Particulate matter concentrations (PM_{10})

This report presents concentrations of particulate matter (PM_{10}) at monitoring sites in Aotearoa New Zealand, between 2020 and 2023. Concentrations are measured against the National Environmental Standards for Air Quality (NESAQ) and the World Health Organisation (WHO) guidelines for PM_{10} exposure.

Key facts

- In 2023, 12 stations (out of 58 total) exceeded the latest WHO guidance for annual average PM_{10} concentrations; 9 of these stations were located in the South Island.
- In 2023, 15 monitoring stations exceeded the NESAQ limit for daily PM_{10} concentrations, most of which (10 stations) were in the South Island.
- Between 2020 and 2023, 72.1% of all exceedances of the NESAQ daily limit occurred during winter and 13.3% in autumn.

North Island	South Island
39 monitoring stations	**19 monitoring stations**
In 2023…	
3 exceeded WHO guidelines	9 exceeded WHO guidelines
5 exceeded national standards	10 exceeded national standards

How PM_{10} affects our health

Particulate matter (PM) consists of small airborne particles, including solid matter and liquid droplets. PM_{10} refers to particles with a diameter of less than 10 micrometres and is one of the major air pollutants monitored in New Zealand. These particles are usually dust, soil or other solid matter produced by transport, farming, construction, or mining activities, and burning coal, wood or oil. PM_{10} also includes sea salts, mould, pollen and other plant parts (Pope & Dockery 2006; WHO 2013).

Short-term and long-term exposure to PM_{10} is associated with a wide range of health impacts. Mild impacts include shortness of breath or coughing. More severe effects include premature death from cardiovascular and respiratory problems and increased risk of lung cancer. Exposure to PM_{10} can also worsen asthma symptoms (Ministry for the Environment and Statistics New Zealand 2018; WHO 2013).

PM_{10} air quality guidelines

PM_{10} air quality standards and guidelines have been developed to provide some level of protection against health risks. However, there is currently no evidence for a threshold below which health effects do not occur (WHO 2021). Instead, the WHO guidelines represent concentrations that could be considered ‘high risk’ to health as opposed to a binding target.

