2025

Lake Water Quality in Tāmaki Makaurau: Annual Data Summary

Auckland Council's online interactive Water Quality and River Ecology Data Explorer presents State of the Environment (SoE) monitoring data for rivers, lakes, groundwater and the coast. Lake water quality can be compared across the region, by season, throughout the lakes' depths and over time.[1]

This report provides a summary of **lake water quality** monitoring results for **July 2020 to June 2025**.

Key messages

Most lakes in Auckland are in poor health

- 11 out of 13 (85%) of the monitored lakes in the Auckland region were in poor or very poor health.

Lake health differs between lake types

- Shallow, polymictic (well-mixed) lakes generally have poorer water quality than deeper, seasonally stratified lakes (where the water separates into layers between October and May).
- Concentrations of nutrients, algae and turbidity were generally higher in the polymictic lakes.

Stratification results in low oxygen and nutrient release from sediments

- Seasonally stratified lakes have prolonged periods with low oxygen and high nutrient concentrations in the bottom waters, where redox conditions allow for potential nutrient release from lakebed sediments (internal loading).

Risks to human health were low

- Cyanobacteria counts were low in publicly accessible lakes, but higher in other lakes.
- There are low levels of *E. coli* across all lakes in the region, with infrequent episodic high results in some lakes.

[1] This does not include the detailed statistical analysis that is required to assess trends in water quality over time and is reported in our five-yearly State of the Environment reports.

Our lake water quality monitoring programme

Where	When	How	What
•13 lakes. •Split into five distinct spatial areas. •Two lake types (polymictic and seasonally-stratified).	•Monthly measurements and samples throughout the year.	•Water quality measured throughout the depth profile using a hand held meter. •Bottles of surface and bottom water collected and sent for laboratory analysis.	•Different measures of water quality including physical factors, nutrients, algae, bacteria, sediments and water clarity.

See the '[Water Quality and River Ecology Data Explorer User Guide and Methodology]' report for more information on the water quality parameters we monitor, how we collect and analyse samples, how we analysed the data, and how to use the data explorer.

Figure 1: Lake type and location of sites monitored around the region from 2021 to 2025.

Lake Trophic Level Index

The ecological health of lakes can be summarised using the Lake Trophic Level Index (TLI), which integrates data on nitrogen, phosphorus, clarity and chlorophyll a. For the most recent hydrological reporting year (July 2024 – June 2025), 11 of the 13 monitored lakes show signs of nutrient enrichment (eutrophication) and are classed as being in poor, or very poor health, based on lake TLI (Figure 2). Lake Rototoa had the lowest TLI score (3.3 - fair) and Lake Keretā had the highest TLI score (6.6 – very poor). None of the monitored Auckland lakes are in the very good or good categories.

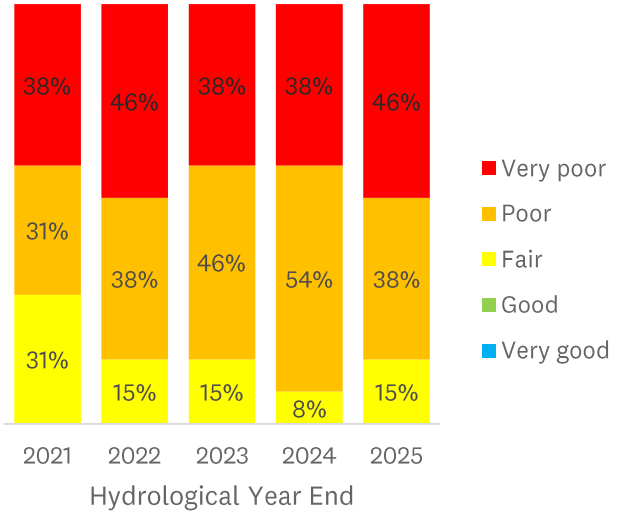

Figure 2: Proportion of Lake Trophic Level Index (TLI) scores for Auckland's lakes for each hydrological year within the 2021 – 2025 reporting period.

These elevated levels of nutrients and algae in Auckland's lakes can reduce water clarity and can result in summer algal blooms.

The lakes surrounded by pastoral land generally have poorer water quality compared to those surrounded by native bush.[2] Eight of the nine lakes surrounded by rural catchments are in a degraded state. However, even Lakes Wainamu and Kawaupaku, which are mostly surrounded by native bush do not score as "good" for lake TLI (in the fair and poor categories respectively). Therefore, surrounding catchment land cover may not always be a good predictor of lake water quality.

As lake TLI is a score calculated annually, we expect fluctuations in the proportion of lakes within each category over the 2021 to 2025 time period. Compared to the 2024 year, 2025 results show one more lake in the fair category, but also one more in the very poor category.

Comparisons between lakes

When comparing the surface waters of all lakes, the shallow polymictic lakes showed higher nutrient concentrations than the deeper, seasonally stratified lakes. In particular, the highest concentrations of nutrients were observed in Lakes Pokorua, Spectacle, Keretā (all polymictic lakes) and in the bottom waters of Lakes Kawaupaku and Kuwakatai. Polymictic lakes also generally had higher algal concentrations,[3] total suspended solids and turbidity levels compared to the deeper, seasonally stratified lakes. The greatest concentrations were observed in Lake Keretā (median total suspended solids 29 mg/L, median turbidity 23 NTU), which aligns with the lowest water clarity[4] in this lake (0.39 m). The lowest nutrient concentrations, total suspended solids and turbidity were found in Lake Rototoa and Lake Pupuke and these two lakes had the highest median water clarity (5.3 and 5.8 m, respectively).

