

# MEMORANDUM



**To:** Andy Bruere  
**Lake Operations Manager**

**From:** Paul Scholes  
**Environmental Scientist**

**Date:** 1 August 2014

**File Ref:** A1654375

**Copy To:** Rob Donald, Anna Grayling

**Subject:** Rotorua Lakes 2013/2014 TLI Update

The following summarises the TLI data for the Rotorua Lakes for the period ending July 2013 to June 2014.

*Table 1 Three-yearly average TLI values, 2013/2014 annual TLI, trophic status and LakeSPI condition for the Rotorua Lakes.*

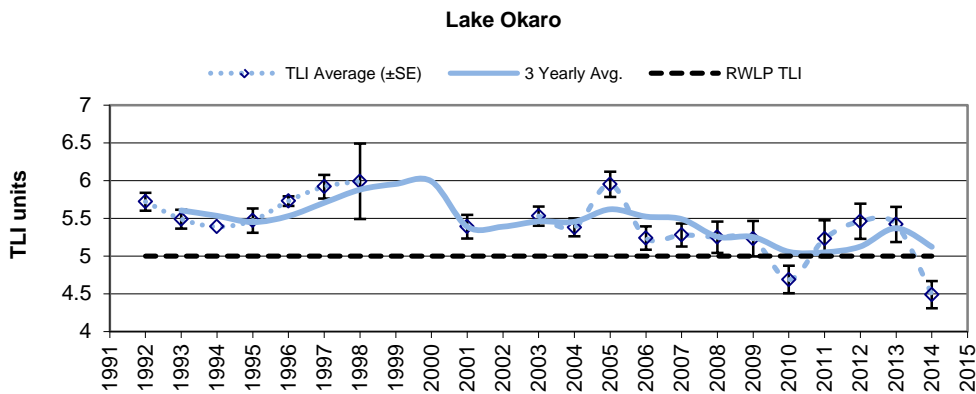
Lake <i>Regional Water &amp; Land Plan Objective TLI units</i>	3-yearly average TLI to 2011 <i>TLI units</i>	3-yearly average TLI to 2012 <i>TLI units</i>	3-yearly average TLI to 2013 <i>TLI units</i>	3-yearly average TLI to 2014 <i>TLI units</i>	2012/13 Annual TLI <i>TLI units</i>	2013/14 Annual TLI <i>TLI units</i>	Lake Type <i>based on Trophic Status</i>	LakeSPI Condition 2013/2014 <sup>1</sup>
Ōkaro <b>5.0</b>	5.1	5.1	5.4	5.1	<b>5.4</b>	<b>4.5</b>	Supertrophic	Moderate
Rotorua <b>4.2</b>	4.6	4.4	4.2	4.2	<b>4.2</b>	<b>4.2</b>	Eutrophic	Moderate
Rotoehu <b>3.9</b>	4.4	4.3	4.1	4.0	<b>4.0</b>	<b>4.0</b>	Eutrophic	Poor
Rotomahana <b>3.9</b>	4.0	4.0	4.0	3.9	<b>3.9</b>	<b>3.8</b>	Mesotrophic	Moderate
Rotoiti <b>3.5</b>	3.9	3.8	3.7	3.5	<b>3.4</b>	<b>3.4</b>	Mesotrophic	Moderate
Rerewhakaaitu <b>3.6</b>	3.8	3.8	3.6	3.5	<b>3.5</b>	<b>3.4</b>	Mesotrophic	Moderate
Okareka <b>3.0</b>	3.3	3.3	3.2	3.3	<b>3.1</b>	<b>3.3</b>	Mesotrophic	Moderate
Tikitapu <b>2.7</b>	3.0	2.9	2.8	2.8	<b>2.8</b>	<b>2.8</b>	Oligotrophic	Moderate
Ōkātina <b>2.6</b>	2.8	2.9	2.9	2.8	<b>2.8</b>	<b>2.7</b>	Oligotrophic	Moderate
Tarawera <b>2.6</b>	2.8	2.9	3.0	3.0	<b>2.9</b>	<b>3.0</b>	Oligotrophic	Moderate
Rotoma <b>2.3</b>	2.3	2.3	2.4	2.4	<b>2.4</b>	<b>2.3</b>	Oligotrophic	High
Rotokakahi* <b>3.1</b>	4.2	4.2	3.8	3.7	<b>3.7</b>	<b>3.6</b>	Mesotrophic	Moderate

