20 May 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, Pakuranga. 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 30 April 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

Most monitoring sites have recorded slightly higher concentrations of particulate matter ($PM_{2.5}$) compared to the previous year. As in the previous year, the highest concentrations of both PM_{10} and $PM_{2.5}$ were recorded at Queen Street site. The ongoing construction activities in the city centre (e.g., the city rail link project) is a primary factor.

As expected, the city centre sites have recorded the highest levels of nitrogen dioxide (NO_2) concentrations. The Queen Street city centre site recorded higher levels of NO_2 in March and April, in contrast to the levels observed in the first two months of the year. This marks a deviation from the short-term downward trend in NO_2 levels that have been observed at the city centre sites since January 2020. The exact cause for this shift is unclear and requires further investigation.

There has been an increase in sulphur dioxide (SO_2) levels at the two monitoring stations, and the reason for this is unclear. Further studies are needed to determine the cause of this increase.

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*.

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 (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 30 April 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 to April 2023)	35.2 µg/m^3 (70.4% of NESAQ)	Recorded at Queen Street on 19 April 2023
Maximum $PM_{2.5}$ 24-hour mean (January to April 2023)	17.3 µg/m^3 (69.2% of Auckland target)	Recorded at Patumahoe on 8 Feb 2023
Maximum NO_2 1-hour mean (January to April 2023)	150.0 µg/m^3 (75.0% of NESAQ)	Recorded at Queen Street on 12 April 2023
Maximum SO_2 1-hour mean (January to April 2023)	24.0 µg/m^3 (6.8% of NESAQ)	Recorded at Customs Street on 27 April 2023
Maximum O_3 1-hour mean (January to April 2023)	67.0 µg/m^3 (44.7% of NESAQ)	Recorded at Patumahoe on 10 April 2023
Maximum CO running 8-hour mean (January to April 2023)	0.54 mg/m^3 (5.4% of NESAQ)	Recorded at Khyber Pass Rd on 22 Feb 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 28, 40 and 52 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 28 months*	*Last 40 months*	*Last 52 months*	*Last 28 months*	*Last 40 months*	*Last 52 months*	*Last 28 months*	*Last 40 months*	*Last 52 months*	*Last 28 months*	*Last 40 months*	*Last 52 months*	*Last 28 months*	*Last 40 months*	*Last 52 months*	*Last 28 months*	*Last 40 months*	*Last 52 months*	*Last 28 months*	*Last 40 months*	*Last 52 months*	*Last 28 months*	*Last 40 months*	*Last 52 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: 28 months (1 January 2021 to 30 April 2023), 40 months (1 January 2020 to 30 April 2023), and 52 months (1 January 2019 to 30 April 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*). No data for Takapuna in Jan and Feb 2023 due to the Auckland floods.

Figure 1. Maps a, b and c show the air quality monitoring sites and their last 12 months (1 May 2022 to 30 April 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 (1 January 2023 to 30 April 2023)

