2009/2010 Rotorua Lakes TLI Update

Bay of Plenty Regional Council
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5 Quay Street
P O Box 364
Whakatane
NEW ZEALAND

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Bay of Plenty
REGIONAL COUNCIL

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Prepared by Paul Scholes

Cover Photo: Lake Rotorua

Acknowledgements

Big thanks to the boys from Environmental Data Services (EDS) who collect all the data and the laboratory for looking after the analyses.

Executive summary

Lake water quality has been monitored in the Rotorua District lakes by the Bay of Plenty Regional Council since 1990. This is carried out under the Natural Environment Regional Monitoring Network (NERMN), a programme for general 'state of the environment' monitoring.

The objective of this report is to update the Trophic Level Index (TLI) for the 12 Rotorua Lakes with the data collected on the lakes from 1 July 2009 to 30 June 2010. The TLI is an indicator of the environmental quality of a lake and is composed of two biological and two chemical components.

The TLI's calculated for 2009/2010 generally show the lakes to be stable, or in the case of three lakes (Lakes Ōkaro, Rotoiti and Okareka), an improvement on the previous years TLI. This is in part due to remediation action for some lakes and potentially also due to the colder winter lake temperatures in 2009 which may have reduced productivity going into the summer. The exception to this is Lake Rotokakahi which shows deteriorating water quality.

Lake Okaro has shown large improvement with its annual average TLI surpassing the (Regional Water and Land Plan) RWLP objective TLI and the lake having reduced incidences of cyanobacterial blooms. Lake Rotoiti also shows continued improvement with respect to its TLI, but still has yet to reach its RWLP TLI objective.

Nine lakes exceed the TLI set in the RWLP and trigger Method 35, Stage 3 of the Plan that calls for Action Plans to be implemented. Action Plans have been completed for Lakes Okareka, Okaro, Rotoehu, Rotorua-Rotoiti and Rotoma. Lakes Tarawera, Rerewhakaaitu, and Okataina have action plan processes or will have in the coming year. An action plan for Rotomahana is less urgent as the TLI does not exceed the 0.2 unit trigger.

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Part 1: Introduction

Lake water quality has been monitored in the Rotorua District lakes by the Bay of Plenty Regional Council since 1990. This is carried out under the Natural Environment Regional Monitoring Network (NERMN), a programme for general 'state of the environment' monitoring.

The objective of this report is to update the Trophic Level Index (TLI) for the 12 Rotorua Lakes (Figure 1) with the data collected on the lakes from 1 July 2009 to 30 June 2010. The TLI is an indicator of the environmental quality of a lake and is composed of two biological and two chemical components.

The Rotorua Lakes are sampled monthly. Each lake is sampled at single or multiple deep water sites. Lake Rotokakahi was previously sampled only at the lake outlet but lake sampling was continued in 2009. Profiles of temperature, dissolved oxygen, conductivity and fluorescence are recorded by a data logger with appropriate sensor arrays. Sampling is dependant upon lake stratification with samples taken to represent the epilimnion (top layer) and the hypolimnion (bottom layer). For a more detailed explanation of the TLI and the parameters that combine to make it see Scholes (2009).

TLI analysis has been performed with the aid of the LakeWatch database. The LakeWatch database software is a useful tool for monitoring the trends in a lake's chemical and physical state by the computation of a Trophic Level Index (TLI), and reinforces the value of long-term and continuous monitoring of the water quality in the region's lakes

Each lake has an objective TLI based on past lake water quality (Objective 10 of the Regional Land and Water Plan (RW&LP)). If a lake TLI exceeds the TLI stated in the Plan by 0.2 TLI units (based on a three year moving average) for two years then Method 35, Rule 11 applies.

Method 35 involves the development and implementation of action plans formulated in conjunction with appropriate stakeholders with the aim of improving water quality.

For each of these lakes action plans have been or will be developed. These plans will be instrumental in formulating management decisions that once implemented will help to reduce the nutrient load to lakes, enhance water quality, and/or halt deterioration of the relevant lake. A risk assessment has also being undertaken as outlined by Method 35 for all the seven lakes without existing action plans.

A standardised procedure known as 'LakeSPI' (Submerged Plant Indicators) is also conducted on all of the lakes to assess the presence and extent of native and invasive species. The 2008/2009 results are given in this report.

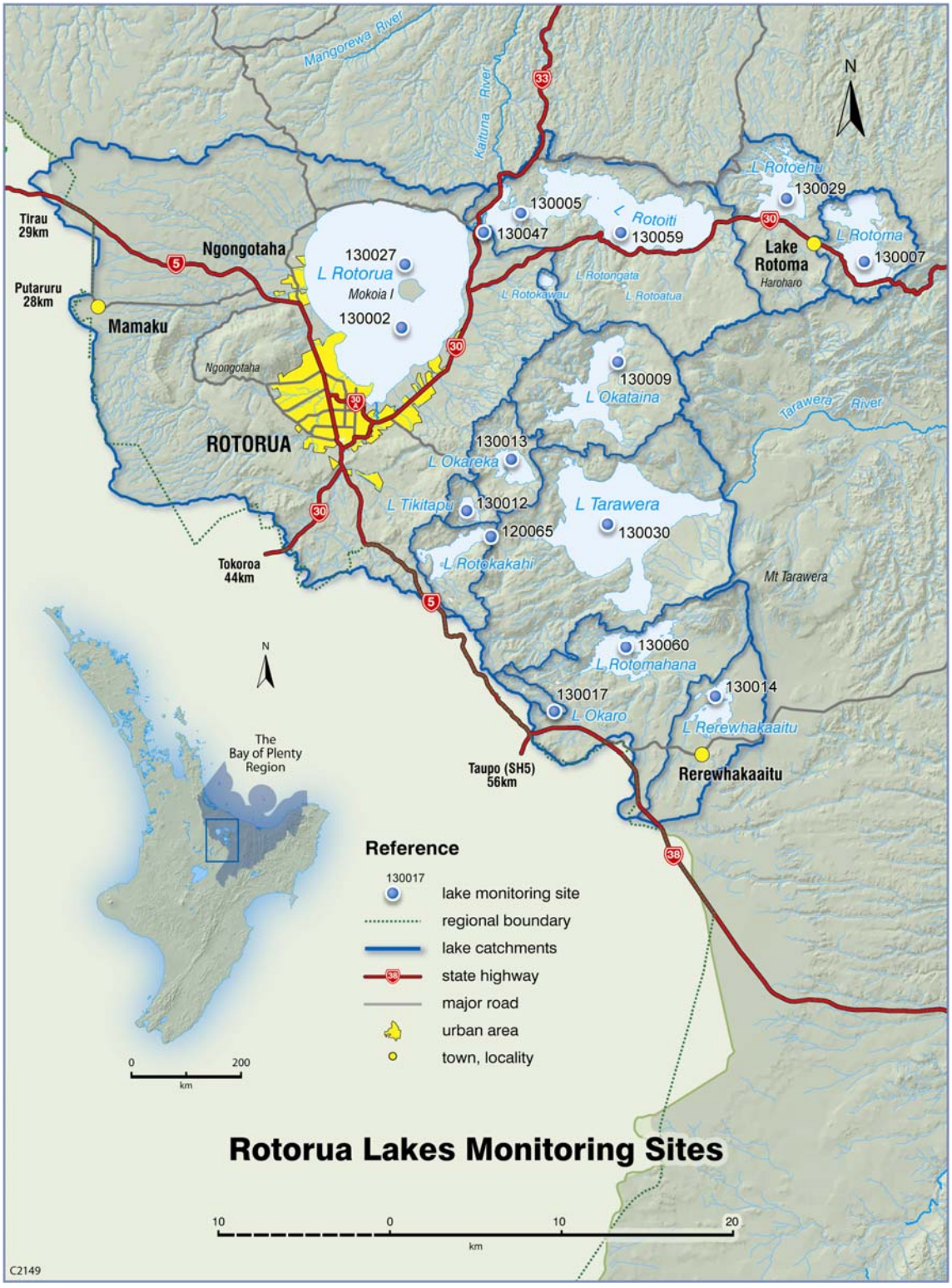

Figure 1.1 Location of the Rotorua Lakes and water quality monitoring sites.

Part 2: TLI Results and Discussion

The three year average TLI's for the 12 Rotorua Lakes have been calculated for the 2009/2010 year and are presented in Table 2.1 along with lake type and Lake SPI condition. The TLI trends for individual lakes are presented in Figures 2.1 to 2.4.