\*Italicised figures are based on Te Wairoa Stream monitoring and a 3-parameter TLI (no secchi disk).

<sup>1</sup> NIWA (2014). Assessment of the Rotorua Te Arawa lakes using LakeSPI – 2014.

## Ōkaro

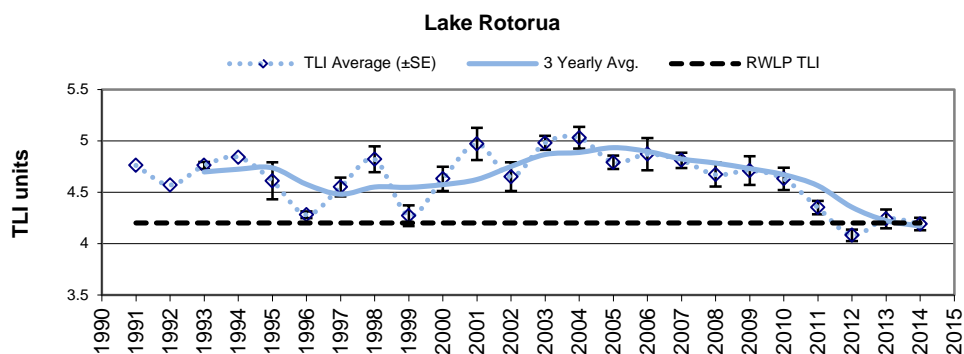
2013/14 has seen a substantial decline in the annual average chlorophyll-a concentration. Likewise no cyano-bacterial blooms have occurred since early January 2014. Nitrogen and phosphorus concentrations have also shown a substantial decline. Together with improved water clarity has resulted in an average TLI of 4.49 TLI units, such a low figure has not previously been calculated for this lake. Hypolimnetic total nitrogen remains stable. Total phosphorus in the hypolimnion is of a reduced concentration over the past two years compared to previous years. Dissolved reactive phosphorus (DRP) over the last year is of a much lower concentration in the epilimnion, probably due to alum dosing.



## Rotorua

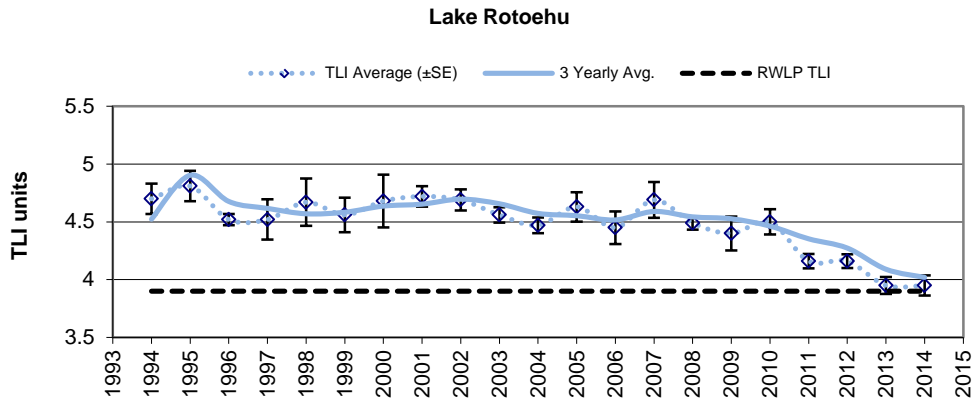
The three yearly average TLI has for the year 2013/14 dipped below the Regional Water and Land Plan (RWLP) objective (4.2 TLI units). This marks three years of annual average TLI values at around 4.2 TLI units indicating a sustained water quality improvement in the lake. Of note are the markedly lower ammonium concentrations in the lake in recent times, along with reduced summer peaks in nitrogen and phosphorus. This is predominantly a result of reduced and sustained intermittent stratification events in the lake over the summer period. Dissolved reactive phosphorus (DRP) concentrations have been increasing slightly over the past four years after a record low in 2011.

