

Particulate matter concentrations (PM₁₀)

This factsheet reports on concentrations of particulate matter (PM₁₀) at monitoring sites in Aotearoa New Zealand, between 2005 and 2020. Concentrations are measured against the National Environmental Standards for Air Quality and WHO guidelines for PM₁₀ exposure.



There is a clear divide between the two main islands of New Zealand, with higher than recommended concentrations of PM₁₀ being much more common in the South Island than in the North.



In 2020, 18 stations (out of 56 total) exceeded the latest WHO guidance for annual average PM₁₀ concentrations; 14 of these stations were in the South Island



In 2020, 15 monitoring stations exceeded the NESAQ limit for daily PM₁₀ concentrations, most of which (12 stations) were in the South Island



Between 2005 and 2020, 69% of all exceedances of the NESAQ daily limit occurred during winter and a further 19% in autumn.

North Island

31 monitoring stations

4 exceeded WHO guidelines
3 exceeded national standards

South Island

25 monitoring stations

14 exceeded WHO guidelines
12 exceeded national standards

In 2020...

How PM₁₀ affects our health

Particulate matter (PM) consists of small airborne particles, including solid matter and liquid droplets. PM₁₀ 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, burning coal, wood or oil. PM₁₀ also includes sea salts, mould, pollen and other plant parts (Pope & Dockery 2006; WHO 2013). Short-term and long-term exposure to PM₁₀ 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 PM₁₀ can also worsen asthma symptoms (Ministry for the Environment and Statistics New Zealand 2018; WHO 2013).

COVID-19 and air quality

As some PM₁₀ is 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 decreases in PM₁₀ concentrations around New Zealand (Ministry for the Environment and Statistics NZ 2021).

PM₁₀ air quality guidelines

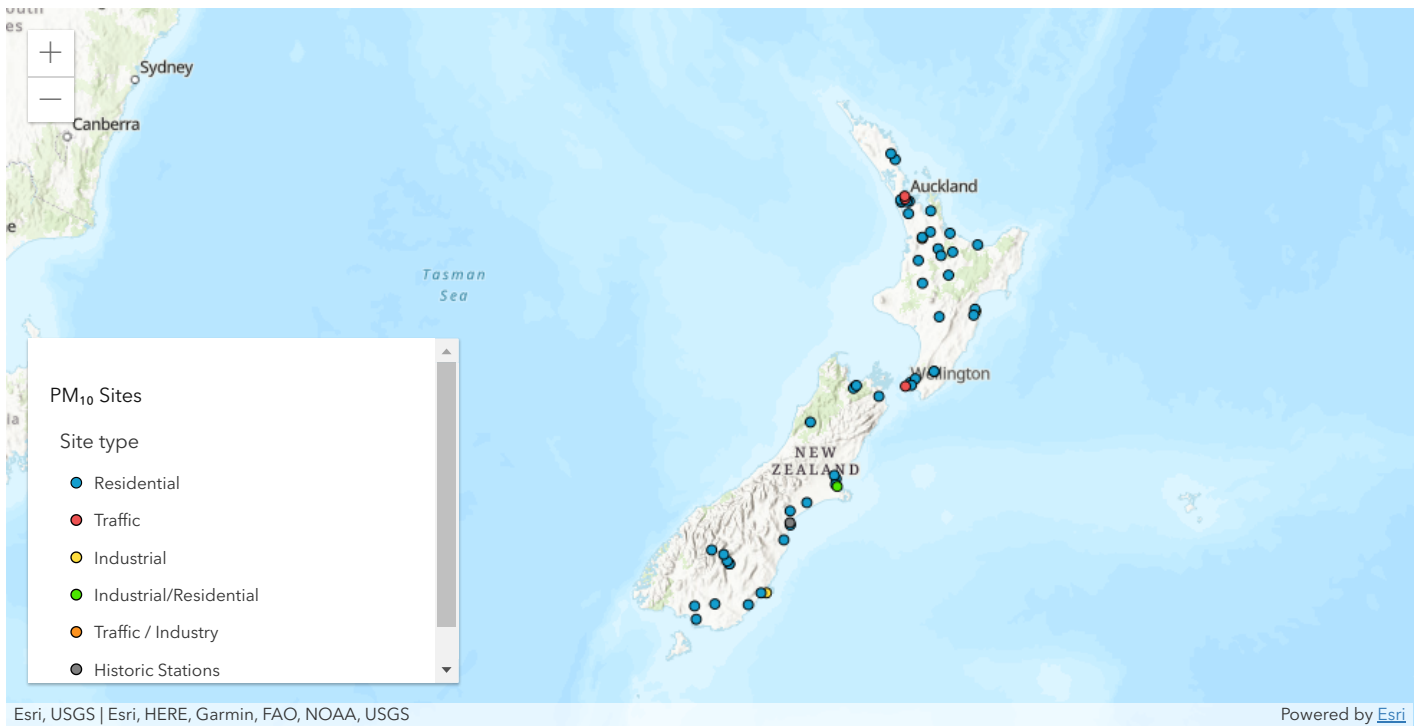
PM₁₀ air quality standards and guidelines have been developed to provide some level of protection against health risks. However, there is currently no evidence for a threshold below which health effects do not occur (WHO 2021). Instead, the WHO guidelines represent concentrations that could be considered 'high risk' to health.