Table 2.1 Three-yearly average TLI values for the Rotorua District lakes in comparison to the TLI values set in the Regional Water and Land Plan, and LakeSPI condition.

Lake *Regional Water & Land Plan TLI units*	3-yearly average TLI to 2007 *TLI units*	3-yearly average TLI to 2008 *TLI units*	3-yearly average TLI to 2009 *TLI units*	3-yearly average TLI to 2010 *TLI units*	2009/2010 Annual TLI (± se) *TLI units*	Lake Type *based on Trophic Level*	LakeSPI Condition 2008/2009
Okaro **5.0**	5.5	5.3	5.3	5.1	4.69 ± 0.24	Supertrophic	Poor
Rotorua **4.2**	4.8	4.8	4.7	4.7	4.56 ± 0.27	Eutrophic	Moderate
Rotoehu **3.9**	4.6	4.5	4.5	4.5	4.50 ± 0.27	Eutrophic	Poor
Rotoiti **3.5**	4.1	4.0	3.9	3.9	3.84 ± 0.25	Mesotrophic	Poor
Rotomahana **3.9**	3.9	3.9	4.0	4.0	3.83 ± 0.38	Mesotrophic	Moderate
Rerewhakaaitu **3.6**	3.5	3.6	3.7	3.8	3.87 ± 0.2	Mesotrophic	Moderate
Okareka **3.0**	3.3	3.3	3.3	3.2	3.17 ± 0.23	Mesotrophic	Moderate
Tikitapu **2.7**	3.0	3.0	3.0	3.1	3.14 ± 0.29	Oligotrophic	Moderate
Okataina **2.6**	2.8	2.8	2.8	2.8	2.72 ± 0.19	Oligotrophic	Moderate
Tarawera **2.6**	2.9	2.9	2.9	2.8	2.60 ± .31	Oligotrophic	Moderate
Rotoma **2.3**	2.5	2.5	2.5	2.4	2.15 ± 0.13	Oligotrophic	High
*Rotokakahi** ***3.1***	*3.7*	*4.1*	*4.1*	*4.8*	4.56 ±0.41	Mesotrophic	Moderate

- Italicised figures based on Te Wairoa monitoring & a 3 parameter TLI (no secchi disk).

All of the lakes have exceeded the TLI objective set in the RW&LP (Objective 11). Method 41 of the Plan requires Action Plans to be implemented where the three-year average TLI is exceeded by 0.2 units for two consecutive years. This threshold has been reached for most of the lakes with the exceptions of Lakes Rotomahana and Rerewhakaaitu.

Action Plans have been completed for Lakes Okareka, Okaro, Rotoehu, Rotorua-Rotoiti and Rotoma. Lakes Tarawera, Rerewhakaaitu, and Okataina have action plan processes underway or will have in the coming year. An action plan for Rotomahana is less urgent as the TLI does not exceed the 0.2 unit trigger.

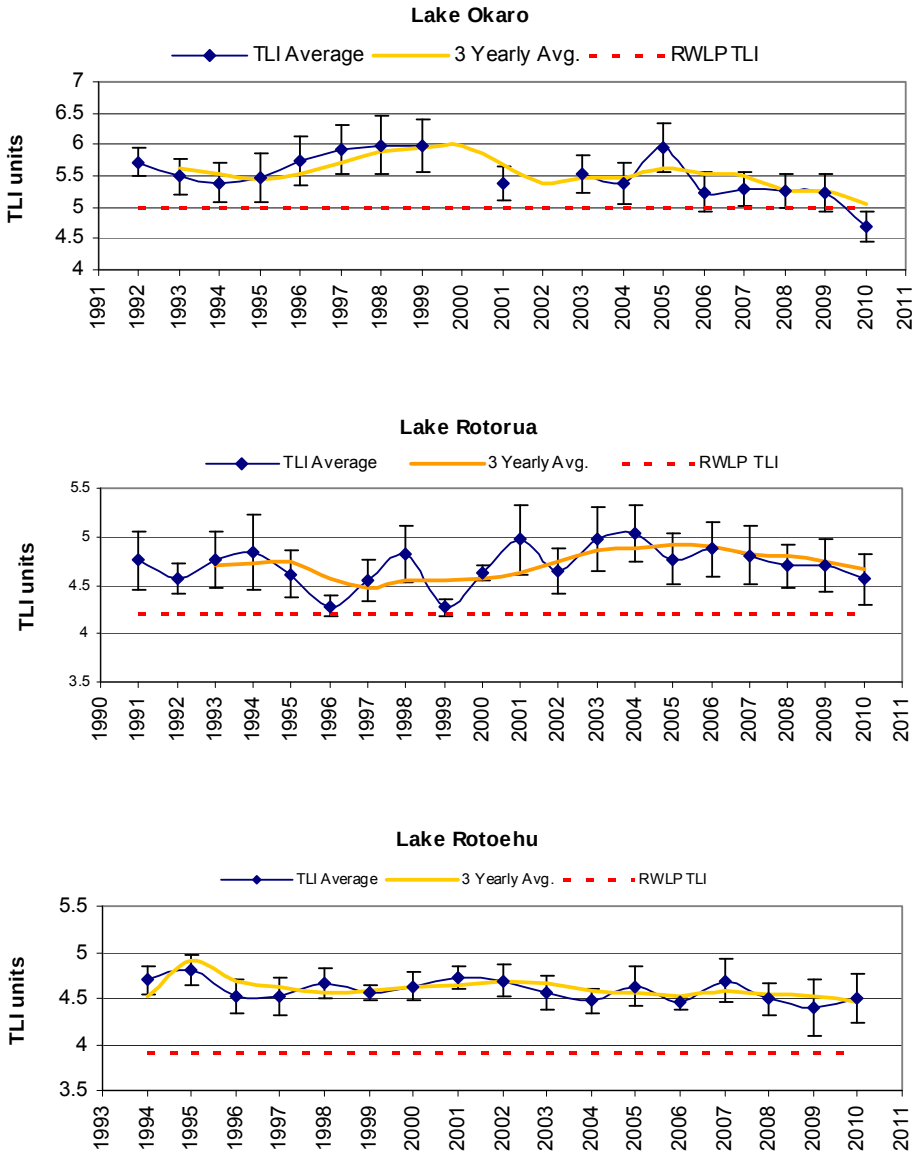

Figure 2.1 Eutrophic lakes annual average TLI with standard error bars, three-yearly average TLI and RW&LP TLI objectives.

The TLI for Lake Ōkaro declined by over half a unit between 2008 and 2010. This dramatic improvement moves the lake nearer to a eutrophic classification rather than supertrophic and it is now under its TLI target for the first time since Regional Council monitoring began. All four TLI parameters improved with the annual average TP levels and water clarity (secchi disk measure) being the best since 1992.

Lakes Rotorua and Rotoehu have remained relatively stable over the last two decades but have shown some improvement in the TLI over the past few years. Lake Rotorua chlorophyll-a levels were lower than the previous few years although water clarity on average has also decreased which may be function of difference in algal species. Like chlorophyll-a, TN and TP have also decreased compared to previous average annual concentrations driving a drop in TLI for Lake Rotorua.

