1 December 2022

Auckland Air Quality Report

Monthly update

Research and Evaluation Unit | RIMU

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Introduction

Auckland Council continuously collects air quality data to assess compliance with national standards and provide information to aid policy development and evaluation. The data the council collects enables us to quantify ambient air quality in the region and note spatial and temporal variations. This report presents a monthly update on air quality in Auckland. It has four sections: sections A and B present tables and graphics illustrating air quality status in the Auckland region based on the data collected from continuous monitoring sites across the region. For this edition, section C focuses on one monitoring site – Papatoetoe. Section D provides the monthly averages for 2022 and the past two to five years' pollutant concentrations (when data is available). The monthly update is prepared using validated data which is generally available one month after raw data is collected. This update covers data to October 2022.

Summary

- In October, there was no exceedance of the National Environmental Standard for Air Quality (NESAQ).
- Apart from the city centre sites, all the air quality monitoring sites recorded average NO_2 concentrations higher than the same period of the previous year (January to October).
- As expected, the highest NO_2 concentrations were measured at the city centre sites, although the concentrations are lower than the same period of the previous year. Auckland transport traffic volume data, collected between 15 - 21 August, shows that 24 hour traffic volume at the city centre monitored intersections are between 70 % to 80 % relative to normal (pre-covid levels).
- Most monitoring sites recorded particulate matter (PM_{10} and $PM_{2.5}$) concentrations higher than the same period of the previous year (January to October). The higher PM levels in the city centre sites is most likely due to the dust generated by the ongoing construction, and road works projects.
- Compared to the same period of the previous year, there has been a 22 % decrease in carbon monoxide (CO) average concentration measured at the Khyber Pass Road monitoring site. This is most likely due to a 4 % reduction in traffic in that area.

- Air quality of a monitoring site can vary from year to year due to weather and other influences and for trend analysis of change see Table 2 and this report.

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 (last report; Trends in Auckland's air quality 2006-2018). The 2021 Annual data report is available on Knowledge Auckland website. See 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 2022 to 31 October 2022

Number of exceedances of NESAQ In 2022	95 [(NO_2 1-hour average at Customs Street (94), Khyber Pass Road (1)] 2 [PM_{10} 24-hour average at Queen Street]	
Number of exceedances of Auckland ambient air quality targets in 2022	10 (NO_2 24-hour average at Customs Street: June 9 – 17),	
Maximum PM_{10} 24-hours mean (Jan – Oct 2022)	54.2 µg/m^3 (108.5% of NESAQ)	*Recorded at Queen Street on 18 Aug 2022*
Maximum $PM_{2.5}$ 24-hour mean (Jan – Oct 2022)	19.3 µg/m^3 (77.2% of Auckland target)	*Recorded at Patumahoe on 13 June 2022*
Maximum NO_2 1-hour mean (Jan – Oct 2022)	399.0 µg/m^3 (199.5% of NESAQ)	*Recorded at Customs Street on 9 June 2022*
Maximum SO_2 1-hour mean (Jan – Oct 2022)	51.0 µg/m^3 (14.6% of NESAQ)	*Recorded at Customs Street on 10 June 2022*
Maximum O_3 1-hour mean (Jan – Oct 2022)	90.0 µg/m^3 (60.0% of NESAQ)	*Recorded at Patumahoe on 30 October 2022*
Maximum CO running 8-hour mean (Jan – Oct 2022)	2.05 mg/m^3 (20.5% of NESAQ)	*Recorded at Khyber Pass Rd on 13 May 2022*
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 22, 34 and 46 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 22 months*	*Last 34 months*	*Last 46 months*	*Last 22 months*	*Last 34 months*	*Last 46 months*	*Last 22 months*	*Last 34 months*	*Last 46 months*	*Last 22 months*	*Last 34 months*	*Last 46 months*	*Last 22 months*	*Last 34 months*	*Last 46 months*	*Last 22 months*	*Last 34 months*	*Last 46 months*	*Last 22 months*	*Last 34 months*	*Last 46 months*	*Last 22 months*	*Last 34 months*	*Last 46 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: 21 months (1 Jan 2021 to 31 Oct 2022), 33 months (1 Jan 2020 to 31 Oct 2022), and 45 months (1 Jan 2019 to 31 Oct 2022)

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 Sep 2021 and Jan 2022. Weather changes significantly affect concentrations of air contaminants (see this report)

