9 March 2023

Research and Evaluation Unit | RIMU

Auckland Air Quality Report

Monthly update

Introduction

We are committed to continuously collecting air quality data to ensure compliance with national standards and aid policy development and evaluation. The data we collect provides a better understanding of ambient air quality in the region, including spatial and temporal variations. To provide regular updates on air quality in Auckland, this report presents a monthly summary. The report is divided into four sections, with sections A and B featuring tables and graphics that illustrate air quality status in the Auckland region based on data collected from continuous monitoring sites across the region.

For this edition, section C focuses on one monitoring site, the Khyber Pass Road. Section D provides monthly averages for 2023 and the past two to five years of pollutant concentrations (when data is available). The monthly update is prepared using validated data, which is typically available one month after raw data collection. This report covers data up to 31 January 2023. By providing regular updates on air quality, Auckland Council aims to promote awareness and encourage actions to improve air quality in the region.

Summary

All monitoring sites have recorded lower concentrations of particulate matter ($PM_{2.5}$ and PM_{10}) compared to the previous year. This reduction can be attributed to increased rainfall in January, resulting in reduced airborne particulates.

As expected, the city centre sites have recorded the highest levels of nitrogen dioxide (NO_2) concentrations, though these levels are lower than the same period in the previous year.

There has been a significant decrease of 73% in carbon monoxide (CO) average concentration measured at the Khyber Pass Road monitoring site compared to the same period in the previous year. This decrease can be attributed to the reduction in traffic in that area. According to Auckland Transport's seven-day traffic count data, the traffic volume in 2022 decreased compared to 2021, from 130,388 to 125,249 vehicles.

It is important to note that air quality at a monitoring site can vary from year to year due to weather and other influences. For a trend analysis of change, please see Table 2 and *Auckland air quality report, October 2021*.

Overall, the report highlights that there have been improvements in some areas such as PM and CO concentrations. However, continued monitoring and analysis are necessary to ensure sustained progress and identify areas that require further action.

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.
Air quality index (AQI)	Score out of 100, based on dividing a pollutant concentration by a relevant standard. It can be used to approximate relative impact of different pollutants.
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

Data can be viewed on the environmental data portal , 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 *2021 Annual data report* is available on the Knowledge Auckland website. The 2022 annual data report is in preparation.

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

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
	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 equivalent (CO_2e)	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 31 January 2023

Number of exceedances of NESAQ In 2023	0	
Number of exceedances of Auckland ambient air quality targets in 2023	0	
Maximum PM_{10} 24-hours mean (January 2023)	29.0 µg/m^3 (58.0% of NESAQ)	Recorded at Henderson on 22 Jan 2023
Maximum $PM_{2.5}$ 24-hour mean (January 2023)	10.5 µg/m^3 (42.0% of Auckland target)	Recorded at Queen St on 4 Jan 2023
Maximum NO_2 1-hour mean (January 2023)	58.0 µg/m^3 (29.0% of NESAQ)	Recorded at Customs Street on 19 Jan 2023
Maximum SO_2 1-hour mean (January 2023)	15.0 µg/m^3 (4.3% of NESAQ)	Recorded at Customs Street on 15 Jan 2023
Maximum O_3 1-hour mean (January 2023)	66.0 µg/m^3 (44.0% of NESAQ)	Recorded at Patumahoe on 8 Jan 2023
Maximum CO running 8-hour mean (January 2023)	0.32 mg/m^3 (3.2% of NESAQ)	Recorded at Khyber Pass Rd on 11 Jan 2023
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. General changes in concentration of key contaminants monitored for the last 25, 37 and 49 months.

↑ indicates an increase ↓ indicates a decrease ↗ increase but not significant ↘ decrease but not significant

	PM_{10}			$PM_{2.5}$			NO_2			Black carbon			Ozone			CO			SO_2			Air Quality Index(AQI)			
Site	*Last 25 months*	*Last 37 months*	*Last 49 months*	*Last 25 months*	*Last 37 months*	*Last 49 months*	*Last 25 months*	*Last 37 months*	*Last 49 months*	*Last 25 months*	*Last 37 months*	*Last 49 months*	*Last 25 months*	*Last 37 months*	*Last 49 months*	*Last 25 months*	*Last 37 months*	*Last 49 months*	*Last 25 months*	*Last 37 months*	*Last 49 months*	*Last 25 months*	*Last 37 months*	*Last 49 months*	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	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	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	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	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
	PM_{10}			$PM_{2.5}$			NO_2			Black carbon			Ozone			CO			SO_2			Air Quality Index(AQI)			

Notes

Change significance was determined using the Theil-Sen method: ↑ and ↓ mean change is statistically significant at the 0.05 level, 95% confidence intervals.

Effective dates: 25 months (1 January 2021 to 31 January 2023), 37 months (1 January 2020 to 31 January 2023), and 49 months (1 January 2019 to 31 January 2023).

PM_{10} is monitored at Glen Eden, Henderson, Khyber Pass Rd, Pakuranga, Papatoetoe, Patumahoe, Penrose, Takapuna, and Queen St.