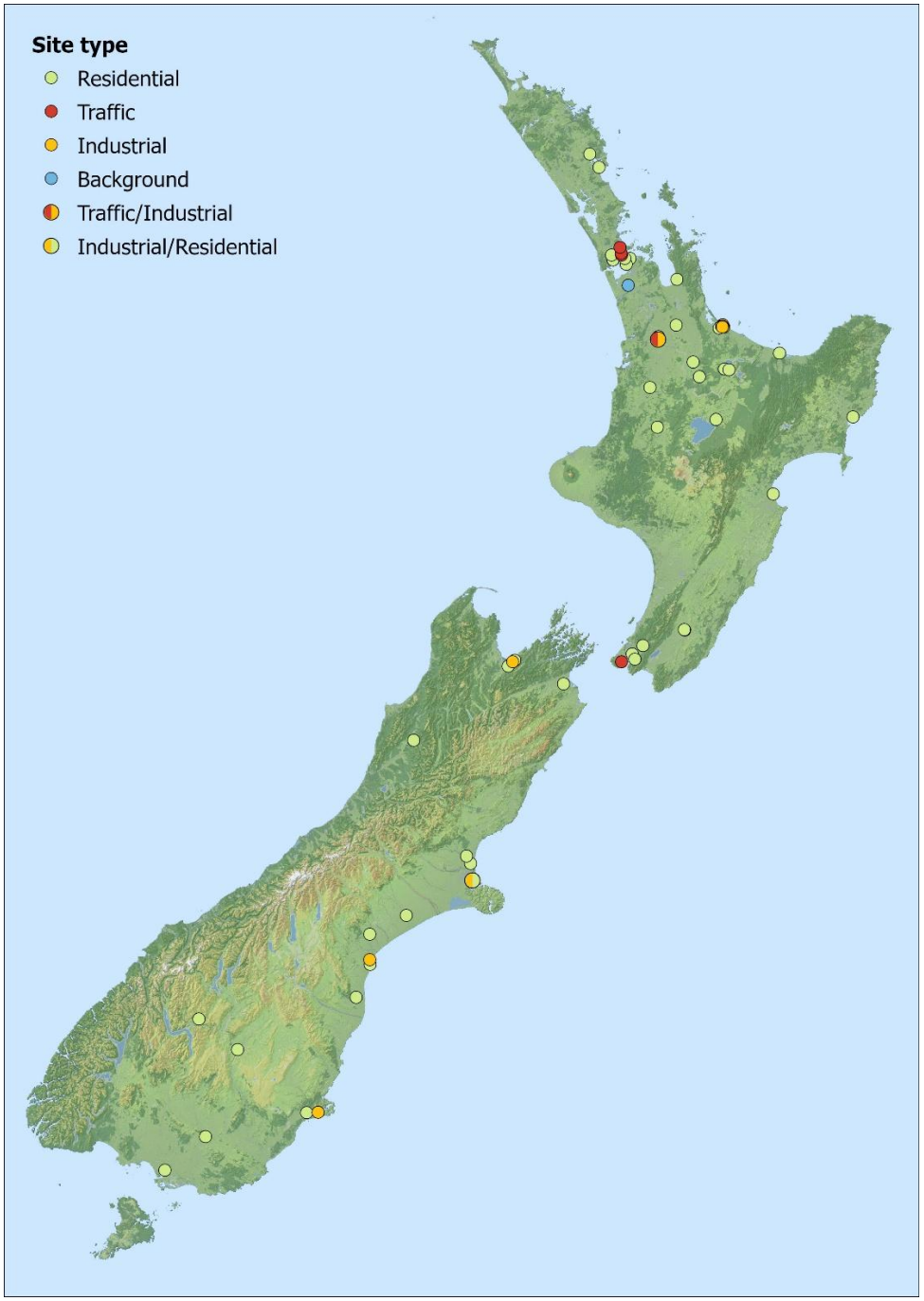
Daily concentrations (24-hour average) are measured against a threshold value of 50µg/m^3 set by the National Environmental Standards for Air Quality (NESAQ). This value can be exceeded once in a calendar year (Ministry for the Environment and Statistics New Zealand 2024).

Additionally, daily average concentrations can be compared against the international WHO recommendation of 45µg/m^3 and annual averages against a recommendation of 15µg/m^3 (WHO 2021). However, these are only guidelines and do not carry any regulatory weight in New Zealand.

58 sites were assessed for the 24-hour average NESAQ standard between 2020 and 2023

Between 2020 and 2023, 58 monitoring stations had records of PM_{10} concentrations for at least three complete years, and 51 had sufficient data for 2023 specifically. Forty-one of the 58 sites are located in residential areas, while the remaining 17 sites are located in high-traffic or industrial areas where PM_{10} emissions may be higher (Figure 1).