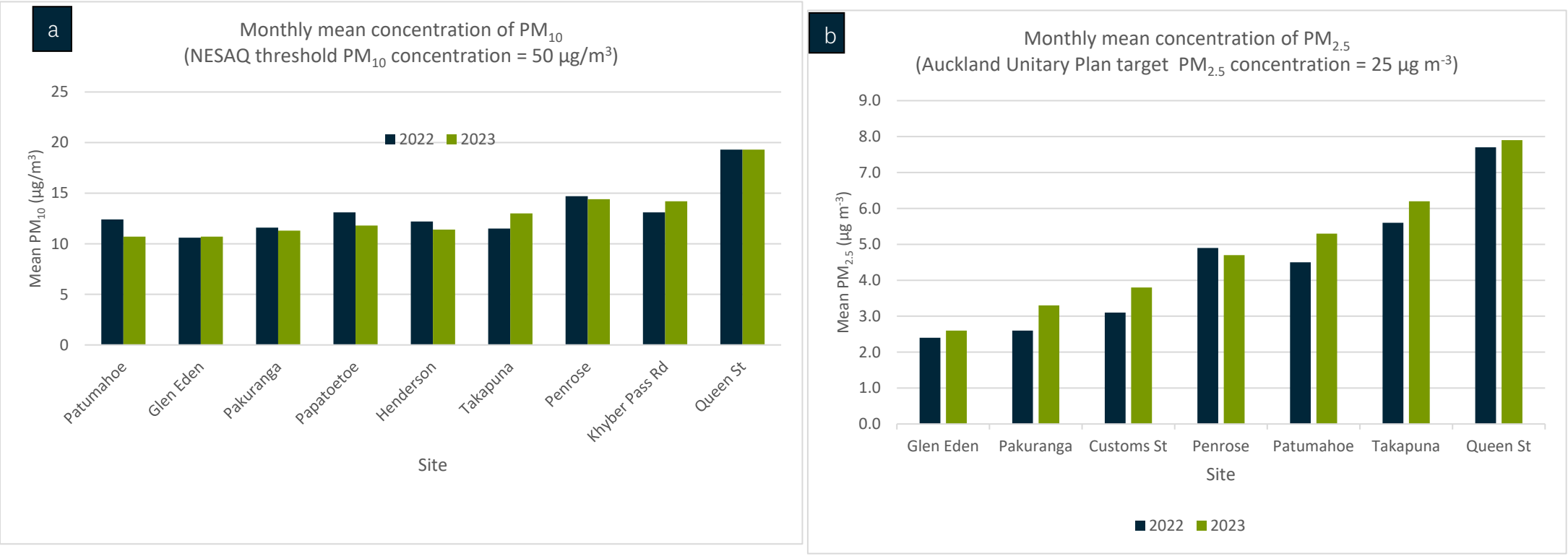

Figure 2. Monthly mean particulate matter concentration. As in the previous year, the highest concentrations of both PM_{10} and $PM_{2.5}$ were recorded at Queen Street site. Plots a and b represent PM_{10} and $PM_{2.5}$ respectively. The average particulate matter concentration at Queen Street is slightly higher than the same period of the previous year. 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).

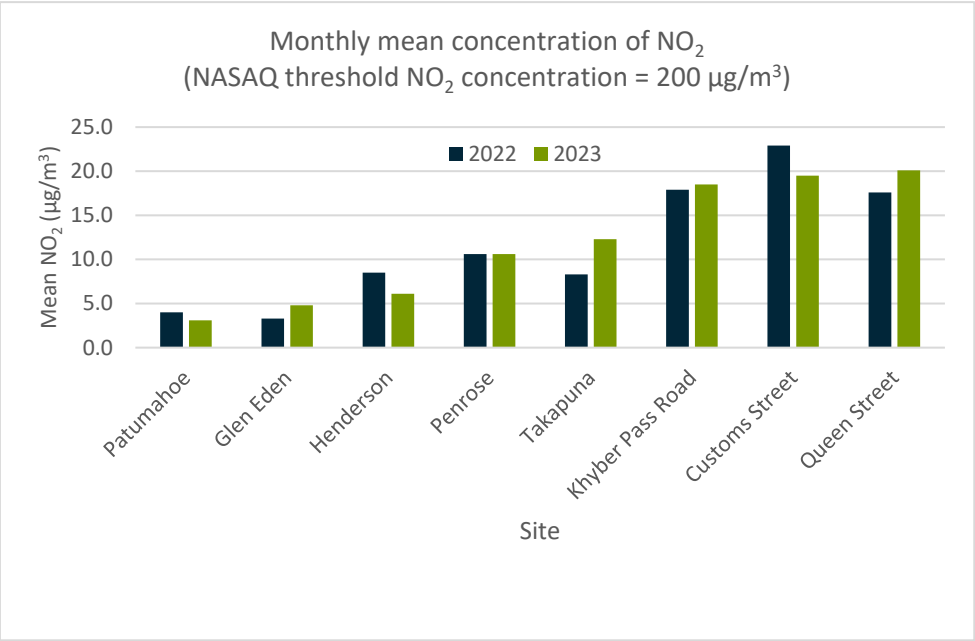

Figure 3. Monthly mean NO_2 concentration in Auckland. The highest concentrations were recorded at monitoring sites in the city centre. In March and April higher levels of NO_2 were recorded at Queen Street compared to the previous year. Motor vehicles are the primary source of NO_2.