Levels of cyanobacteria did not reach alert levels in the lake over the 2013/14 period with the exception of one orange alert level reached in the Ōhau Channel in March 2014.



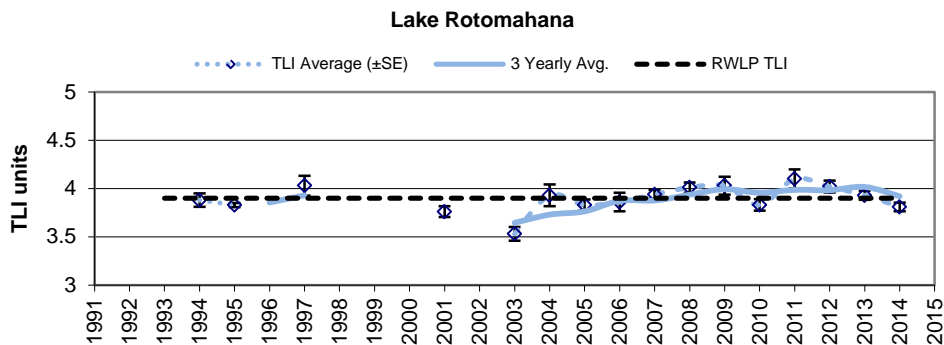
**Rotoehu**

Rotoehu is now close to its TLI objective of 3.9 with an annual average in 2013/14 of 3.95, same as last year. Nitrogen and phosphorus are slightly elevated compared to last year, but this was offset by the best water clarity result since the early 90’s. For dissolved nutrients, DRP is also higher than the last year annual average, but dissolved inorganic nitrogen (DIN) is lower. Two orange alerts for cyanobacteria were experienced mid-summer, and a sustained bloom occurred late summer, early autumn lasting almost a month and reaching red alert warning levels on several occasions.



**Rotomahana**

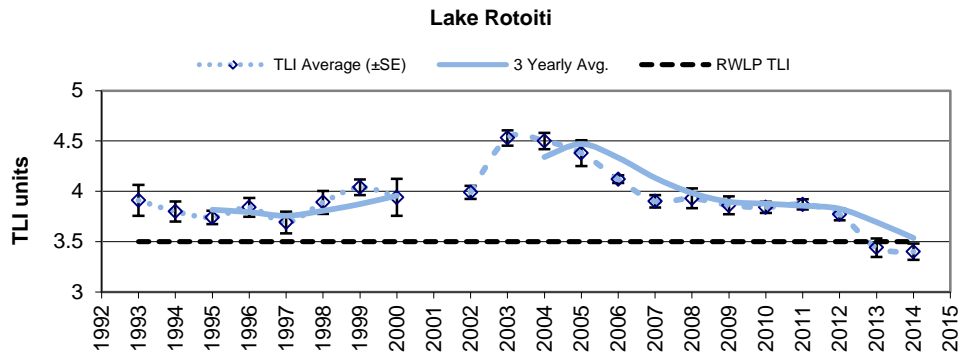
The TLI for Rotomahana remains very stable. Improvements in all TLI parameters in 2013/14 have resulted in a slightly lower annual TLI than the previous three years. There is some increase in DRP in the hypolimnion in the past five years, but TN is lower than the previous few years with water clarity also being the best seen in six years.



