5 April 2024

Research and Evaluation Unit | RIMU

Auckland Air Quality Report

Monthly update – March

Introduction

Auckland Council's Research and Evaluation Unit (RIMU) collects air quality data to ensure compliance with national standards and inform policy development and evaluation. The data we collect provides a better understanding of ambient air quality in the region, including spatial and temporal variations.

This monthly update is prepared using validated data that is available about one month after raw data collection. This report covers data up to 29 February 2024. This regular update on air quality aims to promote awareness and encourage actions to improve air quality in the region.

This update is divided into four sections, with sections A and B featuring tables and graphics that illustrate air quality status in Tāmaki Makaurau / Auckland, and is based on data collected from continuous monitoring sites across the region.

For this edition, section C focuses on one monitoring site – Khyber Pass Road. Section D provides monthly averages for 2024 and the past four to five years of pollutant concentrations (when data is available).

Summary

- No breach of national air quality standards occurred in February 2024.
- Most monitoring sites recorded particulate matter levels slightly higher than those of the same period in the previous year.
- The Customs Street site recorded the highest levels of NO_2 and SO_2 concentrations in February 2024.

It is important to note that air quality at a monitoring site can vary from year to year due to weather and other influences (See *Auckland air quality report, October 2021*). For a brief analysis of short-term concentration changes of key pollutants, please see Table 2.

Where to view our data

Data can be viewed on the council's environmental data portal, the LAWA website LAWA or requested from environmentaldata@aucklandcouncil.govt.nz

Full state and trends analyses and reports are prepared every few years (the most recent report is *Trends in Auckland's air quality 2006-2018*).

The *2022 Annual data report* is available on the Knowledge Auckland website.

See also, the frequently asked questions about the Auckland air quality monitoring programme.

Glossary of terms

Term	Meaning
Aerodynamic diameter	Used to describe the behaviour of a particle as it moves around in the air; it compares the behaviour with that of a spherical particle of unit density.
Air pollutant/contaminant	Any substance in the air that could harm humans, animals, vegetation, or other parts of the environment when present in high enough concentrations.
Air pollution	The presence of one or more air pollutants in high enough concentrations to cause harm.
Air quality	Is the degree to which air is suitable or clean enough for humans, animals, or plants to remain healthy.
Ambient air	The external air environment (does not include the air environment inside buildings or structures)
Black carbon (BC)	Is an air pollutant made up of tiny soot-like particles discharged into the atmosphere from combustion processes.
CO	Carbon monoxide, a type of air pollutant.
Exceedance	An exceedance defines a period of time during which the concentration of a pollutant is greater than the appropriate air quality criteria.
Ground-level ozone (O_3)	At ground level, ozone is considered an air pollutant that can seriously affect the human respiratory system. It is a major component of photochemical smog.
Monitoring site	A facility for measuring the concentration of one or more pollutants in the ambient air; also referred to as 'monitoring station'
NESAQ	National Environmental Standard for Air Quality.
NO_2	Nitrogen dioxide, a type of air pollutant
PM	Particulate matter is made up of a mixture of various sizes of solid and liquid particles suspended in air.
PM_{10}	Particulate matter with an aerodynamic diameter of 10 micrometres or less; a type of air pollutant.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of 2.5 micrometres or less; a type of air pollutant.
SO_2	Sulphur dioxide, a type of air pollutant
$\mu g/m^3$	Microgram of pollutant (1 millionth of a gram) per cubic metre of air, referenced to temperature of 0°C (273.15 K) and absolute pressure of 101.325 kilopascals (kPa)
n/a	Not applicable

What we monitor		Why we monitor
Air	Particulate matter (PM) – PM_{10} and $PM_{2.5}$	Tiny particles (particulate matter) from polluting sources such as vehicles and smoke get into the air. Breathing them may cause health problems.
	Nitrogen dioxide (NO_2)	Vehicles are the main source of NO_2 in Auckland. It can irritate the lungs, increasing susceptibility to asthma and lowering resistance to respiratory infections.
	Other pollutants	Air pollutants ozone, sulphur dioxide, carbon monoxide, black carbon and volatile organic compounds (VOCs) like benzene cause adverse health effects at elevated concentrations.
Greenhouse gas emissions	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3)	The climate is warming due to increased greenhouse gas (GHG) levels in the atmosphere caused by human activities. Reducing GHG emissions will limit temperature rise.

Section A – Data tables

Table 1. Summary information about Auckland air quality monitoring programme 1 January to 29 February 2024

Number of exceedances of NESAQ in 2024	0	
Number of exceedances of Auckland ambient air quality targets in 2024	0	
Maximum PM_{10} 24-hours mean (February 2024)	29.9 µg/m³ (59.8% of NESAQ)	Recorded at Papatoetoe on 4 February 2024
Maximum $PM_{2.5}$ 24-hour mean (February 2024)	9.8 µg/m³ (39.2% of Auckland target)	Recorded at Takapuna on 20 January 2024
Maximum NO_2 1-hour mean (February 2024)	61.0 µg/m³ (30.5% of NESAQ)	Recorded at Customs Street on 13 February 2024
Maximum SO_2 1-hour mean (February 2024)	19.0 µg/m³ (5.4% of NESAQ)	Recorded at Penrose on 4 January 2024
Maximum O_3 1-hour mean (February 2024)	68.0 µg/m³ (45.3% of NESAQ)	Recorded at Patumahoe on 23 January 2024
Maximum CO running 8-hour mean (February 2024)	0.36 mg/m³ (3.6% of NESAQ)	Recorded at Khyber Pass Rd on 23 January 2024
Number of continuous monitoring sites	10	
Location of monitoring sites	Queen Street, Customs Street, Khyber Pass Road, Penrose, Henderson, Takapuna, Glen Eden, Pakuranga, Papatoetoe, and Patumahoe	

Table 2. Short-term trends in concentration of key air pollutants monitored for the past 3, 4, and 5 years

↑ indicates an upward   ↓ indicates a downward   ↗ upward but not significant   ↘ downward but not significant

