2025

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 2020 to June 2025**.

Key messages

Nitrate contamination in some basalt aquifers

- Nitrate concentrations were elevated in the shallow volcanic (basalt) aquifers and surface springs located in the wider Pukekohe area in South Auckland. In many cases, concentrations exceeded the Maximum Acceptable Value (MAV) for drinking water (11.3 mg NO_3-N/L). Further infomation on nitrate in drinking water can be found here: https://environment.govt.nz/assets/publications/Freshwater/risks-associated-with-nitrates-in-drinking-water.pdf

Stormwater inputs affect some basalt aquifers in urban areas

- The water at shallow basalt sites in urban areas 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.

Higher levels of zinc at two Patumahoe sites

- Soluble zinc concentrations were elevated at both of the two sites in Patumahoe Domain, with the Patumahoe Shallow (32m deep, in the Pukekohe basalt aquifer) site having much higher concentrations than the deep site (120m, in the Kaawa aquifer). This could suggest a contamination source or plume in the shallow aquifer that is slowly making its way down to the deeper aquifer.

[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 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: Aquifer names and location of groundwater sites monitored around the region from 2020 to 2025.

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 6.1 (Patumāhoe Springs) to 8.9 (Seagrove Rd) and median temperatures from 14.6°C (BP Bombay) to 19.2°C (Waitākere Rd 2 Deep).

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. Higher concentrations in the latter two may also be influenced by stormwater inputs.

There is a longstanding nitrate contamination issue in the shallow basalt aquifers in the wider Pukekohe area. Median concentrations range from 10.6 mg N/L (Rifle Range Rd Shallow) 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 negatively affects the stream ecology [4]

Ammoniacal N is low in the groundwater at most sites (<0.3 mg/L), but is slightly elevated at the Waitakere Rd Deep site (Kumeu West Waitematā aquifer), and considerably elevated at the Fielding Rd Sand site (Franklin Sand aquifer) with a median value of 0.73 mg/L. Previous results show that ammoniacal-N concentrations have been consistently elevated at this site over time.

E. coli

Escherichia coli bacteria indicate possible faecal contamination from humans and animals. It is rare to detect *E. coli* in groundwater and if present, it may indicate contamination has entered directly via the bore casing. Exceptions 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 the overlying soils

[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 2025. Auckland Council.

[4] Surrey, G. River Ecology in Tāmaki Makaurau: Annual data summary 2025.

have high infiltration rates. These characteristics mean they are used for stormwater discharge (stormwater is soaked through the ground into the aquifers via soak pits) and therefore at higher risk of receiving surface contaminants, including *E. coli*. This is observed in the results with Watson Ave and Alfred St sites showing median *E. coli* counts in the order of 105 and 21 cfu/100mL, respectively. Maximum values were 400 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. Some analytes are not shown in the Data Explorer due to minimum censored data rules; results and discussion (e.g. lead) are available in the latest *Groundwater Quality State and Trends* report[5]. Several metals show elevated concentrations at Watson Ave and Alfred St, including soluble copper, zinc and potassium. This reflects the fractured basalt geology at these sites and the influence of stormwater discharges, which transport urban contaminants (particularly copper and zinc) into the aquifer. Sulphate is also consistently higher at these sites.

Other notable results include:

- Soluble zinc concentrations were elevated at the Patumahoe shallow and deep sites (medians of 0.2 and 0.043 mg/L, respectively). Since these are new sites, it is not yet known if these are naturally high concentrations or pollution. Further investigation is needed.
- Soluble iron concentrations up to six times higher at Waitākere Rd Shallow, and up to three times higher at Ostrich Farm Rd Shallow, compared with most other sites.
- Soluble manganese at Quintals Rd is approximately double that of the next highest site (Waitākere Rd Shallow).
- Fielding Rd Sand has the highest soluble potassium concentrations of all sites and is higher than other South Auckland sites.
- Soluble sodium at Seagrove Rd (deep Kaawa aquifer) is more than double the level at all other sites. Sulphate is also consistently higher. This aligns with the known high-sodium geology of the Waiau Pa Waitematā aquifer.

Total dissolved solids (TDS) are higher at Omaha Flats and Quintals Rd. Both are deep bores (90 m and 130 m, respectively) in the same confined aquifer, suggesting this is likely a natural feature of the background sedimentary geology rather than contamination.

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

[5] https://knowledgeauckland.org.nz/publications/groundwater-quality-state-and-trends-in-tamaki-makaurau-auckland-2017-2024-state-of-the-environment-reporting/

This report can be cited as: Buckthought, L. (2025) Groundwater quality in Tāmaki Makaurau: Annual data summary 2025. Auckland Council.