Figure 1: Monitoring stations with at least three complete years, 2020–2023

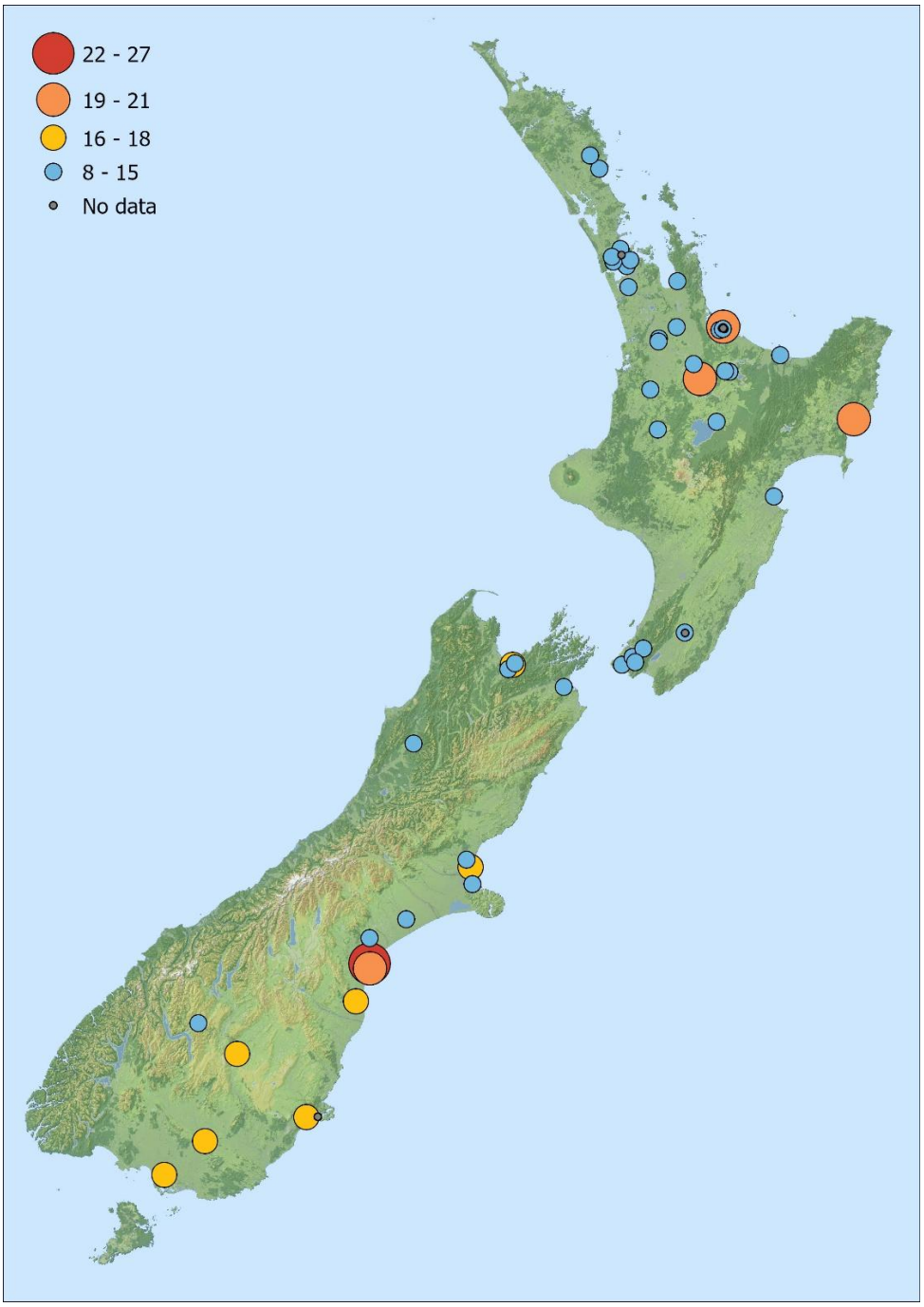


Source: Statistics New Zealand 2024

In 2023, 12 sites exceeded WHO guidelines for annual average concentrations of PM_{10}

In 2023, 12 monitoring stations (out of 58 total) exceeded the 2021 WHO guidelines for annual average PM_{10} (15µg/m^3) (Figure 2). Nine of these stations were in the South Island. Between 2020 and 2023, there were 27 sites that exceeded the WHO guidelines at least one time or once?.