Site	PM₁₀ Past 3 years	PM₁₀ Past 4 years	PM₁₀ Past 5 years	PM₂.₅ Past 3 years	PM₂.₅ Past 4 years	PM₂.₅ Past 5 years	NO₂ Past 3 years	NO₂ Past 4 years	NO₂ Past 5 years	Black carbon Past 3 years	Black carbon Past 4 years	Black carbon Past 5 years	Ozone Past 3 years	Ozone Past 4 years	Ozone Past 5 years	CO Past 3 years	CO Past 4 years	CO Past 5 years	SO₂ Past 3 years	SO₂ Past 4 years	SO₂ Past 5 years	Site
Customs Street*	n/a	n/a	n/a	↑	↘	n/a	↓	↓	n/a	↑	↗	n/a	n/a	n/a	n/a	n/a	n/a	n/a	↑	↑	n/a	Customs Street*
Glen Eden*	↑	↘	↘	↓	↓	↓	↘	↗	↑	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Glen Eden*
Henderson	↗	↗	↘	n/a	n/a	n/a	↗	↗	↗	↘	↘	↓	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Henderson
Khyber Pass Road	↑	↑	↑	n/a	n/a	n/a	↓	↓	↓	n/a	n/a	n/a	n/a	n/a	n/a	↘	↓	↓	n/a	n/a	n/a	Khyber Pass Road
Pakuranga*	↑	↑	↗	↘	↗	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Pakuranga*
Papatoetoe	↓	↗	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Papatoetoe
Patumahoe	↘	↓	↓	↑	↑	↗	↗	↑	↑	n/a	n/a	n/a	↑	↘	↓	n/a	n/a	n/a	n/a	n/a	n/a	Patumahoe
Penrose	↑	↗	↘	↓	↓	↓	↘	↘	↓	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	↑	↑	↑	Penrose
Queen Street*	↑	↑	↑	↑	↑	↑	↘	↓	↓	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Queen Street*
Takapuna*	↑	↑	↗	↑	↑	↗	↗	↗	↘	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Takapuna*

Notes

Trend significance was determined using the Theil-Sen method (deseasonalised): ↑ and ↓ arrows indicate trends are statistically significant at the 0.05 level, 95% confidence intervals. n/a means not applicable.

Effective dates: 3 years (1 January 2021 to 31 December 2023), 4 years (1 January 2020 to 31 December 2023), and 5 years (1 January 2019 to 31 December 2023)

PM₁₀ is monitored at Glen Eden, Henderson, Khyber Pass Rd, Pakuranga, Papatoetoe, Patumahoe, Penrose, Takapuna, and Queen St.

PM₂.₅ is monitored at Customs St, Glen Eden, Pakuranga, Patumahoe, Penrose, Takapuna, and Queen St.

NO₂ is monitored at Customs St, Glen Eden, Henderson, Khyber Pass Rd, Patumahoe, Penrose, Takapuna, and Queen St.

Black carbon is monitored at Customs St, and Henderson.

CO is monitored at Khyber Pass Rd.

Ozone is monitored at Patumahoe.

SO₂ is monitored at Customs St, and Penrose.

*PM₂.₅ data coverage for Glen Eden, Customs Street and Pakuranga is less than 75% due to instrument failure between September 2021 and January 2022. No data for Takapuna in January and February 2023 due to the Auckland floods. Queen St data is up to 22 August due to power outage at the site.
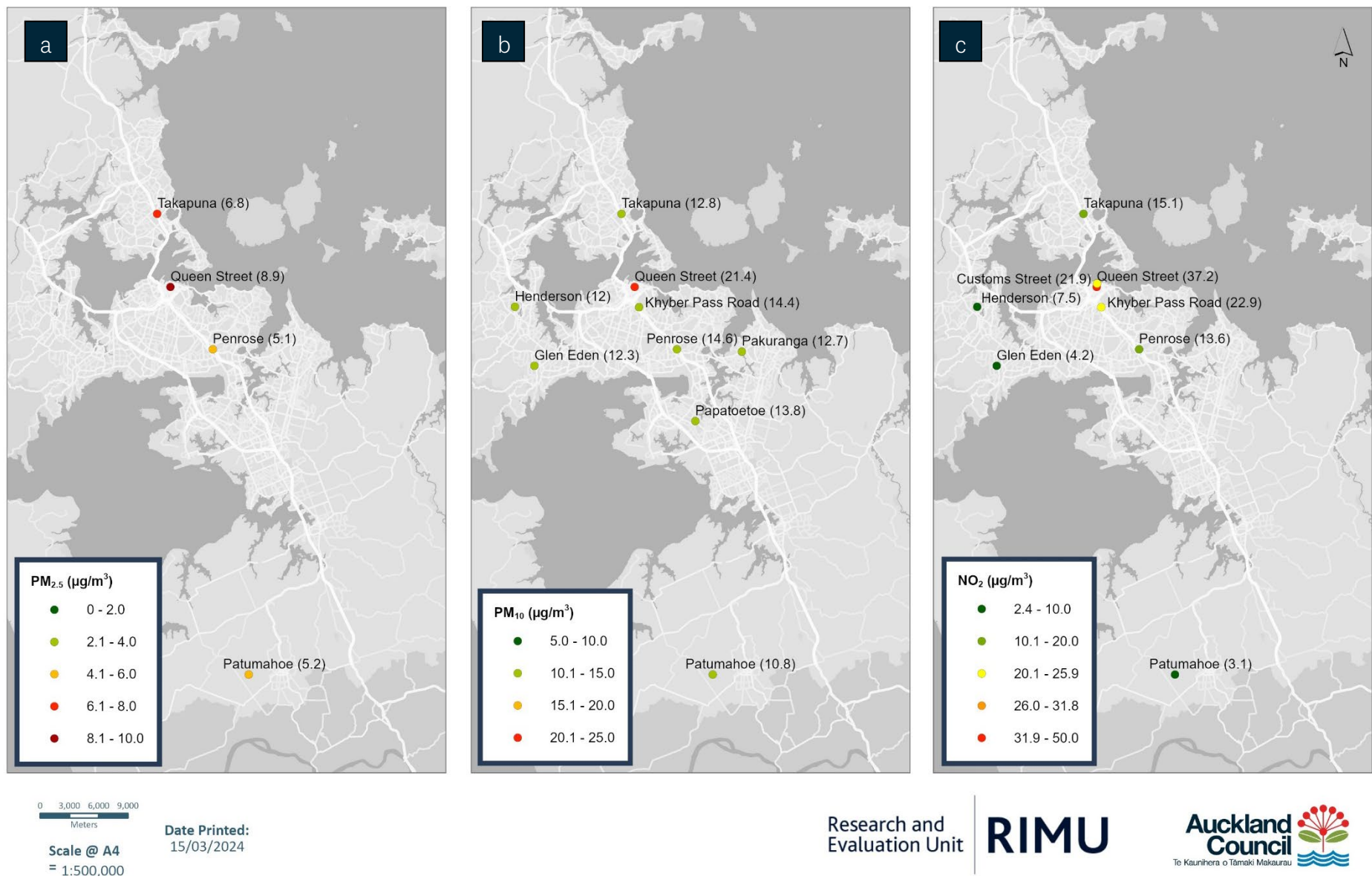
Figure 1. Maps a, b and c show the air quality monitoring sites and their last 12 months (1 March 2023 to 29 February 2024) average PM and NO₂ concentrations in brackets. Auckland city centre monitoring sites recorded the highest PM and NO₂ concentrations.

