26 October 2021

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, B and C 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 D focuses on one monitoring site – Takapuna. The monthly report is prepared using validated data which is generally available one month after raw data is collected.

Summary

- No breach of national air quality standards has occurred this year (January to August).
- Overall, air quality has slightly improved in Auckland over the last two years. A key contributor is COVID-19 restrictions.
- Over the past two years, there is a downward trend in nitrogen dioxide (NO_2) concentration in the Auckland City Centre.

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).

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

Section A – Data tables

Table 1. Summary information about Auckland's air quality monitoring programme – 1 January to 31 August 2021

Number of continuous monitoring sites	**10**
Location of monitoring sites	Queen St, Customs St, Khyber Pass Rd, Penrose, Henderson, Takapuna, Glen Eden, Pakuranga, Papatoetoe, and Patumahoe
Standard contaminants monitored	PM_{10} (fine particles < 10 microns in diameter), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and sulphur dioxide (SO_2)
Other key contaminants monitored	$PM_{2.5}$ (fine particles < 2.5 microns in diameter), and black carbon
Number of exceedances of National Environmental Standards for Air Quality (NESAQ) in 2021	0
Number of exceedances of Auckland Ambient Air Quality Targets in 2021	1 ($PM_{2.5}$) (24 June 2021 at Pakuranga)
Maximum PM_{10} 24-hour mean (Jan - Aug)	41.3 µg m^{-3} (82.6% of NESAQ) ↔ recorded at Pakuranga on 29 August 2021
Maximum $PM_{2.5}$ 24-hour mean (Jan - Aug)	26.5 µg m^{-3} (106% of Auckland target) ↔ recorded at Pakuranga on 24 June 2021
Maximum NO_2 1-hour mean (Jan - Aug)	200 µg m^{-3} (100% of NESAQ) ↔ recorded at Customs St on 15 March 2021
Maximum SO_2 1-hour mean (Jan - Aug)	19 µg m^{-3} (5% of NESAQ) ↔ recorded at Penrose on 24 May 2021
Maximum O_3 1-hour mean (Jan - Aug)	68 µg m^{-3} (45% of NESAQ) ↔ recorded at Patumahoe on 21 February 2021
Maximum CO running 8-hour mean (Jan - Aug)	Approximately 2 mg m^{-3} (20% of NESAQ) ↔ recorded at Khyber Pass Rd on 1 July 2021
Written reports framework	Monthly updates, state of the environment report , trends report (next report Mar 2022)

Table 2. General changes in concentration of key contaminants monitored for the last 8, 20 and 32 months.

● indicates an increase ● indicates a decrease ● indicates no significant change **n/a** implies not applicable.

	PM_{10}			$PM_{2.5}$			NO_2			Black carbon			Ozone			CO			SO_2			Air Quality Index(AQI)			
Site	*Last 8 months*	*Last 20 months*	*Last 32 months*	*Last 8 months*	*Last 20 months*	*Last 32 months*	*Last 8 months*	*Last 20 months*	*Last 32 months*	*Last 8 months*	*Last 20 months*	*Last 32 months*	*Last 8 months*	*Last 20 months*	*Last 32 months*	*Last 8 months*	*Last 20 months*	*Last 32 months*	*Last 8 months*	*Last 20 months*	*Last 32 months*	*Last 8 months*	*Last 20 months*	*Last 32 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**
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**
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**
	PM_{10}			$PM_{2.5}$			NO_2			Black carbon			Ozone			CO			SO_2			Air Quality Index(AQI)			

Notes

Effective dates: 8 months (1 Jan to 31 Aug 2021), 20 months (1 Jan 2020 to 31 Aug 2021), and 32 months (1 Jan 2019 to 31 Aug 2021)

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.

In August, due to malfunction of $PM_{2.5}$ sensors there is no $PM_{2.5}$ data for Glen Eden, Customs Street and Pakuranga sites.

Weather changes significantly affect concentrations of air contaminants (see Section B)

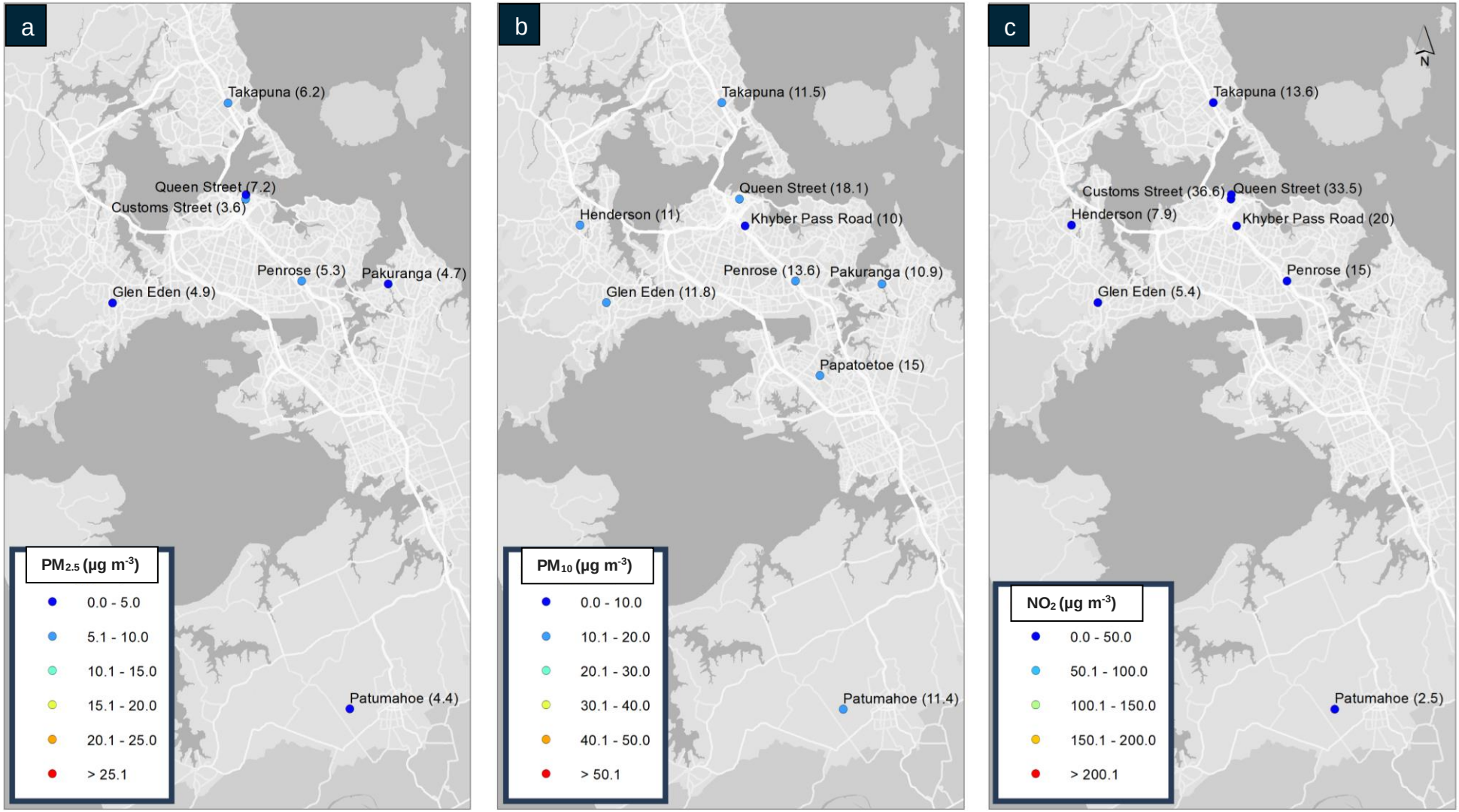


Figure 1. Maps a, b and c show the air quality monitoring sites and their monthly average contaminants concentration (January to August 2021) in brackets. Auckland City Centre monitoring sites have the highest concentration of air contaminants.