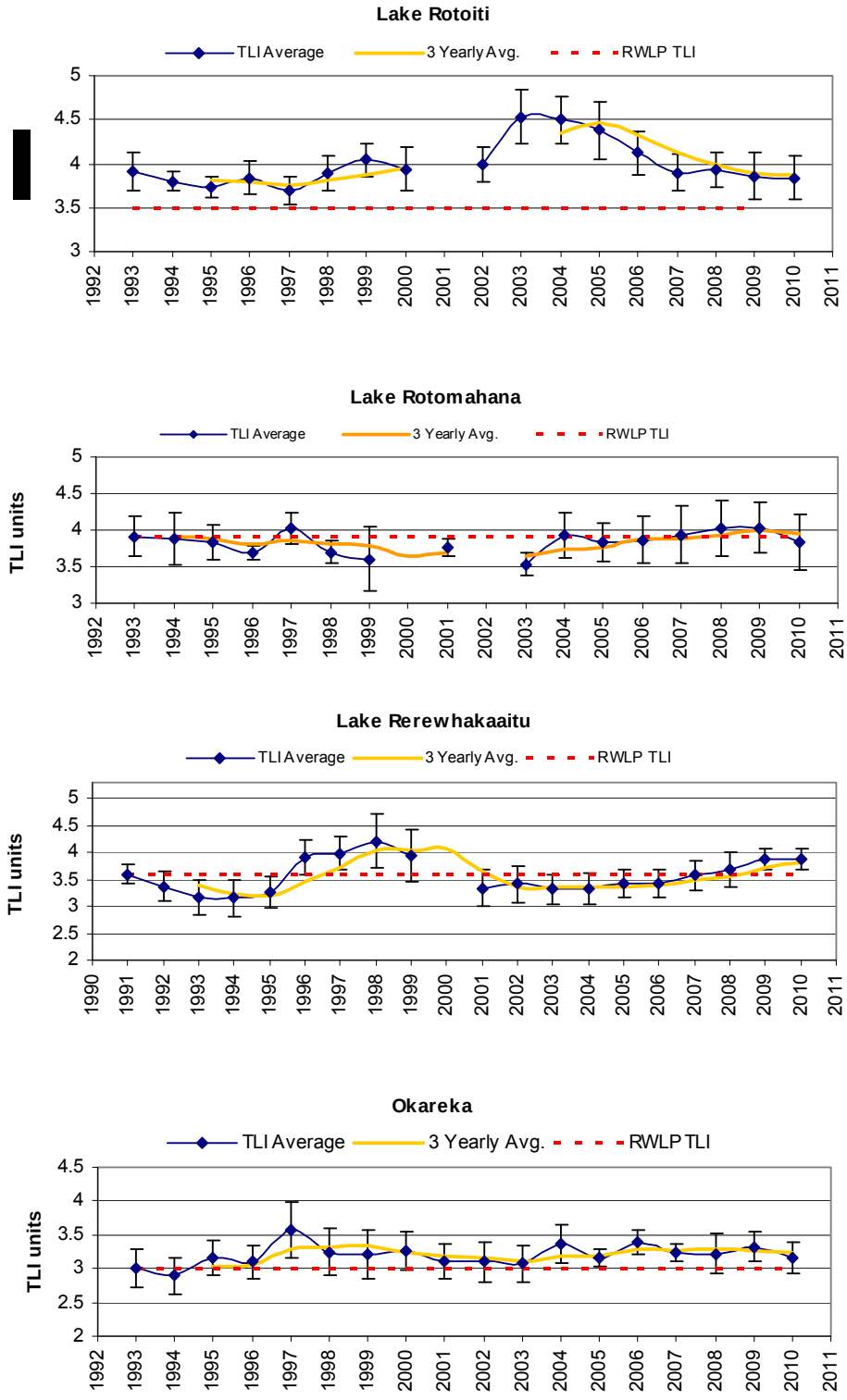

Figure 2.2 Mesotrophic lakes annual average TLI with standard error bars, three-yearly average TLI and RW&LP TLI objectives.

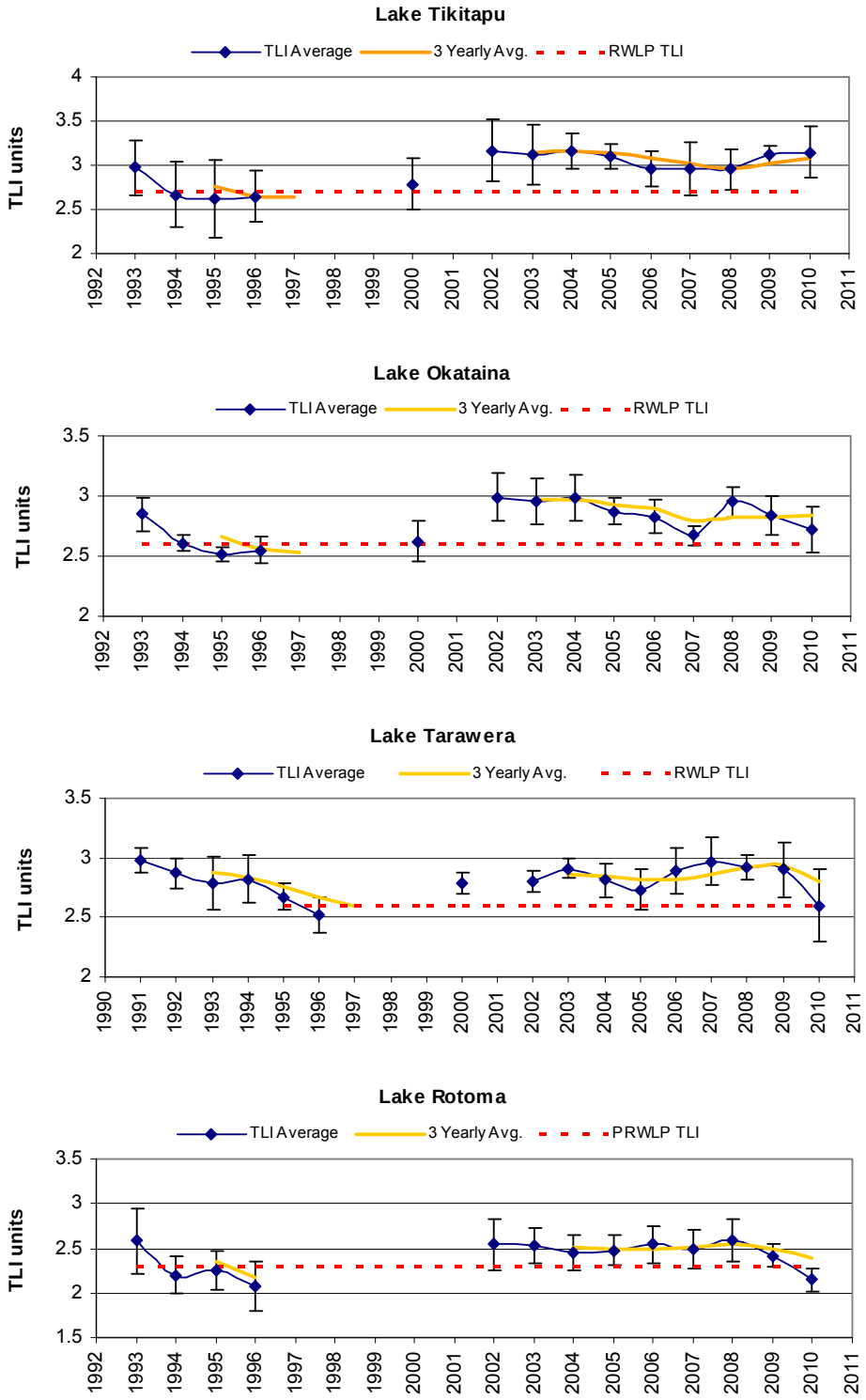

Figure 2.3 Oligotrophic lakes annual average TLI with standard error bars, three-yearly average TLI and RW&LP TLI objectives.

Unlike Lake Rotorua, Lake Rotoehu's TLI has increased from last year predominately due to increases in TP and TN. The three-yearly average TLI remains steady at just under 4.5 TLI units (Figure 2.1), but is well above its TLI objective of 3.9.

Lake Rotoiti again shows a slight improvement in its annual TLI from 2008/2009. The largest change of the four TLI parameters was in chlorophyll-a, while the other parameters remained similar to previous years. At site 4 the oxygen in the hypolimnion took over a month longer to become anoxic compared to the previous two years, indicating productivity in the lake may have slowed. Okawa Bay also continues to show a decline in productivity as determined by chlorophyll-a concentration. TN concentrations also continue to decline although nitrate-nitrogen concentrations display increasing winter time peaks.

The annual TLI of Lake Rotomahana is lower than the previous five years due primarily to a decrease in the annual average TN and chlorophyll-a (Figure 2.2). TP also shows a decrease and, as might be expected with lower chlorophyll-a concentration, water clarity also shows some improvement. However, the three-yearly average TLI still remains above the TLI objective for the lake. Lower winter temperatures may have also helped reduce productivity in the lake.

There is very little change in Lake Rerewhakaaitu's average annual TLI from the previous year (3.87 compared with 3.88 in 2008/2009) (Table 2.1). Nitrate-nitrogen and ammonium-nitrogen are lower than previous years partially explaining a lower annual average nitrogen concentration for 2009/2010 than the previous three years. One stratification event was monitored in February 2010 with oxygen levels being almost totally depleted in the bottom of the lake.

