

Nitrogen dioxide concentrations

This factsheet presents indicators of nitrogen dioxide concentrations at monitoring sites in New Zealand between 2005 and 2020. Concentrations are measured against the National Environmental Standard for Air Quality (NESAQ) and World Health Organization (WHO) guidelines for nitrogen dioxide exposure.



New Zealand's ability to monitor nitrogen dioxide (NO₂) levels is limited by a small number of stations producing valid data. The majority of these stations recorded concentrations of NO₂ well above WHO 2021 guideline levels in 2020.



Almost all monitoring stations with valid data exceeded World Health Organization recommendations for daily concentrations of NO₂ on multiple occasions in 2020.



Six monitoring stations recorded levels of NO₂ exceeding the WHO's 2021 guideline for annual average concentrations in 2020.



Two out of nine monitoring stations recorded NO₂ levels that exceeded the national standard for hourly concentrations between 2005 and 2020.

What is nitrogen dioxide?

Nitrogen dioxide (NO₂) is a corrosive gas that mixes with air. In New Zealand, most human-made forms of NO₂ come from motor vehicles.

Exposure to NO₂ can cause a range of health impacts, including increasing their susceptibility to infections and asthma. Health impacts from NO₂ include premature death, hospitalisations (for cardiovascular and respiratory diseases), and childhood asthma. In 2016, NO₂ was responsible for 61% of the social cost of air pollution in New Zealand, in terms of the direct cost to the health system as well as the loss of life, lost quality of life and lost productivity.

Nearly all NO₂ is from vehicles...



Around 90% of New Zealand's NO₂ emissions are from motor vehicles.

...mostly diesel ones



Diesel vehicles alone contribute 77% of all NO₂ emissions in the country.

In 2016, NO₂ was responsible for:



2,025 premature deaths



8,531 hospitalisations for cardiovascular & respiratory disease



\$9.4 billion social cost

Source: Kuschel, Metcalfe, Sridhar, Davy, Hastings, Mason et al 2022

COVID-19 and air quality

As NO₂ is primarily generated by the combustion of fossil fuels in motor vehicles, travel and economic restrictions implemented during the 2020 COVID-19 lockdowns are likely to have contributed to a decrease in NO₂ concentrations around New Zealand (Ministry for the Environment and Stats NZ 2021).

Air quality standards and guidelines

NO₂ air quality standards and guidelines have been developed to provide some level of protection against health risks. One-hour average NO₂ concentrations are measured against a threshold value of 200 micrograms (µg) per cubic metre in the National Environmental Standards for Air Quality (NESAQ). This value is allowed to be exceeded nine times in a 12-month period.

Additionally, annual and daily average concentrations can be compared against the 2021 guidelines set by the WHO of 10µg/m³ and 25 µg/m³, respectively (Ministry for the Environment and Statistics NZ 2021) though, unlike the NESAQ, these are not binding targets.

Nitrogen dioxide monitoring is limited

Between 2005 and 2020, nine monitoring stations had valid data for NO₂ exposure (Figure 1). All but two of these were in the North Island and the remainder both in Christchurch. This limits the data's ability to portray the state of air quality across all New Zealand. Also, as each station only monitors the air in its immediate area, each station is only representative of a small area around it and not, for instance, of a whole town or city.

For instance, sites closer to roads or industrial sites are likely to record higher concentrations of pollutants than the local norm. Therefore, sites have been classified according to their location as being in either residential areas or areas of high traffic.