Section B. Box plot comparison of air contaminant levels across 10 monitoring sites for January to February, between 2023 and 2024
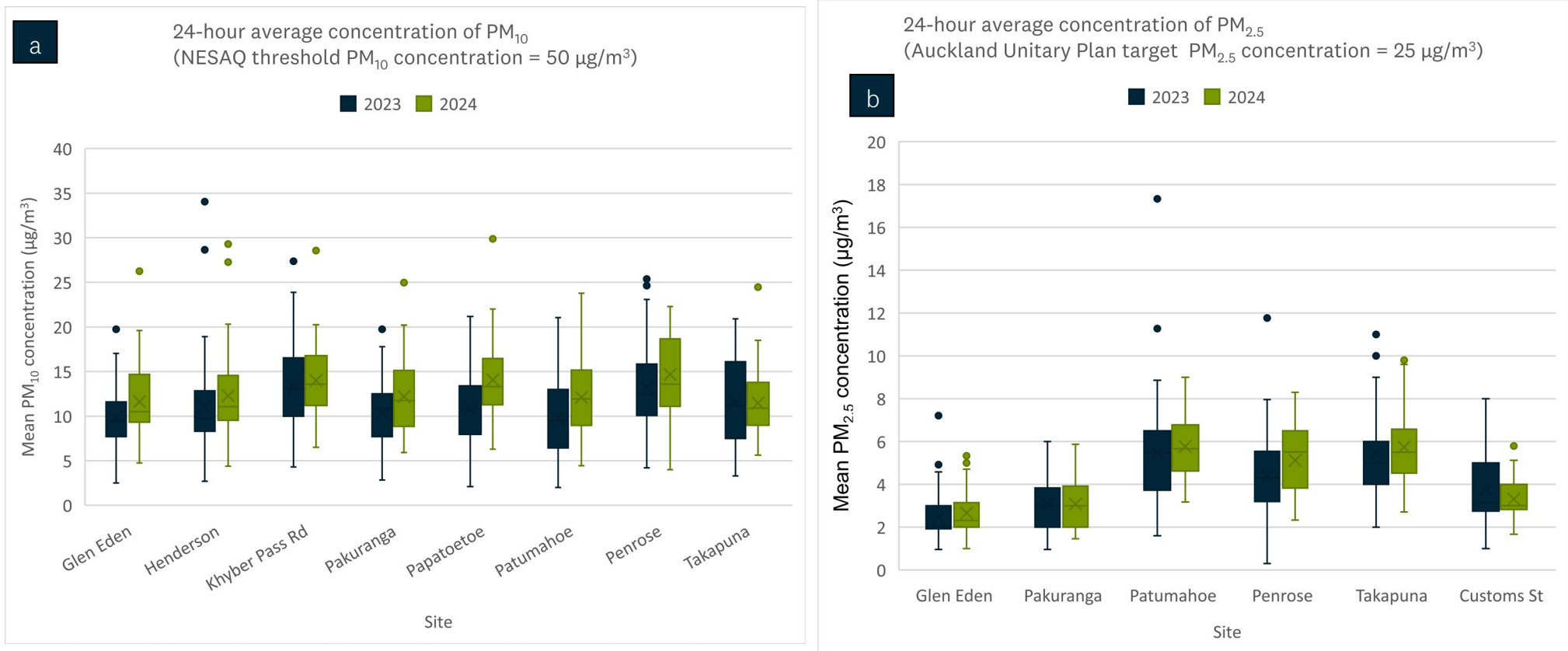

Figure 2. Boxplot of PM mean concentration – January to February, between 2024 and 2023. The highest 24-hour average concentrations of PM_{10} and $PM_{2.5}$ were recorded at the Papatoetoe and Takapuna sites, respectively. Plots 'a' and 'b' represent PM_{10} and $PM_{2.5}$, respectively. PM_{10} and $PM_{2.5}$ have multiple sources including home heating, motor vehicles, sea salt, marine diesel, and soils (windblown soil, road dust, and dust generated by earthworks, construction, and road works).