Mesotrophic Lake Ōkāreka showed an improvement in its three-yearly annual average TLI for 2009/2010, due to an improvement in the annual average TLI. The lake's trophic status remains stable at just above its objective TLI. Hypolimnetic dissolved nitrogen has shown lower concentrations in the past two years, with TN and TP in the hypolimnion also remaining well below concentrations that preceded Phoslock applications.

Lake Tikitapu's annual average TLI increased marginally resulting in an increased three-yearly average TLI. This lake, on the cusp of being classified mesotrophic, interestingly displayed annual average decreases in TP and TN, but an increase in chlorophyll-a. Of more concern is the decrease in secchi disk levels, indicating a decline in water clarity which is echoed in an increasing trend in the vertical light extinction coefficient (VLEC).

Although Lake Ōkataina's three-yearly average TLI remains stable at 3.8 TLI units the annual average TLI continues to show improvement after reaching a high peak in 2007/2008 (Figure 2.3). The improved annual TLI is a result of decreasing nitrogen concentrations after the lake reordered its highest average concentration in 2007/2008. Lake Tarawera displays a similar pattern of decreasing nitrogen and improved annual average TLI. All TLI parameters for Tarawera show an improvement in the 2009/2010 lake year which has resulted in the lowest annual average TLI in the last nine years.

Lake Rotomā also showed a similar change in annual average TLI to Lake Tarawera (Figure 2.3) and a decrease in the three-yearly annual average TLI from 2.5 to 2.4 TLI units. All TLI parameters recorded improvements, with the average annual TN concentration for 2009/2010 being the lowest since Regional Council records began. A lower pH may explain a reduction in productivity, but also dissolved nutrient concentrations in both the epilimnion and the hypolimnion were also lower compared to the previous few years.

Assessment of Lake Rotokakahi's trophic status over the past ten years has primarily been undertaken by calculating a TLI based on chlorophyll-a, TP and TN measured monthly in Te Wairoa Stream, the lake's outlet. This measurement has shown rapid change in trophic status over the past few years. Lake monitoring has also been undertaken for the 2009/2010 season. The TLI is shown in Figure 2.4 along with previous TLI assessments. Calculation of a lake based TLI shows a TLI of 4.56 compared with a TLI of 4.75 TLI units from the Te Wairoa outlet. The stream based trophic status assessment is within the standard error range of the lake TLI and remains a useful tool for gauging changes in the lake. The increasing eutrophication of the lake is apparent in both measures. Oxygen depletion in the lake's hypolimnion also occurred more rapidly in 2009/2010 compared to 2006/2007, which is also likely to be adding to the deteriorating trophic status of the lake.

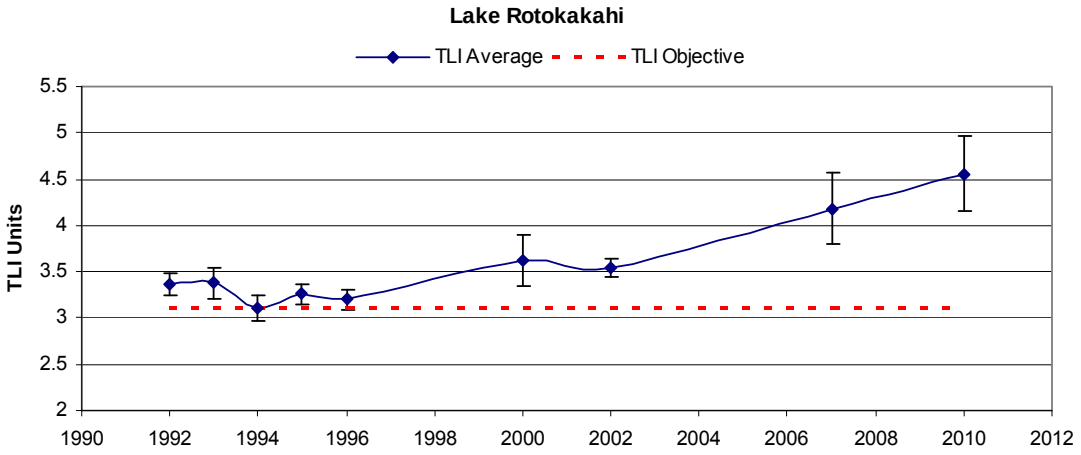

Figure 2.4 Lake Rotokakahi annual average TLI with standard error bars and RW&LP TLI objectives.

Part 3: Conclusion

The TLI's calculated for 2009/2010 generally show the lakes to be stable, or in the case of three lakes, an improvement on the previous years TLI (see Table 3.1). This is in part due to remediation action for some lakes and potentially also due to the colder winter lake temperatures in 2009 which may have reduced productivity going into the summer. The exception to this is Lake Rotokakahi which shows deteriorating water quality.

Lake Ōkaro is classified as supertrophic but is improving towards a eutrophic classification (Table 3.1).Two lakes remain eutropic, with four lakes being mesotrophic. One lake (Tikitapu) is on the cusp of becoming mesotrophic and three lakes are oligotrophic.

	Okaro	Rotorua	Rotoehu	Rotomahana	Rotoiti	Rerewhakaaitu	Okareka	Tikitapu	Okataina	Tarawera	Rotoma
Target TLI	*5.0*	*4.2*	*3.9*	*3.9*	*3.5*	*3.6*	*3.0*	*2.7*	*2.6*	*2.6*	*2.3*
1993		**4.7**				3.4				**2.9**	
1994	**5.5**	**4.7**	**4.5**	3.9		3.2				**2.8**	
1995	**5.5**	**4.7**	**4.9**	3.9	**3.8**	3.2	3.0	**2.8**	**2.7**	**2.8**	2.3
1996	**5.5**	**4.6**	**4.7**	3.8	**3.8**	3.4	**3.1**	2.6	2.6	**2.7**	2.2
1997	**5.7**	**4.5**	**4.6**	3.9	**3.8**	**3.7**	**3.3**	2.6	2.5	2.6	
1998	**5.9**	**4.6**	**4.6**	3.8	**3.8**	**4.0**	**3.3**				
1999	**6.0**	**4.5**	**4.6**	3.8	**3.9**	**4.0**	**3.3**				
2000	**6.0**	**4.6**	**4.6**	3.7	**4.0**	**4.1**	**3.2**				
2001	**5.7**	**4.6**	**4.6**	3.7		3.6	**3.2**				
2002	**5.4**	**4.8**	**4.7**			3.4	**3.2**				
2003	**5.5**	**4.9**	**4.7**	3.6		3.4	**3.1**	**3.1**	**3.0**	**2.9**	
2004	**5.5**	**4.9**	**4.6**	3.7	**4.3**	3.4	**3.2**	**3.2**	**3.0**	**2.8**	**2.5**
2005	**5.6**	**4.9**	**4.6**	3.8	**4.5**	3.4	**3.2**	**3.1**	**2.9**	**2.8**	**2.5**
2006	**5.5**	**4.9**	**4.5**	3.9	**4.3**	3.4	**3.3**	**3.1**	**2.9**	**2.8**	**2.5**
2007	**5.5**	**4.8**	**4.6**	3.9	**4.1**	3.5	**3.3**	**3.0**	**2.8**	**2.9**	**2.5**
2008	**5.3**	**4.8**	**4.5**	3.9	**4.0**	3.6	**3.3**	**3.0**	**2.8**	**2.9**	**2.5**
2009	**5.3**	**4.7**	**4.5**	**4.0**	**3.9**	**3.7**	**3.3**	**3.0**	**2.8**	**2.9**	**2.5**
2010	**5.1**	**4.7**	**4.5**	**4.0**	**3.9**	**3.8**	**3.2**	**3.1**	**2.8**	**2.8**	**2.4**
Classification	Supertrophic	Eutrophic		Mesotrophic				Oligotrophic			

Table 3.1 Three-yearly annual average TLI, RW&LP objective TLI and lake classifications (TLIs in bold are above the RW&LP objective TLI).

Nine lakes exceed the TLI set in the RW&LP and trigger Method 35, Stage 3 of the Plan that calls for Action Plans to be implemented. A risk assessment has been carried out for lakes Rerewhakaaitu, Tarawera, Rotoma, Okataina, Tikitapu, Rotokakahi and Rotomahana. Lakes Tikitapu and Tarawera have the highest priority ranking followed in order by Lake Okataina, Lake Rotoma, Lake Rotokakahi, Lake Rotomahana, and Lake Rerewhakaaitu.