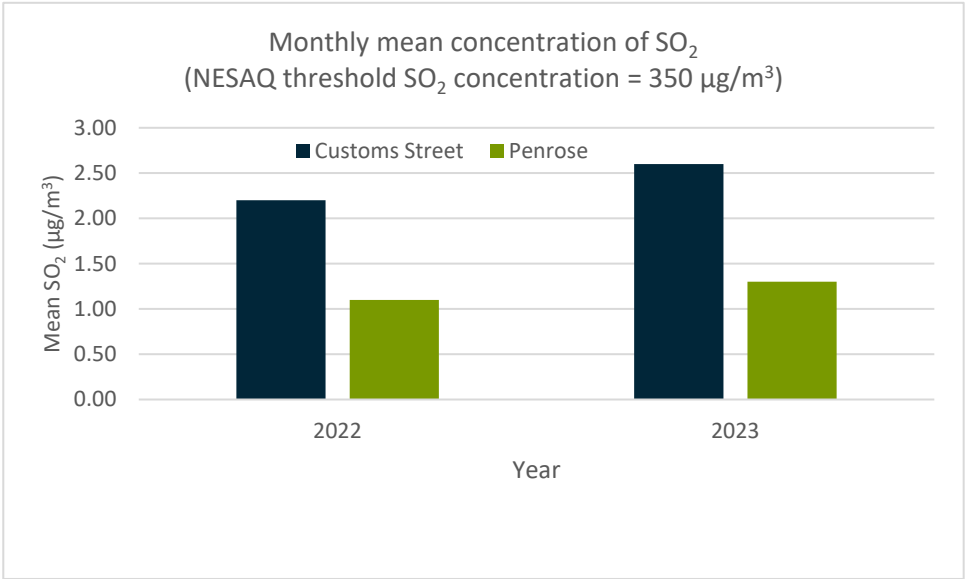

Figure 4. Monthly mean SO_2 levels at Customs Street and Penrose sites. The highest concentrations were recorded at the Customs Street monitoring site in the city centre. The mean concentrations at both sites were higher than the previous year. SO_2 is produced from the combustion of fossil fuels that 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.