> Boxes represent 25th (bottom of the box) and 75th (top of box) percentile, central line through the box is the median, bars outside the box (whiskers) represent the 1.5× interquartile range, × markers are the means, and circles are outliers.
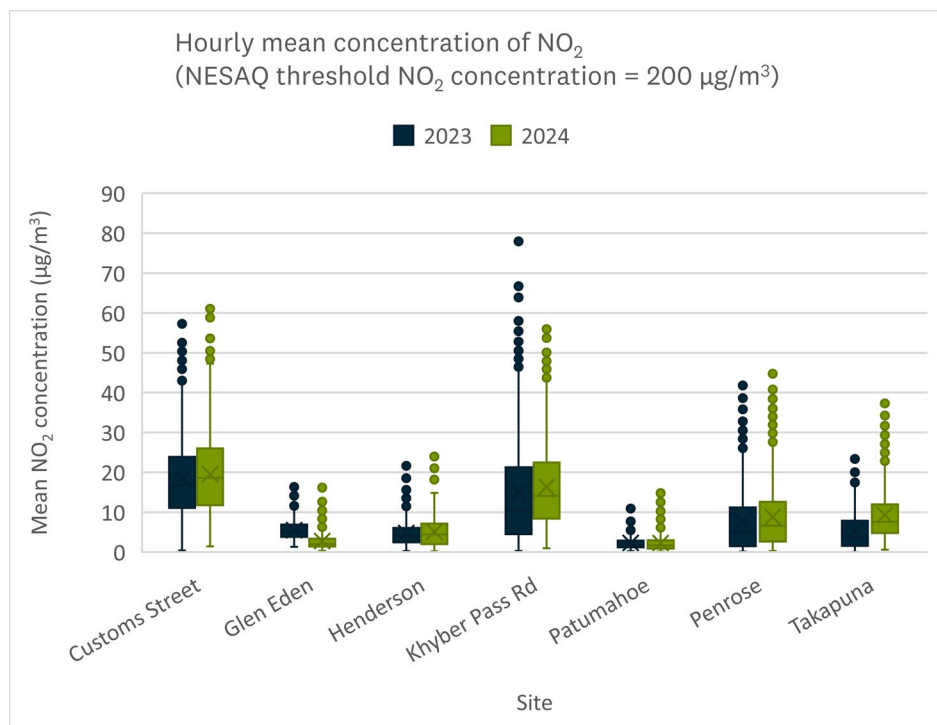
Figure 3. Boxplot of NO_2 mean concentration: Jan-Feb between 2024 and 2023. The highest concentrations were recorded at the Customs Street monitoring site in the city centre. Motor vehicles are the primary source of NO_2.
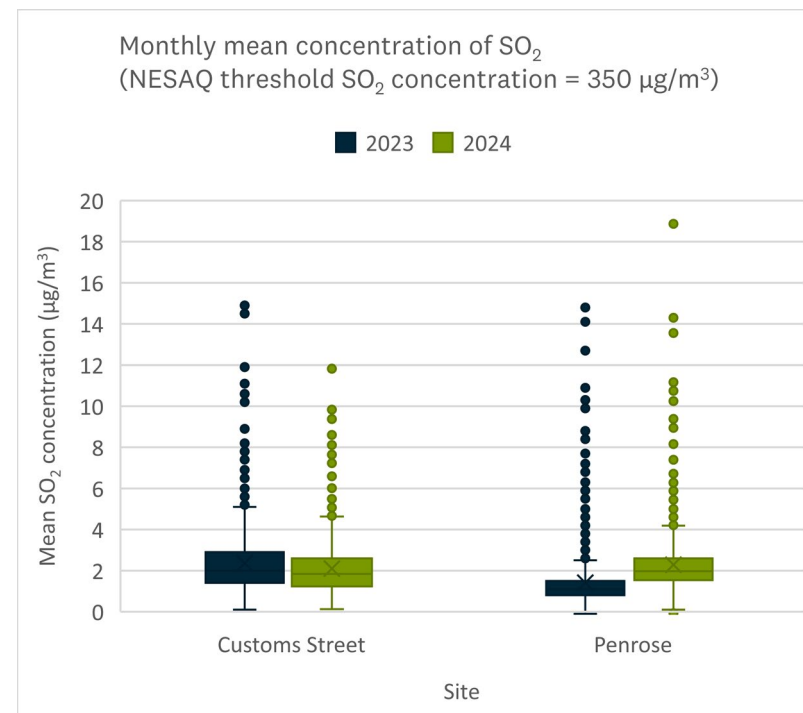

Figure 4. Boxplot of SO_2 mean concentration: Jan-Feb 2024 compared to 2023. The highest average concentration in February was recorded at the Customs St site. SO_2 is produced from the combustion of fossil fuels that contain sulphur, such as coal and oil (used for home heating, industry, and shipping). Motor vehicles also contribute to SO_2 levels in urban air.

Boxes represent 25th (bottom of the box) and 75th (top of box) percentile, central line through the box is the median, bars outside the box (whiskers) represent the 1.5× interquartile range, × markers are the means, and circles are outliers.

