2024

Groundwater 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. Groundwater quality data can be compared across the region, between aquifers and over time.[1]

This report provides a summary of **groundwater quality** monitoring results for **July 2019 to June 2024**.

Key findings

Nitrate contamination in some aquifers affects surface water

- Nitrate concentrations continued to be high in the shallow volcanic (basalt) aquifers and surface springs located in the Pukekohe, Bombay and Glenbrook areas. As this groundwater feeds the streams of the area, these streams also had high concentrations of nitrate.

Stormwater inputs affect some basalt aquifers in urban areas

- The water at shallow basalt sites in urban areas and shallow unconfined basalt aquifers in South Auckland was well oxygenated. This suggests the aquifer is well connected to the surface. The urban sites also showed higher levels of indicator bacteria, dissolved phosphorus, nitrate (though not as high as South Auckland aquifers), soluble copper, sulphate and lower total hardness than other sites. These indicate the effect of stormwater discharges into the aquifer.

Groundwater variables are mostly stable, but there are some seasonal patterns in some aquifers

- At most sites the groundwater quality did not vary considerably between seasons. However, some water quality parameters did show a rough seasonal pattern in some locations. For example, dissolved reactive phosphorus in the Fielding Rd Sand site was higher in summer than winter. The Patumahoe Spring site also showed more seasonal variation since it is exposed to the surface and more influenced by climatic variables.

[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 groundwater quality monitoring programme

Groundwater is water that is stored in the cracks and tiny spaces between soil, sand and rocks. These water-filled spaces are called "aquifers". It can take many years for rainwater to reach and slowly move through these layers of underground geology. Aquifers can be likened to underground reservoirs and can be tapped into for drinking water, irrigation and other uses.

Groundwater is a vital resource for drinking water (humans and animals), agriculture, and supporting natural ecosystems by maintaining flow in many rivers and lakes. Human activities can affect the quality of groundwater so regular monitoring is important to identify contaminants or issues that could affect use. Changes in groundwater generally occur over long time periods because groundwater accumulates slowly and is not exposed to the daily or seasonal climatic fluctuations that occur above ground.

Where	When	How	What
• 8 aquifers. • 21 sites in total. • 18 are groundwater bores (wells). • 3 are surface springs.	• Quarterly sampling (four times per year). • Each season represented.	• Bores are purged to ensure fresh groundwater is sampled. • Water quality measures directly at site using a hand held meter. • Bottles of water collected and sent to laboratory for analysis.	• 24 different water quality parameters, including physical factors, nutrients, bacteria, metals.

See the '[Water Quality and River Ecology Data Explorer 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: Aquifer names and location of groundwater sites monitored around the region from 2019 to 2024.

Physico-chemical results

Some aquifers are well oxygenated, for example most sites in shallow basalt geologies such as the Franklin volcanic sites and the urban Three Kings Basalt and Onehunga Volcanic aquifer sites. These sites have greater connectedness to the atmosphere and may have larger cracks or voids in the geology allowing air circulation. Aquifer sites located within deeper, more confined layers of geology often have zero or very little oxygen due to lack of diffusion of oxygen from the atmosphere.

Groundwater pH (a measure of how acidic or alkaline the water is) and temperature are relatively stable over time at all monitoring sites. Median pH ranged from 6.3 (Wilcox Gunclub Rd) to 9.0 (Seagrove Rd) and median temperatures from 14.5°C (BP Bombay) to 19.2°C (Ōmaha Walkway) with the latter likely influenced by geothermal activity.

Suspended solids are not normally detected in significant amounts in groundwater since most solids have long been filtered out during percolation through the soil and rock profiles. Related variables like turbidity, which is a measure of the cloudiness of water, are also generally low. Occasional spikes can indicate connections to the surface through large cracks or macropore flow, or sometimes sample contamination.

Nutrients

We monitor various forms of the plant nutrients nitrogen (N) and phosphorus (P). Bioavailable P (DRP) and total P concentrations are very low across all sites (e.g., DRP < 0.1 mg/L except Fielding Rd Sand at 0.17 mg/L). Variability in P concentrations between sites is expected and likely explained by differences in geology. For example, P concentrations are slightly higher in groundwater from volcanic geology, such as the South Auckland basalts, Onehunga volcanic and Three Kings basalt aquifers. The higher concentrations in the latter two are also likely influenced by stormwater inputs.