Section C. Focus on a monitoring site: Pakuranga

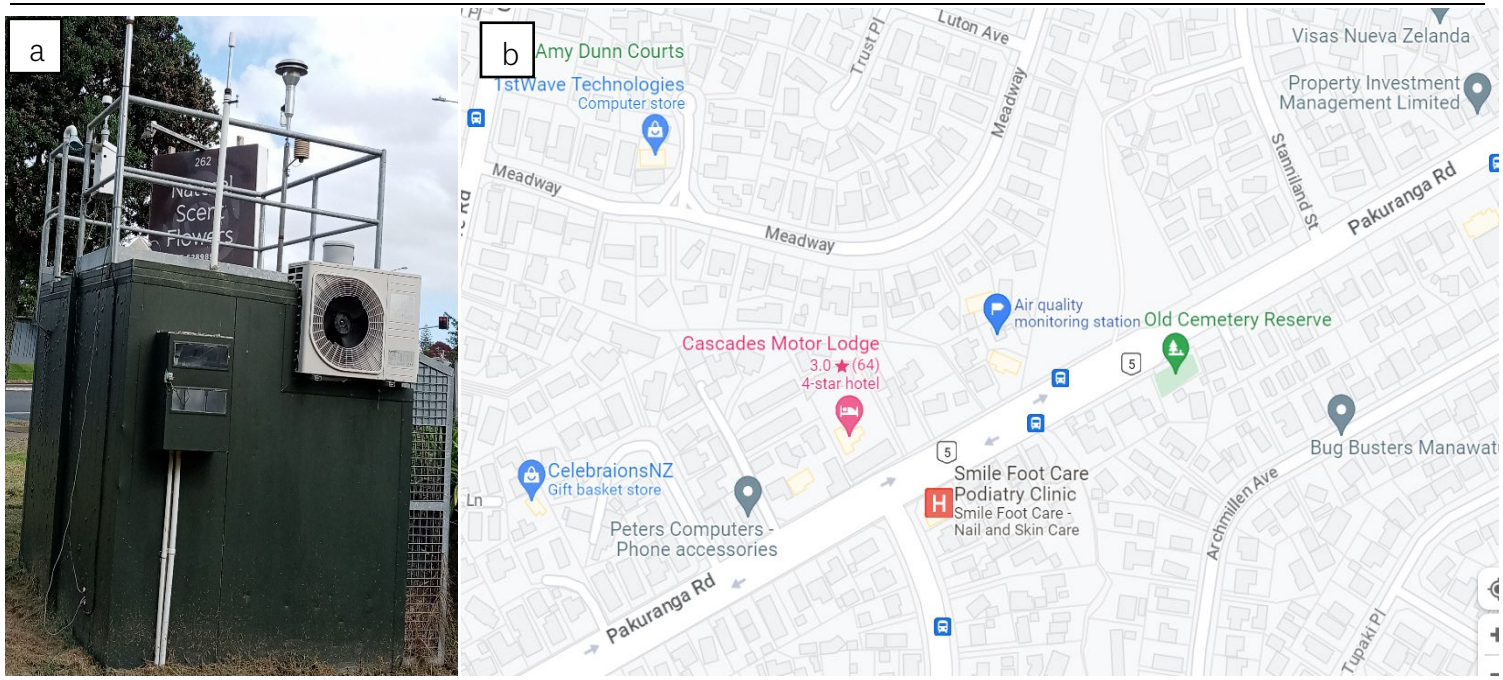

Figure 5. The Pakuranga air quality monitoring site is located within the Bell Reserve, Adjacent to 262A Pakuranga Rd Pakuranga, Manukau. Image a shows the air quality monitoring shed. Image b is an aerial view of the monitoring site and surroundings taken in May 2023 (Source: Google Maps). Air quality monitoring at this site commenced on 18th May 1998. PM_{10}, $PM_{2.5}$ and meteorological parameters are monitored at this site. The main sources of air contaminants are motor vehicles, home heating and roadside dust.

Key findings:

- Pakuranga's average PM_{10} concentration is 1.4% lower than Auckland's average, but 21% higher than Patumahoe rural site.
- The average $PM_{2.5}$ concentration at Pakuranga site is 22.2% lower than Auckland's average and 4.4% lower than Patumahoe site.
- It is worth noting that this monitoring site represents urban background. Thus, lower air pollutant concentrations are expected at this site compared to Auckland's other urban areas.
- The results of trend analysis reveal a decrease in both PM_{10} and $PM_{2.5}$ concentration over the monitoring period.

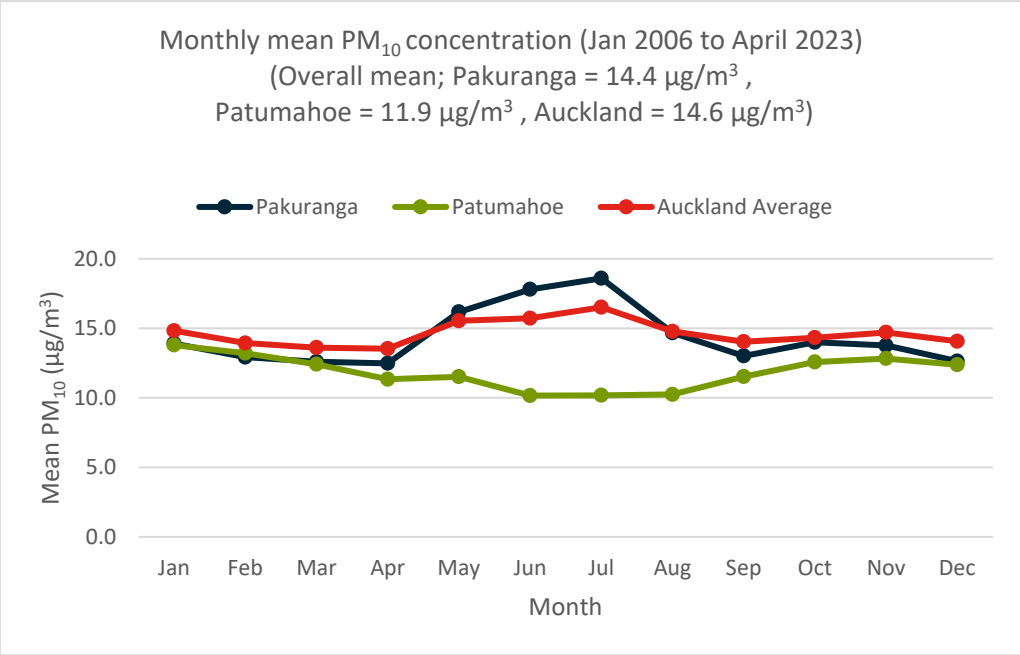

Figure 6. Monthly mean PM_{10} concentrations over time - comparison between Pakuranga, Patumahoe (rural site) and Auckland's Average. The average PM_{10} concentration at Pakuranga site is 1.4% lower than Auckland's average, but 21% higher than Patumahoe site.