$PM_{2.5}$ is monitored at Customs St, Glen Eden, Pakuranga, Patumahoe, Penrose, Takapuna, and Queen St.

NO_2 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.

SO_2 is monitored at Customs St, and Penrose.

*$PM_{2.5}$ data coverage for Glen Eden, Customs Street and Pakuranga is less than 75% due to instrument failure between September 2021 and January 2022. Weather changes significantly affect concentrations of air contaminants (see *Auckland air quality report, October 2021*).

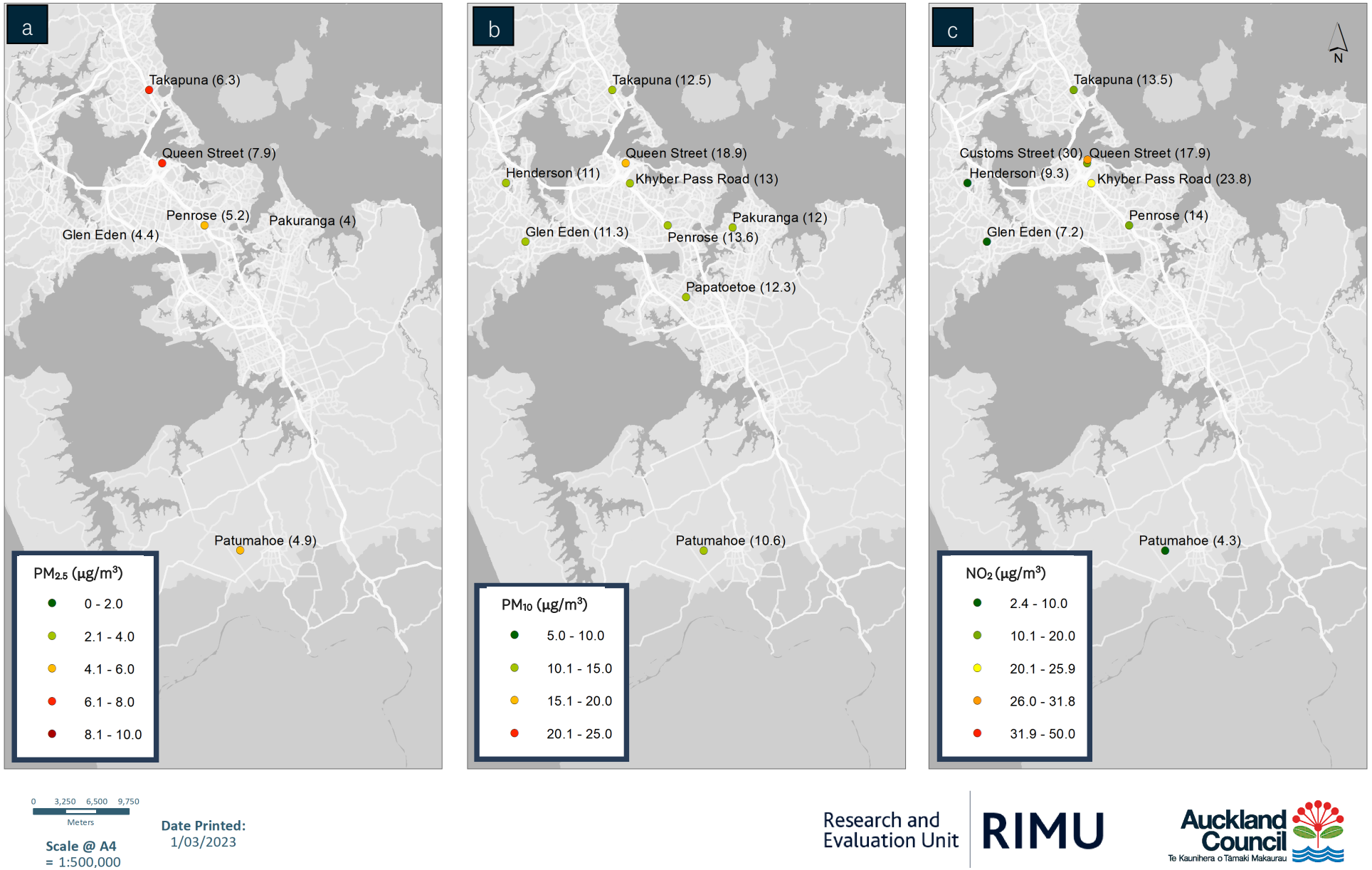


Figure 1. Maps a, b and c show the air quality monitoring sites and their last 12 months (1 February 2022 to 31 January 2023) average PM and NO_2 concentrations in brackets. Auckland city centre monitoring sites recorded the highest PM and NO_2 concentrations.