Section B. Key air contaminants across the 10 air monitoring sites (January to August)

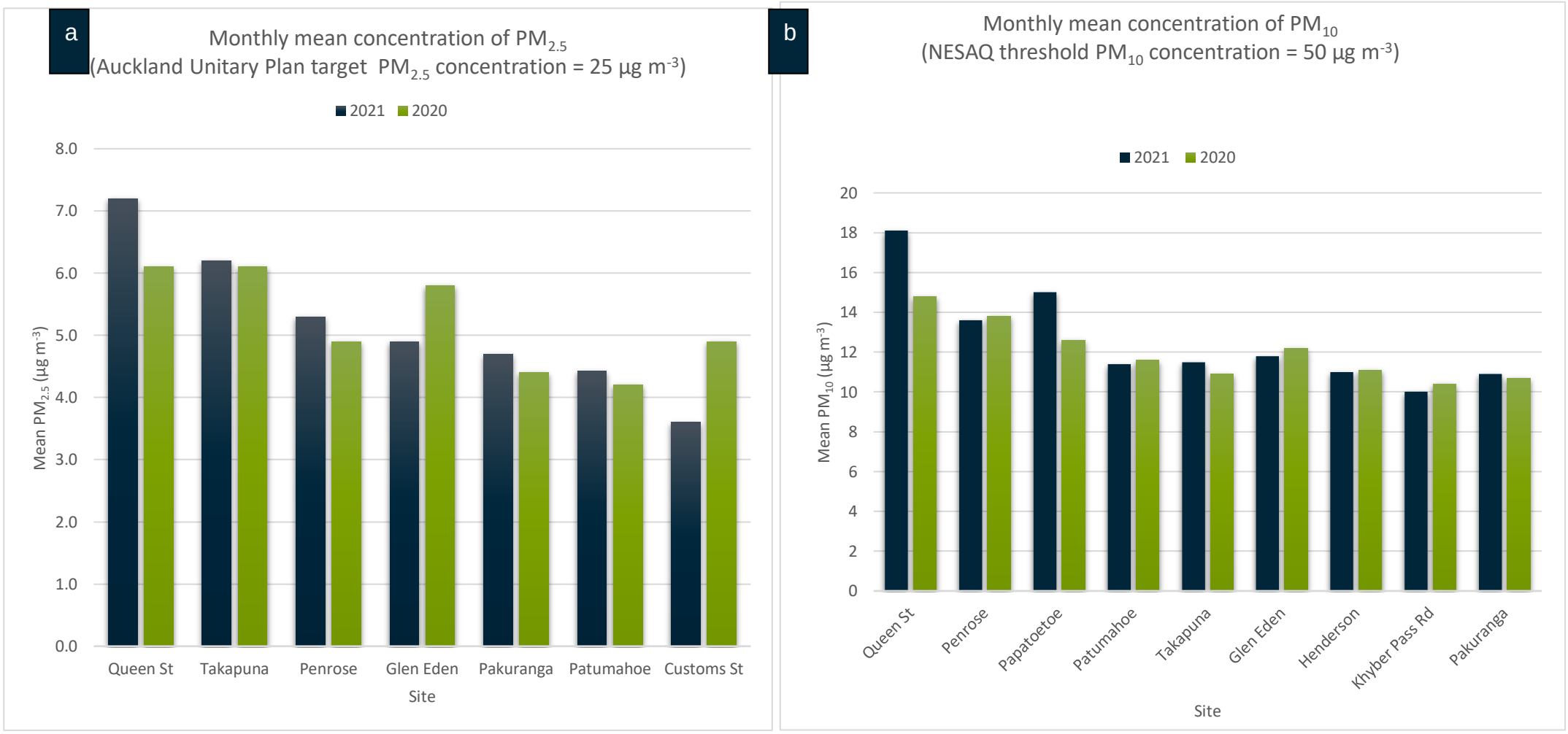
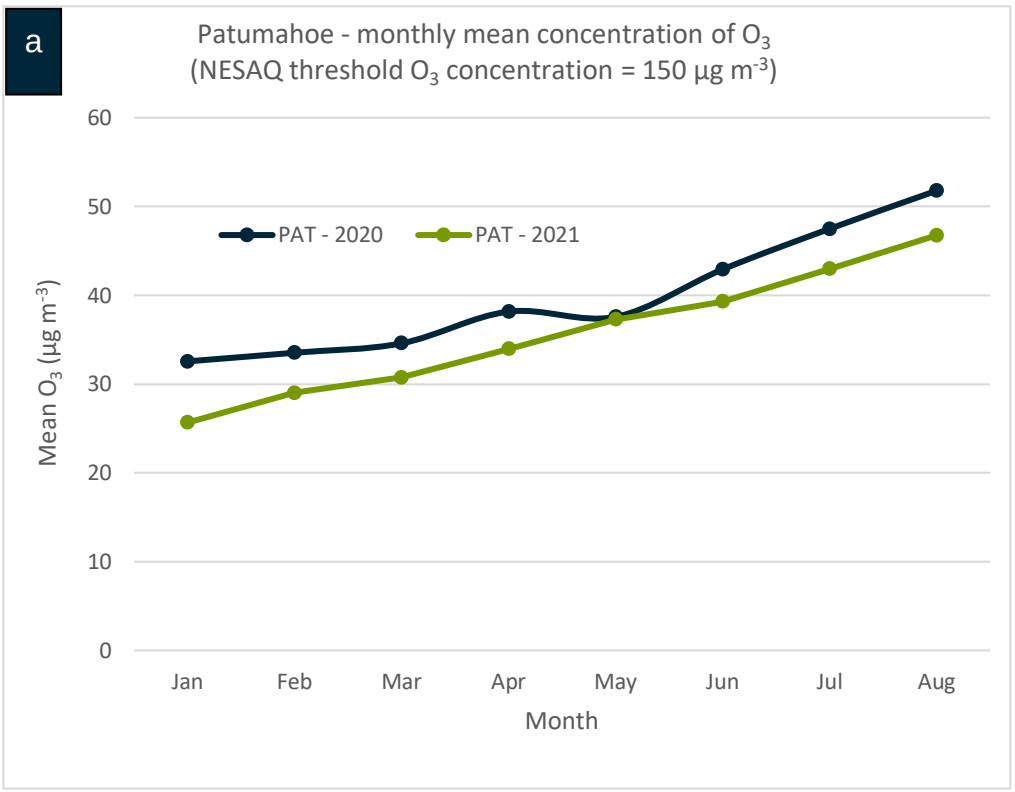


Figure 2. Monthly mean concentration of particulate matter. As in the previous year, highest concentrations of both PM_{10} and $PM_{2.5}$ were recorded at Queen St. Plots a and b represent $PM_{2.5}$ and PM_{10} respectively. The average particulate matter concentration in Queen St is higher than the same period of the previous year. This may be due to the various construction activities.