Daily concentrations (24-hour average) are measured against a threshold value of 50µg/m³ in the National Environmental Standards for Air Quality (NESAQ). This value can be exceeded once in a calendar year before regulatory action is required (Ministry for the Environment and Statistics New Zealand 2021). Additionally, annual averages can be compared to a World Health Organisation recommendation of 15µg/m³ (WHO 2021). However, this is only a guideline and does not carry any regulatory weight in New Zealand.

Over 50 monitoring sites had valid data between 2005–2020

Between 2005 and 2020, 56 monitoring stations had valid records of PM₁₀ concentrations for at least one year, and 49 had valid data for 2020 specifically. Stations were generally well distributed across the country, though some population centres (e.g. New Plymouth, Gisborne, Palmerston North, Whanganui and Greymouth) are not covered. 46 of the 56 sites were located in residential areas, whilst high traffic or industrial areas where PM₁₀ emissions may have been greater were few in number.

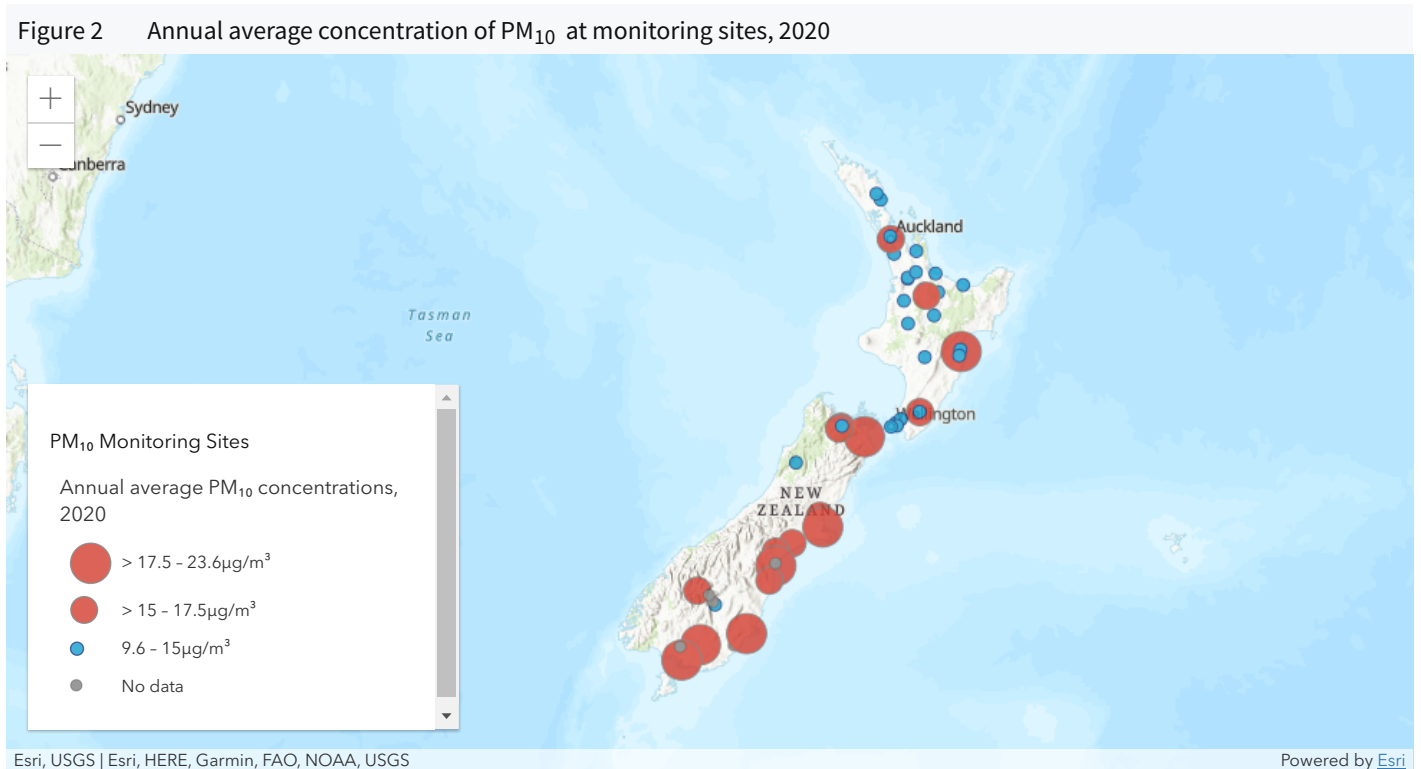
Figure 1 Monitoring stations with valid data, 2005-2020



Source: Ministry for the Environment and Statistics New Zealand 2021

18 sites exceeded WHO guidelines for annual average concentrations

In 2020, 18 monitoring stations exceeded the 2021 WHO guideline for annual average PM₁₀ concentrations (15µg/m³). Most of these stations (14, or 78%) were in the South Island.