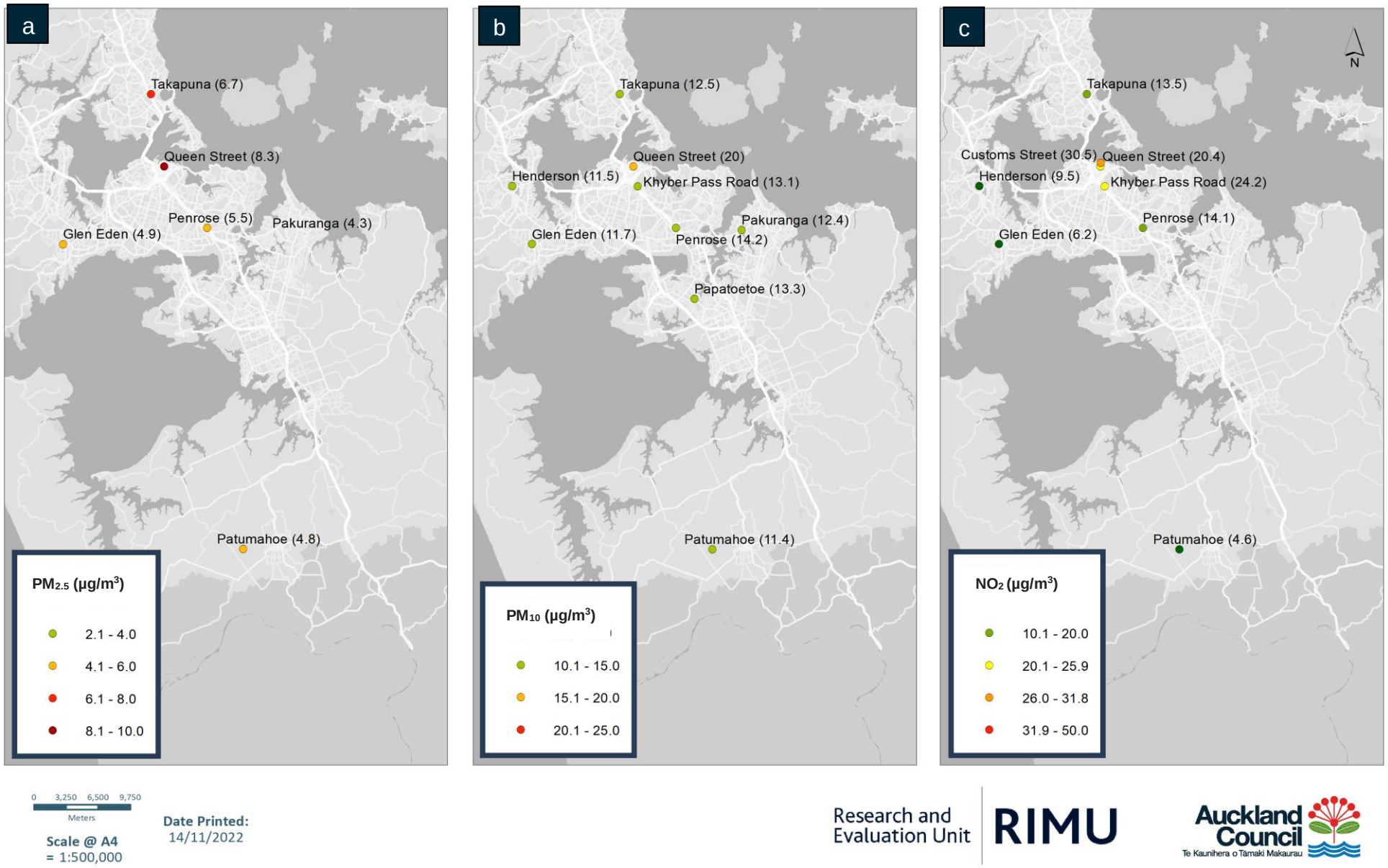

Figure 1. Maps a, b and c show the air quality monitoring sites and their last 12- months (1 November 2021 to 31 October 2022) average PM and NO_2 concentrations in brackets. Auckland city centre monitoring sites recorded the highest PM and NO_2 concentrations.

Section B. Key air contaminants across the 10 air quality monitoring sites (1 January 2022 to 31 October 2022)