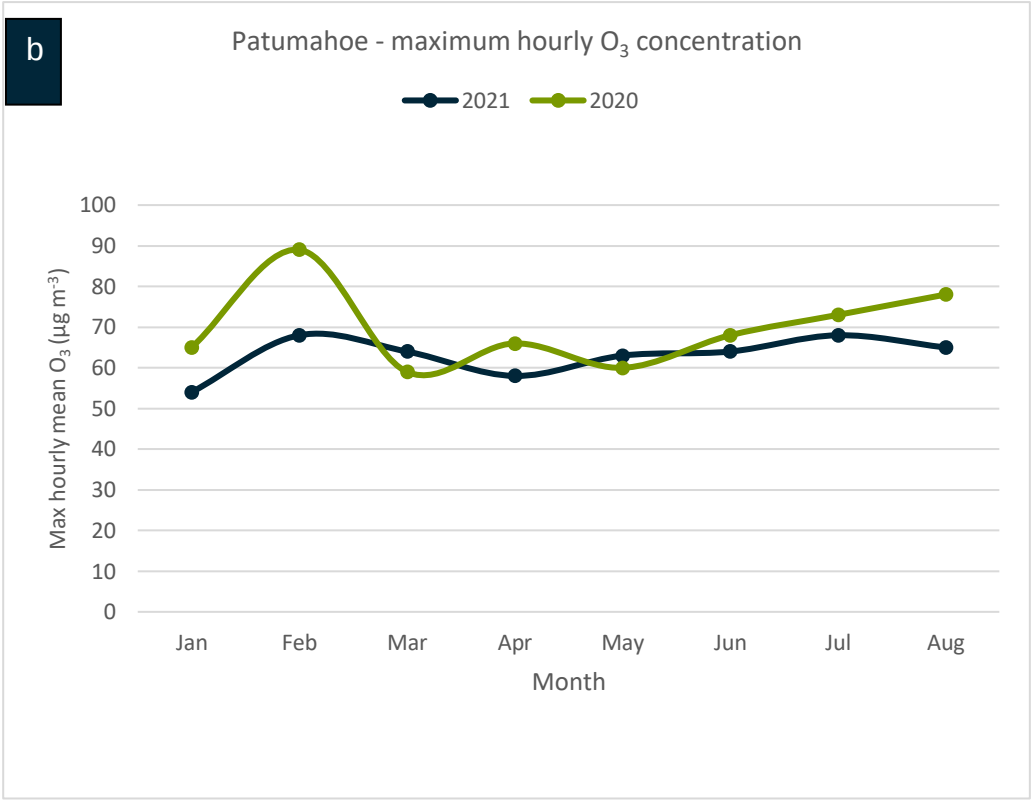
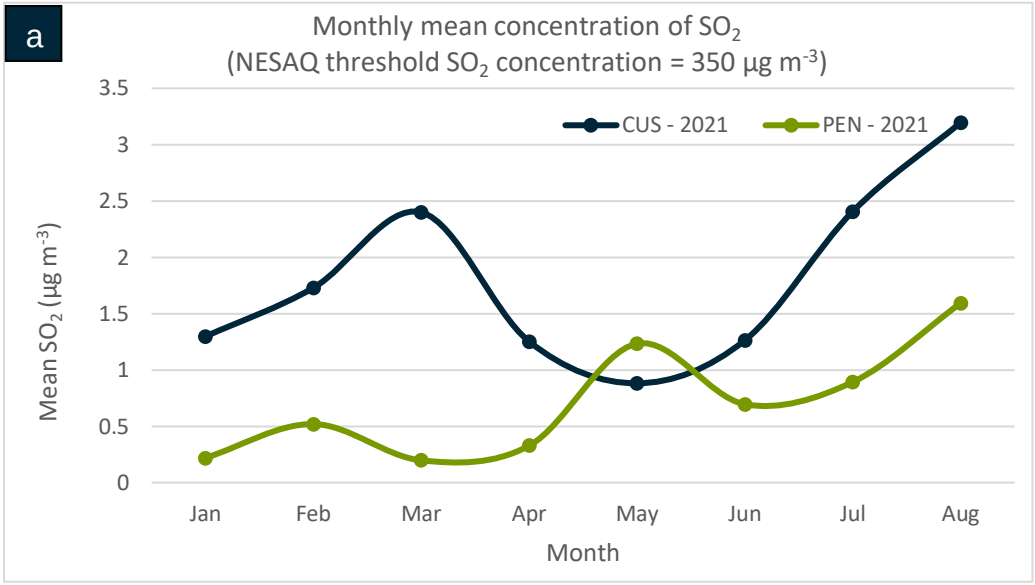


Figure 3. Monthly mean and maximum hourly concentration of O_3. Plots a and b represent monthly mean and maximum concentrations respectively. As in the previous year, mean concentrations of O_3 tend to increase from Jan to August due to weather changes. Generally, average O_3 concentration this year is lower than same period of the previous year. Note: O_3 is monitored only at Patumahoe.



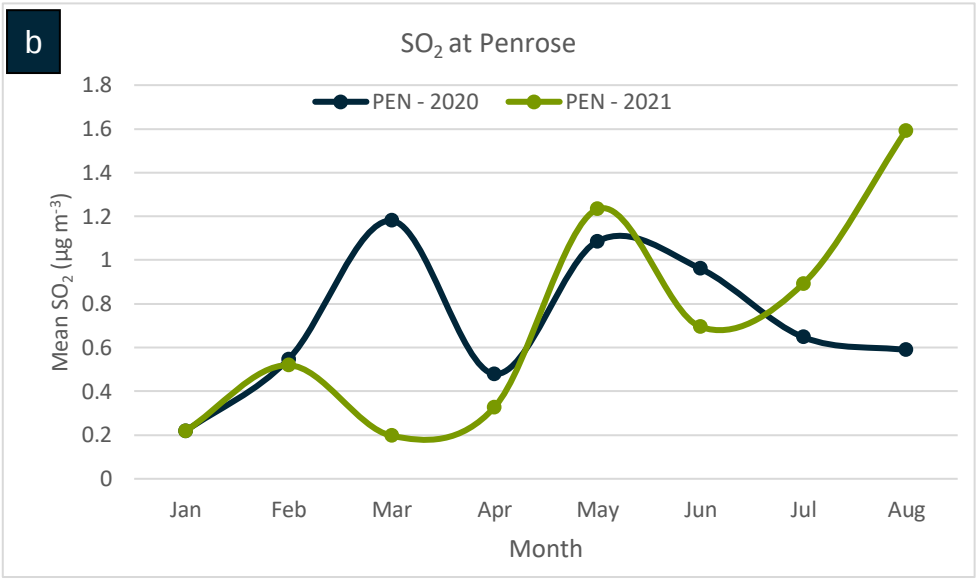


Figure 4. Monthly mean concentration of SO_2. Plot a shows the monthly variation in SO_2 concentrations at Customs St (CUS) and Penrose (PEN) monitoring sites. Plots b and c show the monthly variation in SO_2 concentrations at Penrose and Customs St sites respectively. Generally, highest concentrations of SO_2 were recorded at Customs St site due to its proximity to the Auckland Port. SO_2 is typically associated with combustion of fuels containing high levels of sulphur commonly found in heavy fuel oils used in shipping[a].