Figure 1 Monitoring stations with valid data, 2005-2020



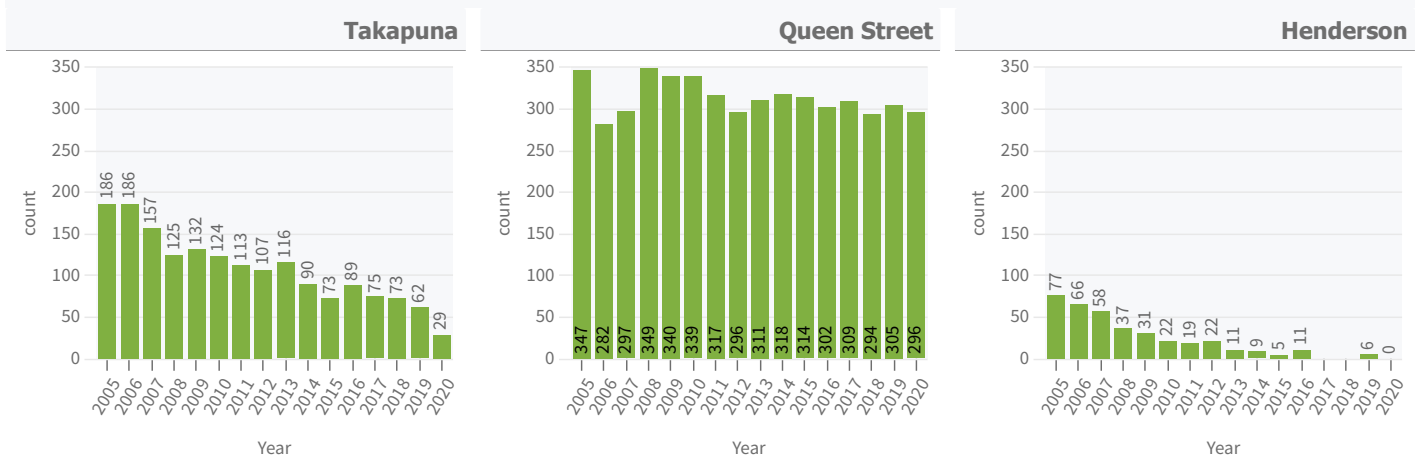
Source: Ministry for the Environment and Statistics New Zealand 2021