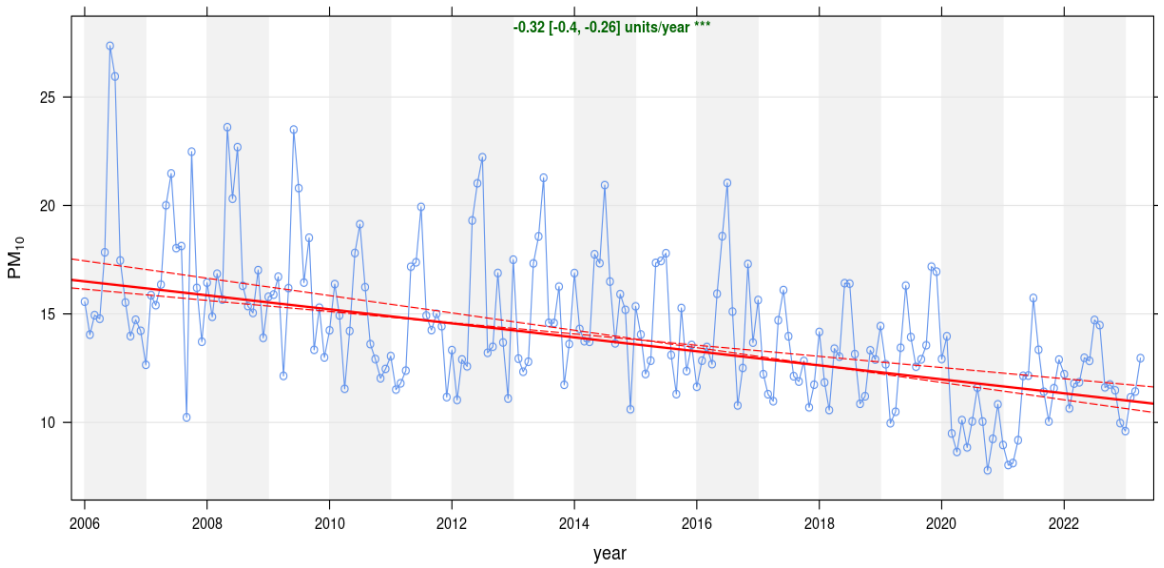

Figure 7. Trends in PM_{10} Concentrations at Pakuranga from January 2006 to April 2023. The plot shows the deseasonalised monthly mean concentrations of PM_{10}. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as -0.32 (µg/m^3) per year (statistically significant at the 0.05 level) and the 95% confidence intervals in the slope from -0.04 – (-0.26) µg/m^3/year

