

## **Ruamāhanga whaitua rivers, streams and lakes: Comparison with National Policy Statement for Freshwater Management attributes for ecosystem health and human health for recreation**

The National Policy Statement for Freshwater Management (MfE 2014) identifies two compulsory values that apply to freshwater bodies; ecosystem health and human health for recreation. For each of these values the National Policy Statement for Freshwater identifies ‘attributes’ (ie measures such as periphyton and *E. coli*) and ‘numeric attribute states’. Numeric attribute states consist of four bands ranging from A to D with the boundary between the C and D bands representing the ‘national bottom line’ or the minimum level at which the compulsory values are provided for. The National Policy Statement for Freshwater Management also requires that the overall water quality within a region is maintained or improved.

This paper provides comparison of river, stream and lake ecosystem health and water quality data collected within the Ruamāhanga whaitua to National Policy Statement for Freshwater Management attributes for ecosystem health and human health for recreation. The data used in this assessment have been collected under the Rivers State of the Environment, Recreational Water Quality, Lakes State of the Environment and Riparian Management Pilot programmes.

### **1. Ecosystem health**

The National Policy Statement for Freshwater Management ecosystem health attributes for rivers and streams are periphyton (algae/slime growing on the river bed), nitrate toxicity, ammonia toxicity and dissolved oxygen. The dissolved oxygen attribute currently applies only below point source discharges. Ecosystem health attributes for lakes are phytoplankton (algae growing in the water column), total nitrogen, total phosphorus and ammonia toxicity.

#### **1.1 River and stream attributes**

Assessment of the periphyton and nitrate toxicity attributes for rivers and streams was based on data from the Rivers State of the Environment monitoring programme and a single site from the Riparian Management Pilot programme (Table 1).

Assessment of the periphyton attribute is indicative only. This is because the National Policy Statement for Freshwater Management requires monthly assessment of periphyton biomass as opposed to the annual measurements that are currently undertaken. Annual data collected during summer/autumn between 2004 and 2014 (ie, 10 results) have been compared to the bottom line ( $200 \text{ mg/m}^2$ ) to provide an indicative assessment. Sites with two or less results within 80% or greater of  $200 \text{ mg/m}^2$  were identified as likely to meet the bottom line. Sites with more than two results within 80% or greater of  $200 \text{ mg/m}^2$  were identified as unlikely to meet the bottom line (Table 1). An indicative periphyton attribute band based on a rough qualitative assessment has also been provided.

As outlined in the National Policy Statement for Freshwater Management, assessment of the nitrate toxicity attribute has been based on a median (ie the value below which 50% of results are found) and a 95<sup>th</sup> percentile (ie the value below which 95% of results are found) nitrate-

nitrogen concentration. Calculation of the median nitrate-nitrogen concentration was based on monthly measurements collected between July 2013 and June 2014 (12 results). Calculation of the 95<sup>th</sup> percentile nitrate-nitrogen concentration was based on monthly measurements collected between July 2011 and June 2014 (36 results). There were insufficient data to calculate an annual 95<sup>th</sup> percentile nitrate-nitrogen concentration as specified by the National Policy Statement for Freshwater Management.

Note that ammonia toxicity and dissolved oxygen attributes have not been assessed due to lack of guidance from the Ministry for the Environment as to their application and, in the case of the dissolved oxygen attribute, lack of data from below point source discharges.

**Table 1: Assessment of data from Rivers State of the Environment and Riparian Monitoring Pilot monitoring sites in the Ruamāhanga whaitua against National Policy Statement for Freshwater Management periphyton and nitrate toxicity attributes**