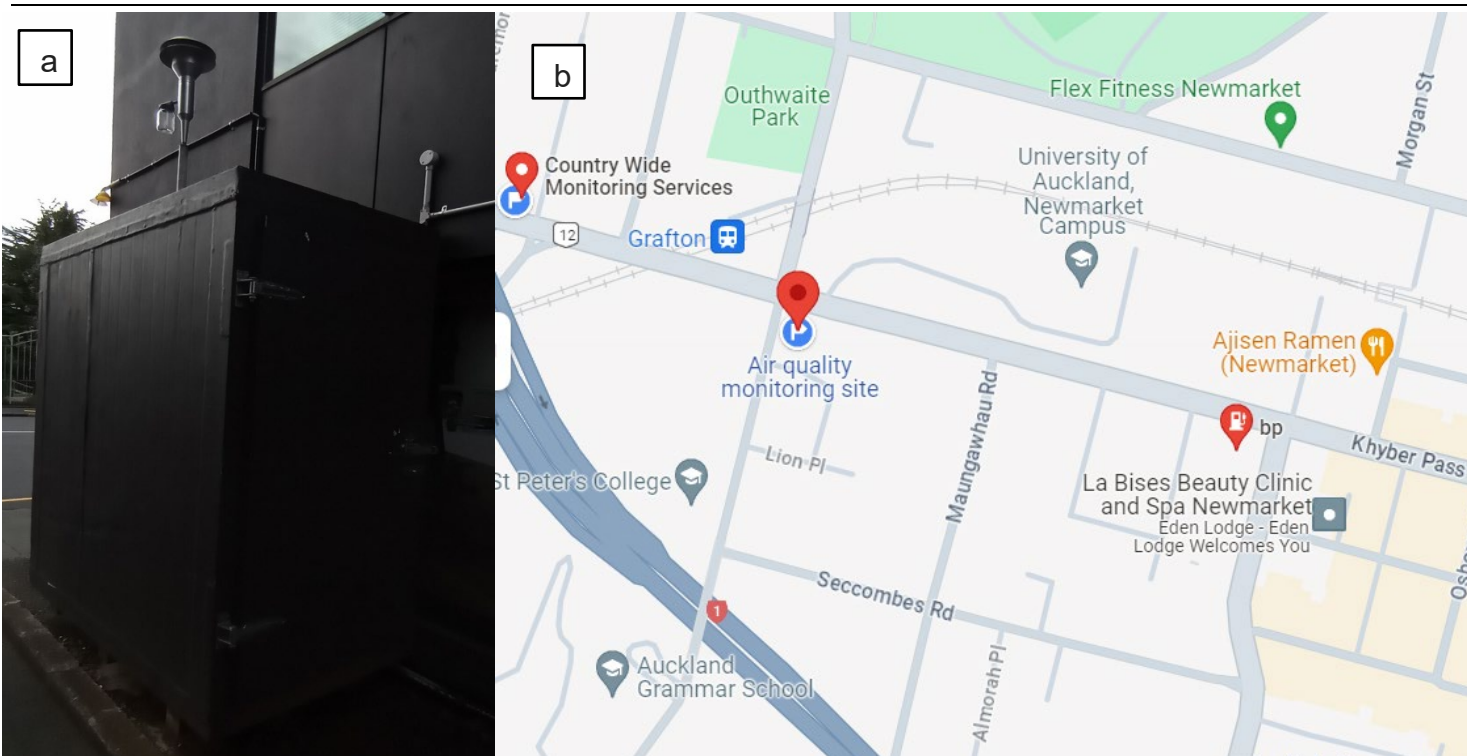# Section C. Focus on a monitoring site: Khyber Pass Road

Figure 5. The Khyber Pass Road air quality monitoring site is located between 269 and 289 Khyber Pass Road, Newmarket. Image 'a' shows the air quality monitoring shed viewed from the east. Image 'b' is an aerial view of the monitoring site and surroundings taken in March 2024 (Source: Google Maps). Air quality monitoring at this site commenced on 29 October 1995. It was paused in May 2015 for redevelopment and restarted in September 2019. PM_{10}, NO_2, and CO are monitored at this site. The main anthropogenic sources of air contaminants are motor vehicles, biomass burning (during winter), and soils/road dust.

Key findings:

• The average PM_{10} concentration at Khyber Pass Road is 22.2% higher than Auckland's average and 49.2% higher than Patumahoe, a rural site.

• Khyber Pass Road's average NO_2 concentration is 63.9% higher than Auckland's average and approximately nine times higher than Patumahoe.

• It is important to note that Khyber Pass Road monitoring site is situated in a location where there is a high concentration of vehicle exhaust emissions. Therefore, it is not unexpected to observe higher average NO_2 concentrations than Auckland's average.

• The deseasonalised trend analysis results reveal that there is a long-term downward trend in PM_{10}, NO_2, and CO average concentrations over the monitoring period (Jan 2006 to Feb 2024). Overall, the results indicate that while Khyber Pass Road has higher concentrations of PM_{10} and NO_2 compared to most sites, it is expected given its location in a peak traffic area.

Monthly mean PM$_{10}$ concentration (Jan 2006 to Feb 2024)
(Overall mean; Khyber Pass Rd = 17.6 μg/m^3 ,
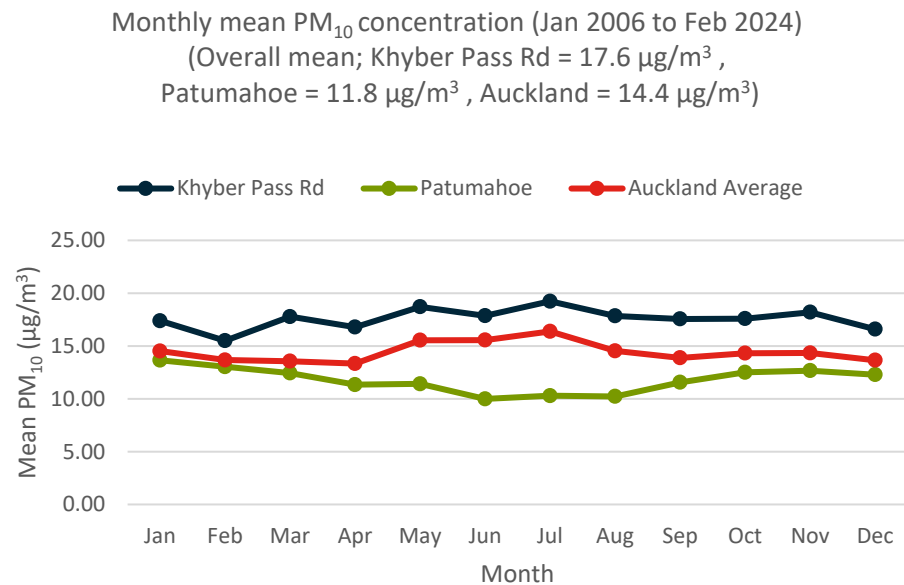Patumahoe = 11.8 μg/m^3 , Auckland = 14.4 μg/m^3)

Figure 6. Temporal variation in monthly PM$_{10}$ concentrations – Khyber Pass Rd site compared to Patumahoe (rural site) and Auckland average. Overall, Khyber Pass Rd site average PM$_{10}$ concentration is 22.2% and 49.2% higher than Auckland's average and Patumahoe site, respectively.

Figure 7. Trends in PM$_{10}$ at Khyber Pass Rd site – January 2006 to February 2024. The plot shows the deseasonalised monthly mean concentrations of PM$_{10}$. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as – 0.7 (μg/m^3) per year and the 95% confidence intervals in the slope from -0.78 - (-0.64) μg/m^3/year. The '∗∗∗' show that the trend is significant to the 0.001 level.