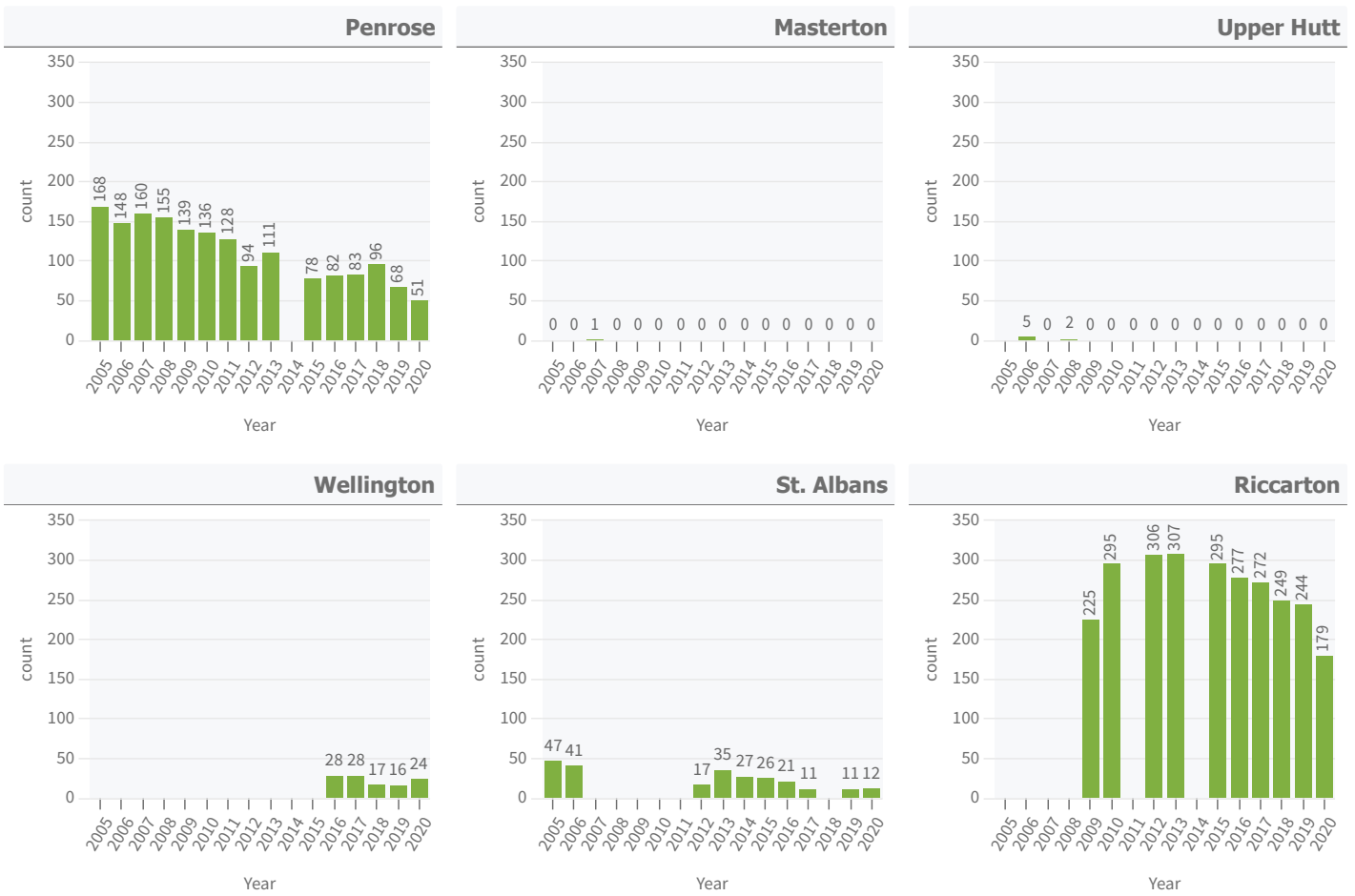
The daily average WHO guideline has been exceeded by all nine monitoring stations at least once

In 2020, most monitoring stations recorded some of the fewest exceedances of the WHO’s 2021 daily guideline value for NO₂ (25 µg/m³), likely due to travel restrictions during the COVID-19 pandemic.

All nine monitoring stations exceeded the WHO daily average guideline at least once between 2005 and 2020 (Figure 2). Queen Street in Auckland had the most exceedances of the daily guideline. It exceeded the guideline on average 313 times per year, between 2005 and 2020. Masterton had the fewest, with just one exceedance in 2007.

Figure 2 Number of exceedances of the daily average WHO guideline for NO₂





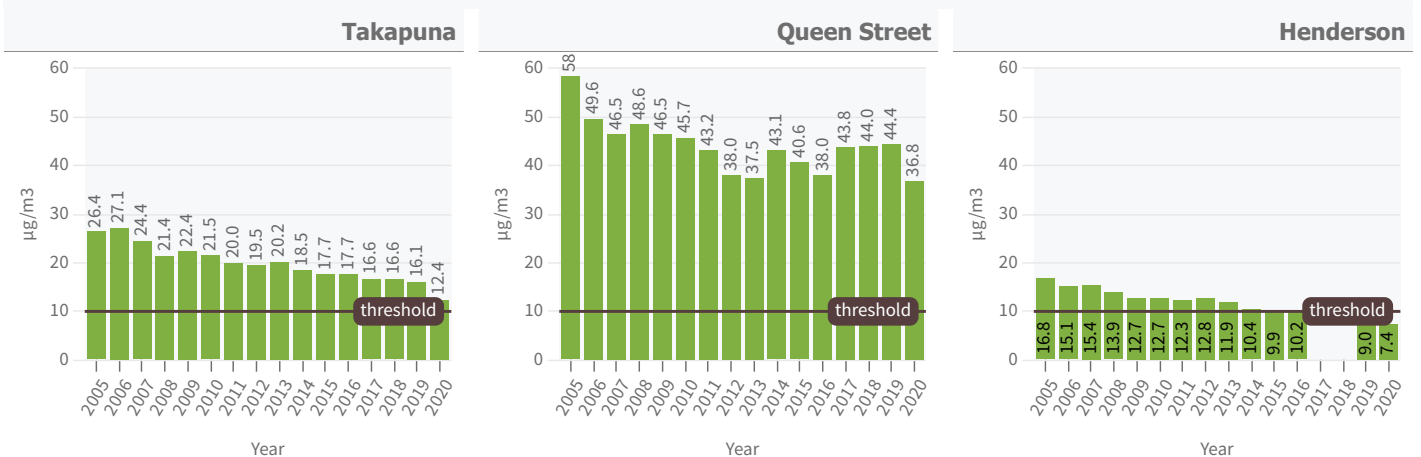
Note: These graphs show the number of days when the NO₂ annual average concentration exceeded the WHO 2021 guideline of 25µg/m³. Blank columns with no label indicate no data exists for that year, i.e. data was unavailable or invalid.