[a]Talbot, N and P Crimmins (2020). Trends in Auckland's air quality 2006-2018. Auckland Council technical report, TR2020/004

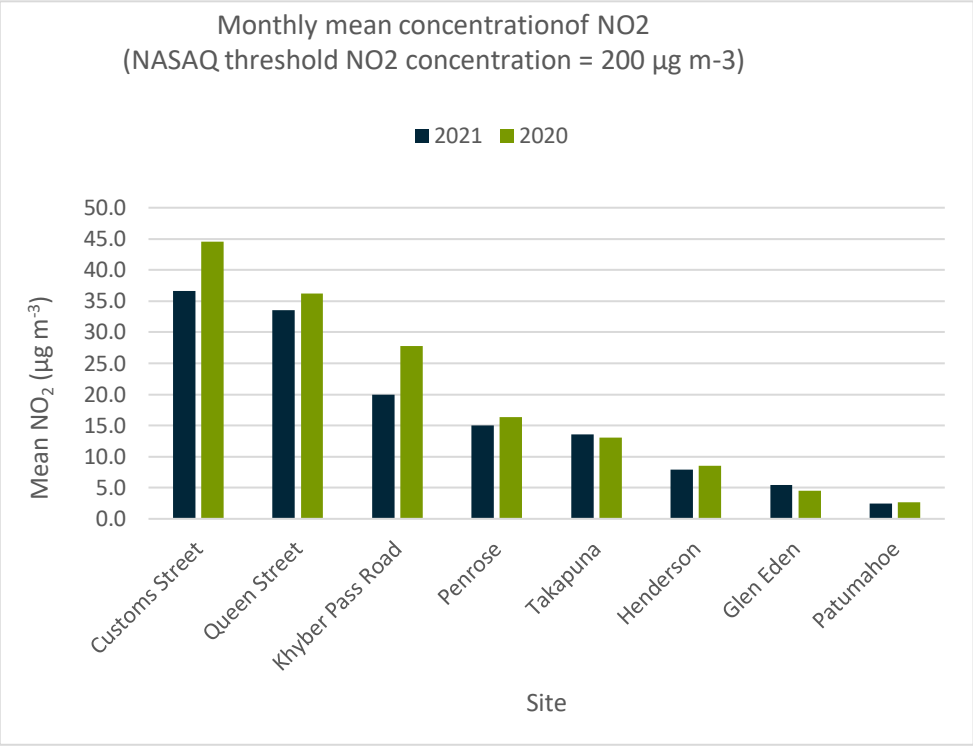


Figure 5. Monthly mean concentration of NO_2 across monitoring sites. Auckland City Centre monitoring sites recorded the highest concentrations while the lowest concentrations occurred at the rural monitoring site. Most sites have recorded lower average NO_2 concentrations compared to the previous year. Motor vehicles are the main sources of NO_2 in Auckland.

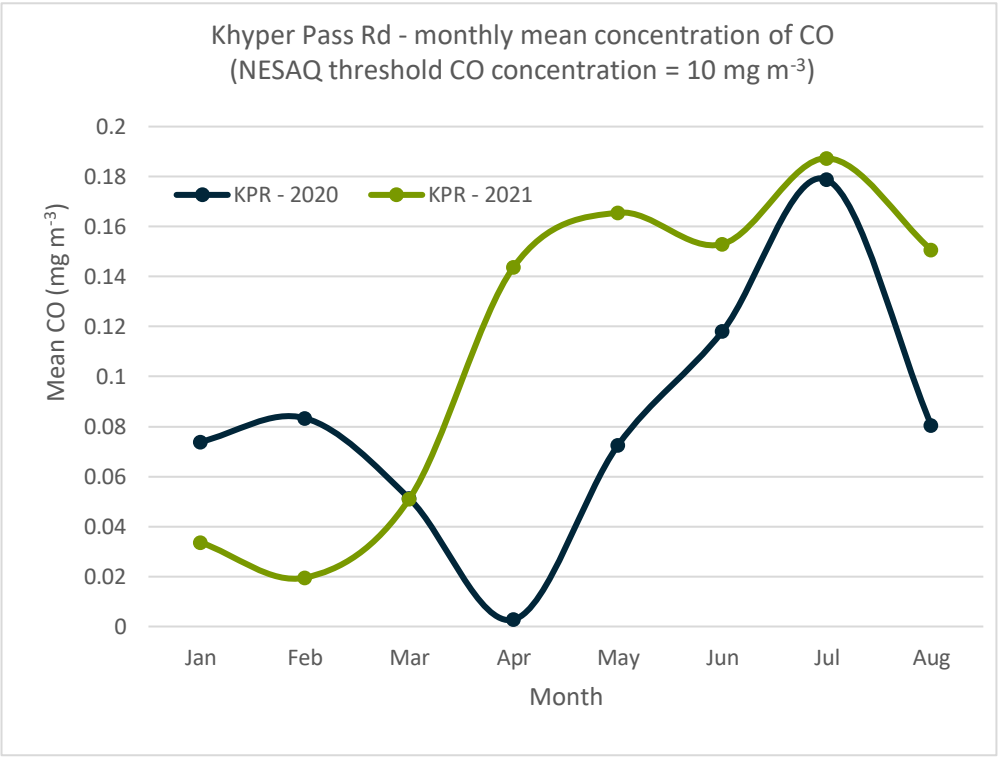
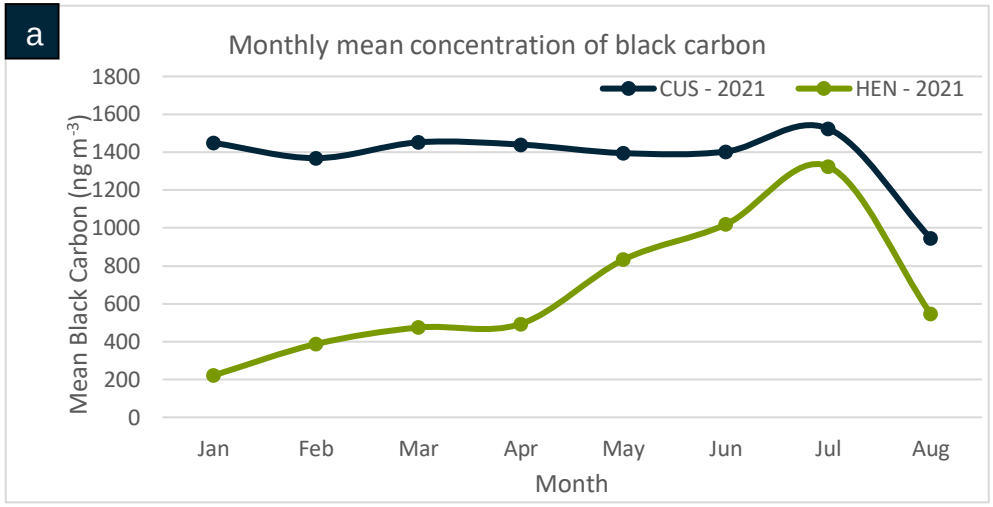
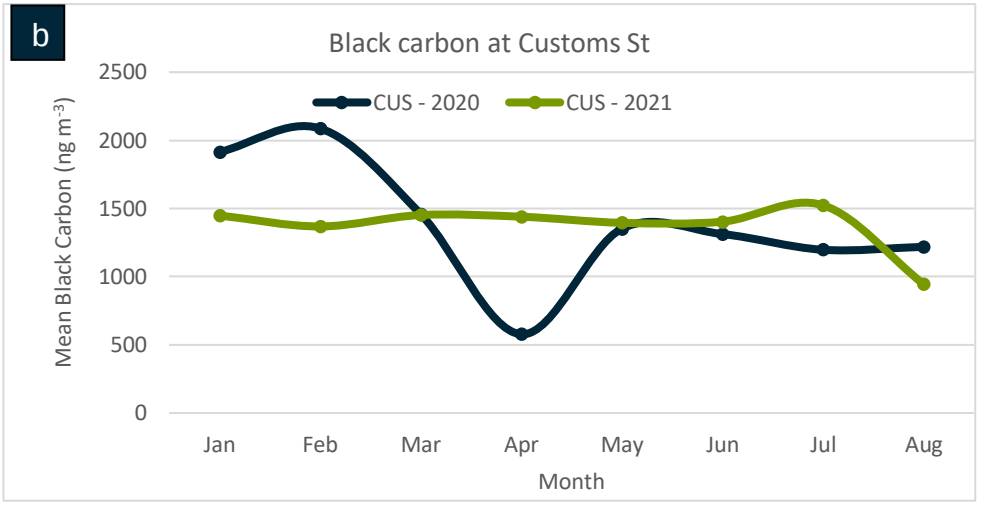