Figure 8. Temporal variation in monthly CO concentrations. The highest concentrations tend to occur during winter months.
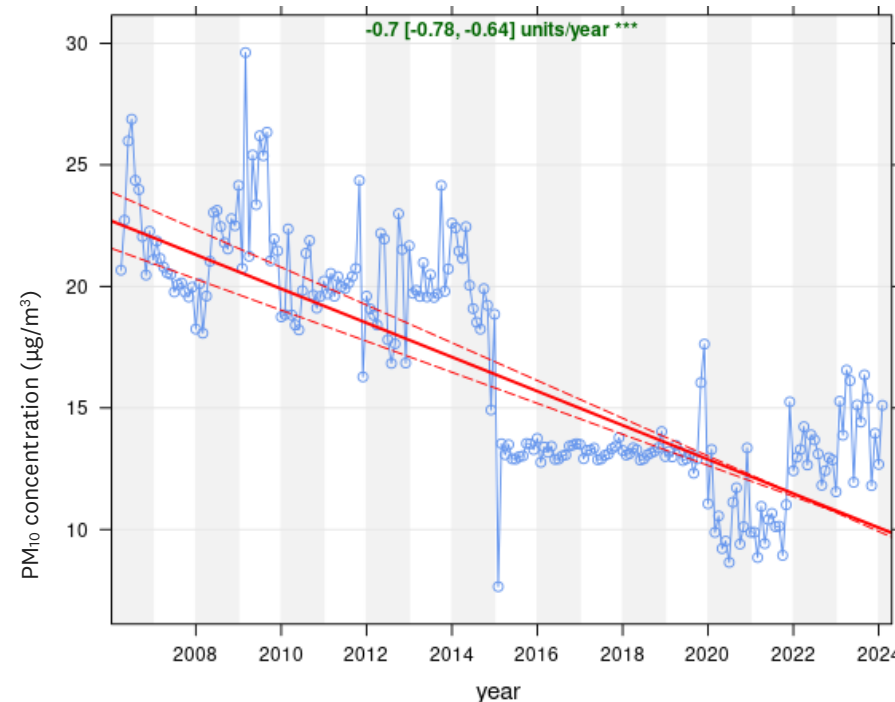