Action Plans have been completed for Lakes Okareka, Okaro, Rotoehu, Rotorua-Rotoiti and Rotoma. Lakes Tarawera, Rerewhakaaitu, and Okataina have action plan processes underway or will have in the coming year. An action plan for Rotomahana is less urgent as the TLI does not exceed the 0.2 unit trigger.

Remediation works aimed at reducing nutrient input and nutrient cycling within these lake catchments have been taking place and in many cases further actions are planned.

Land use or other activities that may increase the nutrient input to lakes where the TLI has been exceeded may be restricted under RW&LP rules, or must be given careful consideration due to the potential impacts on water quality. Common land use changes that may occur are intensive agriculture or urban subdivision. Both have potential to result in increased nutrient discharges to sensitive lake catchments.

Part 4: References

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Appendices

Lake Okareka

1992 to 2010 Site 1 (1 Jul 1992 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(-0.04)	-0.08	0.19	-1.74	-0.62			
Average Over Period	(4.34)	8.08	7.16	217.09	42.47			
Percent Annual Change (%/Year)	**0.00**	**0.99**	**2.65**	**-0.80**	**-1.46**	**0.28**	**0.72**	**0.72**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1992 - Jun 1993	3.16	10.56	5.86	231.75	3.49	2.55	2.46	3.51	3.00	0.29			
Jul 1993 - Jun 1994	2.44	9.97	4.91	226.15	3.20	2.64	2.24	3.48	2.89	0.28			
Jul 1994 - Jun 1995	3.88	7.79	6.23	220.63	3.72	3.00	2.54	3.44	3.17	0.26			
Jul 1995 - Jun 1996	3.10	8.04	5.92	229.50	3.47	2.95	2.47	3.50	3.10	0.24			
Jul 1996 - Jun 1997	9.70	7.36	7.79	260.14	4.73	3.08	2.82	3.66	3.57	0.42			
Jul 1997 - Jun 1998	5.40	9.06	6.25	245.25	4.08	2.78	2.54	3.58	3.25	0.36			
Jul 1998 - Jun 1999	5.23	8.55	5.75	236.40	4.04	2.86	2.44	3.53	3.22	0.36			
Jul 1999 - Jun 2000	5.12	7.92	7.00	209.45	4.02	2.97	2.69	3.38	3.26	0.29			
Jul 2000 - Jun 2001	3.62	8.70	6.20	216.86	3.64	2.84	2.53	3.42	3.11	0.26			
Jul 2001 - Jun 2002	4.03	8.31	5.41	210.41	3.76	2.91	2.36	3.38	3.10	0.30			
Jul 2002 - Jun 2003	3.90	8.03	5.75	183.45	3.72	2.95	2.44	3.20	3.08	0.27			
Jul 2003 - Jun 2004	5.21	6.45	6.72	229.03	4.04	3.26	2.63	3.49	3.36	0.29			
Jul 2004 - Jun 2005	2.93	7.42	7.75	197.55	3.41	3.07	2.81	3.30	3.15	0.13			
Jul 2005 - Jun 2006	4.51	7.59	10.70	215.21	3.88	3.03	3.22	3.41	3.39	0.18			
Jul 2006 - Jun 2007	3.12	7.72	9.00	225.30	3.48	3.01	3.00	3.47	3.24	0.13			
Jul 2007 - Jun 2008	4.32	7.88	6.61	219.43	3.83	2.98	2.61	3.44	3.22	0.27			
Jul 2008 - Jun 2009	4.62	8.41	10.14	199.32	3.91	2.89	3.16	3.31	3.32	0.22			
Jul 2009 - Jun 2010	4.09	8.13	7.20	190.14	3.77	2.94	2.72	3.25	3.17	0.23			
Averages	**4.35**	**8.22**	**6.95**	**219.22**	**3.79**	**2.93**	**2.65**	**3.43**	**3.20**	**0.06**	**0.01**	**0.01**	**0.4099**

Lake Okaro

1991 to 2010 Site 1 (1 Jul 1991 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(-0.27)	0.07	-3.84	-19.98	(-2.50)			
Average Over Period	(27.81)	2.24	86.96	1,008.49	(73.39)			
Percent Annual Change (%/Year)	**0.00**	**-3.13**	**-4.42**	**-1.98**	**0.00**	**-1.90**	**0.87**	**0.09**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1991 - Jun 1992	24.44	1.42	115.78	1,289.67	5.75	5.12	6.24	5.75	5.72	0.23			
Jul 1992 - Jun 1993	27.75	2.08	91.67	1,015.67	5.89	4.67	5.95	5.44	5.49	0.29			
Jul 1993 - Jun 1994	12.35	1.93	101.10	1,259.33	4.99	4.76	6.07	5.72	5.39	0.31			
Jul 1994 - Jun 1995	12.15	1.87	138.00	1,193.71	4.97	4.80	6.47	5.65	5.47	0.38			
Jul 1995 - Jun 1996	22.85	1.86	165.83	1,271.83	5.67	4.80	6.70	5.73	5.73	0.39			
Jul 1996 - Jun 1997	42.74	1.85	146.78	1,492.44	6.36	4.81	6.54	5.94	5.92	0.39			
Jul 1997 - Jun 1998	81.68	1.72	119.33	1,246.33	7.08	4.90	6.28	5.71	5.99	0.46			
Jul 1998 - Jun 1999	55.90	1.94	126.00	1,754.00	6.66	4.76	6.35	6.15	5.98	0.42			
Jul 1999 - Jun 2000													
Jul 2000 - Jun 2001	17.10	2.02	99.17	1,013.54	5.35	4.71	6.05	5.44	5.39	0.27			
Jul 2001 - Jun 2002													
Jul 2002 - Jun 2003	26.54	1.85	107.94	936.54	5.84	4.81	6.15	5.33	5.53	0.29			
Jul 2003 - Jun 2004	19.73	2.38	103.66	984.78	5.51	4.51	6.10	5.40	5.38	0.33			
Jul 2004 - Jun 2005	77.18	1.48	92.76	1,266.94	7.01	5.08	5.96	5.73	5.95	0.40			
Jul 2005 - Jun 2006	17.05	2.74	84.67	1,005.03	5.35	4.34	5.85	5.43	5.24	0.32			
Jul 2006 - Jun 2007	19.97	2.42	75.33	975.78	5.52	4.49	5.70	5.39	5.28	0.27			
Jul 2007 - Jun 2008	27.28	2.37	60.28	867.44	5.87	4.52	5.42	5.23	5.26	0.28			
Jul 2008 - Jun 2009	24.46	2.60	54.61	1,038.24	5.75	4.41	5.29	5.47	5.23	0.29			
Jul 2009 - Jun 2010	13.87	3.59	39.65	602.61	5.12	4.01	4.88	4.76	4.69	0.24			
Averages	**30.77**	**2.12**	**101.33**	**1130.23**	**5.81**	**4.68**	**6.00**	**5.55**	**5.51**	**0.08**	**-0.03**	**0.01**	**0.0205**

Lake Okataina

1992 to 2010 Site 1 (1 Jul 1992 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(0.02)	(0.04)	(0.12)	(0.19)	(-0.02)			
Average Over Period	(2.27)	(10.34)	(8.06)	(131.92)	(29.59)			
Percent Annual Change (%/Year)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1992 - Jun 1993	1.92	11.10	9.92	139.44	2.94	2.47	3.13	2.84	2.85	0.14			
Jul 1993 - Jun 1994	1.56	9.57	5.56	117.91	2.71	2.70	2.39	2.63	2.61	0.07			
Jul 1994 - Jun 1995	1.23	11.37	6.00	124.00	2.44	2.44	2.49	2.69	2.52	0.06			
Jul 1995 - Jun 1996	1.71	10.44	5.00	112.17	2.81	2.57	2.26	2.56	2.55	0.11			
Jul 1996 - Jun 1997													
Jul 1997 - Jun 1998													
Jul 1998 - Jun 1999													
Jul 1999 - Jun 2000	2.16	11.21	5.14	121.50	3.07	2.46	2.29	2.66	2.62	0.17			
Jul 2000 - Jun 2001													
Jul 2001 - Jun 2002	3.34	8.11	6.40	143.62	3.55	2.94	2.57	2.88	2.99	0.20			
Jul 2002 - Jun 2003	3.11	8.20	8.12	111.28	3.47	2.93	2.87	2.55	2.95	0.19			
Jul 2003 - Jun 2004	2.76	11.08	10.70	142.13	3.34	2.48	3.22	2.87	2.98	0.19			
Jul 2004 - Jun 2005	2.12	10.47	8.70	144.95	3.05	2.57	2.96	2.90	2.87	0.11			
Jul 2005 - Jun 2006	1.89	11.53	9.16	150.48	2.92	2.42	3.03	2.94	2.83	0.14			
Jul 2006 - Jun 2007	1.65	11.42	7.00	134.53	2.77	2.43	2.69	2.80	2.67	0.08			
Jul 2007 - Jun 2008	2.35	10.20	8.75	163.90	3.16	2.60	2.97	3.06	2.95	0.12			
Jul 2008 - Jun 2009	2.46	10.84	8.81	119.77	3.21	2.51	2.98	2.65	2.84	0.16			
Jul 2009 - Jun 2010	2.22	10.44	8.50	89.56	3.10	2.57	2.93	2.27	2.72	0.19			
Averages	**2.18**	**10.43**	**7.70**	**129.66**	**3.04**	**2.58**	**2.77**	**2.74**	**2.78**	**0.04**	**0.01**	**0.01**	**0.0685**