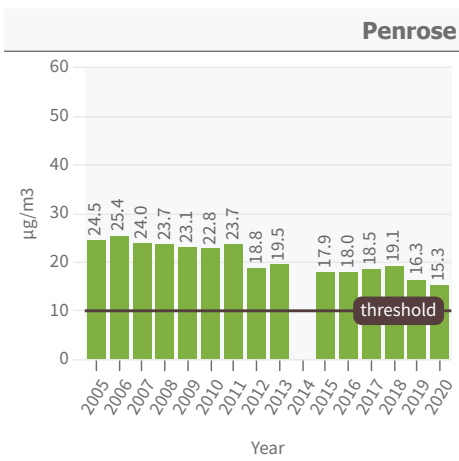
Source: Ministry for the Environment and Statistics New Zealand 2021

Six out of nine monitoring stations regularly exceed the annual average WHO guideline

Six out of nine monitoring stations regularly exceeded the WHO’s 2021 recommended annual average limit (of 10µg/m³) between 2005 and 2020. Three stations in the Auckland region exceeded the threshold in 2020 (Figure 3) as did one in Wellington and one in Christchurch (Figure 4 - below). The monitoring station Queen Street in Auckland, a traffic-focused station, exceeded the guideline in all of the 16 monitored years. Queen Street is a high-traffic, inner city monitoring station surrounded by tall buildings, enabling the accumulation of motor vehicle emissions (Ministry for the Environment and Stats NZ 2021).

Figure 3 Annual average NO₂ concentrations at monitoring stations, Auckland Region, 2005-2020