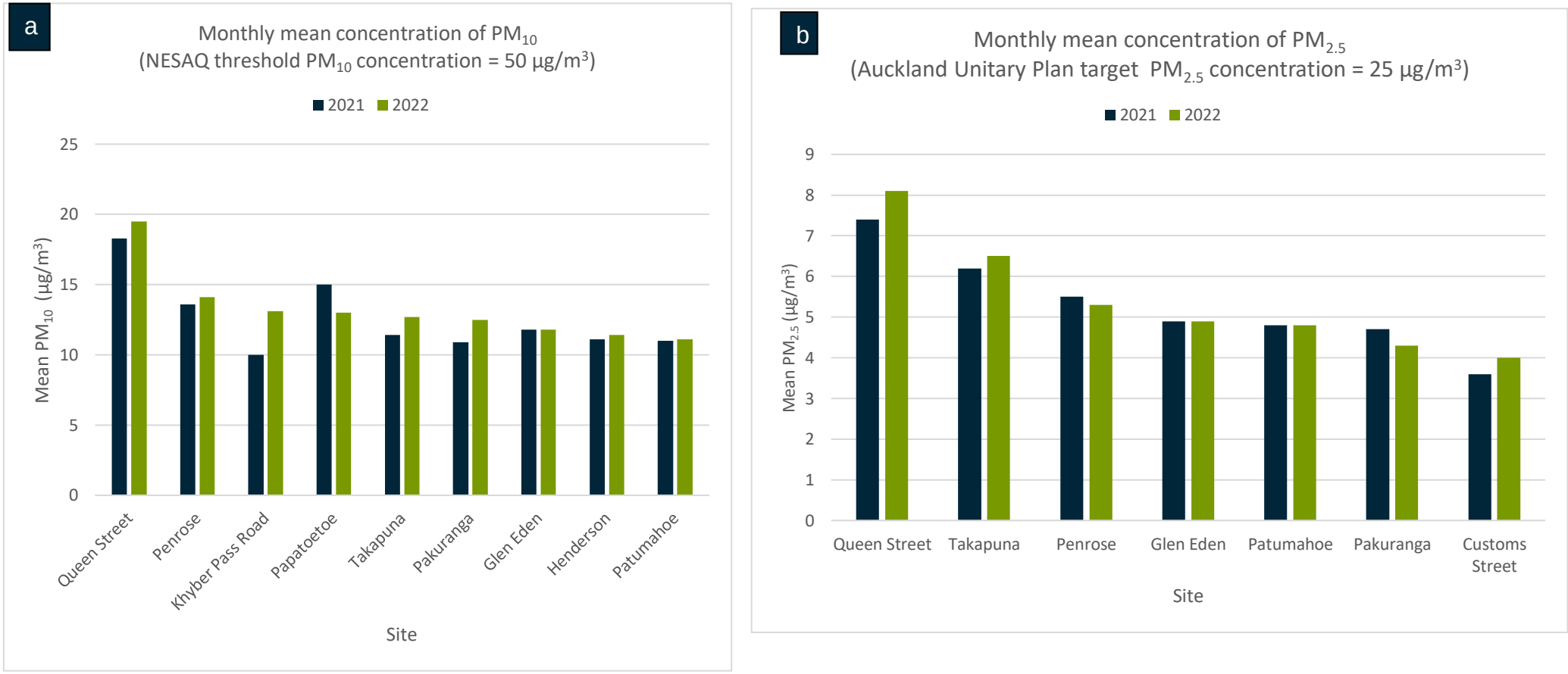

Figure 2. Monthly mean concentration of particulate matter. As in the previous year, the highest concentrations of both PM_{10} and $PM_{2.5}$ were recorded at Queen St. Plots a and b represent PM_{10} and $PM_{2.5,}$ respectively. The average PM_{10} concentration in most of the monitoring sites is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

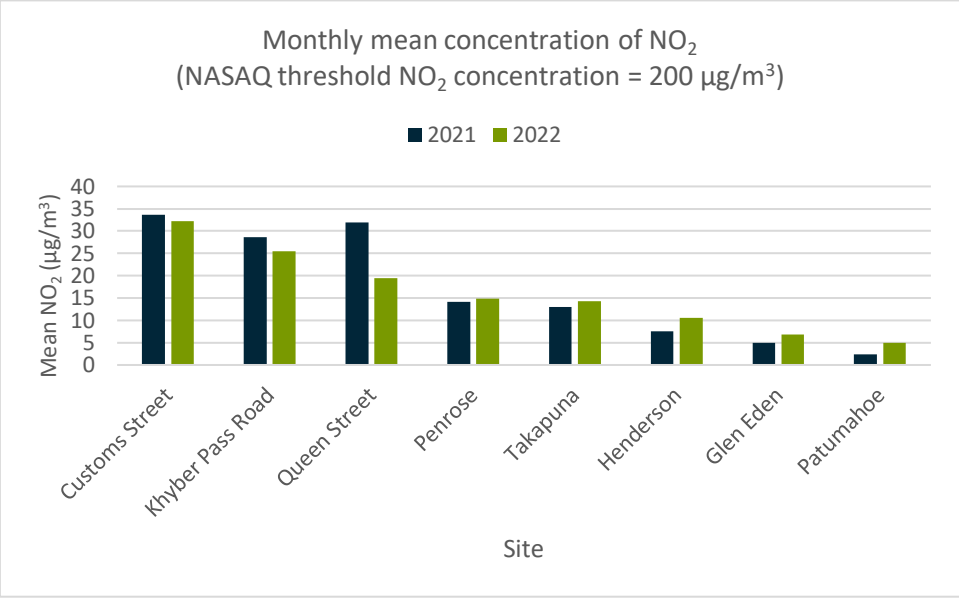

Figure 3. Monthly mean concentration of NO_2 across monitoring sites. Auckland city centre monitoring sites recorded the highest concentrations. All monitoring sites, except Queen St, Customs St, and Khyber Pass Rd, recorded higher average NO_2 concentrations compared to 2021. The main source of NO_2 is motor vehicles.