Section B. Key air contaminants across the 10 air quality monitoring sites (January 2023 compared to January 2022)

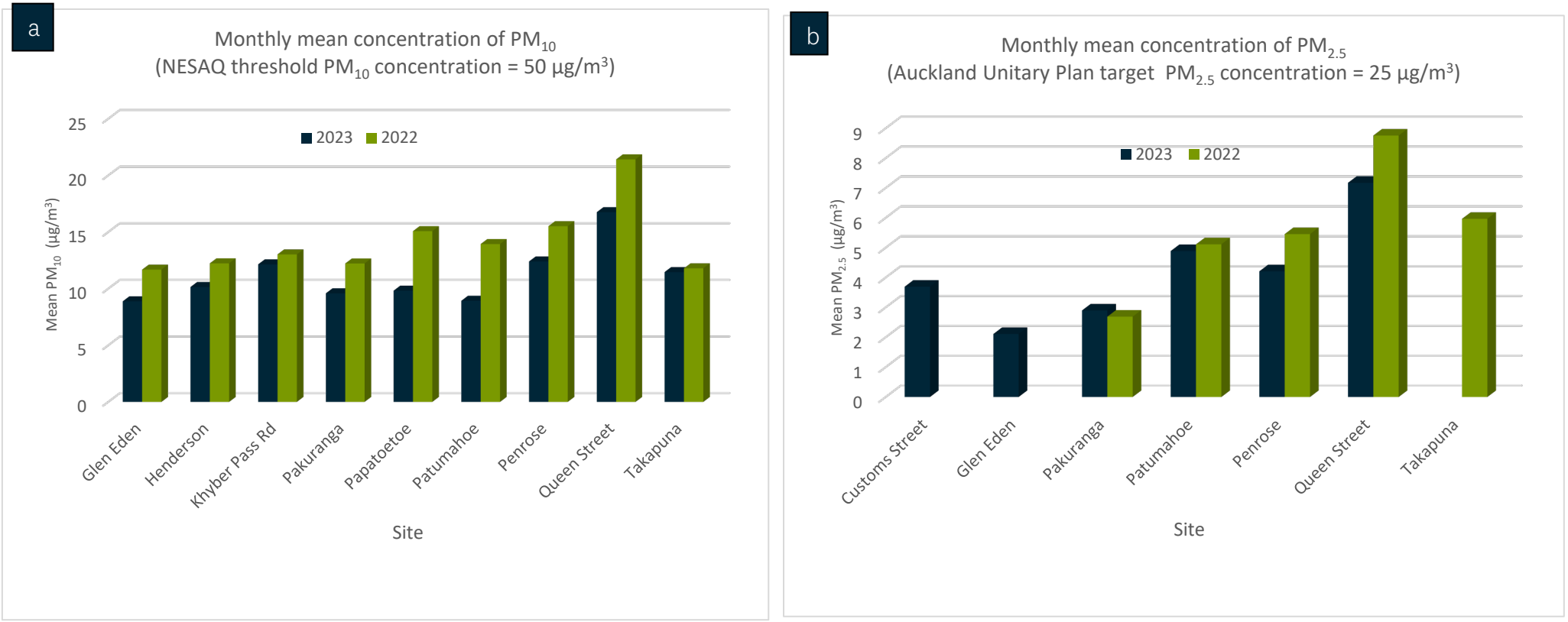
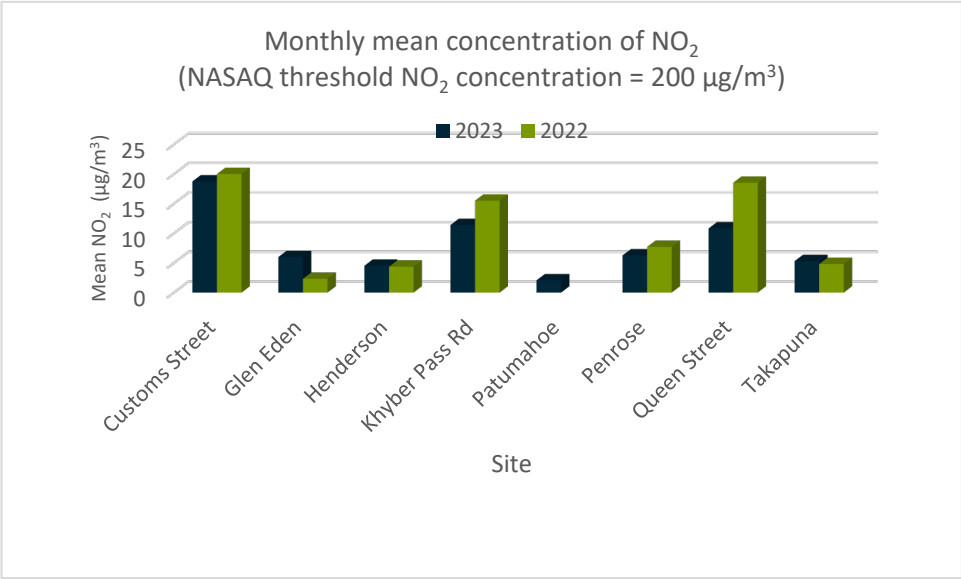


Figure 2. January mean particulate matter concentration – 2023 and 2022 compared. As in the previous year, the highest concentrations of both PM_{10} and $PM_{2.5}$ were recorded at Queen St. Plots a and b represent $PM_{2.5}$ and PM_{10} respectively. The average particulate matter concentration at Queen St is higher than the same period of the previous year. PM_{10} and $PM_{2.5}$ have multiple sources including motor vehicles, sea salt, marine diesel and soils (windblown soil, road dust, and dust generated by earthworks, construction, and road works).