Most lakes showed elevated cyanobacteria concentrations at times, indicating potential risks to human health. The concentrations were lower in Lakes Rototoa, Pupuke and Wainamu which are publicly accessible and recreationally used lakes; and in Lake Ōkaihau which is on private land. Generally, there were low levels of *E. coli* in lakes across the region, although occasional higher values were observed.

Across the monitored lakes, surface waters had higher pH and temperatures, while bottom waters of seasonally stratified lakes had elevated conductivity and salinity levels. Notably, Lake Keretā had the highest dissolved oxygen levels, with

[2] Verburg, P., Hamill, K., Unwin, M., and Abell, J. 2010. Lake water quality in New Zealand 2010: Status and trends. NIWA Client report for the Ministry for the Environment. NIWA Client report number: HAM2010-107

[3] Algae concentrations are shown on the dashboard as chlorophyll parameter, which is a photosynthetic pigment in plants and algae and is used as a measure of algal biomass in the water column.

[4] As shown by the Secchi depth parameter.

median concentrations exceeding 100% saturation. This could be due to the shallow depth allowing oxygenation via wind and atmosphere, and oxygen produced via photosynthesis by the large amount of algae in the lake.

Peaks and/or increases in lake water level were observed after the Auckland Anniversary flooding in January 2023 and Cyclone Gabrielle in late February 2023. Shallow polymictic lakes such as Lakes Spectacle, Slipper and Pokorua also experienced peaks in nutrient concentrations, whilst West Coast lakes including Lakes Kawaupaku, Wainamu and Ōkaihau showed peaks in both nutrients and turbidity, especially in the bottom waters. This timing aligns with flooding and landslides in the region during these weather events and is likely from disturbance and sediment/organic matter entering the lake.

Differences in water quality by lake type

Depth profiles help to reveal differences between lake types and provide insights into stratification patterns of each lake. Eight of the 13 monitored lakes are seasonally stratified. Stratification typically starts in late September/October and lasts until May. These lakes display a U-shape in temperature profiles, with warmer surface waters and cooler, deeper water in summer. In winter, temperatures became more uniform, resembling the year-round pattern in polymictic (fully mixed) lakes.

The pH depth profiles were less distinct than temperature but also showed higher values near the surface when stratified, especially in Lakes Kuwakatai, Kawaupaku, and Pupuke.

Anoxic (low oxygen) conditions were common near the bottom of all seasonally stratified lakes and even occurred closer to the surface (e.g. at four metres depth in Lakes Kawaupaku, Whatihua, and Okaihau). In Lake Pupuke, the deepest and only volcanic lake, we observe layers of oxygenated water within the anoxic zones during the stratification period. The patterns of anoxia and redox conditions in these lakes increase the likelihood of internal release of nutrients from lakebed sediments.

Stratification and anoxic conditions are expected to be longer and more intense with climate-change driven temperature increases. This may exacerbate the release of nutrients from sediments.[5] This is supported by higher nutrient concentrations observed in the bottom waters during stratified conditions. Release of nutrients has flow on effects as it promotes further algal growth throughout the lake.[6] However, in some lakes, and most obviously in Lake Rototoa, the algal and nutrient concentrations can also be high during isothermal (well-mixed) periods, particularly in the surface waters. For other parameters such as water clarity, patterns in variability between stratified and isothermal conditions were less obvious.

Polymictic lakes show little variation in pH and dissolved oxygen throughout the water column. Anoxic conditions do occasionally occur at depth in all five polymictic lakes, and more regularly in Lakes Slipper, Spectacle, Tomorata. When oxygen is low throughout the water column there is less habitat available for aquatic species.[7]

[5] Woolway, R. et al. (2021) Phenological shifts in lake stratification under climate change. Nature Communications 12:2318.

[6] Graham, E., Woodward, B., Dudley, B., Stevens, L., Verberg, P., Zeldis, J., Hofstra, D., Matheson, F. and Elliott, S. (2020) Consequences of inaction: Potential ramifications of delaying proposed nutrient source reductions for New Zealand rivers, lakes and estuaries. Report prepared for Ministry for the Environment. NIWA Client Report No: 2020046HN.

[7] Rowe, D. & Graynoth, E (2002) Lake managers handbook. Fish in New Zealand lakes. Ministry for the Environment, Wellington.

Disclaimer

Find out more:

Visit the Data Explorer: https://environmentauckland.org.nz/Data/Dashboard/456

Read the user guide and methodology report: https://www.knowledgeauckland.org.nz/publications/water-quality-and-river-ecology-data-explorer-methodology-supplementary-report/

For more information and data, contact: EnvironmentalData@aucklandcouncil.govt.nz

This report can be cited as: Atoa, J. & Buckthought, L. (2025) Lake water quality in Tāmaki Makaurau: Annual data summary 2025. Auckland Council.

Auckland Council
Te Kaunihera o Tāmaki Makaurau