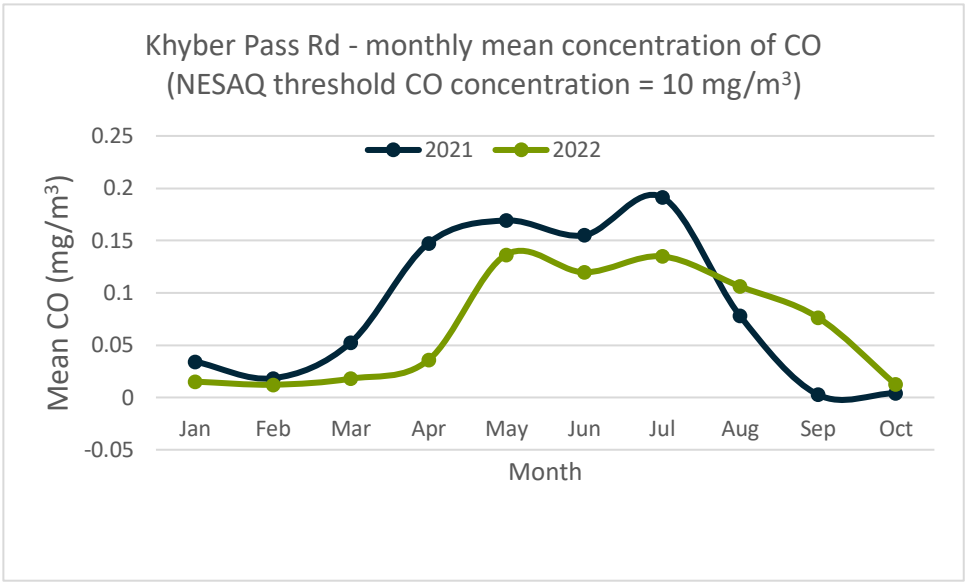

Figure 4. Monthly mean concentration of CO. The mean CO concentration for the first seven months is less than the previous year. The main source of CO is motor vehicles. Note: currently, CO is only monitored at Khyber Pass Road. There is 22% decrease in CO average concentration (from 0.085 mg/m^3 to 0.067 mg/m^3). Auckland Transport 7- day traffic count data showed that traffic volume has decreased in 2022 compared to 2021; from 130388 to 125249 vehicles. Khyber Pass Road: Carriageway start: Mountain Rd, Carriageway end: Maungawhau Rd)(both direction), the 2021 count was conducted between 24th and 30th May, while the 2022 count occurred between 13th and 19th June.