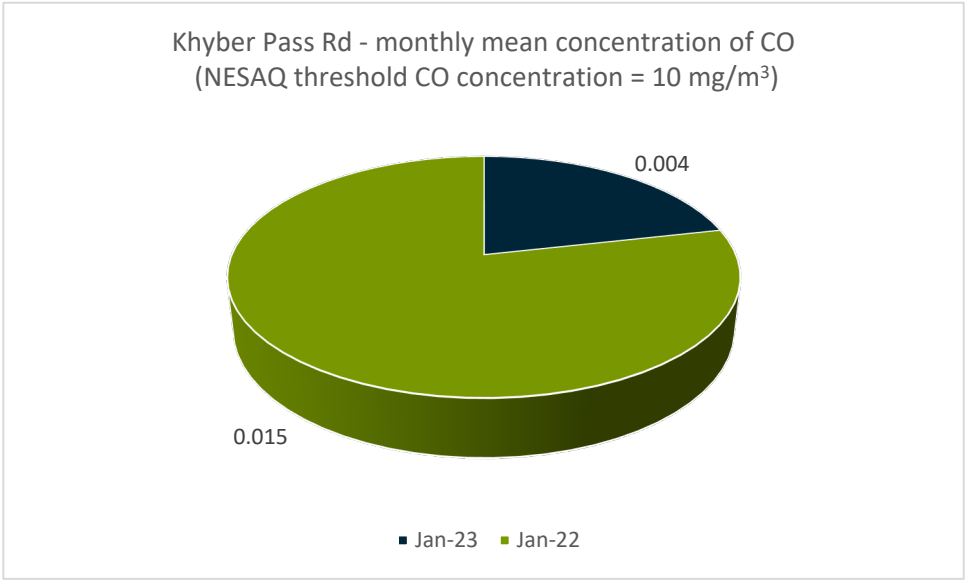


Figure 3. January mean NO_2 concentration – 2023 and 2022 compared. Auckland city centre monitoring sites recorded the highest concentrations. The main source of NO_2 is motor vehicles.

Figure 4. Shows a comparison of the January mean CO concentration in 2023 and 2022. The mean CO concentration in 2023 is 72.9% less than in the previous year. The main source of CO is motor vehicles. It's worth noting that CO is currently only monitored at Khyber Pass Road. According to Auckland Transport's 7-day traffic count data, the traffic volume in 2022 decreased compared to 2021, from 130,388 to 125,249 vehicles. The count was conducted at Khyber Pass Road, between Mountain Rd and Maungawhau Rd (both directions). The 2021 count took place between May 24th and 30th, while the 2022 count occurred between June 13th and 19th.