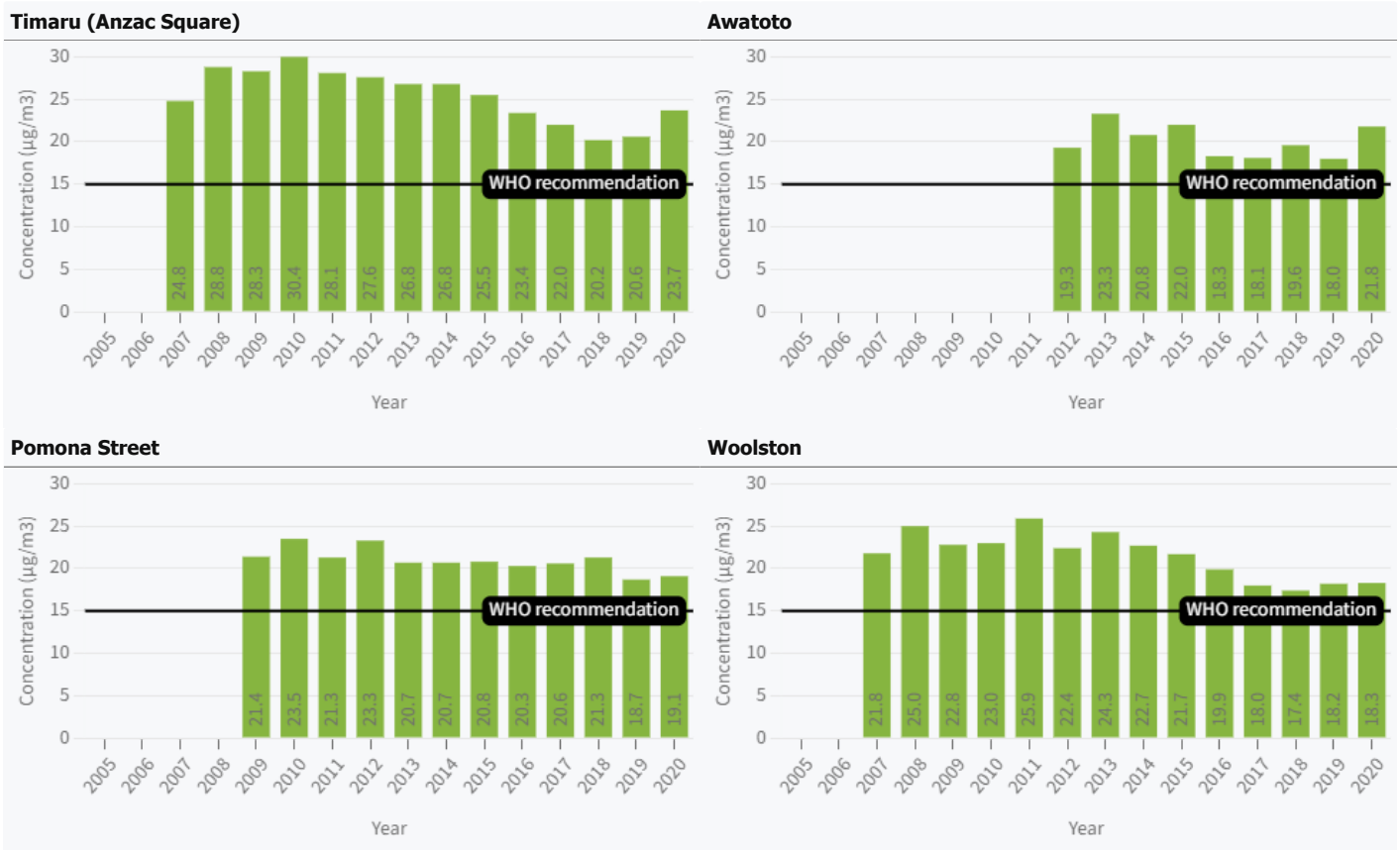


Note: 'No data' indicates that the data for 2020 was invalid, or that no data was available.

Source: Ministry for the Environment and Statistics New Zealand 2021

The highest annual average PM₁₀ concentrations (Figure 3a-d) were recorded in Timaru (at Anzac Square - 23.7µg/m³). Awatoto (near Napier - 21.8µg/m³), Pomona Street (in Invercargill, 19.1µg/m³) and Woolston (18.3µg/m³).

Figure 3 Annual average concentrations of PM₁₀ at selected monitoring sites, 2005–2020



Note: Blank columns without labels indicate that data was either unavailable or that the data for that year was invalid.