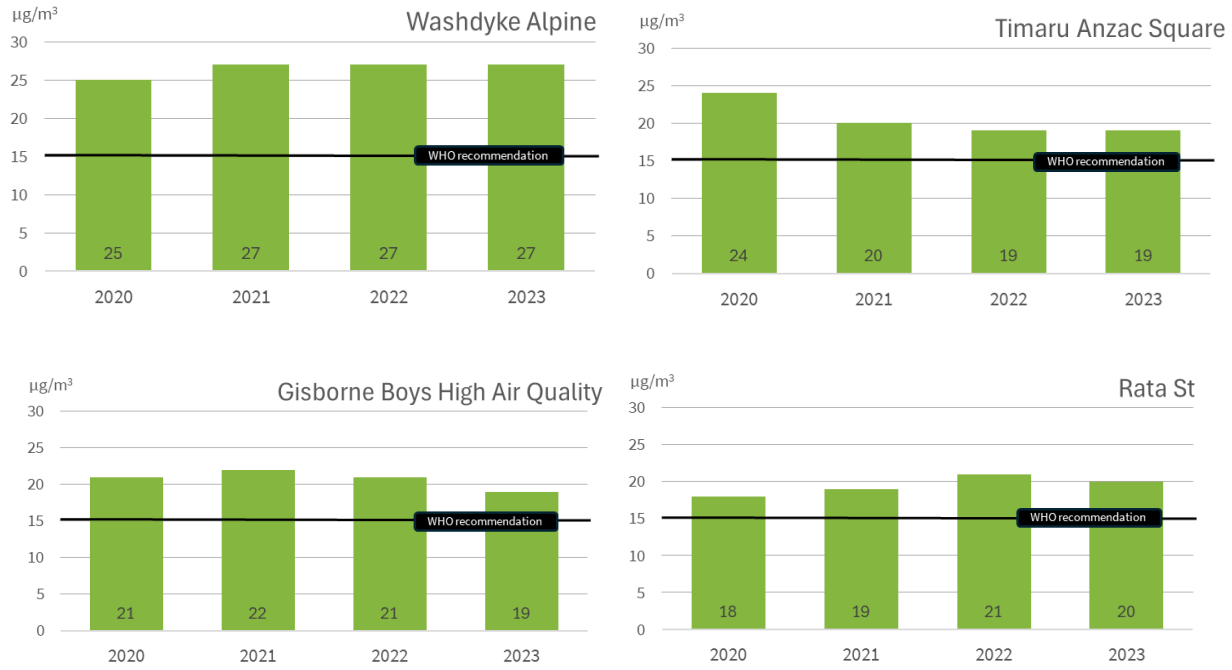
Figure 2: Annual average concentration of PM10 (µg/m^3) at monitoring sites, 2023



Note: 'No data' indicates data was unavailable or incomplete in 2023.
Source: Statistics New Zealand 2024

In 2023, the highest annual average concentrations of PM_{10} (Figure 3) were recorded at Washdyke Alpine (27 µg/m^3), Rata St - Bay of Plenty (20µg/m^3), Gisborne Boys High Air Quality (19µg/m^3), and Timaru Anzac Square (19µg/m^3).

Figure 3: The highest annual average concentrations of PM_{10} at selected monitoring sites, 2020–2023