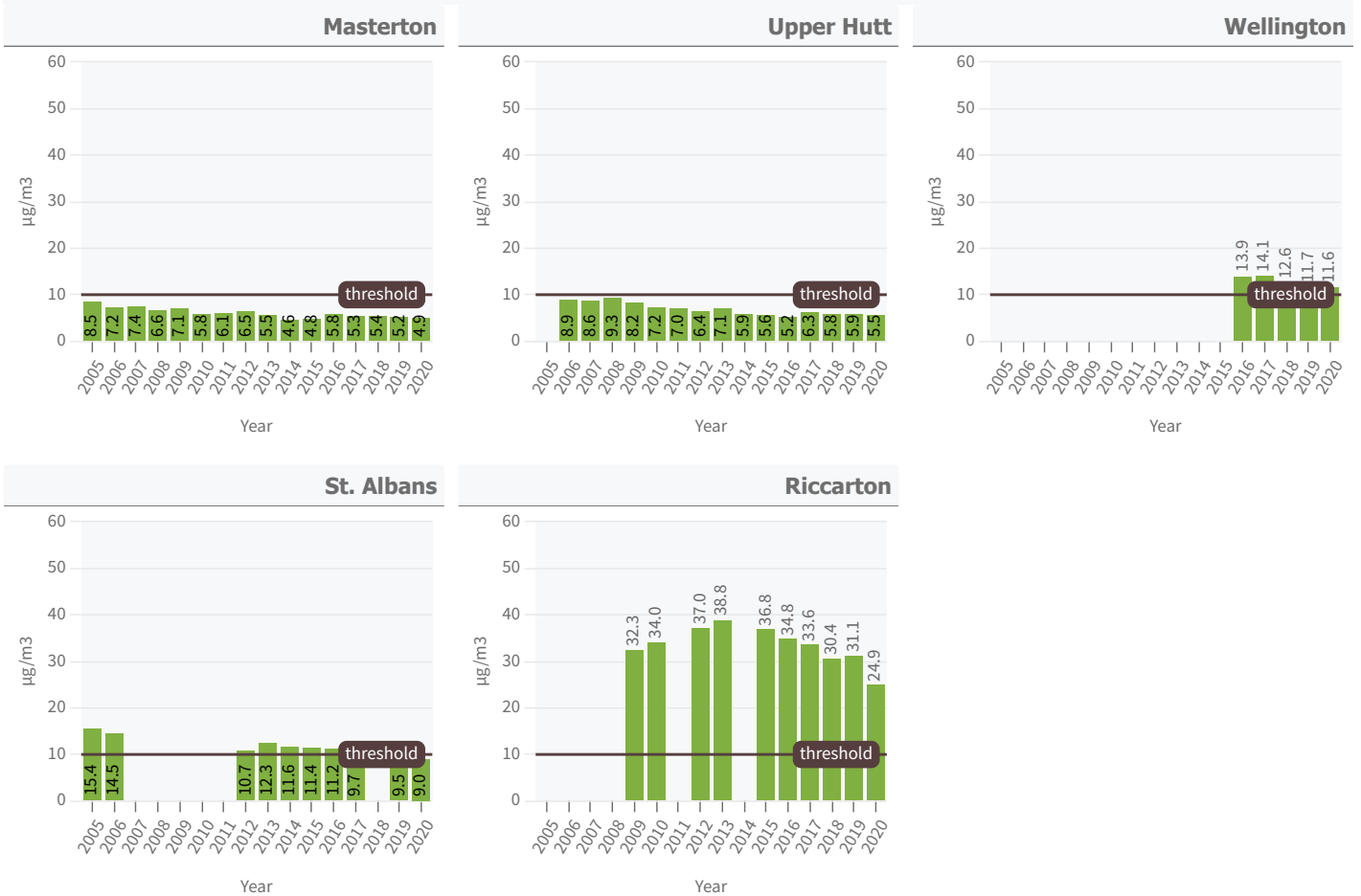


Note: These graphs show where the average annual NO₂ concentrations exceeded the WHO 2021 guideline of 10 µg/m³. Blank columns without labels represent no data for that year, i.e. data was unavailable or invalid.

Source: Ministry for the Environment and Statistics New Zealand 2021

The two monitoring stations in the Christchurch region (St. Albans & Riccarton) and one out of three in the Wellington region (the station in Wellington city itself) exceeded the WHO annual average guideline between 2005 and 2020 (Figure 4). In general, monitoring stations with a traffic focus (such as Wellington, and Riccarton) had higher annual average NO₂ concentrations than monitoring stations with a residential focus. This reflects the high contribution of motor vehicle emissions to NO₂ concentrations and highlights the localised nature of NO₂ emissions (Ministry for the Environment and Stats NZ 2018).

