045	>0.045 ≤0.060	>0.060
Dissolved oxygen	% Saturation	25th	≥90	<90 ≥80	<80 ≥60	<60

Table 4. Uplands A – The Grampians

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥5.4	<5.4 ≥5.0	<5.0 ≥4.5	<4.5
pH upper	pH	75th	≤7.0	>7.0 ≤7.5	>7.5 ≤8.0	>8.0
Electrical conductivity	µS/cm	75th	≤200	>200 ≤300	>300 ≤500	>500
Turbidity	NTU	75th	≤5	>5 ≤10	>10 ≤25	>25
Reactive phosphorus	mg/L	75th	≤0.035	>0.035 ≤0.040	0.040> ≤0.055	>0.055
Dissolved oxygen	% Saturation	25th	≥80	<80 ≥70	<70 ≥60	<60

Table 5. Uplands A – Upper Thompson. Latrobe, South Gippsland, Bunyip and Yarra Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.4	<6.4 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.6	>7.6 ≤8.0	>8.0 ≤8.5	>8.5
Electrical conductivity	µS/cm	75th	≤100	>100 ≤125	>125 ≤400	>400
Turbidity	NTU	75th	≤15	>15 ≤20	>20 ≤25	>25
Reactive phosphorus	mg/L	75th	≤0.035	>0.035 ≤0.045	>0.045 ≤0.060	>0.060
Dissolved oxygen	% Saturation	25th	≥80	<80 ≥70	<70 ≥60	<60

Table 6. Uplands A – Upper Goulburn (part) and Broken Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.4	<6.4 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.4	>7.4 ≤8.0	>8.0 ≤8.5	>8.5
Electrical conductivity	µS/cm	75th	≤100	>100 ≤125	>125 ≤400	>400
Turbidity	NTU	75th	≤10	>10 ≤15	>15 ≤25	>25
Reactive phosphorus	mg/L	75th	≤0.025	>0.025 ≤0.040	>0.040 ≤0.045	>0.045
Dissolved oxygen	% Saturation	25th	≥90	<90 ≥80	<80 ≥60	<60

Uplands B Segment

Table 7. Uplands B – Otway Ranges

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.5	<6.5 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.5	>7.5 ≤8.0	>8.0 ≤8.5	>8.5
Electrical conductivity	µS/cm	75th	≤200	>200 ≤500	>500 ≤750	>750
Turbidity	NTU	75th	≤10	>10 ≤15	>15 ≤25	>25
Reactive phosphorus	mg/L	75th	≤0.025	>0.025 ≤0.035	>0.035 ≤0.040	>0.040
Dissolved oxygen	% Saturation	25th	≥85	<85 ≥75	<75 ≥60	<60

Table 8. Uplands B – Uplands of southern draining basins, East Gippsland, Snowy, Tambo and Mitchell

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.7	<6.7 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.7	>7.7 ≤8.3	>8.3 ≤8.8	>8.8
Electrical conductivity	µS/cm	75th	≤100	>100 ≤200	>200 ≤250	>250
Turbidity	NTU	75th	≤10	>10 ≤15	>15 ≤25	>25
Reactive phosphorus	mg/L	75th	≤0.025	>0.025 ≤0.030	>0.030 ≤0.035	>0.035
Dissolved oxygen	% Saturation	25th	≥90	<90 ≥80	<80 ≥60	<60

Table 9. Uplands B – Uplands of northern draining basins, Ovens, Broken and Goulburn

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.4	<6.4 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.4	>7.4 ≤8.0	>8.0 ≤8.5	>8.5
Electrical conductivity	µS/cm	75th	≤50	>50 ≤100	>100 ≤250	>250
Turbidity	NTU	75th	≤10	>10 ≤15	>15 ≤25	>25
Reactive phosphorus	mg/L	75th	≤0.025	>0.025 ≤0.030	>0.030 ≤0.040	>0.040
Dissolved oxygen	% Saturation	25th	≥85	<85 ≥75	<75 ≥60	<60

Central Foothills and Coastal Plains Segment

Table 10. Central Foothills - Uplands of the Moorabool, Werribee, Maribyrnong, Campaspe, Loddon, Avoca, Wimmera and Hopkins Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.8	<6.8 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤8.0	>8.0 ≤8.5	>8.5 ≤9.0	>9.0
Electrical conductivity	µS/cm	75th	≤2,000	>2,000 ≤3,000	>3,000 ≤4,000	>4,000
Turbidity	NTU	75th	≤15	>15 ≤30	>30 ≤80	>80
Reactive phosphorus	mg/L	75th	≤0.055	>0.055 ≤0.75	>0.075 ≤0.100	>0.100
Dissolved oxygen	% Saturation	25th	≥70	<70 ≥60	<60 ≥40	<40