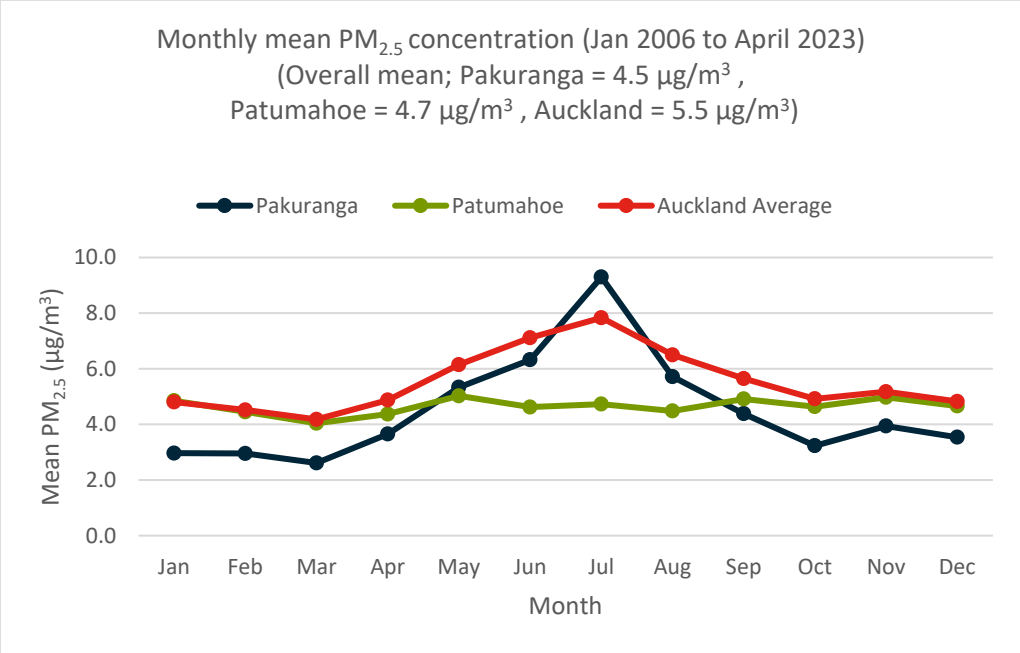

Figure 8. Monthly mean $PM_{2.5}$ concentrations over time - comparison between Pakuranga, Patumahoe (rural site) and Auckland's Average. The average $PM_{2.5}$ concentration at Pakuranga site is 22.2% and 4.4% lower than Auckland's average and Patumahoe site respectively.

Figure 9. Trends in $PM_{2.5}$ Concentrations at Pakuranga from March 2019 to April 2023. The plot shows the deseasonalised monthly mean concentrations of $PM_{2.5}$. 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 -0.23 (µg/m^3) per year (statistically significant at the 0.05 level) and the 95% confidence intervals in the slope from -0.65 – (0.08) µg/m^3/year.