Figure 9. Trends in CO at Khyber Pass Rd site – January 2006 to February 2024. The plot shows the deseasonalised monthly mean concentrations of CO. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as – 0.06 (mg/m^3) per year and the 95% confidence intervals in the slope from -0.06 - (-0.05) mg/m^3/year. The '∗∗∗' show that the trend is significant to the 0.001 level.
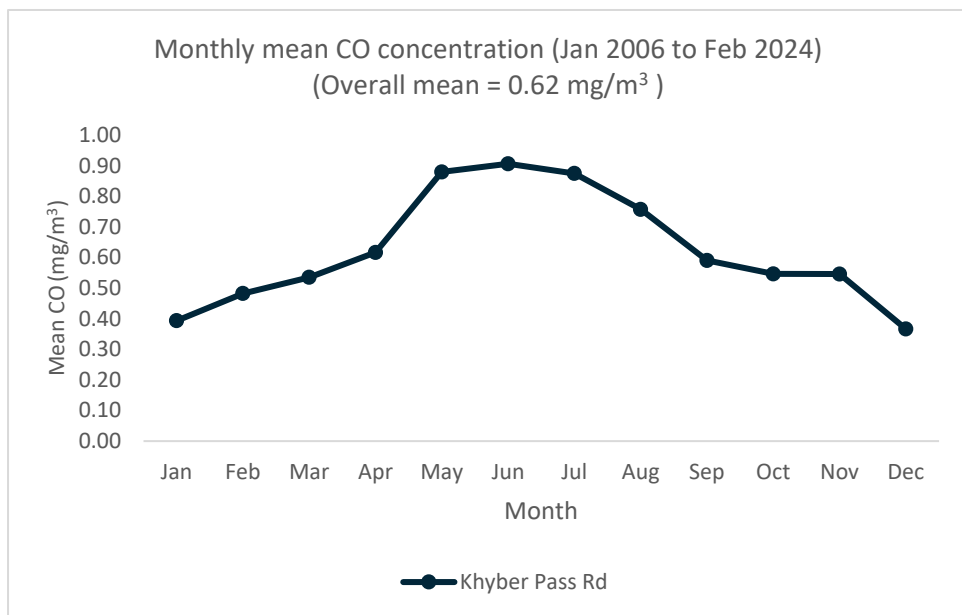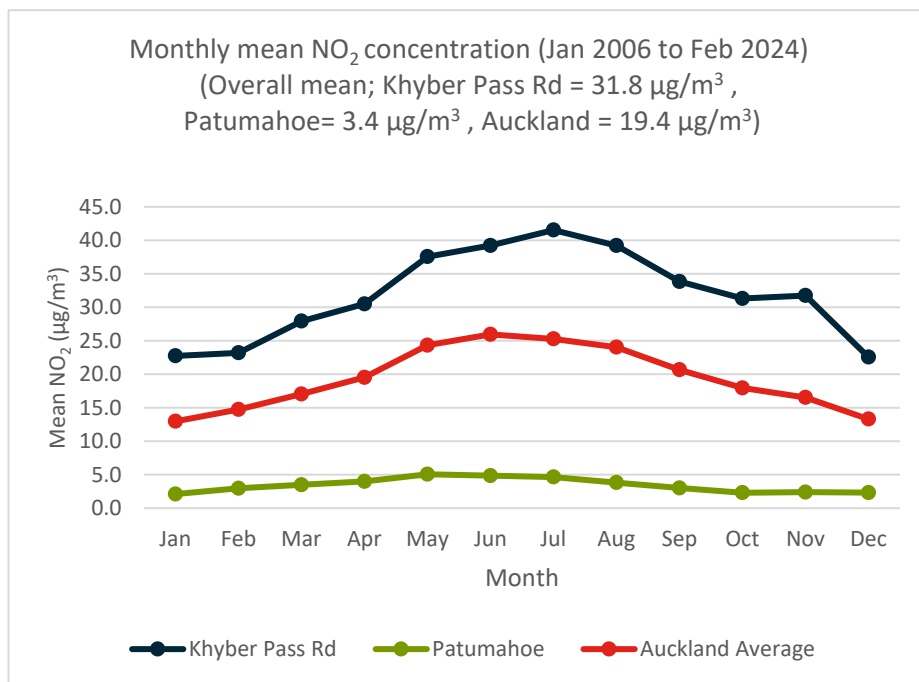
Figure 10. Temporal variation in monthly NO_2 concentrations – Khyber Pass Rd site compared to Patumahoe (rural site) and Auckland average. Overall, Khyber Pass Rd site average NO2 concentration is 63.9% higher than Auckland's average and nine times higher than the Patumahoe rural site.
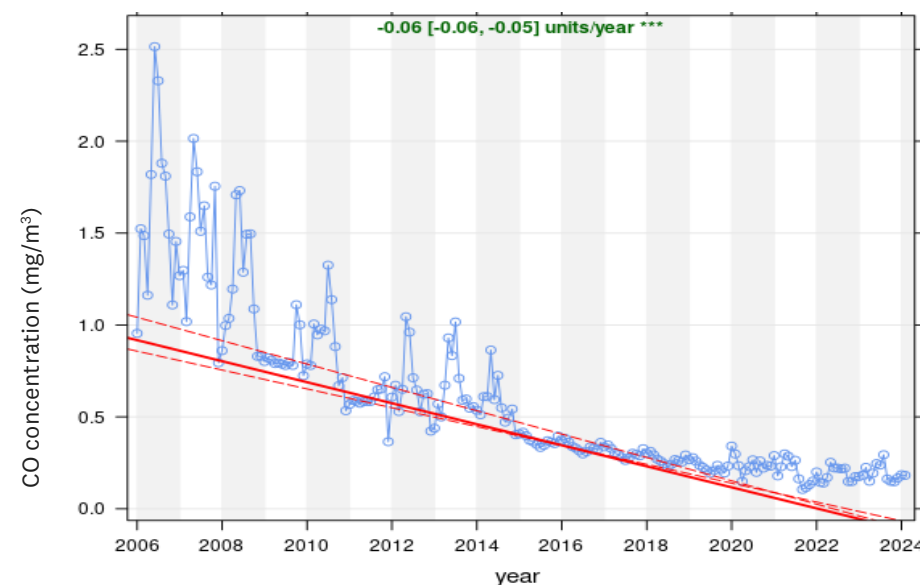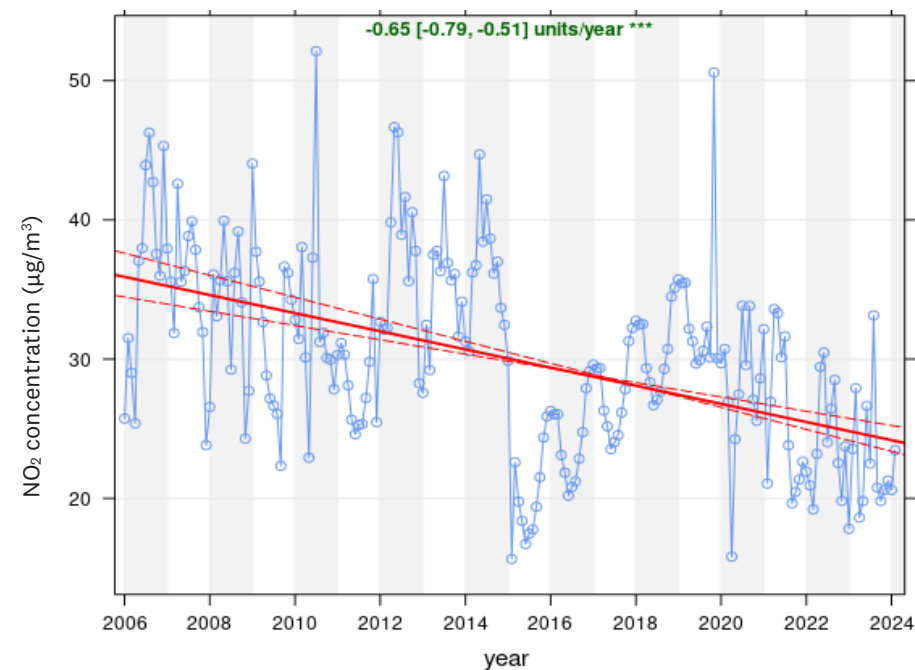

Figure 11. Trends in NO_2 at Khyber Pass Rd site – January 2006 to February 2024. The plot shows the deseasonalised monthly mean concentrations of NO_2. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as -0.65 ($\mu g/m^3$) per year and the 95% confidence intervals in the slope from -0.79 - (-0.51) $\mu g/m^3$/year. The '∗∗∗' show that the trend is significant to the 0.001 level.

Section D. Table 3. Monthly averages: 2024 and past four to five years (when data is available)