**Rotoiti**

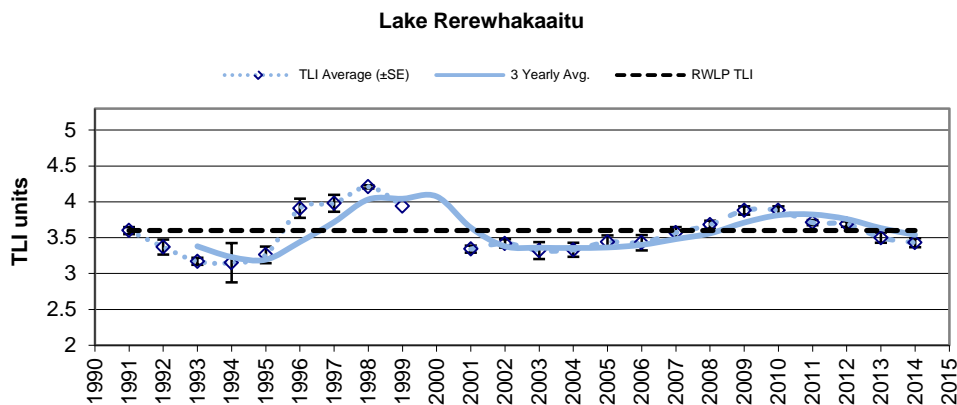
Lake Rotoiti’s annual average TLI continues to show improvement from 3.77 in 2011/12 to 3.40 in 2013/14. The objective TLI for the lake is 3.5. The annual average secchi depth has further improved on last years’ big improvement, showing the lake to be the clearest it’s been since council records began in 1990. The annual average chlorophyll-a concentration for the main body of the lake is the lowest recorded for council records. The exception to this is the occurrence of cyanobacterial blooms occurring in Okawa Bay extending at times to Okere Arm. Issues with

aquatic macrophyte growth and control are contributing to increased nutrient levels in the Bay, which has been exasperating cyanobacterial growth.



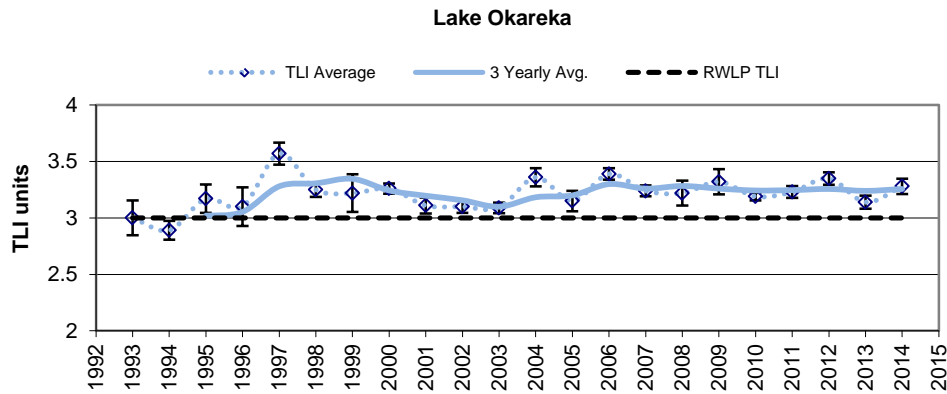
## Rerewhakaaitu

Trophic indicators continue to show improvement over the past five years at Lake Rerewhakaaitu resulting in a three year average below the RWLP TLI objective. The annual TLI for Rerewhakaaitu is at 3.43 for 2013/14 almost 0.2 TLI units below the TLI objective level of 3.6. There has been a noticeable decreasing in dissolved nitrogen in the lake, particularly ammonium. Lower nutrient status may have been driven by relatively dry summers over the last two years.