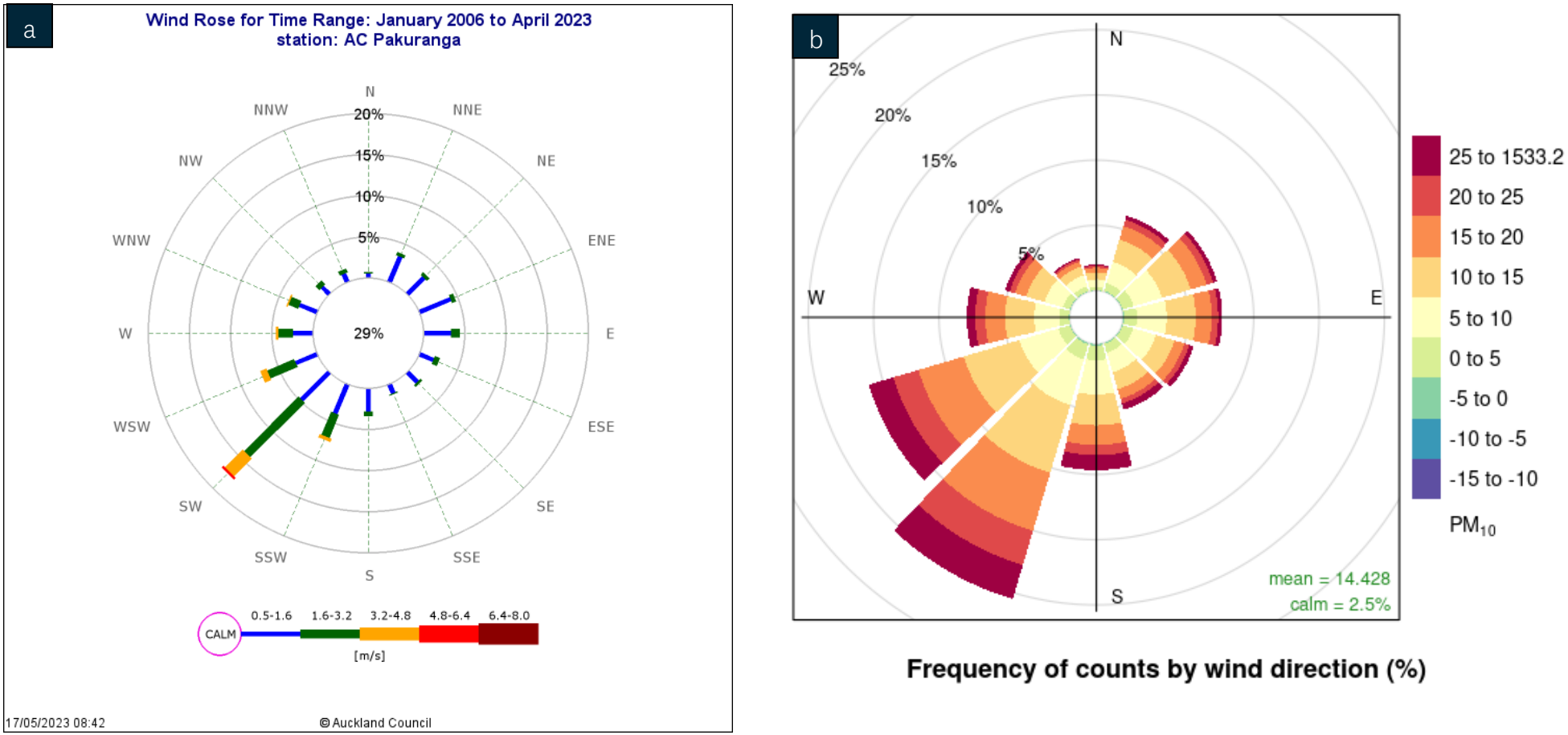

Figure 10. Wind and pollution roses for Pakuranga air quality monitoring site. Plots a and b represent wind and pollution roses, respectively. Wind speeds are split into the intervals indicated by the scale in each panel. The grey circles show the percent frequencies. Higher PM_{10} concentrations ($\mu g/m^3$) are associated with predominant prevailing wind direction from the southwest.

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	10.9	10.0	13.0	-	-	-	-	-	-	-	-
		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	12.2	10.6	12.5	-	-	-	-	-	-	-	-
		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	14.6	14.0	16.0	-	-	-	-	-	-	-	-
		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	11.1	11.4	13.0	-	-	-	-	-	-	-	-
		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	12.0	12.8	12.6	-	-	-	-	-	-	-	-
		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	10.7	12.0	11.0	-	-	-	-	-	-	-	-
		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	14.2	14.6	16.5	-	-	-	-	-	-	-	-
		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	19.5	19.2	21.7	-	-	-	-	-	-	-	-
		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	ND	12.6	15.0	-	-	-	-	-	-	-	-
		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	3.8	3.1	4.5	-	-	-	-	-	-	-	-
		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	2.7	2.2	3.3	-	-	-	-	-	-	-	-
		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	3.2	3.1	4.0	-	-	-	-	-	-	-	-
		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	6.4	4.8	5.2	-	-	-	-	-	-	-	-
		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	4.7	4.6	5.1	-	-	-	-	-	-	-	-
		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	8.0	7.5	9.0	-	-	-	-	-	-	-	-
		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	ND	5.3	7.1	-	-	-	-	-	-	-	-
		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	17.8	20.1	21.3	-	-	-	-	-	-	-	-
		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	5.0	4.0	4.1	-	-	-	-	-	-	-	-
		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	5.1	7.0	7.6	-	-	-	-	-	-	-	-
		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	18.7	26.0	11.2	-	-	-	-	-	-	-	-
		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	2.5	3.2	4.6	-	-	-	-	-	-	-	-
		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	9.2	15.4	11.7	-	-	-	-	-	-	-	-
		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	10.0	30.1	29.7								
		Past 5 years	28.2	28.8	30.8	31.0	-	-	-	-	-	-	-	-
	Takapuna	2023	5.3	ND	19.0	12.6								
		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	2.4	2.5	3.2	-	-	-	-	-	-	-	-
		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	1.6	1.7	0.9	-	-	-	-	-	-	-	-
		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	25.8	26.3	40.1	-	-	-	-	-	-	-	-
		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	0.105	0.159	0.220	0.160	-	-	-	-	-	-	-	-
		Past 4 years	0.206	0.180	0.192	0.216	0.268	0.258	0.297	0.220	0.204	0.178	0.183	0.164
Black carbon (ng/m^3)	Customs Street	2023	1095	1286	1735	1429	-	-	-	-	-	-	-	-
		Past 3 years	1447	1535	1316	1094	1356	3363	1350	1326	1034	1016	1127	1047
	Henderson	2023	247	316	510	455	-	-	-	-	-	-	-	-
		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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