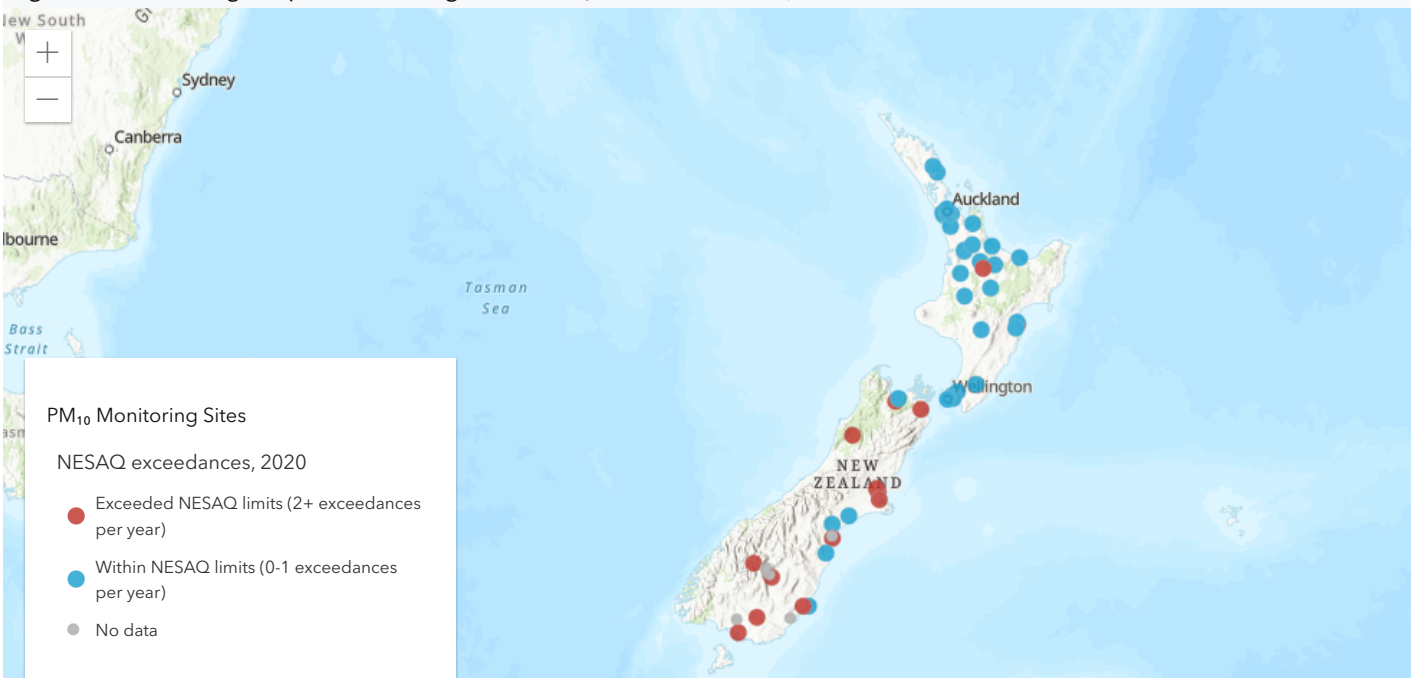
Source: Ministry for the Environment and Statistics New Zealand 2021

Exceedances of the NESAQ daily limit for PM₁₀ are most common in the South Island

In 2020, 18 monitoring stations recorded at least one exceedance of the NESAQ daily threshold for daily PM₁₀ concentrations (50µg/m³). Fifteen recorded two or more exceedances - more than is permitted under the NESAQ framework.

Twelve of those 15 stations were in the South Island (Figure 4), meaning that half of the South Island's 25 stations exceeded the limit, compared to 3 out of 31 in the North Island.

Figure 4 Monitoring site performance against NESAQ exceedance limits, 2020



Note: 'No data' indicates that the data for 2020 was invalid, or that no data was available.