Lake Rerewhakaaitu

1990 to 2010 Site 1 (1 Jul 1990 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(-0.02)	-0.06	0.22	4.45				
Average Over Period	(3.95)	5.70	8.45	382.19				
Percent Annual Change (%/Year)	**0.00**	**1.05**	**2.60**	**1.16**	**0.00**	**1.21**	**0.53**	**0.11**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1990 - Jun 1991	3.90	4.95	9.83	321.86	3.72	3.60	3.12	3.94	3.60	0.17			
Jul 1991 - Jun 1992	3.14	7.34	8.00	356.96	3.48	3.08	2.86	4.07	3.37	0.27			
Jul 1992 - Jun 1993	2.74	7.41	5.47	310.22	3.33	3.07	2.37	3.89	3.17	0.32			
Jul 1993 - Jun 1994	2.20	6.92	5.40	334.14	3.09	3.16	2.36	3.99	3.15	0.33			
Jul 1994 - Jun 1995	2.42	6.37	6.50	329.85	3.19	3.27	2.59	3.97	3.26	0.28			
Jul 1995 - Jun 1996	7.80	3.78	8.86	398.14	4.49	3.95	2.98	4.22	3.91	0.33			
Jul 1996 - Jun 1997	8.43	4.34	10.53	446.27	4.57	3.77	3.20	4.37	3.98	0.31			
Jul 1997 - Jun 1998	17.18	4.45	9.67	547.67	5.36	3.74	3.10	4.63	4.21	0.50			
Jul 1998 - Jun 1999	7.38	2.78	6.00	499.50	4.42	4.32	2.49	4.51	3.94	0.48			
Jul 1999 - Jun 2000													
Jul 2000 - Jun 2001	2.97	5.62	5.74	359.46	3.42	3.44	2.43	4.08	3.34	0.34			
Jul 2001 - Jun 2002	3.33	4.88	5.65	348.07	3.55	3.62	2.41	4.04	3.41	0.35			
Jul 2002 - Jun 2003	2.93	6.68	6.93	333.33	3.40	3.21	2.67	3.98	3.32	0.27			
Jul 2003 - Jun 2004	2.35	8.25	9.61	376.59	3.16	2.92	3.09	4.14	3.33	0.28			
Jul 2004 - Jun 2005	3.42	5.88	7.50	338.63	3.58	3.38	2.77	4.00	3.43	0.26			
Jul 2005 - Jun 2006	2.82	7.01	8.78	389.92	3.37	3.14	2.97	4.19	3.42	0.27			
Jul 2006 - Jun 2007	2.87	5.77	10.98	406.80	3.38	3.41	3.26	4.24	3.57	0.23			
Jul 2007 - Jun 2008	3.87	4.93	8.54	483.54	3.71	3.61	2.94	4.47	3.68	0.31			
Jul 2008 - Jun 2009	5.15	4.29	12.17	429.70	4.03	3.79	3.39	4.32	3.88	0.20			
Jul 2009 - Jun 2010	5.56	3.97	11.24	390.91	4.11	3.88	3.29	4.19	3.87	0.20			
Averages	**4.76**	**5.56**	**8.28**	**389.56**	**3.76**	**3.49**	**2.86**	**4.17**	**3.57**	**0.07**	**0.01**	**0.01**	**0.3945**

Lake Rotoehu

1990 to 2010 Sites 1 & 3 (1 Jul 1990 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(-0.08)	-0.03	(0.27)	-6.93				
Average Over Period	(11.43)	2.89	(38.88)	429.43				
Percent Annual Change (%/Year)	**0.00**	**1.04**	**0.00**	**-1.61**	**0.00**	**-0.14**	**0.55**	**0.81**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1990 - Jun 1991	2.60	4.52	31.28	285.44	3.27	3.72	4.58	3.78	3.84	0.27			
Jul 1991 - Jun 1992	1.59	5.28	28.53	324.40	2.73	3.52	4.47	3.95	3.67	0.37			
Jul 1992 - Jun 1993	35.45	2.67	48.19	801.75	6.16	4.37	5.13	5.13	5.20	0.37			
Jul 1993 - Jun 1994	10.28	2.63	46.44	502.50	4.79	4.39	5.09	4.52	4.70	0.15			
Jul 1994 - Jun 1995	11.67	1.76	47.06	443.76	4.93	4.87	5.10	4.36	4.81	0.16			
Jul 1995 - Jun 1996	7.90	2.81	44.82	405.45	4.50	4.31	5.04	4.24	4.52	0.18			
Jul 1996 - Jun 1997	11.90	3.45	35.63	434.97	4.95	4.06	4.75	4.33	4.52	0.20			
Jul 1997 - Jun 1998	13.54	2.81	33.85	529.85	5.09	4.31	4.68	4.59	4.67	0.16			
Jul 1998 - Jun 1999	10.33	2.57	32.50	458.50	4.80	4.42	4.63	4.40	4.56	0.09			
Jul 1999 - Jun 2000	13.55	2.45	30.10	461.10	5.10	4.48	4.54	4.41	4.63	0.16			
Jul 2000 - Jun 2001	12.65	2.25	37.09	486.43	5.02	4.58	4.80	4.48	4.72	0.12			
Jul 2001 - Jun 2002	14.53	2.12	30.27	459.90	5.17	4.65	4.54	4.40	4.69	0.17			
Jul 2002 - Jun 2003	13.38	2.52	26.50	438.12	5.08	4.44	4.37	4.34	4.56	0.18			
Jul 2003 - Jun 2004	10.07	2.78	32.63	382.76	4.77	4.32	4.64	4.16	4.47	0.14			
Jul 2004 - Jun 2005	13.27	2.99	39.83	426.34	5.07	4.24	4.89	4.31	4.63	0.21			
Jul 2005 - Jun 2006	7.97	2.80	33.00	433.43	4.51	4.31	4.65	4.33	4.45	0.08			
Jul 2006 - Jun 2007	11.05	2.78	54.68	418.16	4.87	4.33	5.29	4.28	4.69	0.24			
Jul 2007 - Jun 2008	11.75	2.56	30.25	349.35	4.94	4.42	4.54	4.05	4.49	0.18			
Jul 2008 - Jun 2009	10.21	3.60	45.67	275.87	4.78	4.01	5.06	3.74	4.40	0.31			
Jul 2009 - Jun 2010	9.01	3.08	51.13	326.96	4.64	4.20	5.21	3.96	4.50	0.27			
Averages	**11.64**	**2.92**	**37.97**	**432.25**	**4.76**	**4.30**	**4.80**	**4.29**	**4.54**	**0.05**	**0.01**	**0.01**	**0.3963**