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

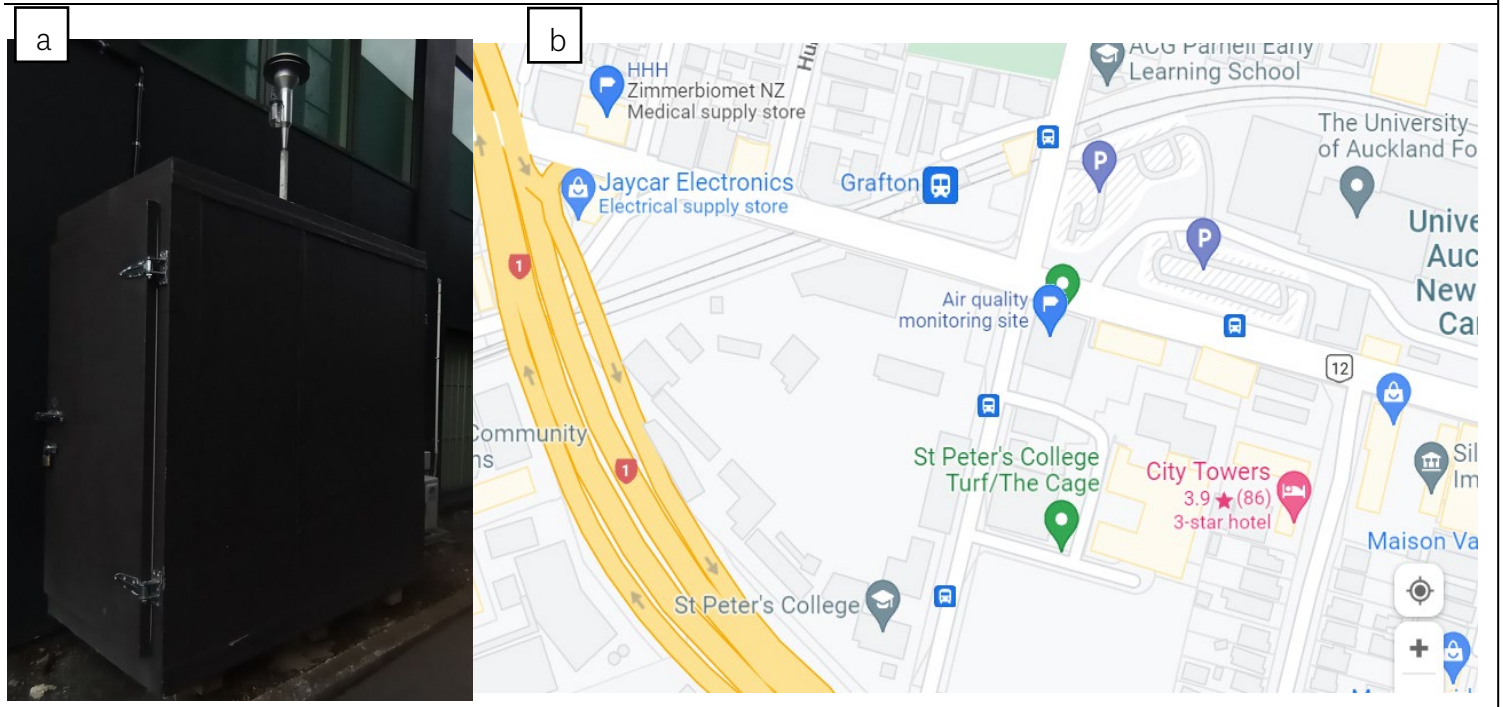


Figure 5. The Khyber Pass Road air quality monitoring site is located between 269 and 289 Khyber Pass Road, Newmarket. Image a shows the air quality monitoring shed viewed from the east. Image b is an aerial view of the monitoring site and surroundings taken in March 2023 (Source: Google Maps). Air quality 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 sources of air contaminants are motor vehicles, biomass burning, and soils.

Key findings:

- The average PM_{10} concentration at Khyber Pass Road is 23.3% higher than Auckland's average and 51.3% higher than Patumahoe, a rural site.
- Khyber Pass Road's average NO_2 concentration is 46.6% 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 (January 2006 to January 2023). This trend is likely due to reduced vehicle traffic.

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.

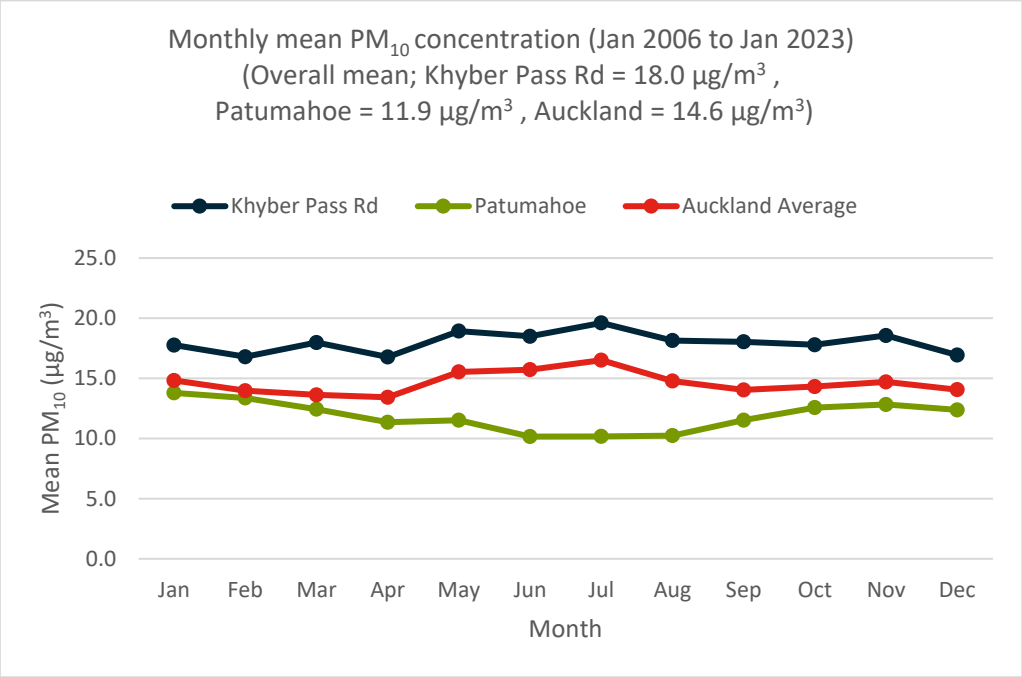


Figure 6. Temporal variation in monthly PM_{10} concentrations – Khyber Pass Rd site compared to Patumahoe (rural site) and Auckland average. Overall, Khyber Pass Rd site average PM_{10} concentration is 23.3% and 51.3% higher than Auckland's average and Patumahoe site, respectively.