Source: Ministry for the Environment and Statistics New Zealand 2021

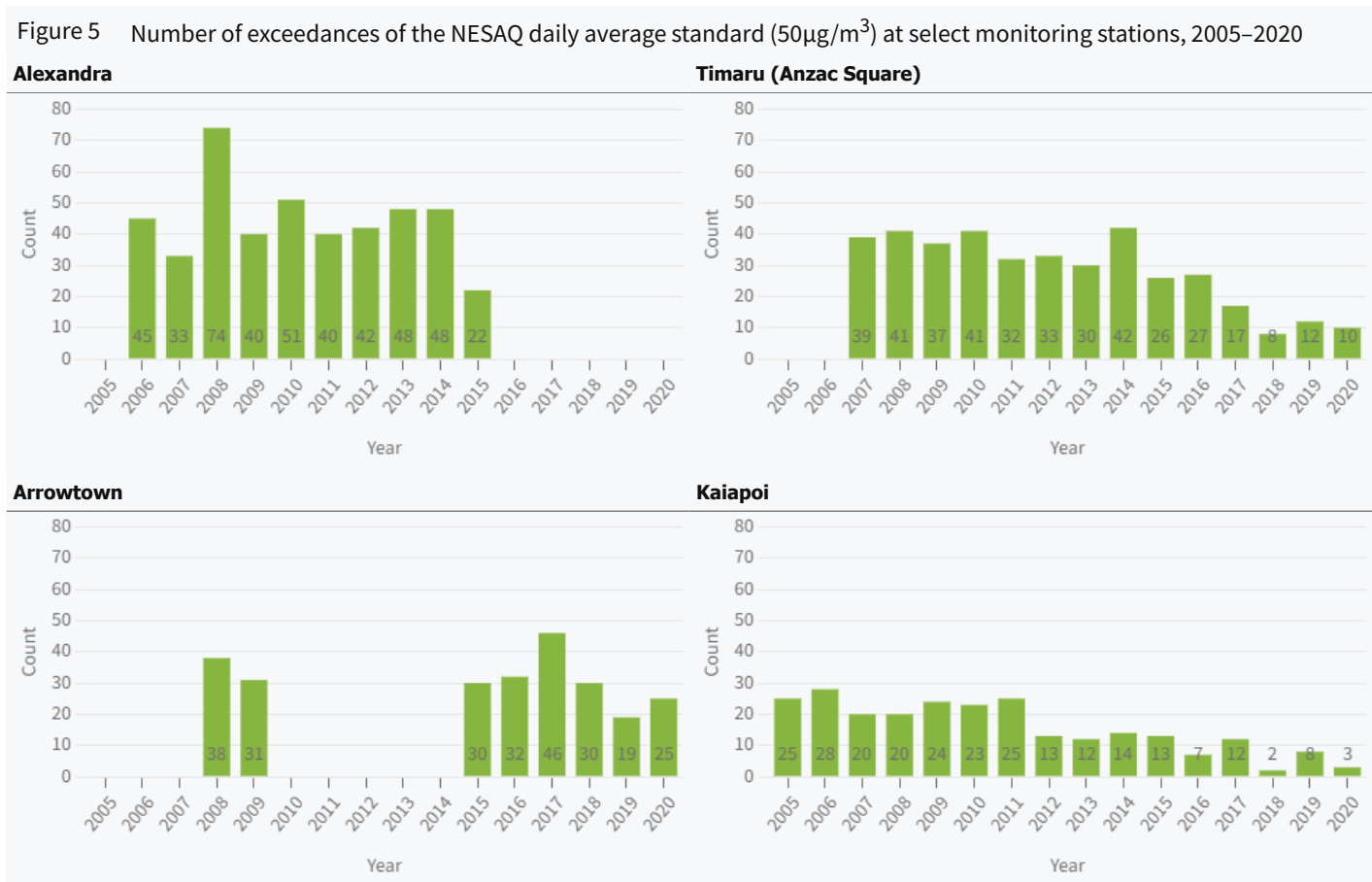
The most exceedances in 2020 occurred at the Arrowtown monitoring station (25 exceedances). This accounted for 26% of the 98 exceedances across the country in 2020, and made Arrowtown the only station with more than 20 annual exceedances in 2020 (Table 1).

Table 1 Frequency of exceedances of the NESAQ daily standard ($50\mu\text{g}/\text{m}^3$), 2020

2 - 5 exceedances	6 - 9 exceedances	10 - 19 exceedances	20+ exceedances
Awatoto	Alexandra (Ventry Street)	Timaru (Anzac Square)	Arrowtown
Blenheim Bowling Club	Woolston	Pomona Street	
Gore at Main Street			
Kaiapoi			
Masterton East			
Mosgiel			
Rangiora			
Reefton School			
Richmond Central			
St. Albans			

Source: Ministry for the Environment and Statistics New Zealand 2021

Since 2005, the number of annual exceedances varied greatly from site to site, rising to as many as 74 exceedances per year at the Alexandra station in 2008. Between 2005 and 2020, there were 3,632 exceedances of the NESAQ threshold; 12% of these 443 were at Alexandra. Other sites with a high number of exceedances in this period were Timaru's Anzac Square (395), Arrowtown (251), and Kaiapoi (249).