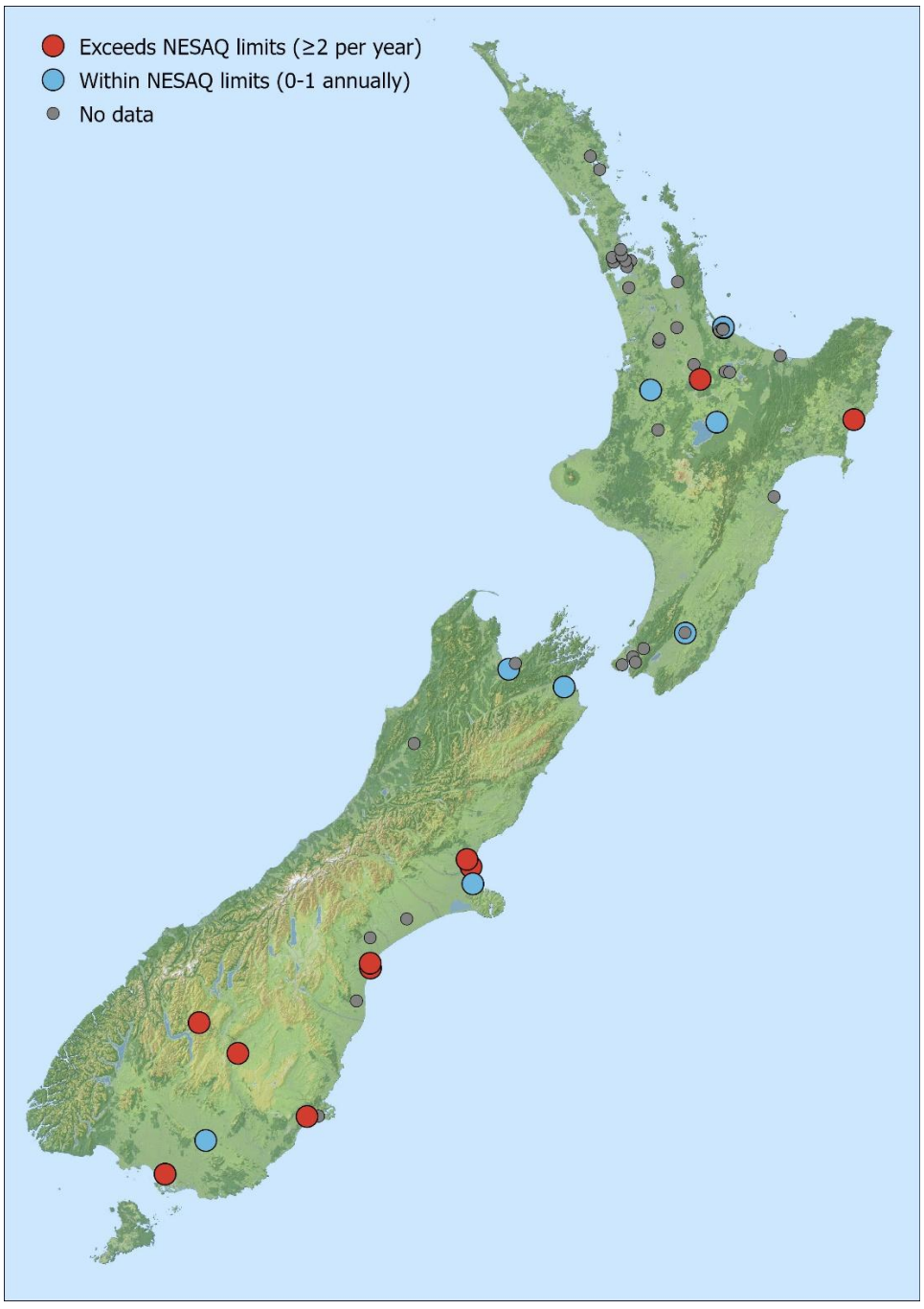


Source: Statistics New Zealand 2024

Exceedances of the NESAQ daily limit for PM_{10} are most common in the South Island

In 2023, 15 monitoring stations with valid data recorded at least one exceedance of the NESAQ daily threshold for daily PM_{10} concentrations (50µg/m^3). Ten of the 15 with more than two exceedances were in the South Island.

Figure 4: Monitoring site performance against NESAQ daily PM_{10} standard, 2023



Note: 'No data' indicates data was unavailable or incomplete in 2023.
Source: Statistics New Zealand 2024

The greatest number of exceedances in 2023 occurred at the Washdyke Alpine monitoring station (35 exceedances). This station alone accounted for 36% of the 97 exceedances across the country in 2023, and made Washdyke Alpine the only station with more than 20 annual exceedances in 2023 (Table 1).