Section C. Focus on a monitoring site: **Papatoetoe**

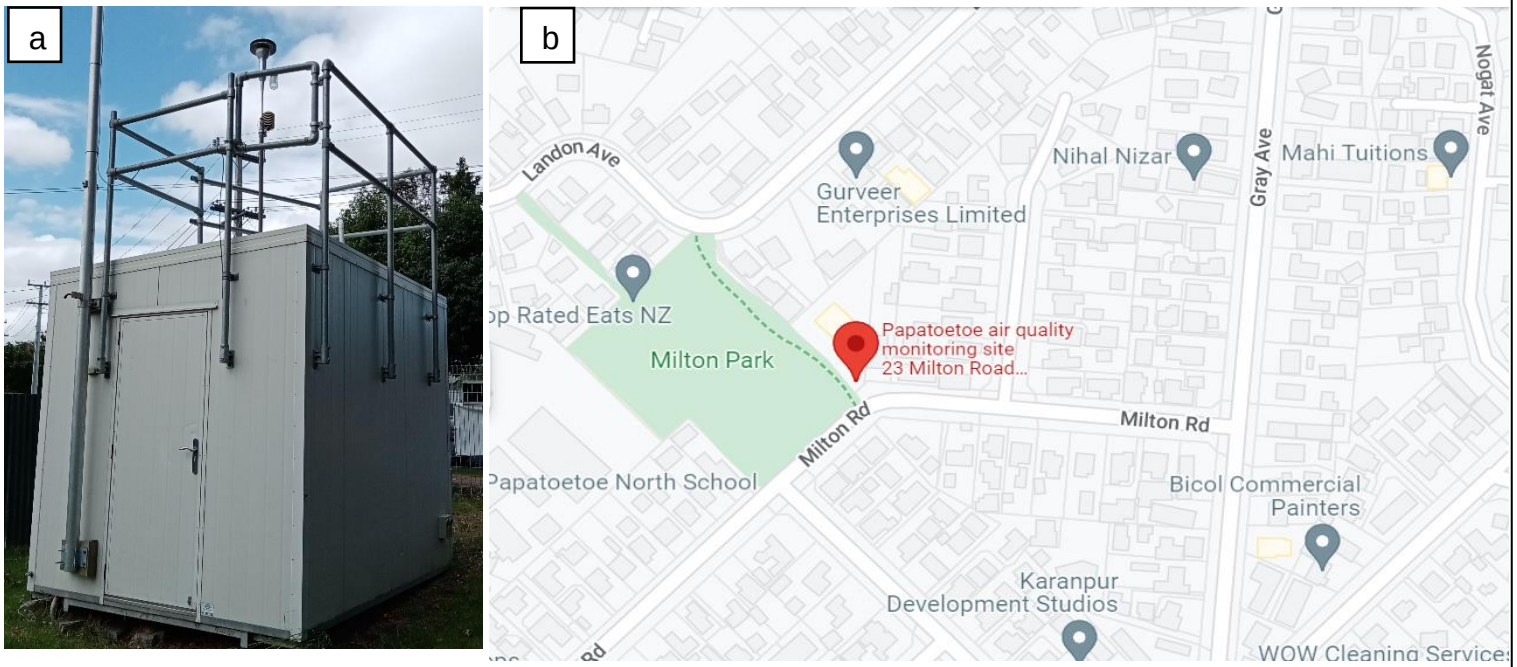

Figure 5. The Glen Eden air quality monitoring site is located at 23 Milton Road, Papatoetoe. Image a shows the air quality monitoring shed. Image b is an aerial view of the monitoring site and surroundings taken in October 2022 (Source: Google Maps). Air quality monitoring at this site commenced in December 2017. Particulate matter (PM_{10}) and meteorological parameters are monitored at this site. The main sources of air contaminants are motor vehicles, biomass burning (during winter), and soils.

Key findings:

- In general, Papatoetoe site average PM_{10} concentration is 6 % and 13.7 % higher than Auckland's average and Patumahoe site (rural site), respectively.
- This monitoring site is located at 'residential peak' for airborne particulate matter exposure. Therefore, it is normal for the average PM_{10} concentrations to be higher than Auckland's average.
- There is no significant trend in the PM_{10} concentrations at this site.
- Meteorological data collected from 2018 to October 2022 indicates that, higher PM_{10} concentrations are associated with predominant prevailing wind direction from the south of the monitoring site.

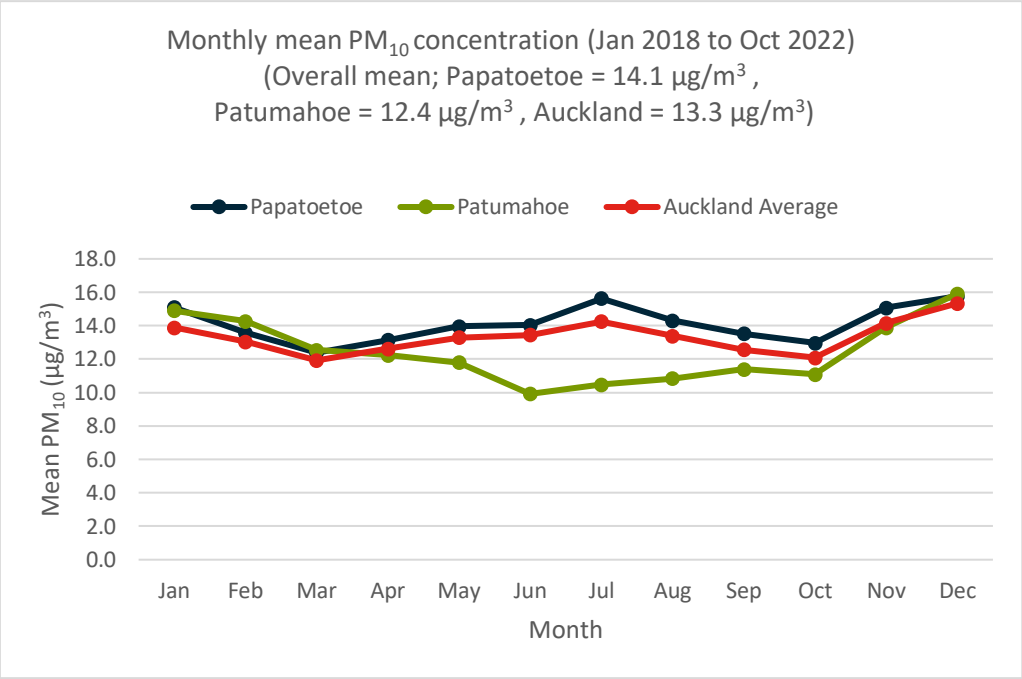

Figure 6. Temporal variation in monthly PM_{10} concentrations – Papatoetoe site compared to Patumahoe (rural site) and Auckland average. Overall, Papatoetoe site average PM_{10} concentration is 6.0 % and 13.7 % higher than Auckland's average and Patumahoe site, respectively.