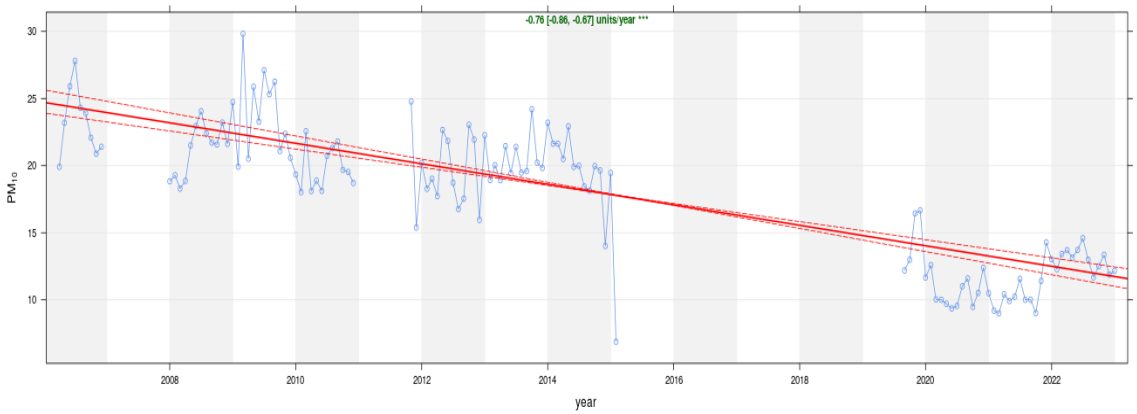


Figure 7. January 2006 to January 2023, trends in PM_{10} at Khyber Pass Rd site. The plot shows the deseasonalised monthly mean concentrations of PM_{10}. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as – 0.76 (µg/m^3) per year (statistically significant at the 0.05 level) and the 95% confidence intervals in the slope from -0.86 – (- 0.67) µg/m^3/year.

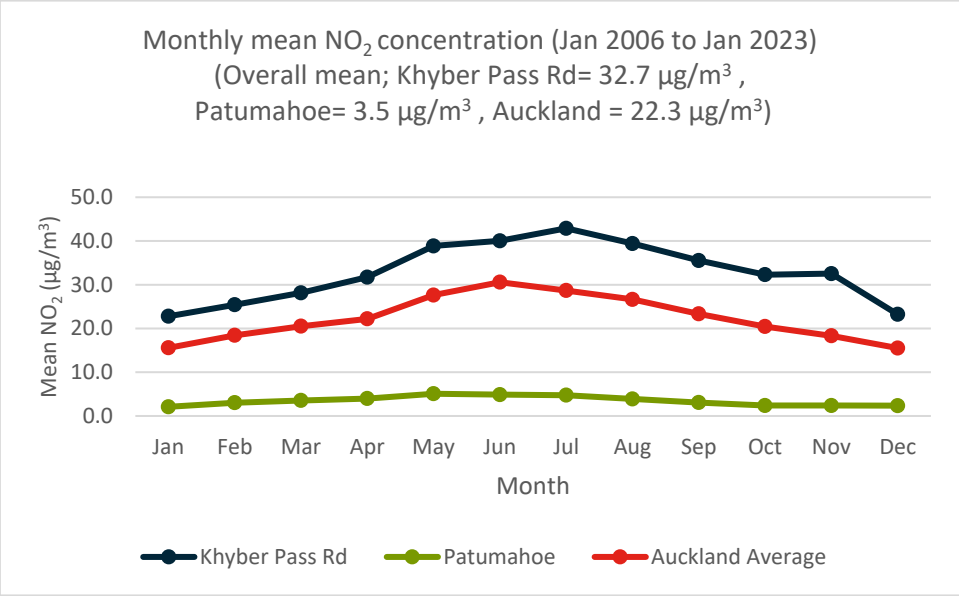


Figure 8. Temporal variation in monthly NO_2 concentrations – Khyber Pass Rd site compared to Patumahoe (rural site) and Auckland average. Overall, Khyber Pass Rd site average NO_2 concentration is 46.6% higher than Auckland's average and nine times higher than the Patumahoe rural site.

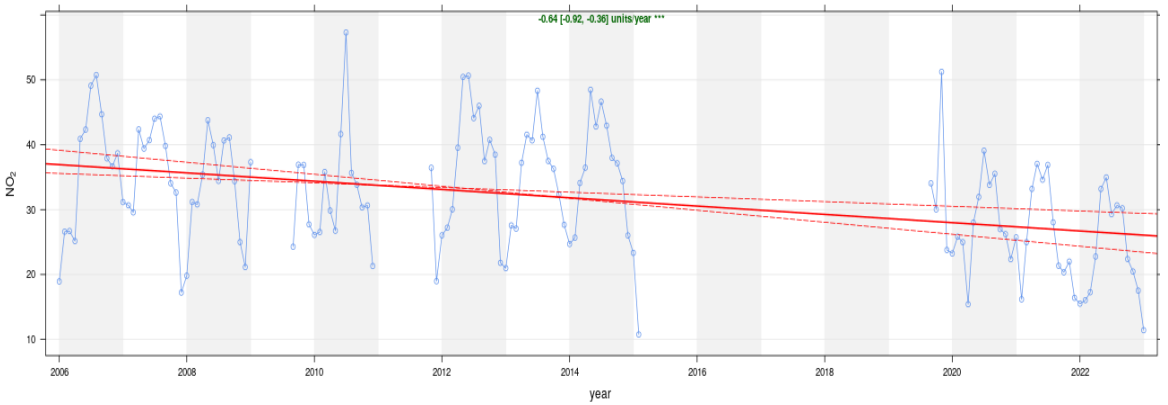


Figure 9. January 2006 to January 2023, trends in NO_2 at Khyber Pass Rd site. The plot shows the deseasonalised monthly mean concentrations of NO_2. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as – 0.64 (µg/m^3) per year (statistically significant at the 0.05 level) and the 95% confidence intervals in the slope from -0.92 – (- 0.36) µg/m^3/year.