Site code	Site name	Periphyton - number of results >= 80% of bottom line (200mg/m <sup>2</sup> )	Periphyton bottom line likely to be met?	Periphyton likely attribute state	Nitrate-nitrogen (mg/L) median	Nitrate-nitrogen (mg/L) 95th percentile	Nitrate-nitrogen attribute state
RS31	Ruamahanga River at McLays	0	Likely	A	0.02	0.05	A
RS32	Ruamahanga River at Te Ore Ore	0	Likely	B	0.36	1.27	A
RS33	Ruamahanga River at Gladstone Bridge	1	Likely	B	0.35	1.36	A
RS34	Ruamahanga River at Pukio	1	Likely	B/C	0.31	1.24	A
RS36	Taueru River at Castlehill	NA soft bottomed site			0.18	0.54	A
RS37	Taueru River at Gladstone	8	Unlikely	D	0.66	1.50	B
RS38	Kopuaranga Stream at Stewarts	8	Unlikely	D	0.99	1.57	B
RS39	Whangaehu River at 250m from Confluence	NA soft bottomed site			0.86	2.50	B
RS40	Waipoua River at Colombo Rd Bridge	0	Likely	B/C	1.02	1.52	B
RS41	Waingawa River at South Rd	0	Likely	A	0.06	0.23	A
RS45	Parkvale tributary at Lowes Reserve	0	Likely	A	7.00	7.80	D
RS46	Parkvale Stream at weir	4	Unlikely	D	2.60	4.02	C
RS47	Waiohine River at Gorge	0	Likely	A	0.03	0.06	A
RS48	Waiohine River at Bicknells	0	Likely	A/B	0.33	0.90	A
RS49	Beef Creek at headwaters	0	Likely	A	0.02	0.07	A
RS50	Mangatarere Stream at State Highway 2	1	Likely	C	1.18	2.10	B
RS51	Huangarua River at Ponatahi Bridge	5	Unlikely	D	0.16	0.68	A
RS52	Tauanui River at Whakatomotomo Rd	0	Likely	A	0.01	0.04	A
RS55	Tauherenikau River at Websters	0	Likely	A	0.06	0.15	A
RS56	Waiorongomai River at Forest Park	0	Likely	A	0.04	0.06	A
-	Enaki Stream D/S site for Riparian	0	Likely	A	0.69	1.90	B

## 1.2 Lake attributes and Trophic Level Index

A summary of the assessment of Lake Wairarapa data against the National Policy Statement for Freshwater Management phytoplankton, total nitrogen and total phosphorus attributes is presented in Table 2. The lake attributes technically do not apply to Lake Onoke as it is classed as an Intermittently Closed and Open Lake/Lagoon which are currently excluded from the National Policy Statement for Freshwater Management. However, an assessment of lake attributes for Lake Onoke has been provided in Table 3 as the Ministry for the

Environment have recently indicated that Intermittently Closed and Open Lakes/Lagoons are likely to be included in future iterations of the National Policy Statement for Freshwater Management.

Although not included in the National Policy Statement for Freshwater, the Trophic Level Index for Lakes Wairarapa and Onoke is presented here to provide an overall indication of lake water quality. The Trophic Level Index is a nationally used indicator for assessing the water quality status of New Zealand lakes. The Trophic Level Index is calculated using four key variables of lake water quality: chlorophyll *a* (phytoplankton biomass), Secchi depth (water clarity) total nitrogen and total phosphorus. The Trophic Level Index score generated can then be assigned a 'trophic status' (an indication of nutrient enrichment). See Burns et al. (2000) for further details on the Trophic Level Index and Cockeram and Perrie (2014) for details specific to the calculation of the values provided in Tables 2 and 3.

**Table 2: Assessment of data collected from Lake Wairarapa against National Policy Statement for Freshwater phytoplankton, total nitrogen and total phosphorus attributes. A Trophic Level Index score is also provided**

Attribute		Lake Wairarapa	
			Attribute state
Phytoplankton (chlorophyll <i>a</i> (mg/m <sup>3</sup> ))	Annual median	7	C
	Annual maximum	14	
Total nitrogen* (mg/m <sup>3</sup> )	Annual median	610	C
Total phosphorus (mg/m <sup>3</sup> )	Annual median	91	D
<b>Trophic Level Index</b>		<b>5.2 (supertrophic)</b>	

\* Two different thresholds are provided in the National Policy Statement for Freshwater for the total nitrogen attribute to be applied to different lake types (stratified/brackish or polymictic). For Lake Wairarapa the polymictic threshold was used given that the lake is typically considered to be 'mixed' (ie, it does not stratify).