Figure 6. Monthly mean concentration of CO. Overall the mean concentration of CO is lower than the previous year. Motor vehicles are the main sources of CO in Auckland. Note: currently, CO is only monitored at Khyber Pass Road.





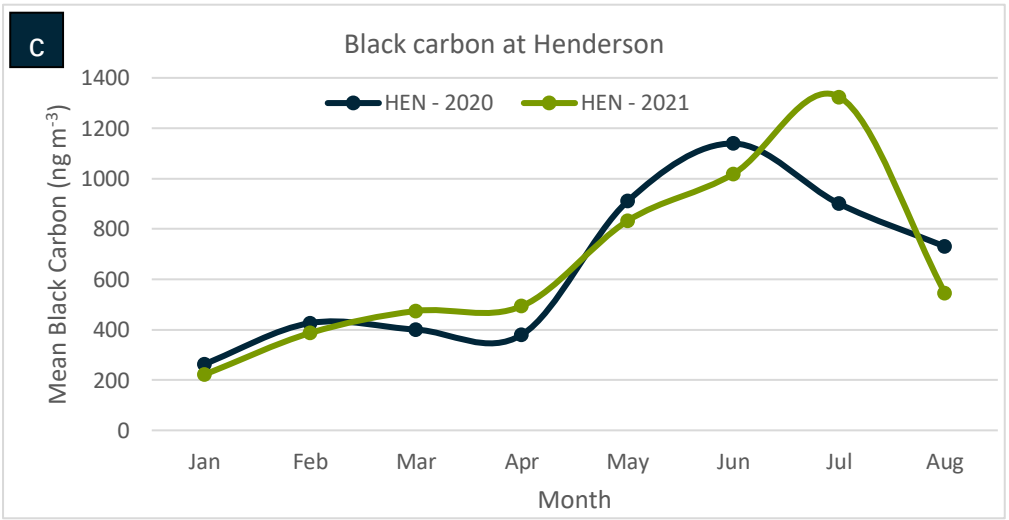


Figure 7. Monthly mean concentration of black carbon. Plot a shows the monthly variation in black carbon concentrations at Customs St (CUS) and Henderson (HEN) monitoring sites. Plots b and c show the monthly variation in black carbon concentrations at Customs St and Henderson respectively. Generally, highest concentrations of black carbon were recorded at Customs St. Motor vehicles and home heating are the main sources of black carbon in Auckland. Note, black carbon is monitored at only Customs St and Henderson.

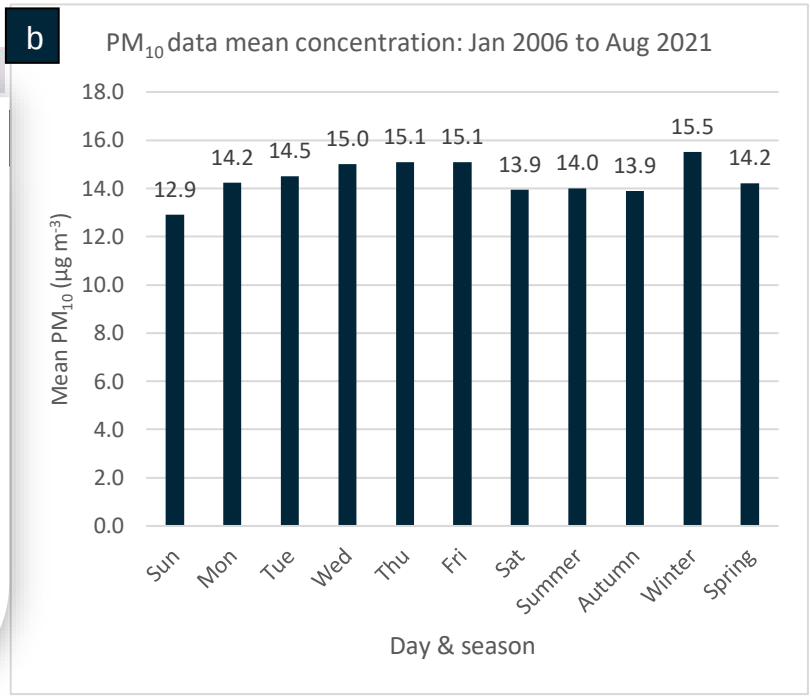
Section C – Seasonal, day and hour variations in air contaminants concentrations: Auckland wide

a

High Medium Low

PM_{10}	Summer	Autumn	Winter	Spring
Sun	12.0	12.1	14.2	13.3
Mon	13.9	13.7	15.2	14.1
Tue	14.3	14.3	15.5	13.9
Wed	14.6	14.4	16.8	14.2
Thu	14.9	14.8	16.1	14.5
Fri	14.6	14.4	16.0	15.3
Sat	13.5	13.5	15.0	13.7