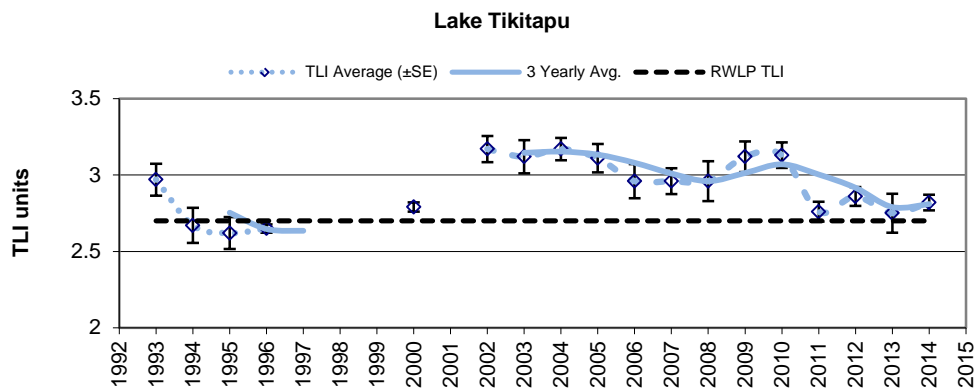
## Okareka

The 2013/14 three year TLI for Lake Okareka remains stable at approximately 0.3 units above the objective TLI of 3.0. Along with an increase in TP concentration in the hypolimnion there was also an increase in the oxygen depletion rate, the highest in eight years. Increased anoxia has also led to an increase in ammonium release in the hypolimnion, although no notable increase in DRP.



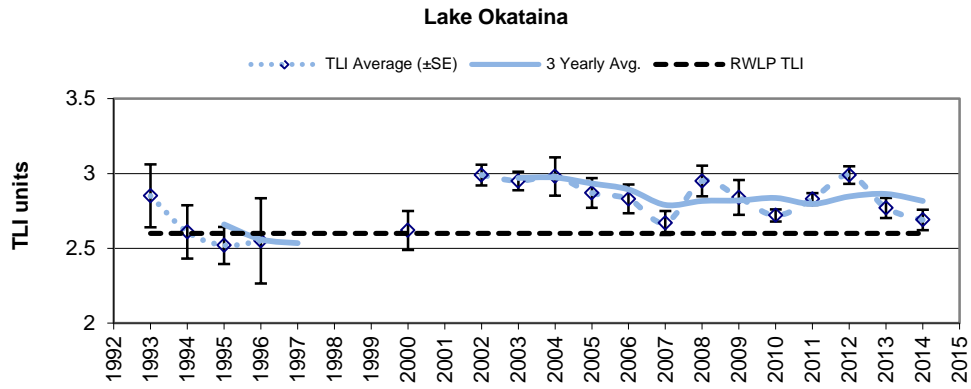
## Tikitapu

There has been a slight increase in the annual average 2012/13 TLI from 2.75 to 2.82 TLI units. The three yearly average TLI shows the lake is stable with a TLI of 2.8, 0.1 TLI unit above the RWLP objective. Ammonium releases in the hypolimnion were much lower than previous years possibly reflecting a lower/improved oxygen depletion rate in the hypolimnion compared to the past four years. However, water clarity was lower for 2013/14 than the past three years, although the euphotic depth is relatively unchanged from last year.