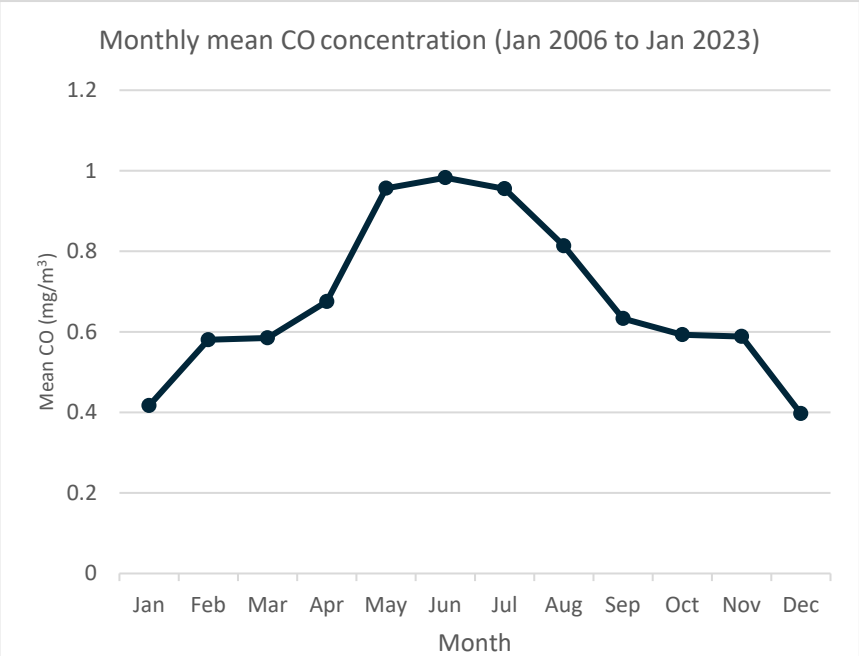


Figure 10. Temporal variation in average monthly CO concentrations. The highest concentrations tend to occur during winter months.

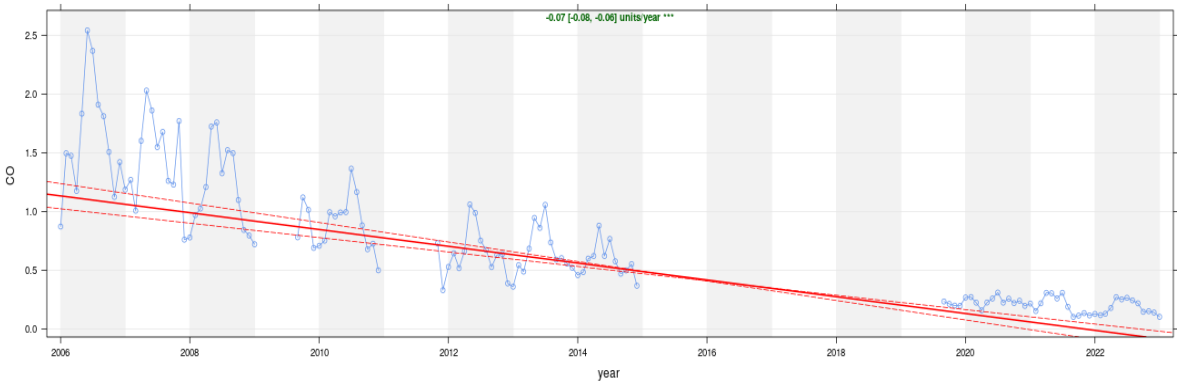


Figure 11. January 2006 to January 2023, trends in CO at Khyber Pass Rd site. The plot shows the deseasonalised monthly mean concentrations of CO. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as – 0.07 (mg/m^3) per year (statistically significant at the 0.05 level) and the 95% confidence intervals in the slope from -0.08 – (- 0.06) mg/m^3/year.