b



c

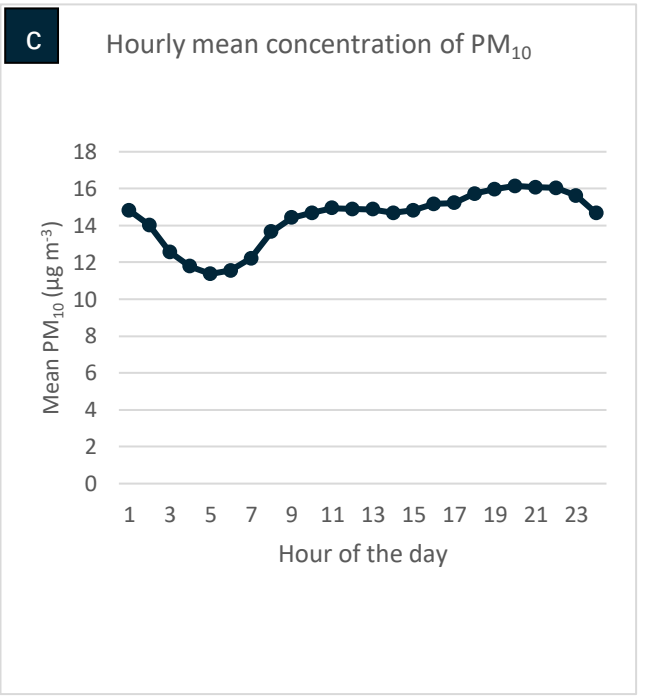
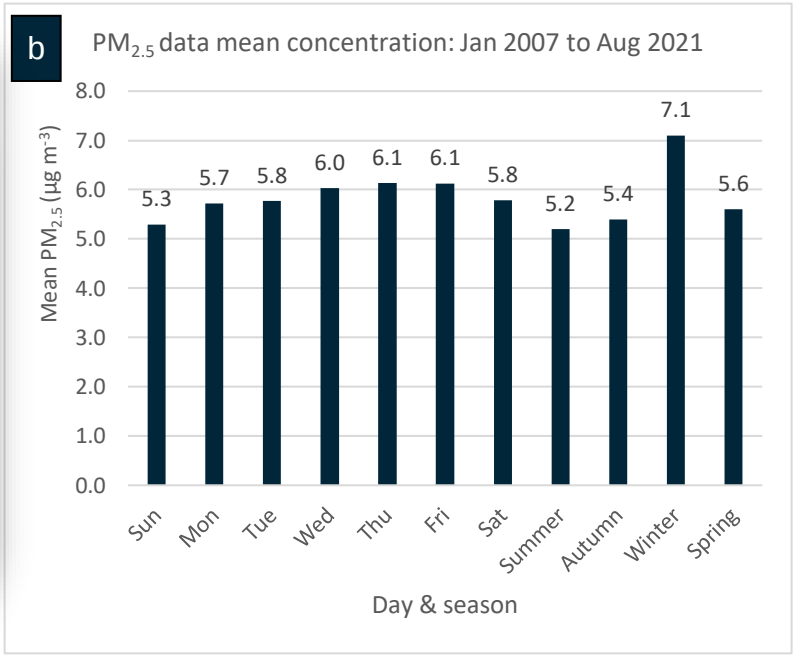


Figure 8. Temporal variations in PM_{10} levels in Auckland region (Jan 2006 to Aug 2021). The data show that average PM_{10} concentrations depend on season, day of the week and hour of the day. The highest and lowest concentrations tend to occur in winter and summer respectively. As expected, highest concentrations were recorded during peak traffic hours (7 – 9 am and 5 – 7 pm). The lowest concentrations were recorded during weekends. Note: charts a, b & c present concentration variation in each season, day and hour of the day respectively. Summer: December to February; autumn: March to May; winter: June to August and spring; September to November.

a

High Medium Low

$PM_{2.5}$	Summer	Autumn	Winter	Spring
Sun	4.5	4.8	6.6	5.3
Mon	5.2	5.2	6.8	5.6
Tue	5.2	5.4	6.8	5.6
Wed	5.3	5.5	7.5	5.7
Thu	5.5	5.8	7.4	5.8
Fri	5.4	5.7	7.4	5.9
Sat	5.1	5.4	7.1	5.4



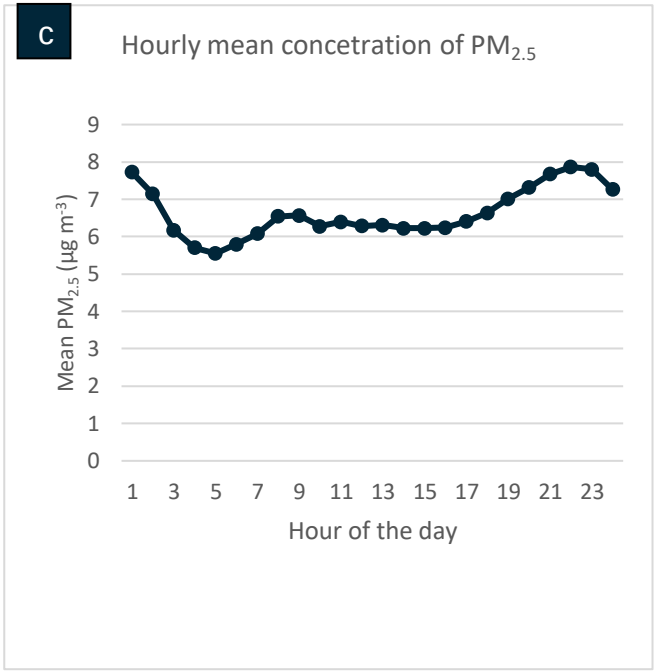


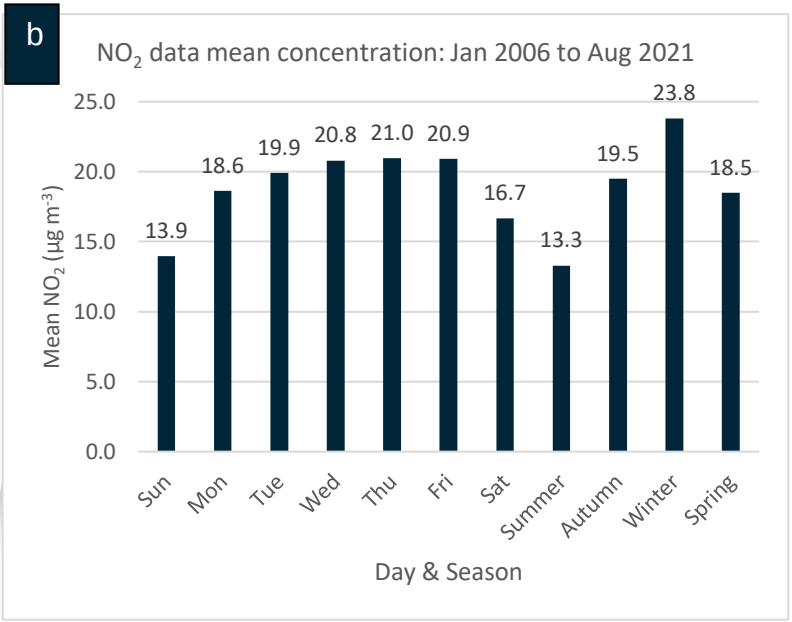
Figure 9. Temporal variations in $PM_{2.5}$ levels in Auckland region (Jan 2007 to Aug 2021). The data show that average $PM_{2.5}$ concentrations depend on season, day of the week and hour of the day. The highest and lowest concentrations tend to occur in winter and summer respectively. Highest concentrations were recorded during the night – probably due to home heating. The lowest concentrations were recorded during weekends. Note: charts a, b & c present concentration variation in each season, day and hour of the day respectively. Monitoring of $PM_{2.5}$ in Auckland commenced in 2007. Summer: December to February; autumn: March to May; winter: June to August and spring; September to November.