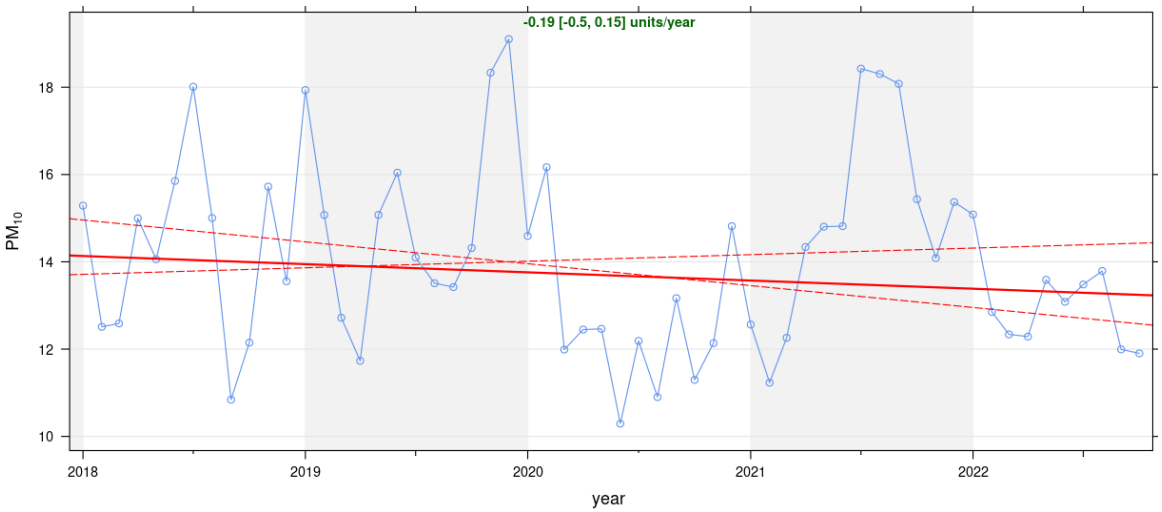

Figure 7. Jan 2018 to Oct 2022, trends in PM_{10} at Papatoetoe site. The plot shows the deseasonalised monthly mean concentrations of PM_{10}. The solid red line shows the trend estimate and the dashed red lines show the 95% confidence intervals for the trend based on resampling methods. The overall trend is shown at the top-left as – 0.19 (µg/m^3) per year (not statistically significant at the 0.05 level) and the 95% confidence intervals in the slope from -0.05 – (- 0.15) µg/m^3/year.