Note: Blank columns without labels indicate that data was either unavailable or that the data for that year was invalid. The 'Alexandra' station above should not be confused with the 'Alexandra (Ventry Street)' station. The station above is in an industrial area and ceased monitoring after 2015, the latter is in a residential area and first produced data in 2018.

Source: Ministry for the Environment and Statistics New Zealand 2021

Most exceedances occur in colder months

Between 2005 and 2020, 69% of the NESAQ 24-hour threshold exceedances occurred in the winter months (June-August) (Figure 6). A further 19% occurred in autumn, predominantly in May. Therefore, most exceedances (88%) happened in the colder months. During the cooler months, home heating emissions increase, contributing to worse PM₁₀ 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).

Table 2 Distribution of exceedances of the NESAQ threshold (for daily average concentrations) by month, 2005–2020

January (Summer)	February (Summer)	March (Autumn)	April (Autumn)	May (Autumn)	June (Winter)	July (Winter)	August (Winter)	September (Spring)	October (Spring)	November (Spring)	December (Summer)
131	135	193	222	949	1952	2101	915	195	168	138	97
1.8%	1.9%	2.7%	3.1%	13.2%	27.1%	29.2%	12.7%	2.7%	2.3%	1.9%	1.3%

Source: Ministry for the Environment and Statistics New Zealand 2021

Data for these indicators

Monitoring sites exceeding NESAQ standard for daily average concentrations of PM₁₀

Daily average PM₁₀ concentration data (in µg/m³) comes from the Ministry for the Environment and Statistics New Zealand as part of New Zealand's Environmental Reporting Series. These daily averages are compared with the NESAQ threshold for PM₁₀, exceedances of which occur when concentrations rise above 50µg/m³.

Monitoring sites exceeding the WHO annual average guideline for PM₁₀

Annual average values are created by EHINZ using the 24-hour average values for each year as a basis. Annual average values are then compared with the WHO's 2021 guideline for PM₁₀. Exceedances occur when concentrations are above 15µg/m³. For additional information, see the metadata link below.

What is 'valid data'?

For a monitoring site's records to count as 'valid' data, it must meet Ministry for the Environment 'completeness' criteria; that is, it must have records that cover:

- at least 75% of the hours in a day (18 hours) for a valid daily average.
- at least 75% of the days in a year (274 days) for a valid annual average. The days used must all meet the daily requirement above.

If a given year does not meet this requirement, no daily average values or count of exceedances will be reported for that year either. This is discussed in greater detail in the metadata. If a given day/year does not meet this requirement, no daily average values or count of exceedances will be reported for that year. This is discussed in greater detail in the methodology. For this and 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.

Ministry for the Environment and Statistics NZ. 2018. *Our air 2018. Data to 2017*. Wellington: Ministry for the Environment.

Ministry for the Environment and Statistics NZ. 2021. *Our air 2021*. Wellington: Ministry for the Environment.

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

WHO. 2021. *WHO global air quality guidelines: particulate matter (PM_{2.5} and PM₁₀), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide*. Bonn: WHO European Centre for Environment and Health

Other related topics include:

[Fine particulate matter \(PM_{2.5}\)](#)

[Motor vehicles](#)

[Wood and coal fires](#)

[Other air pollutants](#)

[Health effects of air pollution](#)

[HAPINZ 3.0](#)

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Citation

Environmental Health Intelligence NZ, 2022. *Particulate matter (PM₁₀) concentrations*. {Factsheet}. Wellington: Environmental Health Intelligence NZ, Massey University.

Further information

For descriptive information about the data [i Metadata Sheet](#)

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