High Medium Low

a

NO_2	Summer	Autumn	Winter	Spring
Sun	10.0	14.4	17.8	13.5
Mon	13.0	19.0	23.8	18.5
Tue	13.9	20.4	25.1	20.2
Wed	14.6	22.0	26.2	20.2
Thu	15.0	22.1	26.4	20.0
Fri	14.9	21.3	26.5	20.7
Sat	12.1	17.4	20.6	16.3

b



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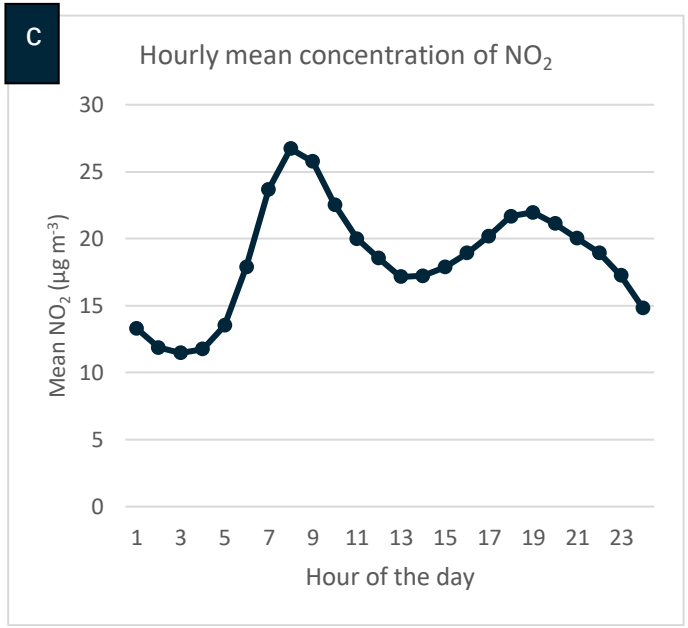
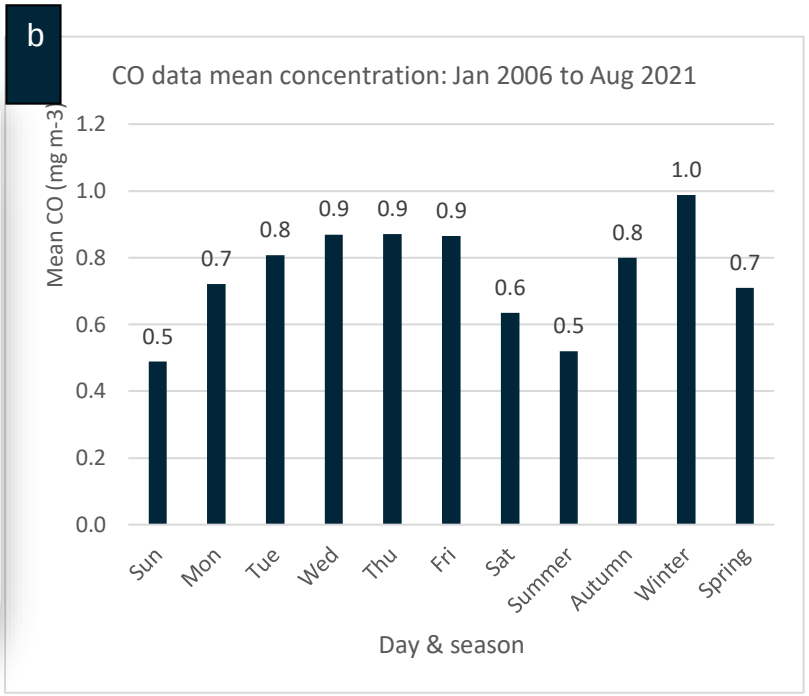


Figure 10. Temporal variations in NO_2 levels in Auckland region (Jan 2006 to Aug 2021). The data show that average NO_2 concentrations depend on season, day of the week and hour of the day. The highest and lowest concentrations tend to occur in winter and summer respectively. As expected, the highest concentrations were recorded during peak traffic hours (7 – 9 am and 5 – 7 pm). The lowest concentrations were recorded during weekends. Note: charts a, b & c present concentration variation in each season, day and hour of the day respectively. Summer: December to February; autumn: March to May; winter: June to August and spring; September to November.

a

High Medium Low

CO	Summer	Autumn	Winter	Spring
Sun	0.3	0.5	0.7	0.4
Mon	0.5	0.7	1.0	0.7
Tue	0.5	0.8	1.1	0.8
Wed	0.6	1.0	1.1	0.8
Thu	0.6	1.0	1.2	0.8
Fri	0.6	0.9	1.1	0.9
Sat	0.5	0.7	0.8	0.6



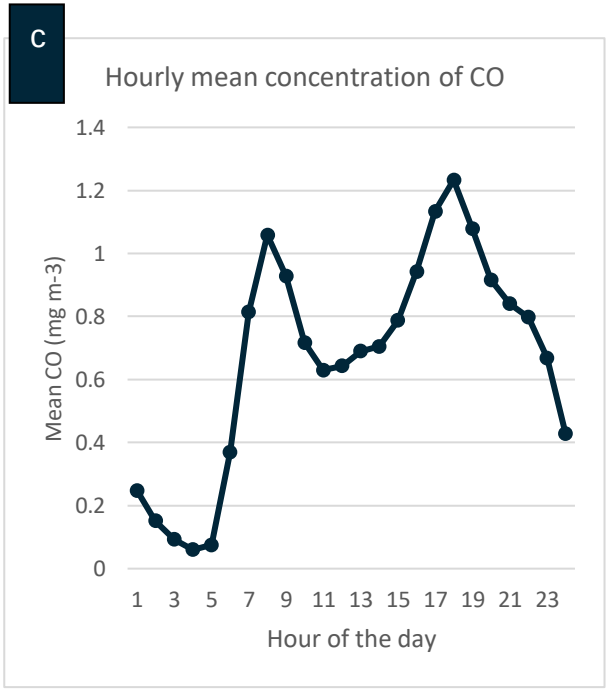
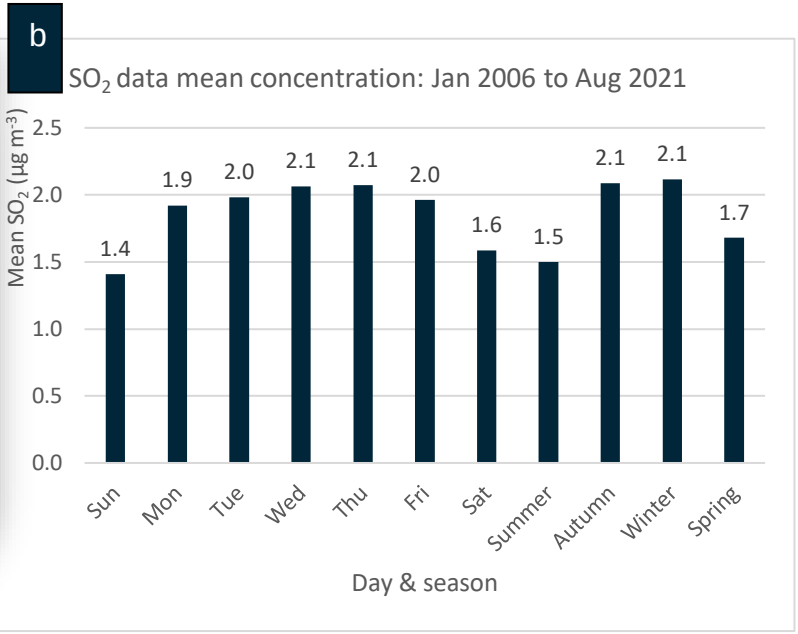


Figure 11. Temporal variations in CO levels in Auckland region (Jan 2006 to Aug 2021). The data show that average CO concentrations depend on season, day of the week and hour of the day. The highest and lowest concentrations tend to occur in winter and summer respectively. As expected, the highest concentrations were recorded during peak traffic hours (7 – 9 am and 5 – 7 pm). Motor vehicles are the main source of CO. Note: charts a, b & c present concentration variation in each season, day and hour of the day respectively. Summer: December to February; autumn: March to May; winter: June to August and, spring; September to November.