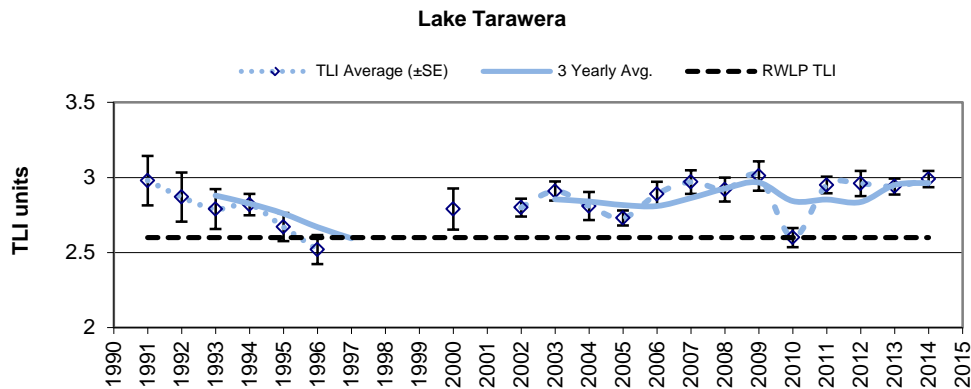
## Ōkātaina

The annual average TLI in Lake Ōkātaina (2.69 TLI units) has continued to show some improvement, decreasing almost 0.1 TLI unit on the previous year, but still above the objective TLI of 2.6. With the exception of nitrogen, improvements have occurred in all other TLI parameters. Hypolimnetic volumetric oxygen demand has increased marginally compared to previous years but DRP levels remain unchanged, and ammonium levels have decreased.



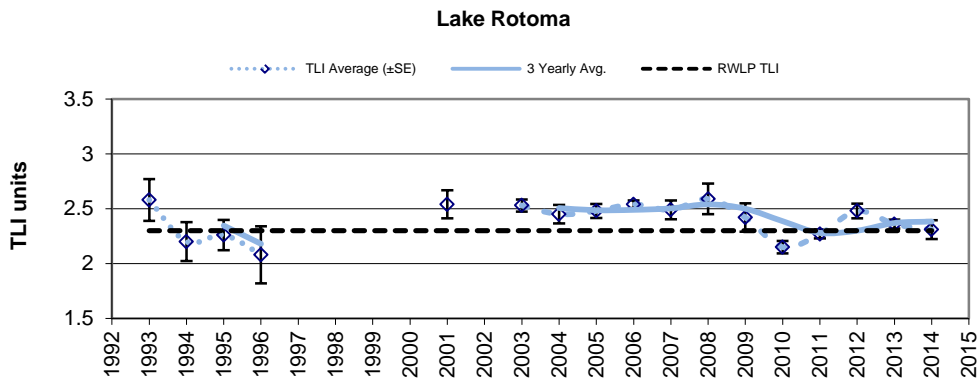
## Tarawera

Lake Tarawera TLI remains stable at around 3.0 TLI units, 0.4 above the RWLP objective of 2.6 TLI units. Phosphorous concentrations have previously appeared elevated in the epilimnion, but have remained relatively stable over the past four years with a decrease in 2013/14 compared to the previous three years. This equally applied to DRP concentrations.



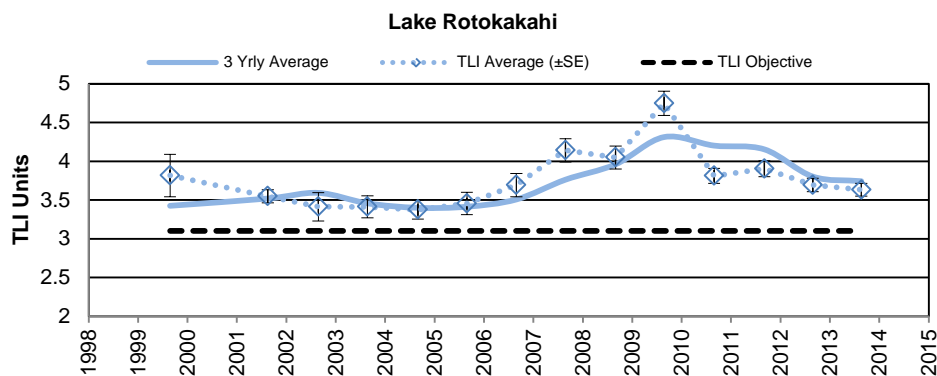
## Rotomā

Lake Rotomā was above its RWLP objective TLI for 2013/14 at 2.38 TLI units, above the objective of 2.3. The annual average TLI was lower than the previous two years at 2.31 TLI units. Overall the lake remains in a stable state with TN showing almost no change in the past three years and only minor fluctuation in TP over the same interval.