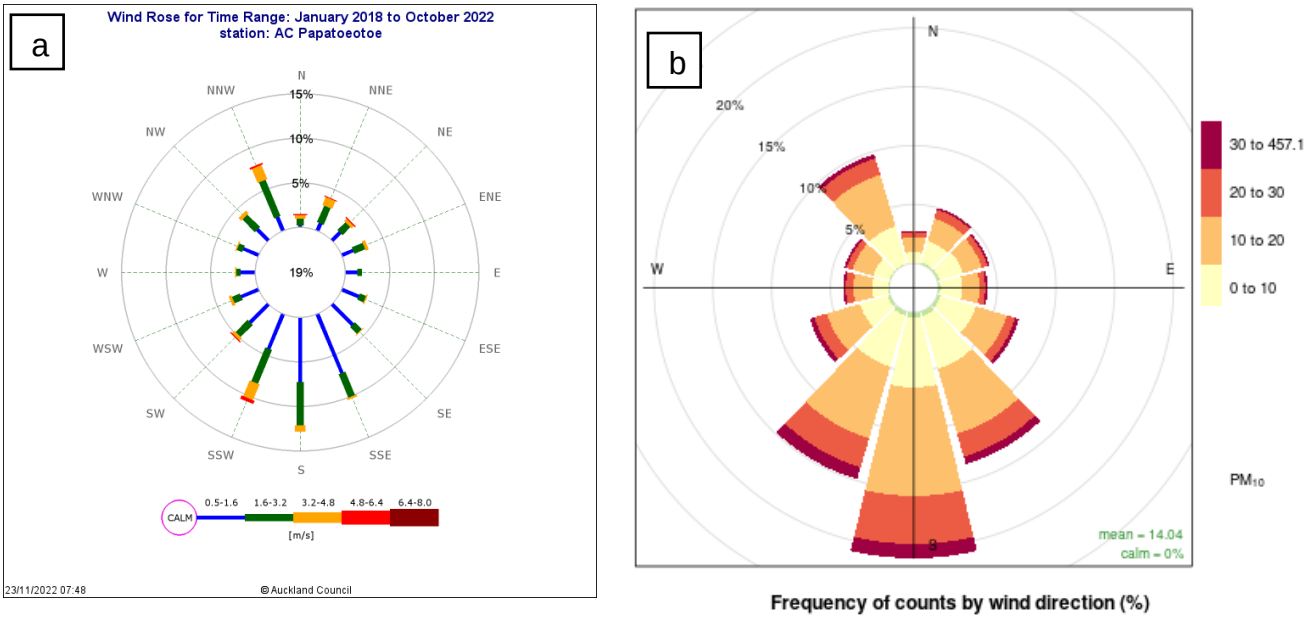

Figure 8. Wind and pollution roses for Papatoetoe air quality monitoring site. Plots a and b represent wind and pollution roses, respectively. Wind speeds are split into the intervals indicated by the scale in each panel. The grey circles show the percent frequencies. Higher PM_{10} concentrations ($\mu g/m^3$) are associated with predominant prevailing wind direction from the south.