Lake Rotoiti

1992 to 2010 Sites 1,2,3 & 4 (1 Jul 1992 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	0.17	(-0.01)	0.43	(0.84)				
Average Over Period	8.08	(5.17)	25.29	(288.31)				
Percent Annual Change (%/Year)	**2.10**	**0.00**	**1.70**	**0.00**	**0.00**	**0.95**	**0.56**	**0.19**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1992 - Jun 1993	7.58	5.50	20.43	267.10	4.45	3.47	4.04	3.69	3.91	0.22			
Jul 1993 - Jun 1994	4.15	5.07	21.33	273.70	3.79	3.57	4.10	3.73	3.80	0.11			
Jul 1994 - Jun 1995	4.48	5.52	19.97	253.27	3.87	3.46	4.02	3.62	3.74	0.12			
Jul 1995 - Jun 1996	5.28	5.74	23.40	265.23	4.06	3.41	4.22	3.69	3.84	0.18			
Jul 1996 - Jun 1997	5.13	6.33	17.70	244.67	4.02	3.28	3.86	3.58	3.69	0.16			
Jul 1997 - Jun 1998	6.09	5.80	22.28	288.33	4.21	3.40	4.15	3.79	3.89	0.19			
Jul 1998 - Jun 1999	6.49	4.64	27.00	285.07	4.28	3.69	4.40	3.78	4.04	0.18			
Jul 1999 - Jun 2000	8.01	5.53	22.56	252.56	4.52	3.46	4.17	3.62	3.94	0.24			
Jul 2000 - Jun 2001													
Jul 2001 - Jun 2002	7.30	4.44	23.06	249.15	4.41	3.74	4.20	3.60	3.99	0.19			
Jul 2002 - Jun 2003	17.63	3.32	31.05	354.14	5.39	4.11	4.57	4.06	4.53	0.31			
Jul 2003 - Jun 2004	12.03	4.30	39.83	447.77	4.96	3.79	4.89	4.37	4.50	0.27			
Jul 2004 - Jun 2005	13.39	5.05	34.51	374.08	5.08	3.58	4.71	4.13	4.38	0.33			
Jul 2005 - Jun 2006	7.15	5.21	33.12	307.06	4.39	3.54	4.66	3.88	4.12	0.25			
Jul 2006 - Jun 2007	5.70	5.84	24.67	289.37	4.14	3.39	4.28	3.80	3.90	0.20			
Jul 2007 - Jun 2008	7.35	5.36	20.41	277.27	4.42	3.50	4.04	3.74	3.93	0.20			
Jul 2008 - Jun 2009	7.67	5.50	21.77	209.82	4.47	3.47	4.12	3.38	3.86	0.26			
Jul 2009 - Jun 2010	6.45	5.51	24.28	206.63	4.28	3.47	4.26	3.36	3.84	0.25			
Averages	**7.76**	**5.22**	**25.14**	**285.01**	**4.40**	**3.55**	**4.28**	**3.75**	**3.99**	**0.06**	**0.01**	**0.01**	**0.1656**

Lake Rotoma

1992 to 2010 Site 1 (1 Jul 1992 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	-0.02	0.09	0.12	(-0.25)				
Average Over Period	1.31	12.82	4.43	(145.50)				
Percent Annual Change (%/Year)	**-1.53**	**-0.70**	**2.71**	**0.00**	**0.00**	**0.12**	**0.92**	**0.90**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1992 - Jun 1993	2.52	13.63	3.45	176.89	3.24	2.14	1.79	3.16	2.58	0.36			
Jul 1993 - Jun 1994	0.98	11.99	3.00	117.50	2.20	2.35	1.61	2.62	2.20	0.21			
Jul 1994 - Jun 1995	0.93	12.71	3.44	139.67	2.14	2.26	1.79	2.85	2.26	0.22			
Jul 1995 - Jun 1996	0.85	15.61	2.83	139.83	2.04	1.90	1.54	2.85	2.08	0.28			
Jul 1996 - Jun 1997		14.00				2.09			2.09	0.00			
Jul 1997 - Jun 1998													
Jul 1998 - Jun 1999													
Jul 1999 - Jun 2000													
Jul 2000 - Jun 2001	1.96	9.81	3.27	137.91	2.96	2.66	1.72	2.83	2.54	0.28			
Jul 2002 - Jun 2003	1.47	9.36	4.00	129.84	2.65	2.73	1.98	2.75	2.53	0.19			
Jul 2003 - Jun 2004	1.37	14.16	4.91	147.07	2.56	2.07	2.24	2.91	2.45	0.19			
Jul 2004 - Jun 2005	1.33	13.01	4.85	150.24	2.54	2.22	2.22	2.94	2.48	0.17			
Jul 2005 - Jun 2006	1.27	14.30	6.33	164.55	2.48	2.06	2.56	3.06	2.54	0.21			
Jul 2006 - Jun 2007	1.23	11.23	4.10	162.93	2.45	2.46	2.01	3.05	2.49	0.21			
Jul 2007 - Jun 2008	1.21	13.05	5.72	195.75	2.43	2.21	2.43	3.29	2.59	0.24			
Jul 2008 - Jun 2009	1.33	14.20	5.55	122.67	2.54	2.07	2.39	2.68	2.42	0.13			
Jul 2009 - Jun 2010	1.04	15.29	3.92	103.11	2.27	1.94	1.95	2.45	2.15	0.13			
Averages	**1.35**	**13.02**	**4.26**	**145.23**	**2.50**	**2.23**	**2.02**	**2.88**	**2.40**	**0.06**	**0.01**	**0.01**	**0.3906**

Lake Rotomahana

1992 to 2010 Sites 1 & 2 (1 Jul 1992 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(-0.01)	0.07	1.03	(-0.85)	(-0.31)			
Average Over Period	(4.36)	5.04	34.67	(217.41)	(18.55)			
Percent Annual Change (%/Year)	**0.00**	**-1.39**	**2.97**	**0.00**	**0.00**	**0.32**	**0.72**	**0.68**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1992 - Jun 1993	3.80	4.95	34.75	251.33	3.69	3.60	4.72	3.61	3.91	0.27			
Jul 1993 - Jun 1994	2.90	4.46	40.56	228.42	3.39	3.74	4.91	3.49	3.88	0.35			
Jul 1994 - Jun 1995	3.72	4.35	29.43	206.00	3.67	3.77	4.51	3.35	3.83	0.24			
Jul 1995 - Jun 1996	4.63	5.07	16.00	237.00	3.91	3.57	3.73	3.54	3.69	0.09			
Jul 1996 - Jun 1997	5.94	4.28	31.00	240.00	4.19	3.79	4.57	3.55	4.03	0.22			
Jul 1997 - Jun 1998	5.63	4.84	13.00	239.33	4.13	3.63	3.47	3.55	3.70	0.15			
Jul 1998 - Jun 1999	7.38	3.10	6.00	195.00	4.42	4.19	2.49	3.28	3.60	0.44			
Jul 1999 - Jun 2000													
Jul 2000 - Jun 2001	4.21	4.36	20.15	219.48	3.81	3.77	4.03	3.44	3.76	0.12			
Jul 2002 - Jun 2003	4.65	5.49	13.69	181.38	3.92	3.47	3.54	3.19	3.53	0.15			
Jul 2003 - Jun 2004	4.62	5.29	37.12	226.29	3.91	3.52	4.80	3.48	3.93	0.31			
Jul 2004 - Jun 2005	4.38	5.00	30.75	198.43	3.85	3.59	4.56	3.31	3.83	0.27			
Jul 2005 - Jun 2006	3.84	4.94	37.09	202.18	3.70	3.61	4.80	3.33	3.86	0.32			
Jul 2006 - Jun 2007	3.76	5.70	47.64	235.69	3.68	3.42	5.12	3.53	3.94	0.40			
Jul 2007 - Jun 2008	4.31	5.28	48.33	237.73	3.83	3.52	5.14	3.54	4.01	0.38			
Jul 2008 - Jun 2009	5.11	5.12	43.05	237.13	4.02	3.56	4.99	3.54	4.03	0.34			
Jul 2009 - Jun 2010	3.80	5.38	40.95	186.45	3.69	3.50	4.93	3.22	3.83	0.38			
Averages	**4.54**	**4.85**	**30.59**	**220.12**	**3.86**	**3.64**	**4.39**	**3.44**	**3.83**	**0.07**	**0.01**	**0.01**	**0.5996**