**Table 3: Assessment of data collected from Lake Onoke against National Policy Statement for Freshwater phytoplankton, total nitrogen and total phosphorus attributes. Note that the National Policy Statement for Freshwater Management currently does not apply to Lake Onoke as it is classed as an Intermittently Closed and Open Lake/Lagoon system. A Trophic Level Index score is also provided**

Attribute		Lake Onoke	
			Attribute state
Phytoplankton (chlorophyll <i>a</i> (mg/m <sup>3</sup> ))	Annual median	2.3	B
	Annual maximum	10	
Total nitrogen* (mg/m <sup>3</sup> )	Annual median	550	C
Total phosphorus (mg/m <sup>3</sup> )	Annual median	46	C
<b>Trophic Level Index</b>		<b>4.8 (eutrophic)</b>	

\* Two different thresholds are provided in the National Policy Statement for Freshwater for the total nitrogen attribute to be applied to different lake types (stratified/brackish or polymictic). For Lake Onoke the brackish threshold was used given that the lake is highly influenced by tidal movements of saline water.

Due to changes in monitoring site locations on Lake Wairarapa, only one site (Site 2) located at the northern end of the lake has been consistently sampled over the last two years, hence only data from this site was compared against National Policy Statement for Freshwater Management attributes and used in the calculation of the Trophic Level Index. While some differences in water quality can at times be apparent across the lake, the results presented here are probably a reasonable representation of the water quality in Lake Wairarapa. Note that monthly sampling is not always possible on this lake due to strong winds making accessing sampling sites unsafe (ie some years it is not possible to collect 12 samples). Assessments against National Policy Statement for Freshwater Management attributes and Trophic Level Index calculations were undertaken using data collected monthly (where possible) over July 2013 to June 2014 (9 results) and July 2012 to June 2014 (19 results), respectively (note that a three-year period is generally recommended for calculation of a Trophic Level Index score).

The Lake Onoke monitoring site is located at the point where the Ruamāhanga River enters Lake Onoke and so is unlikely to be representative of water quality across the whole lake. Assessments against National Policy Statement for Freshwater attributes and Trophic Level Index calculations were undertaken using data collected monthly between July 2013 and June 2014 (12 results) and July 2011 and June 2014 (36 results), respectively.

## **Human health for recreation**

The National Policy Statement for Freshwater Management attributes for the human health for recreation value are *E. coli* (an indicator of faecal contamination) and planktonic cyanobacteria (toxic algae that live in the water column). The *E. coli* attribute applies to lakes and rivers while the planktonic cyanobacteria attribute applies to lakes and lake fed rivers only.

The *E. coli* attribute includes a set of numeric attribute states for both secondary and primary contact recreation. The secondary contact recreation value, which relates to activities involving occasional immersion such as wading or boating, is compulsory while the primary contact recreation value, which relates to activities involving full immersion such as swimming, is optional. For primary contact recreation the boundary between the B and C attribute states is identified as the 'minimum acceptable state'.

Assessment of the *E. coli* attribute for lakes and rivers is based on data from the Recreational Water Quality, Rivers State of the Environment, Riparian Management Pilot and Lakes State of the Environment monitoring programmes (Table 4). Recreational Water Quality monitoring sites are sampled weekly over the bathing season (mid-November to 31 March inclusive) as recommended by the national microbiological water quality guidelines (MfE/MoH 2003). Assessment of the *E. coli* attribute at Recreational Water Quality sites was based on data collected during the 2011/12-13/14 bathing seasons. Assessment at Rivers State of the Environment and Riparian Management Pilot monitoring sites was based on data collected monthly, year-round between July 2011 and June 2014. Assessment at Lake Wairarapa sites is based on water samples taken on a roughly quarterly basis between 2002 and 2012. Assessment at the Lake Onoke site is based on samples taken on a roughly monthly basis between 2009 and 2012.

*E. coli* monitoring ceased at Lake State of the Environment monitoring sites in 2012 as at this time it was not considered to be an essential indicator of lake water quality.