Table 11. Central Foothills – Foothills and the Ovens Broken and Goulburn Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.4	<6.4 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.4	>7.4 ≤8.0	>8.0 ≤8.5	>8.5
Electrical conductivity	µS/cm	75th	≤250	>250 ≤300	>300 ≤500	>500
Turbidity	NTU	75th	≤20	>20 40	>40 ≤60	>60
Reactive phosphorus	mg/L	75th	≤0.050	>0.050 ≤0.075	0.075> ≤0.100	>0.100
Dissolved oxygen	% Saturation	25th	≥70	<70 ≥60	<60 ≥40	<40

Table 12. Coastal Plains – Lowlands of the Barwon, Moorabool, Werribee and Maribyrnong Basins and the Curdies and Gellibrand Rivers

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.8	<6.8 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤8.0	>8.0 ≤8.5	>8.5 ≤9.0	>9.0
Electrical conductivity	µS/cm	75th	≤2,000	>2,000 ≤3,000	3000> ≤4,000	>4,000
Turbidity	NTU	75th	≤25	>25 ≤40	>40 ≤60	>60
Reactive phosphorus	mg/L	75th	≤0.060	>0.060 ≤0.075	0.075> ≤0.110	>0.110
Dissolved oxygen	% Saturation	25th	≥70	<70 ≥60	<60 ≥40	<40

Table 13. Coastal Plains – Lowlands of the Yarra, South Gippsland, Bunyip, Latrobe, Thompson, Mitchell, Tambo and Snowy Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.7	<6.7 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.7	>7.7 ≤8.3	>8.3 ≤8.8	>8.8
Electrical conductivity	µS/cm	75th	≤250	>250 ≤300	>300 ≤500	>500
Turbidity	NTU	75th	≤20	>20 ≤40	>40 ≤60	>60
Reactive phosphorus	mg/L	75th	≤0.055	>0.055 ≤0.075	>0.075 ≤0.110	>0.110
Dissolved oxygen	% Saturation	25th	≥70	<70 ≥60	<60 ≥40	<40

Murray and Western Plains Segment

Table 14. Murray Plains – Lowlands of the Kiewa, Ovens and Goulburn Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.4	<6.4 ≥6.0	<6.0 ≥5.0	<5.0
pH upper	pH	75th	≤7.5	>7.5 ≤8.0	>8.0 ≤8.5	>8.5
Electrical conductivity	µS/cm	75th	≤500	>500 ≤1,000	>1,000 ≤2,000	>2,000
Turbidity	NTU	75th	≤25	>25 ≤40	>40 ≤80	>80
Reactive phosphorus	mg/L	75th	≤0.055	>0.055 ≤0.075	>0.075 ≤0.110	>0.110
Dissolved oxygen	% Saturation	25th	≥75	<75 ≥60	<60 ≥40	<40

Table 15. Murray plains - Lowlands of the Campaspe, Loddon, Avoca, Wimmera and Mallee Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥6.8	<6.8 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤7.8	>7.8 ⩽8.5	>8.5 ≤9.0	>9.0
Electrical conductivity	µS/cm	75th	≤2,000	>2,000 ≤3,000	>3,000 ≤4,000	>4,000
Turbidity	NTU	75th	≤40	>40 ≤60	>60 ≤80	>80
Reactive phosphorus	mg/L	75th	≤0.050	>0.050 ≤0.075	>0.075 ≤0.100	>0.100
Dissolved oxygen	% Saturation	25th	≥65	<65 ≥55	<55 ≥40	<40

Table 16. Coastal Plains - Western Plains – Lowlands of the Glenelg, Hopkins, Portland, Corangamite and Millicent Coast Basins

Indicator	Units	Percentile	Good	Moderate	Poor	Very poor
pH lower	pH	25th	≥7.0	<7.0 ≥6.0	<6.0 ≥5.5	<5.5
pH upper	pH	75th	≤8.0	>8.0 ≤8.5	>8.5 ≤9.0	>9.0
Electrical conductivity	µS/cm	75th	≤2,000	>2,000 ≤3,000	>3,000 ≤4,000	>4,000
Turbidity	NTU	75th	≤20	>20 ≤40	>40 ≤60	>60
Reactive phosphorus	mg/L	75th	≤0.055	>0.055 ≤0.075	0.075> ≤0.100	>0.100
Dissolved oxygen	% Saturation	25th	≥65	<65 ≥55	<55 ≥40	<40

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