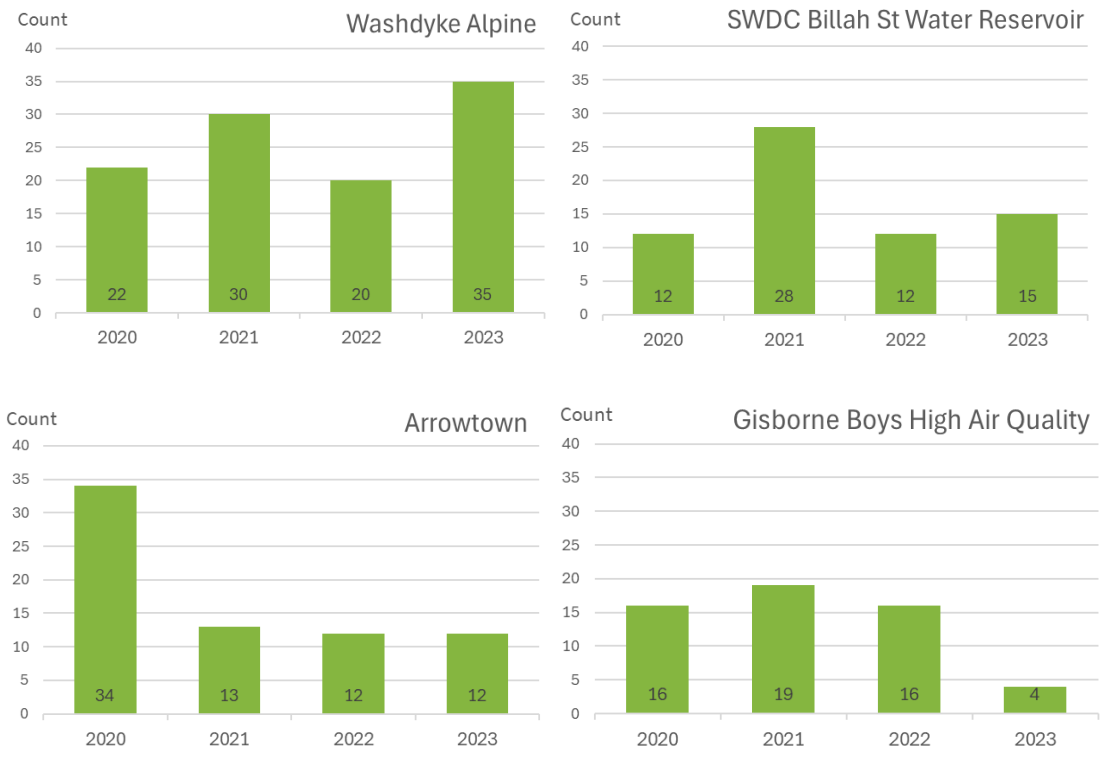
Table 1: Frequency of exceedances of the NESAQ daily PM_{10} standard (50µg/m^3), 2023

2 - 5 exceedances	6 - 9 exceedances	10 - 19 exceedances	20+ exceedances
Rangiora Gisborne Boys High Air Quality Alexandra at Ventry St Mosgiel Pomona Street	Kaiapoi Timaru Anzac Square	Arrowtown SWDC Billah St Water Reservoir	Washdyke Alpine

Source: Statistics New Zealand 2024

Between 2020 and 2023, there were 504 exceedances of the NESAQ threshold; 21% of these (107) were at Washdyke Alpine. Other sites with a high number of exceedances in this period were Arrowtown (71), SWDC Billah St Water Reservoir (67), and Gisborne Boys High(55) (Figure 5).