## Rotokakahi

Lake Rotokakahi (as measured at the outflow) continues to show improvement since the severe algal blooms of 2009. The annual TLI (as measured by TP, TN and chlorophyll-a) is much improved from 3.9 in 2011/12 to 3.63 in 2013/14. The greatest improvement has been in chlorophyll-a, with nitrogen remaining stable over the past four years and only a slight decline in phosphorus. Recent improvements in turbidity may also signal improving water clarity in the lake.

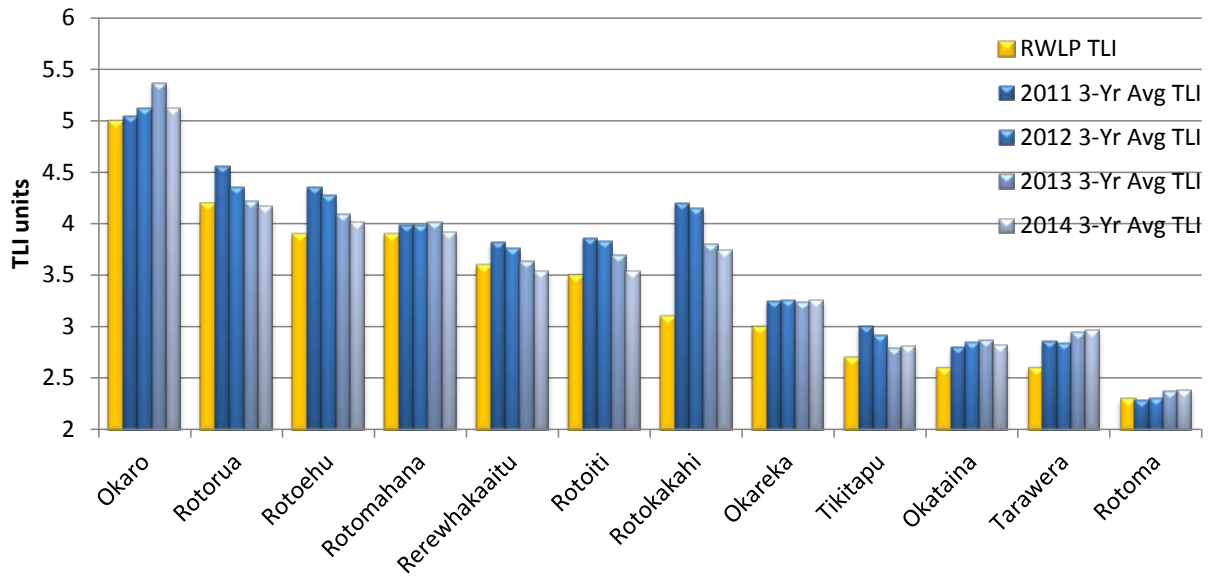


## Summary

Annual water quality results can fluctuate due to an array of reasons, including climatic conditions and rainfall. It is important to track the long-term trend in water quality results for each lake to track progress. Of the 12 Rotorua lakes in the programme, tracking of the long-term water quality trend shows:

- Water quality in Lakes Rotorua, Rotoiti, Rotoehu, Rerewhakaaitu, Rotomā and Tikitapu is improving;
- Water quality in Lakes Ōkātaina, Ōkareka and Rotomahana is stable;
- Water quality in Lakes Tarawera, and Rotokakahi shows deterioration over the long term data set (Rotokakahi has improved over the last five years); and
- Water quality in Lake Ōkaro fluctuates and continued investigation is needed.

Currently seven of the twelve Rotorua-Te Arawa Lakes are above their RWLP TLI objective. Three of these, Rotoehu, Tikitapu and Rotomā, are only 0.1 TLI units above the lakes respective TLI objective. Recent improvements in the TLI of some lakes, has resulted in these lakes meeting their RWLP TLI target. These were lakes Rotorua, Rotoiti, Okaro and Rerewhakaaitu and Rotomahana.



Note: Lake Rotokakahi TLI's are based on Te Wairoa Stream monitoring and a 3-parameter TLI (no secchi disk).