There is clear nitrate contamination in the Franklin Volcanic aquifers, with median concentrations ranging from 10.4 mg N/L (BP Bombay) to 25 mg N/L (Wilcox Gunclub Rd), at times/regularly exceeding the Maximum Acceptable Value (MAV) in drinking water of 11.3 mg N/L. In aquifers that are not affected by nitrate contamination, concentrations are generally less than 0.5 mg N/L. Nitrate concentrations are also elevated at the urban sites, Watson Ave and Alfred St (median concentrations 4.3 and 2.4 mg N/L, respectively), most likely from stormwater inputs.

In the South Auckland volcanic area, groundwater from the shallow basalt aquifers resurfaces to form a significant proportion of the baseflow of some streams in the area.[2] This results in those streams also being contaminated with nitrate.[3] Since nitrate is a bioavailable form of N and an important plant nutrient, it encourages the growth of algae and macrophytes and can negatively affect stream ecology.

Ammoniacal N is low at most sites (<0.3 mg/L), but is slightly elevated at the Waitākere Rd Deep site (Kumeu West Waitematā aquifer), and considerably elevated at the Fielding Rd Sand site (Franklin Sand aquifer) with a median value of 0.725 mg/L. We would not normally expect to see this concentration of ammoniacal N in groundwater, as it does not leach through the soil profile (like nitrate does). This higher ammoniacal N, coupled with the higher DRP at this site suggests the there may be macropores or cracks which water rapidly flows through, transporting these nutrients into the aquifer.

E. coli

Escherichia coli bacteria indicate possible faecal contamination from humans and animals. It is generally uncommon to detect *E. coli* in groundwater. If it is measured, it can indicate contamination has entered directly via the bore

[2] Morgenstern U, Buckthought L, Gardner P, Stenger R. (2024). Nitrate processes in the Pukekohe–Bombay area. Lower Hutt (NZ): GNS Science. 55 p. (GNS Science report; 2024/31).

[3] Ingley, R., Dikareva, N. (2025) River water quality in Tāmaki Makaurau: Annual data summary 2024. Auckland Council.

casing. Exceptions to this arise in some parts of Auckland where there are highly fractured basalt geologies, e.g. the Onehunga Volcanic (Alfred St site) and Three Kings Basalt (Watson Ave site) aquifers. These aquifers have high transmissivity (ability of water to flow), and as a result, high infiltration rates and throughflow. These characteristics mean they are used for stormwater discharge (stormwater is soaked through the ground into the aquifers) and therefore at higher risk of receiving surface contaminants, including *E. coli*. This is shown in the results with Watson Ave and Alfred St sites showing median *E. coli* counts in the order of 100 and 20 cfu/100mL, respectively. Maximum values were 1900 and 230 cfu/100mL, respectively. All other sites have negligible or less than detectable levels of *E. coli*, except for Patumahoe Spring, which discharges into an above-ground pond, and as such occasionally returns a high result, likely from bird or animal droppings entering the spring close to sampling time.

Metals and ions

We measure metals, cations and anions in groundwater to help understand contamination and geology. Concentrations of some metals (such as soluble copper, soluble zinc, soluble potassium) are higher at the Watson Ave and/or Alfred St sites. This is due to their fractured basalt geology and the fact they receive stormwater, which transports the urban contaminants copper and zinc into the aquifer. Sulphate (a non-metal) is also notably higher at these two sites.

Some other notable metal results include concentrations of soluble iron up to six times higher at Waitākere Rd Shallow, and up to three times higher at Ostrich Farm Rd Shallow than most other sites. At the Quintals Rd site, soluble manganese is double the concentration, than that of the next lowest site (Waitākere Rd Shallow).

The Fielding Rd Sand site has the highest soluble potassium concentrations of all sites. Although median concentrations of soluble potassium varied across sites, it is notable that the Fielding Rd Sand results are higher than all the other sites in the same South Auckland area.

Soluble sodium (a non-metal) is much greater (more than double) at the Seagrove Rd site (deep Kaawa aquifer) than all other sites. Sulphate is also slightly but consistently higher at this site compared to all the shallower aquifer sites in this area. This site is close to the Manukau Harbour and could be a result of seawater influence.

Total dissolved solids (TDS) includes all dissolved salts (such as sodium and calcium) and organic matter and provides a general indication of contamination. Higher TDS usually indicates greater levels of contaminants (or salt water intrusion), but can also reflect the mineral content of background geology. The Omaha Flats and Quintals Rd sites have higher TDS results than other sites. These are both deep bores (90 m and 130 m, respectively) in the same confined aquifer so this could be a natural occurrence due to the background sedimentary geology.

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Find out more:

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

Read the 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: Buckthought, L. (2025) Groundwater quality in Tāmaki Makaurau: Annual data summary 2024. Auckland Council.