**Table 4: Assessment of data from Recreational Water Quality, Rivers State of the Environment, Riparian Monitoring Pilot and Lakes State of the Environment monitoring sites in the Ruamāhanga whaitua against the National Policy Statement for Freshwater Management *E. coli* attribute for secondary and primary contact recreation. Note that for primary contact the boundary between the B and C attribute states is identified as the 'minimum acceptable state'**

Programme	Site code	Site name	Secondary			Primary	
			No. of results	<i>E. coli</i> (cfu/100mL) Hazen median	Attribute state	<i>E. coli</i> (cfu/100mL) Hazen 95th percentile	Attribute state
RSoE	RS31	Ruamahanga River at McLays	36	6	A	50	A
RWQ	-	Ruamahanga River at Double Bridges	60	38	A	311	B
RWQ	-	Ruamahanga River at Te Ore Ore	60	81	A	750	C
RWQ	-	Ruamahanga River at The Cliffs	60	27	A	1,120	D
RSoE	RS33	Ruamahanga River at Gladstone Bridge	36	36	A	861	C
RWQ	-	Ruamahanga River at Kokotau	60	30	A	1,350	D
RWQ	-	Ruamahanga River at Morrisons Bush	60	20	A	1,130	D
RWQ	-	Ruamahanga River at Waihenga Bridge	60	24	A	1,310	D
RSoE	RS34	Ruamahanga River at Pukio	36	56	A	1,570	D
RSoE	RS38	Kopuaranga Stream at Stewarts	36	215	A	1,800	D
RWQ	-	Waipoua River at Colombo Road	60	66	A	950	C
RSoE	RS39	Whangaehu River at 250m from Confluence	36	305	B	1,740	D
RWQ	-	Waingawa River at Kaituna	60	9	A	96	A
RWQ	-	Waingawa River at South Road	60	21	A	404	B
RSoE	RS36	Taueru River at Castlehill	36	110	A	3,990	D
RSoE	RS37	Taueru River at Gladstone	36	155	A	3,830	D
RSoE	RS45	Parkvale tributary at Lowes Reserve	31	11	A	45	A
RSoE	RS46	Parkvale Stream at weir	36	365	B	3,940	D
RSoE	RS47	Waiohine River at Gorge	36	8	A	65	A
RSoE	RS49	Beef Creek at headwaters	35	8	A	163	A
RWQ	-	Waiohine River at State Highway 2	60	5	A	125	A
Riparian	-	Enaki Stream D/S site for Riparian	33	120	A	943	C
RSoE	RS50	Mangatarere Stream at State Highway 2	36	170	A	1,270	D
RSoE	RS48	Waiohine River at Bicknells	36	48	A	356	B
RSoE	RS51	Huangerua River at Ponatahi Bridge	36	95	A	4,960	D
RSoE	RS55	Tauherenkau River at Websters	36	19	A	310	B
RSoE	RS52	Tauanui River at Whakatomotomo Rd	36	6	A	50	A
RSoE	RS56	Waiorongomai River at Forest Park	36	9	A	39	A
Lake SoE	-	Lake Wairarapa - site 1	31	14	A	147	A
Lake SoE	-	Lake Wairarapa - site 2	31	10	A	40	A
Lake SoE	-	Lake Wairarapa - site 3	31	5	A	45	A
Lake SoE	-	Lake Wairarapa - site 4	31	5	A	30	A
Lake SoE	-	Lake Onoke - site 1	27	90	A	2,150	D

Note that median *E. coli* has been calculated from multiple years of data (in most cases three) rather than one year as stipulated in the National Policy Statement for Freshwater Management. This is unlikely to have a significant effect on the results.

Lake Wairarapa sampling sites are located away from the lake edge and therefore results may not reflect *E. coli* concentrations present around the lake edge which is likely to be more influenced by tributary streams and drains.

The planktonic cyanobacteria attribute cannot be assessed as the attribute unit (cell counts or biovolume) is not routinely measured. However, relative abundance of phytoplankton in water samples collected semi-regularly between July 2012 and June 2014 indicate that cyanobacteria are seldom recorded in lakes Wairarapa and Onoke.

## References

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