Section D. Table 3. Monthly averages: 2022 and past 2 - 5 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	2022	11.7	10.5	9.6	10.6	12.3	15.0	14.6	13.6	10.3	9.7	-	-
		Past 5 years	12.6	11.1	9.4	11.0	13.5	15.4	15.8	13.8	11.8	10.6	11.7	13.2
	Henderson	2022	12.2	11.7	13.8	11.1	11.7	11.9	12.3	10.7	9.3	9.4	-	-
		Past 5 years	12.7	11.4	10.4	11.6	12.8	13.3	13.2	12.5	11.6	11.1	12.2	13.2
	Khyber Pass Road	2022	13.0	12.3	13.4	13.7	13.1	13.7	14.6	13.0	11.7	12.0	-	-
		Past 5 years	16.2	14.5	13.5	13.6	14.2	13.2	13.7	13.1	13.1	12.9	14.5	14.4
	Pakuranga	2022	12.2	10.6	11.8	11.9	13.0	12.8	14.7	14.5	11.6	11.7	-	-
		Past 5 years	13.2	11.8	9.9	10.5	12.7	14.0	14.0	12.6	11.4	11.1	12.4	13.1
	Papatoetoe	2022	15.1	12.8	12.3	12.3	13.6	13.1	13.5	13.8	12.0	12.0	-	-
		Past 4 years	15.1	13.8	12.4	13.4	14.1	14.3	16.2	14.4	13.9	13.2	15.1	15.8
	Patumahoe	2022	13.9	10.1	14.6	11.1	11.9	10.3	10.3	8.7	9.7	10.0	-	-
		Past 5 years	15.0	13.7	11.5	11.9	11.3	9.7	10.0	11.0	11.7	11.7	13.3	15.4
	Penrose	2022	15.5	13.7	15.5	14.3	16.0	13.0	14.6	14.0	12.4	12.1	-	-
		Past 5 years	15.9	15.1	13.4	14.2	15.4	14.9	14.6	13.9	13.7	13.1	15.0	16.2
	Queen Street	2022	21.4	19.4	18.4	17.9	18.4	19.2	21.7	20.6	19.2	19.2	-	-
		Past 5 years	16.5	16.0	15.1	15.8	16.7	16.1	17.0	17.3	17.3	17.4	18.1	19.0
	Takapuna	2022	11.8	11.0	10.5	12.8	13.4	13.5	15.5	14.5	11.9	11.7	-	-
		Past 5 years	13.9	12.7	11.2	12.2	13.0	13.5	13.8	12.7	11.8	11.5	12.7	13.7
$PM_{2.5}$ ($\mu g/m^3$)	Customs Street	2022	ND	2.9	2.6	3.8	3.8	5.7	4.9	4.9	4.1	3.8	-	-
		Past 2 years	4.4	4.1	3.6	3.9	4.1	4.1	4.7	6.5	6.8	4.0	3.7	4.0
	Glen Eden	2022	ND	ND	2.0	2.8	5.0	6.9	7.4	7.6	4.6	2.9	-	-
		Past 3 years	2.7	2.5	2.0	3.2	6.0	10.8	10.6	7.8	5.1	3.4	3.8	3.8
	Pakuranga	2022	2.7	2.8	2.4	ND	4.8	5.3	6.3	6.3	4.4	3.2	-	-
		Past 3 years	3.1	2.9	2.5	3.5	5.5	6.7	10.2	5.4	4.4	3.2	4.4	4.0
	Patumahoe	2022	5.1	3.3	4.6	4.9	5.4	5.8	4.5	5.2	4.7	4.9	-	-
		Past 5 years	5.5	4.7	4.2	4.9	5.6	5.0	5.0	4.8	5.0	4.7	5.7	5.9
	Penrose	2022	5.5	4.6	4.5	5.0	6.1	5.8	6.1	6.1	5.2	4.4	-	-
		Past 5 years	7.0	5.6	5.0	5.7	6.8	8.0	7.5	6.5	5.9	6.1	7.0	6.5
	Queen Street	2022	8.8	7.8	7.1	7.4	8.0	8.4	9.4	8.8	7.9	7.7	-	-
		Past 5 years	6.7	6.1	5.8	6.6	7.0	7.2	7.5	7.3	7.1	7.2	7.3	7.6
	Takapuna	2022	6.0	5.7	4.9	5.7	6.5	7.0	8.6	8.1	6.5	5.6	-	-
		Past 5 years	5.9	5.4	4.9	5.6	6.9	8.5	8.8	7.4	6.7	6.3	6.7	6.3
NO_2 ($\mu g/m^3$)	Customs Street	2022	20.0	18.8	26.7	26.3	26.5	80.4	31.5	33.9	33.7	24.1	-	-
		Past 2 years	42.1	45.7	45.1	33.1	42.4	39.0	40.5	36.4	29.4	31.9	25.6	27.2
	Glen Eden	2022	2.3	2.7	2.6	5.3	8.9	9.2	9.9	10.2	9.4	8.6	-	-
		Past 5 years	2.0	3.4	4.4	4.6	7.3	8.1	7.6	5.8	3.5	3.4	3.0	2.2
	Henderson	2022	4.4	8.9	9.4	11.2	12.5	10.9	9.9	16.3	11.8	8.4	-	-
		Past 5 years	3.6	7.3	8.2	9.0	12.7	14.1	12.8	8.1	6.1	5.9	6.1	4.4
	Khyber Pass Road	2022	15.5	16.0	17.3	22.8	33.2	35.0	29.3	30.6	30.2	22.4	-	-
		Past 5 years	24.1	21.6	27.8	28.3	37.4	36.1	40.5	34.7	32.0	28.5	33.5	22.0
	Patumahoe	2022	ND	ND	3.9	4.2	5.3	5.6	5.4	6.5	5.4	3.9	-	-
		Past 5 years	1.5	2.3	3.3	2.8	3.8	4.2	4.2	3.0	1.9	1.9	2.2	1.9
	Penrose	2022	7.7	7.5	11.4	15.7	21.8	19.1	18.3	19.9	16.6	10.8	-	-
		Past 5 years	9.5	11.9	14.5	17.2	23.1	24.6	25.4	19.2	17.0	13.4	13.2	9.1
	Queen Street	2022	18.5	18.5	18.5	15.0	17.4	21.9	21.8	22.5	21.1	19.6	-	-
		Past 5 years	31.4	32.3	34.7	37.6	43.0	43.3	49.4	48.8	45.0	42.0	36.8	32.2
	Takapuna	2022	4.8	6.9	8.7	12.7	20.3	20.0	19.1	19.9	18.9	11.4	-	-
		Past 5 years	7.6	9.5	11.9	15.4	21.2	22.4	23.9	18.7	14.9	12.5	11.5	8.1
SO_2 ($\mu g/m^3$)	Customs Street	2022	2.1	1.7	2.6	2.3	2.0	10.3	3.3	3.3	3.3	3.0	-	-
		Past 2 years	1.4	1.6	2.2	1.1	1.6	1.5	2.2	2.6	1.7	1.7	1.3	1.4
	Penrose	2022	1.0	1.0	1.2	1.2	1.4	1.3	1.1	1.3	1.1	1.1	-	-
		Past 5 years	0.4	0.9	1.1	0.9	1.3	1.4	1.1	0.8	0.9	0.8	1.0	0.5
O_3 ($\mu g/m^3$)	Patumahoe	2022	24.4	26.1	31.0	33.4	37.4	41.2	47.6	48.4	52.5	50.8	-	-
		Past 5 years	27.4	28.9	32.9	38.9	41.6	42.2	46.3	52.1	51.3	46.2	40.1	32.2
CO (mg/m^3)	Khyber Pass Road	2022	0.015	0.012	0.018	0.036	0.137	0.120	0.135	0.106	0.080	0.012	-	-
		Past 5 years	0.199	0.262	0.281	0.357	0.509	0.425	0.540	0.336	0.229	0.226	0.232	0.160
Black carbon (ng/m^3)	Customs Street	2022	1001	1005	1055	1265	1322	7818	1303	1807	1444	1156.0	-	-
		Past 2 years	1675	1740	1456	1009	1375	1357	1372	1076	818	945	1061	992
	Henderson	2022	254	452	502	530	825	802	699	1055	729.0	419.0	-	-
		Past 5 years	236	444	577	603	1105	1337	1272	890	476	391	413	302

ND = No data measured due to faulty sensor

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