Lake Rotorua

1990 to 2010 Sites 2 & 5 (1 Jul 1990 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	0.72	-0.02	-0.85	2.48				
Average Over Period	18.39	2.54	41.28	449.55				
Percent Annual Change (%/Year)	**3.92**	**0.79**	**-2.06**	**0.55**	**0.00**	**0.80**	**1.22**	**0.56**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1990 - Jun 1991	20.60	2.35	37.62	379.08	5.56	4.52	4.82	4.15	4.76	0.30			
Jul 1991 - Jun 1992	7.47	2.28	42.55	423.48	4.44	4.56	4.97	4.30	4.57	0.15			
Jul 1992 - Jun 1993	15.82	2.60	52.57	371.95	5.27	4.41	5.24	4.13	4.76	0.29			
Jul 1993 - Jun 1994	7.00	2.14	92.94	457.10	4.37	4.64	5.97	4.40	4.84	0.38			
Jul 1994 - Jun 1995	8.73	2.93	54.00	421.76	4.61	4.26	5.28	4.29	4.61	0.24			
Jul 1995 - Jun 1996	7.77	3.18	28.31	344.23	4.48	4.16	4.46	4.03	4.28	0.11			
Jul 1996 - Jun 1997	14.55	3.16	30.78	421.90	5.17	4.17	4.56	4.29	4.55	0.22			
Jul 1997 - Jun 1998	21.69	2.90	39.68	490.95	5.61	4.27	4.89	4.49	4.82	0.30			
Jul 1998 - Jun 1999	5.77	3.21	30.13	401.37	4.15	4.15	4.54	4.23	4.27	0.09			
Jul 1999 - Jun 2000	10.81	2.48	31.43	536.00	4.85	4.46	4.59	4.60	4.63	0.08			
Jul 2000 - Jun 2001	29.17	2.56	47.51	459.24	5.94	4.42	5.11	4.40	4.97	0.36			
Jul 2001 - Jun 2002	14.51	2.71	40.35	386.26	5.17	4.35	4.91	4.18	4.65	0.23			
Jul 2002 - Jun 2003	28.13	2.03	41.96	447.46	5.90	4.70	4.96	4.37	4.98	0.33			
Jul 2003 - Jun 2004	26.36	2.17	46.57	531.98	5.83	4.62	5.09	4.59	5.03	0.29			
Jul 2004 - Jun 2005	19.93	2.56	36.00	454.27	5.52	4.43	4.76	4.39	4.77	0.26			
Jul 2005 - Jun 2006	21.82	2.60	45.35	464.23	5.62	4.41	5.06	4.42	4.87	0.29			
Jul 2006 - Jun 2007	23.24	2.52	32.55	481.36	5.69	4.44	4.63	4.46	4.81	0.30			
Jul 2007 - Jun 2008	17.12	2.61	31.00	480.70	5.35	4.40	4.57	4.46	4.70	0.22			
Jul 2008 - Jun 2009	19.00	2.57	34.52	407.74	5.47	4.42	4.71	4.25	4.71	0.27			
Jul 2009 - Jun 2010	15.36	2.02	26.18	325.53	5.23	4.71	4.36	3.95	4.56	0.27			
Averages	**16.74**	**2.58**	**41.10**	**434.33**	**5.21**	**4.43**	**4.87**	**4.32**	**4.71**	**0.06**	**0.01**	**0.01**	**0.4260**

Lake Tarawera

1994 to 2010 Sites 1 & 5 (1 Jul 1990 - 30 Jun 2002)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(-0.01)	0.12	0.53	(0.27)	(-0.64)			
Average Over Period	(1.54)	8.55	10.38	(115.96)	(12.47)			
Percent Annual Change (%/Year)	**0.00**	**-1.40**	**5.11**	**0.00**	**0.00**	**0.74**	**1.12**	**0.55**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1994 - Jun 1995	1.23	8.05	7.00	116.05	2.45	2.95	2.69	2.60	2.67	0.11			
Jul 1995 - Jun 1996	1.17	7.93	5.60	92.70	2.40	2.97	2.40	2.31	2.52	0.15			
Jul 1996 - Jun 1997		8.93				2.80			2.80	0.00			
Jul 1997 - Jun 1998													
Jul 1998 - Jun 1999													
Jul 1999 - Jun 2000	1.89	7.98	7.11	113.79	2.92	2.96	2.71	2.58	2.79	0.09			
Jul 2000 - Jun 2001													
Jul 2001 - Jun 2002	1.81	7.91	7.50	112.32	2.87	2.98	2.77	2.56	2.80	0.09			
Jul 2002 - Jun 2003	1.81	7.08	8.13	130.12	2.87	3.13	2.87	2.75	2.91	0.08			
Jul 2003 - Jun 2004	1.42	7.52	9.45	108.21	2.61	3.05	3.07	2.51	2.81	0.14			
Jul 2004 - Jun 2005	1.21	9.40	10.59	112.69	2.43	2.73	3.21	2.57	2.73	0.17			
Jul 2005 - Jun 2006	1.76	9.00	12.36	109.20	2.84	2.79	3.41	2.53	2.89	0.19			
Jul 2006 - Jun 2007	1.57	9.47	14.05	142.98	2.72	2.72	3.57	2.88	2.97	0.20			
Jul 2007 - Jun 2008	1.61	9.18	10.59	154.23	2.74	2.76	3.21	2.98	2.92	0.11			
Jul 2008 - Jun 2009	1.56	8.94	14.19	109.19	2.71	2.80	3.58	2.52	2.90	0.23			
Jul 2009 - Jun 2002	1.12	9.26	12.12	68.53	2.34	2.75	3.38	1.92	2.60	0.31			
Averages	**1.51**	**8.51**	**9.89**	**114.17**	**2.66**	**2.88**	**3.07**	**2.56**	**2.79**	**0.05**	**0.01**	**0.01**	**0.1632**

Lake Tikitapu

1992 to 2010 Site 1 (1 Jul 1992 - 30 Jun 2010)

Percent Annual Change (PAC)

Lake	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	HVOD (mg/m3/day)	Avg PAC	Std Err	P-Value
Change - Units Per Year	(-0.01)	-0.06	0.21	(1.23)	(-1.02)			
Average Over Period	(2.06)	6.22	5.34	(207.41)	(39.48)			
Percent Annual Change (%/Year)	**0.00**	**0.96**	**3.93**	**0.00**	**0.00**	**0.98**	**0.76**	**0.27**

Burns Trophic Level Index Values and Trends

Period	Chla (mg/m3)	SD (m)	TP (mgP/m3)	TN (mg/m3)	TLc	TLs	TLp	TLn	TLI Average	Std. Err. TL av	TLI Trend units/yr	Std. Err. TLI trend	P-Value
Jul 1992 - Jun 1993	2.93	7.37	4.21	203.74	3.40	3.07	2.04	3.34	2.97	0.32			
Jul 1993 - Jun 1994	1.46	6.56	3.07	180.89	2.64	3.23	1.64	3.18	2.67	0.37			
Jul 1994 - Jun 1995	1.56	6.70	2.42	185.27	2.71	3.20	1.34	3.22	2.62	0.44			
Jul 1995 - Jun 1996	1.23	7.27	3.75	179.69	2.45	3.09	1.89	3.18	2.65	0.30			
Jul 1996 - Jun 1997													
Jul 1997 - Jun 1998		7.86				2.98			2.98	0.00			
Jul 1998 - Jun 1999													
Jul 1999 - Jun 2000	1.52	6.78	4.25	190.71	2.68	3.19	2.05	3.25	2.79	0.28			
Jul 2000 - Jun 2001													
Jul 2001 - Jun 2002	2.89	4.44	4.59	209.90	3.39	3.74	2.15	3.38	3.17	0.35			
Jul 2002 - Jun 2003	2.69	5.04	4.47	221.64	3.31	3.58	2.12	3.45	3.12	0.34			
Jul 2003 - Jun 2004	1.78	7.24	8.74	281.31	2.86	3.10	2.97	3.76	3.17	0.20			
Jul 2004 - Jun 2005	2.12	6.43	7.30	210.79	3.05	3.26	2.74	3.38	3.11	0.14			
Jul 2005 - Jun 2006	1.54	6.85	6.29	214.47	2.69	3.17	2.55	3.41	2.96	0.20			
Jul 2006 - Jun 2007	1.94	6.51	4.50	235.24	2.95	3.24	2.13	3.53	2.96	0.30			
Jul 2007 - Jun 2008	1.74	6.84	5.50	223.05	2.83	3.18	2.38	3.46	2.96	0.23			
Jul 2008 - Jun 2009	2.04	6.33	8.25	196.93	3.00	3.28	2.89	3.30	3.12	0.10			
Jul 2009 - Jun 2010	2.21	4.06	5.82	175.96	3.10	3.86	2.45	3.15	3.14	0.29			
Averages	**1.97**	**6.42**	**5.23**	**207.83**	**2.93**	**3.28**	**2.24**	**3.36**	**2.96**	**0.07**	**0.02**	**0.01**	**0.0662**