Section D. Table 3. Monthly averages: 2023 and past two 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	2023	8.9	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	11.6	11.1	9.6	11.1	12.9	15.4	15.6	13.8	11.5	10.2	11.9	12.9
	Henderson	2023	10.1	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	12.0	11.5	11.0	11.7	12.5	12.9	13.1	12.1	11.1	10.5	12.5	12.8
	Khyber Pass Road	2023	12.2											
		Past 4 years	11.8	11.4	10.8	11.4	10.9	11.1	11.9	11.3	11.2	11.0	12.9	13.8
	Pakuranga	2023	9.6	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	12.1	11.5	10.0	10.7	12.4	13.3	14.2	13.0	11.4	10.9	12.6	12.7
	Papatoetoe	2023	9.8	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	14.2	13.6	12.4	13.1	14.0	14.0	15.6	14.3	13.5	13.0	14.5	14.7
	Patumahoe	2023	8.9	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	14.9	14.3	12.5	12.2	11.8	9.9	10.5	10.8	11.4	11.1	13.3	14.9
	Penrose	2023	12.4	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	15.6	14.9	14.1	14.3	15.5	14.2	14.9	13.9	13.5	12.9	15.0	15.9
	Queen Street	2023	16.8	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	17.5	16.7	16.0	16.5	16.9	16.7	18.4	18.2	17.8	17.9	19.1	19.4
	Takapuna	2023	11.5	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	13.1	12.3	11.0	12.4	12.8	13.3	14.1	12.9	11.7	11.3	13.0	13.4
$PM_{2.5}$ ($\mu g/m^3$)	Customs Street	2023	3.7	-	-	-	-	-	-	-	-	-	-	-
		Past 3 years	4.4	3.7	3.3	3.9	4.0	4.7	4.8	5.6	5.5	3.8	3.8	3.7
	Glen Eden	2023	2.1	-	-	-	-	-	-	-	-	-	-	-
		Past 4 years	2.7	2.5	2.0	3.1	5.7	9.8	9.7	7.7	5.0	3.2	3.5	3.2
	Pakuranga	2023	2.9	-	-	-	-	-	-	-	-	-	-	-
		Past 4 years	3.0	2.9	2.5	3.5	5.3	6.3	9.3	5.7	4.4	3.2	3.9	3.5
	Patumahoe	2023	4.9	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	5.4	4.5	4.3	5.0	5.4	5.1	4.7	4.8	4.7	4.4	5.2	5.3
	Penrose	2023	4.2	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	6.8	5.3	5.0	5.6	6.5	7.3	7.3	6.3	5.8	5.8	6.5	5.9
	Queen Street	2023	7.2	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	7.1	6.5	6.0	6.7	7.2	7.4	8.0	7.7	7.3	7.3	7.7	7.9
	Takapuna	2023	ND	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	5.9	5.4	4.9	5.7	6.8	8.2	8.8	7.7	6.6	6.1	6.7	6.3
NO_2 ($\mu g/m^3$)	Customs Street	2023	18.7	-	-	-	-	-	-	-	-	-	-	-
		Past 3 years	34.8	36.9	39.1	30.8	37.1	52.4	37.4	35.6	30.8	29.1	24.1	23.9
	Glen Eden	2023	6.0	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	2.0	3.0	4.0	4.6	7.4	8.2	7.9	6.1	4.7	4.6	3.8	2.9
	Henderson	2023	4.5	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	3.9	7.3	8.4	8.7	12.0	12.8	11.7	9.2	7.5	6.5	6.1	4.7
	Khyber Pass Road	2023	11.4	-	-	-	-	-	-	-	-	-	-	-
		Past 4 years	21.5	19.5	22.4	23.8	32.8	33.8	35.1	30.8	30.2	24.9	30.0	20.1
	Patumahoe	2023	2.1	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	1.4	2.0	2.9	2.8	3.8	4.2	4.3	3.4	2.5	2.4	2.4	2.1
	Penrose	2023	6.3	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	9.0	10.8	13.4	16.9	22.3	22.8	22.8	18.7	16.6	12.6	12.9	8.5
	Queen Street	2023	10.8	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	28.2	28.8	30.8	31.0	37.4	39.5	43.2	42.1	37.7	36.4	32.2	28.0
	Takapuna	2023	5.3											
		Past 5 years	6.5	8.4	10.7	14.6	20.2	21.1	22.1	18.5	15.2	12.7	11.8	7.9
SO_2 ($\mu g/m^3$)	Customs Street	2023	2.3	-	-	-	-	-	-	-	-	-	-	-
		Past 3 years	1.6	1.6	2.3	1.5	1.7	4.4	2.6	2.8	2.2	2.2	1.6	1.5
	Penrose	2023	1.2	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	0.5	0.8	1.1	0.8	1.2	1.2	1.0	0.8	1.0	0.8	1.0	0.5
O_3 ($\mu g/m^3$)	Patumahoe	2023	26.1	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	26.6	29.3	33.4	38.9	41.2	43.1	46.8	52.6	51.4	46.9	41.0	31.4
CO (mg/m^3)	Khyber Pass Road	2023	0.004	-	-	-	-	-	-	-	-	-	-	-
		Past 4 years	0.042	0.040	0.041	0.062	0.127	0.131	0.170	0.089	0.060	0.026	0.025	0.012
Black carbon (ng/m^3)	Customs Street	2023	1095	-	-	-	-	-	-	-	-	-	-	-
		Past 3 years	1447	1535	1316	1094	1356	3363	1350	1326	1034	1016	1127	1047
	Henderson	2023	247	-	-	-	-	-	-	-	-	-	-	-
		Past 5 years	265	458	566	540	995	1204	1113	879	542	412	381	301

ND = No data measured due to faulty sensor

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