Figure 4 Annual average NO₂ concentrations at monitoring stations, Greater Wellington and Christchurch, 2005-2020



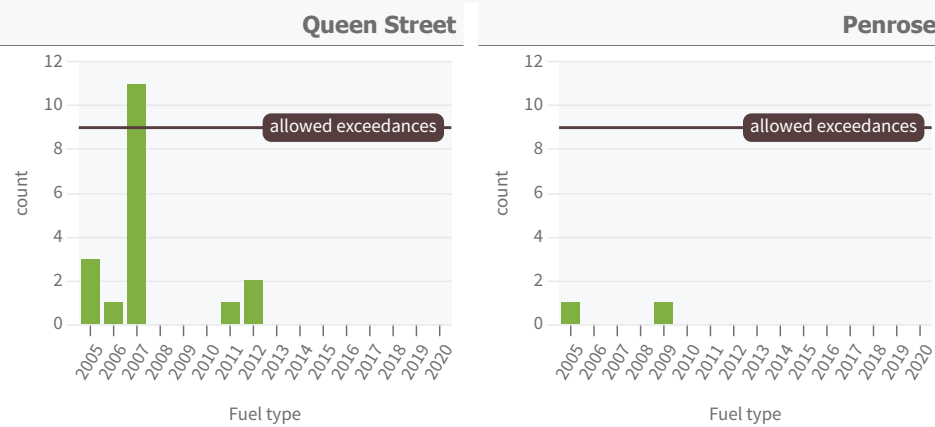
Note: These graphs show where the average annual NO₂ concentrations exceeded the WHO 2021 guideline of 10 µg/m³. Blank columns without labels represent no data for that year, i.e. data was unavailable or invalid.

Source: Ministry for the Environment and Statistics New Zealand 2021

Two monitoring sites exceeded the NESAQ hourly threshold

Overall, exceedances of the NESAQ threshold are rare, with none occurring in 2020 and the last exceedances recorded in 2012. Between 2005 and 2020, two out of nine monitoring stations exceeded the national one-hour average standard on at least one occasion (Figure 5). The monitoring station Queen Street in Auckland, a traffic-focussed station, had the most exceedances (11) in 2007.

Figure 5 Number of exceedances of the NESAQ threshold (one-hour average), 2005-2020



Note: Nine exceedances of the NESAQ one-hour average standard ($200\mu\text{g}/\text{m}^3$) per 12-month period are allowed. Only stations with valid data are displayed. Missing data labels indicate that there was no monitoring data available for that year.

Source: Ministry for the Environment and Statistics New Zealand 2021

Data for this indicator

Monitoring sites exceeding the national environmental standard (one-hour average) for nitrogen dioxide

One-hour average nitrogen dioxide concentration data comes from the Ministry for the Environment and Stats NZ (Ministry for the Environment and Stats NZ 2021) as part of New Zealand's Environmental Reporting Series. One-hour average nitrogen dioxide concentrations (in $\mu\text{g}/\text{m}^3$) are compared with the National Environmental Standard for Air Quality for nitrogen dioxide. The threshold is exceeded when concentrations are above $200\mu\text{g}/\text{m}^3$. Nine exceedances in a 12-month period are allowed.

Monitoring sites exceeding the WHO average guidelines for nitrogen dioxide

Using the same data source as above, EHINZ calculates 24-hour and 12-month averages from the hourly data and these are measured against the WHO guideline limits. Exceedances occur when concentrations are above $25\mu\text{g}/\text{m}^3$ for daily concentrations or $10\mu\text{g}/\text{m}^3$ for annual concentrations. For additional information, see the metadata link below.

References

Kuschel G, Metcalfe J, Sridhar S, Davy P, Hastings K, Mason, K et al. 2022. *Health and air pollution in New Zealand 2016 (HAPINZ 3.0): Volume 1 – Findings and implications*. Report prepared by G Kuschel, J Metcalfe, S Sridhar, P Davy, K Hastings, K Mason, T Denne, J Berentson-Shaw, S Bell, S Hales, J Atkinson and A Woodward for Ministry for the Environment, Ministry of Health, Te Manatū Waka Ministry of Transport and Waka Kotahi NZ Transport Agency.

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