Figure 5: Number of exceedances of the NESAQ daily average PM_{10} standard (for 24-hour average concentrations) at select monitoring stations, 2020–023

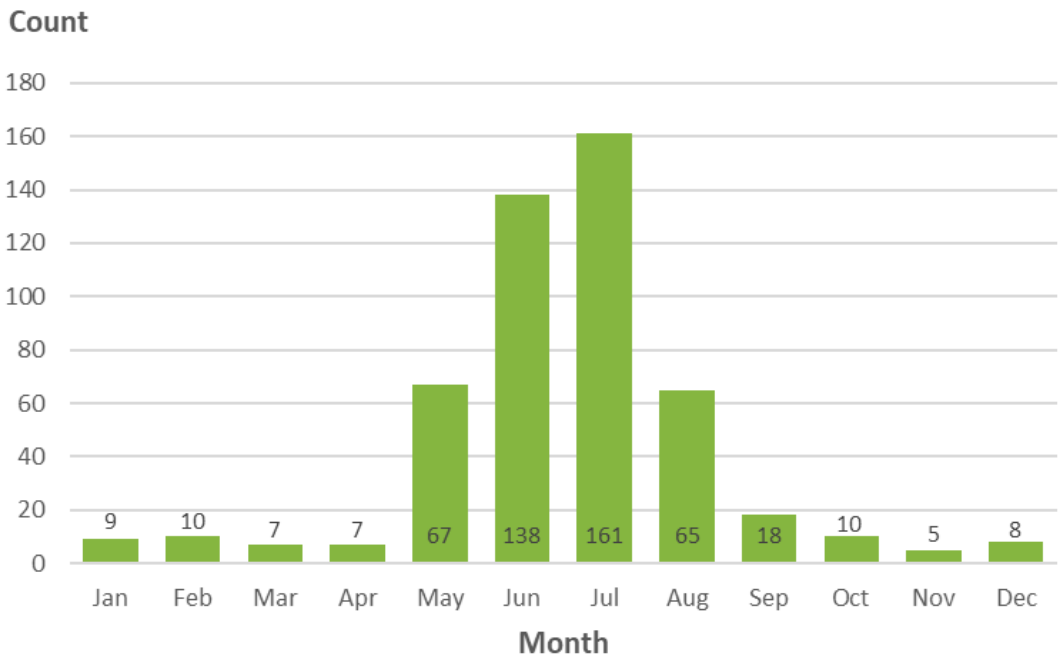


Source: Statistics New Zealand 2024

Most exceedances occur in colder months

Between 2020 and 2023, 72.1% of the NESAQ 24-hour threshold exceedances occurred in the winter months (June-August) (Figure 6). A further 13.3% occurred in autumn, predominantly in May. Therefore, most exceedances (85.3%) happened in the colder months. During the cooler months, home heating emissions increase, contributing to worse PM_{10} concentrations. Furthermore, calm and frosty weather conditions in the winter months more easily allow for a build-up of air pollutants (Ministry for the Environment and Statistics New Zealand 2021).

Figure 6: Number of exceedances of the NESAQ threshold for daily PM_{10} concentrations, by month, 2020–2023



Source: Statistics New Zealand 2024

Data for this indicator

Data of sites exceeding NESAQ standard for daily average concentrations of PM_{10}, and sites exceeding the WHO annual average guideline for PM_{10}, 2020–2023 is collated and published by Statistics New Zealand online in 2024. Further information is available at: PM_{10} concentrations (air quality): Data to 2023 | Stats NZ. The raw data for the period discussed in this report was provided to EHINZ by analysts at Statistics New Zealand.

EHINZ calculated the number of monthly exceedances of the NESAQ threshold for daily PM_{10} concentrations based on the data provided by Statistics New Zealand.

A complete year is defined as a year in which:

- Each season is at least 75% comprised of complete days, and
- A complete day is defined as one with at least 18 out of 24 hours of valid data recorded for the daily (24-hour) average.

A site is required to have a 75% completion rate for a given period of time for the data to be considered valid.

For additional information, see the Metadata sheet.

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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Ministry for the Environment & Stats NZ (2024). New Zealand's Environmental Reporting Series: *Our air 2024* | Tō tātou hau takiwā. Retrieved from environment.govt.nz (accessed August 2025)

WHO. 2013. *Review of evidence on health aspects of air pollution – REVIHAAP Project*. Copenhagen: WHO Regional Office for Europe.

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