Pollutant	Site	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PM_{10} ($\mu g/m^3$)	Glen Eden	2024	11.3	12.0	-	-	-	-	-	-	-	-	-	-
		Past 5 years	11.4	11.0	9.7	11.3	13.0	14.4	14.7	13.6	12.1	11.1	11.5	12.6
	Henderson	2024	11.4	13.2	-	-	-	-	-	-	-	-	-	-
		Past 5 years	11.6	11.6	11.0	11.4	12.5	12.3	12.8	11.5	11.7	11.1	11.9	12.3
	Khyber Pass Road	2024	13.3	14.4	-	-	-	-	-	-	-	-	-	-
		Past 5 years	11.8	12.2	11.6	12.5	12.3	11.3	12.9	12.1	12.3	11.9	12.8	13.6
	Pakuranga	2024	11.1	13.2	-	-	-	-	-	-	-	-	-	-
		Past 5 years	11.6	11.3	10.2	10.6	12.7	12.4	14.0	13.1	11.9	11.2	11.9	12.3
	Papatoetoe	2024	13.0	15.2	-	-	-	-	-	-	-	-	-	-
		Past 5 years	14.0	13.5	12.4	12.7	14.0	13.0	14.9	14.2	14.5	13.6	13.8	14.5
	Patumahoe	2024	11.1	13.1	-	-	-	-	-	-	-	-	-	-
		Past 5 years	13.7	13.0	12.3	11.6	11.2	9.3	10.5	10.5	11.7	11.0	12.3	14.0
	Penrose	2024	14.3	15.3	-	-	-	-	-	-	-	-	-	-
		Past 5 years	14.8	15.1	14.2	14.4	15.6	13.5	14.8	13.8	14.3	13.3	14.2	15.4
	Queen Street	2024	ND	ND	-	-	-	-	-	-	-	-	-	-
		Past 5 years	17.4	17.3	16.7	17.0	18.0	17.2	19.9	19.1	18.6	18.4	19.6	20.1
	Takapuna	2024	10.5	12.6	-	-	-	-	-	-	-	-	-	-
		Past 5 years	12.3	11.9	10.8	12.2	13.1	12.5	13.7	12.5	12.8	11.6	12.3	12.9
$PM_{2.5}$ ($\mu g/m^3$)	Customs Street	2024	3.1	3.4	-	-	-	-	-	-	-	-	-	-
		Past 4 years	4.1	3.8	3.2	4.1	4.3	4.4	4.8	5.3	5.3	4.0	3.5	3.6
	Glen Eden	2024	2.5	2.8	-	-	-	-	-	-	-	-	-	-
		Past 5 years	2.5	2.6	2.1	3.1	5.8	9.0	9.2	7.8	4.8	3.3	3.2	3.1
	Pakuranga	2024	2.8	3.3	-	-	-	-	-	-	-	-	-	-
		Past 5 years	2.9	2.9	2.6	3.7	5.5	6.4	7.8	5.8	4.3	3.3	3.6	3.4
	Patumahoe	2024	5.7	5.8	-	-	-	-	-	-	-	-	-	-
		Past 5 years	5.1	4.8	4.4	4.9	5.3	4.8	4.9	5.0	5.0	4.7	5.2	5.3
	Penrose	2024	4.9	5.5	-	-	-	-	-	-	-	-	-	-
		Past 5 years	6.0	5.8	4.8	5.4	6.2	6.6	6.6	5.9	5.4	5.0	6.0	5.6
	Queen Street	2024	ND	ND	-	-	-	-	-	-	-	-	-	-
		Past 5 years	7.1	6.8	6.4	7.0	7.7	7.5	8.5	8.1	7.5	7.6	8.0	8.2
	Takapuna	2024	5.8	5.7	-	-	-	-	-	-	-	-	-	-
		Past 5 years	5.9	5.4	4.9	5.9	7.0	7.4	8.3	7.5	6.8	6.2	6.8	6.3
NO_2 ($\mu g/m^3$)	Customs Street	2024	17.0	22.2	-	-	-	-	-	-	-	-	-	-
		Past 4 years	30.8	31.9	34.3	28.5	33.7	46.7	33.7	34.4	28.7	27.6	23.5	22.1
	Glen Eden	2024	2.5	3.1	-	-	-	-	-	-	-	-	-	-
		Past 5 years	2.7	3.4	4.0	4.6	7.2	7.8	7.0	6.1	4.6	4.4	3.7	2.9
	Henderson	2024	4.2	6.2	-	-	-	-	-	-	-	-	-	-
		Past 5 years	4.0	6.8	8.1	8.7	11.6	12.9	10.7	9.4	7.7	6.4	6.1	4.5
	Khyber Pass Road	2024	14.2	18.6	-	-	-	-	-	-	-	-	-	-
		Past 5 years	19.0	19.2	23.3	22.4	30.4	33.2	33.2	32.5	28.7	23.9	28.2	19.0
	Patumahoe	2024	1.9	2.5	-	-	-	-	-	-	-	-	-	-
		Past 5 years	1.6	2.3	3.1	3.3	4.1	4.3	3.9	3.6	2.6	2.3	2.3	1.9
	Penrose	2024	7.0	10.8	-	-	-	-	-	-	-	-	-	-
		Past 5 years	9.1	10.6	13.6	15.4	20.2	21.4	20.5	18.2	14.6	11.3	12.2	7.9
	Queen Street	2024	ND	ND	-	-	-	-	-	-	-	-	-	-
		Past 5 years	25.1	24.8	30.4	30.7	33.3	36.2	40.5	41.2	34.9	33.1	30.2	26.3
	Takapuna	2024	7.7	11.0	-	-	-	-	-	-	-	-	-	-
		Past 5 years	6.6	8.4	12.2	13.8	18.9	20.6	20.3	18.8	14.4	11.5	12.2	8.1
SO_2 ($\mu g/m^3$)	Customs Street	2024	2.0	2.3	-	-	-	-	-	-	-	-	-	-
		Past 4 years	1.8	1.8	2.4	1.9	2.0	4.1	2.5	2.9	2.5	2.2	2.0	1.9
	Penrose	2024	2.5	2.1	-	-	-	-	-	-	-	-	-	-
		Past 5 years	0.6	1.0	1.2	0.9	1.2	1.3	1.1	0.9	0.9	0.9	1.2	0.9
O_3 ($\mu g/m^3$)	Patumahoe	2024	27.6	27.4	-	-	-	-	-	-	-	-	-	-
		Past 5 years	26.7	28.3	30.5	36.6	39.7	42.1	47.6	50.5	51.9	47.3	39.6	31.1
CO (mg/m^3)	Khyber Pass Road	2024	0.006	0.007	-	-	-	-	-	-	-	-	-	-
		Past 5 years	0.032	0.039	0.044	0.058	0.126	0.134	0.167	0.119	0.056	0.023	0.021	0.011
Black carbon (ng/m^3)	Customs Street	2024	1160	1248	-	-	-	-	-	-	-	-	-	-
		Past 4 years	1365	1437	1426	1178	1381	3075	1317	1481	1090	1070	1205	1088
	Henderson	2024	186	281	-	-	-	-	-	-	-	-	-	-
		Past 5 years	244	406	523	524	906	1084	912	700	458	334	339	286

ND = No data: station has been temporarily closed due to the renovation of the building hosting the site.

Find out more:
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