High Medium Low

a

SO_2	Summer	Autumn	Winter	Spring
Sun	1.2	1.5	1.6	1.2
Mon	1.5	2.1	2.3	1.7
Tue	1.5	2.2	2.3	2.0
Wed	1.6	2.4	2.3	1.9
Thu	1.6	2.5	2.4	1.8
Fri	1.6	2.2	2.2	1.7
Sat	1.4	1.8	1.7	1.4



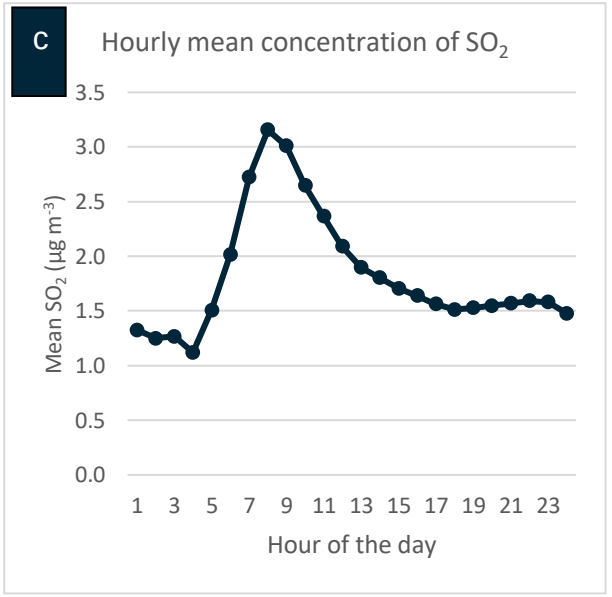


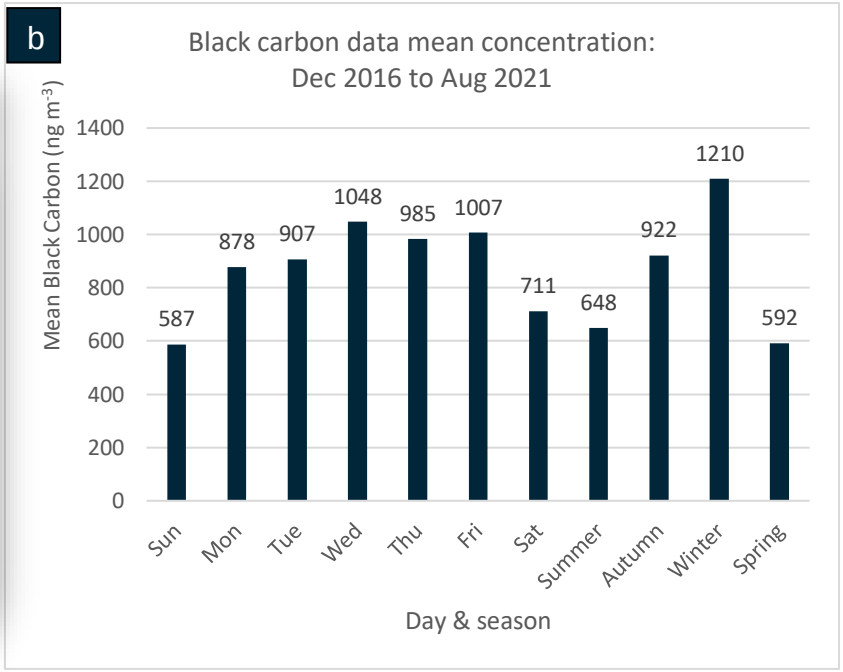
Figure 12. Temporal variations in SO_2 levels in Auckland region (Jan 2006 to Aug 2021). The data show that average SO_2 concentrations depend on season, day of the week and hour of the day. Highest concentrations tend to occur in winter and autumn probably due to shipping emissions and smaller contribution from biomass burning. Highest concentrations were recorded during morning rush hours (7 – 9 am). As expected, the lowest concentrations were recorded on weekends. Note: charts a, b & c present concentration variation in each season, day and hour of the day respectively. Summer: December to February; autumn: March to May; winter: June to August and spring; September to November.

a

High Medium Low

Black C	Summer	Autumn	Winter	Spring
Sun	396	585	900	366
Mon	607	945	1177	661
Tue	739	974	1140	673
Wed	797	1063	1501	685
Thu	746	1097	1297	660
Fri	748	1050	1423	646
Sat	499	744	1029	456

b



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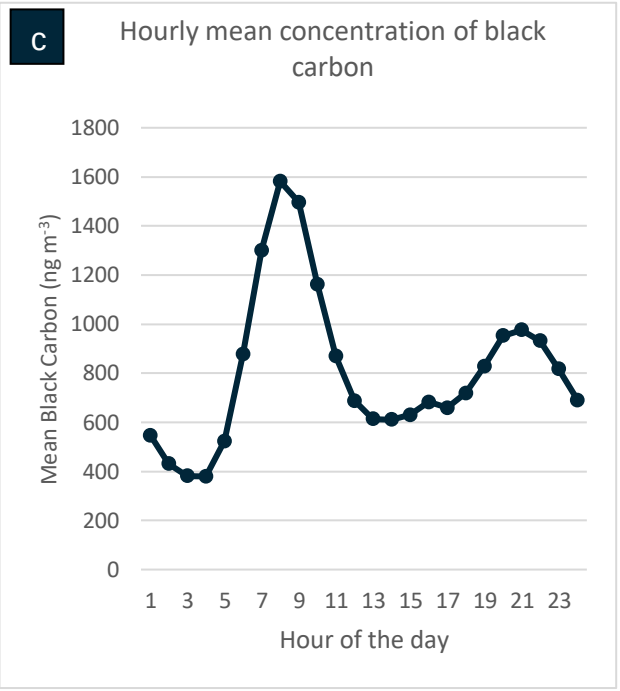

Figure 13. Temporal variations in black carbon levels in Auckland region (Dec 2016 to Aug 2021). The data show that average black carbon concentrations depend on season, day of the week and hour of the day. The highest and lowest concentrations tend to occur in winter and summer respectively. Motor vehicles and biomass burning are the main sources of black carbon. As expected, highest concentrations were recorded during peak traffic hours (7 – 9 am and 5 – 7 pm). The lowest concentrations were recorded during weekends. Note: charts a, b & c present concentration variation in each season, day and hour of the day respectively. Black carbon monitoring in Auckland started in December 2016. Summer: December to February; autumn: March to May; winter: June to August and, spring; September to November.

Section D. Focus on a monitoring site: Takapuna

Figure 14. Takapuna air quality monitoring station located in Westlake Girls High School. Image a shows the air quality monitoring shed viewed from the south. Image b is an aerial view of the monitoring site and surroundings taken in October 2021 (Source: Google Maps). Air quality monitoring at this site commenced on 31st May 1995. Air contaminants monitored are particulate matter and nitrogen dioxide. The main sources of air contaminants are motor vehicles, biomass burning, marine aerosol, and soils.

Key findings:

- Takapuna's average PM_{10} concentration is 12% and 38% higher than Auckland's average and Patumahoe (rural site) respectively.
- Takapuna's $PM_{2.5}$ average concentration is 18% and 51% higher than Auckland's average and Patumahoe respectively
- Takapuna's NO_2 average concentration is13% lower than Auckland's average and approximately 5 - folds more than Patumahoe.
- There is a downward long-term trend in particulate matter and nitrogen dioxide concentrations.

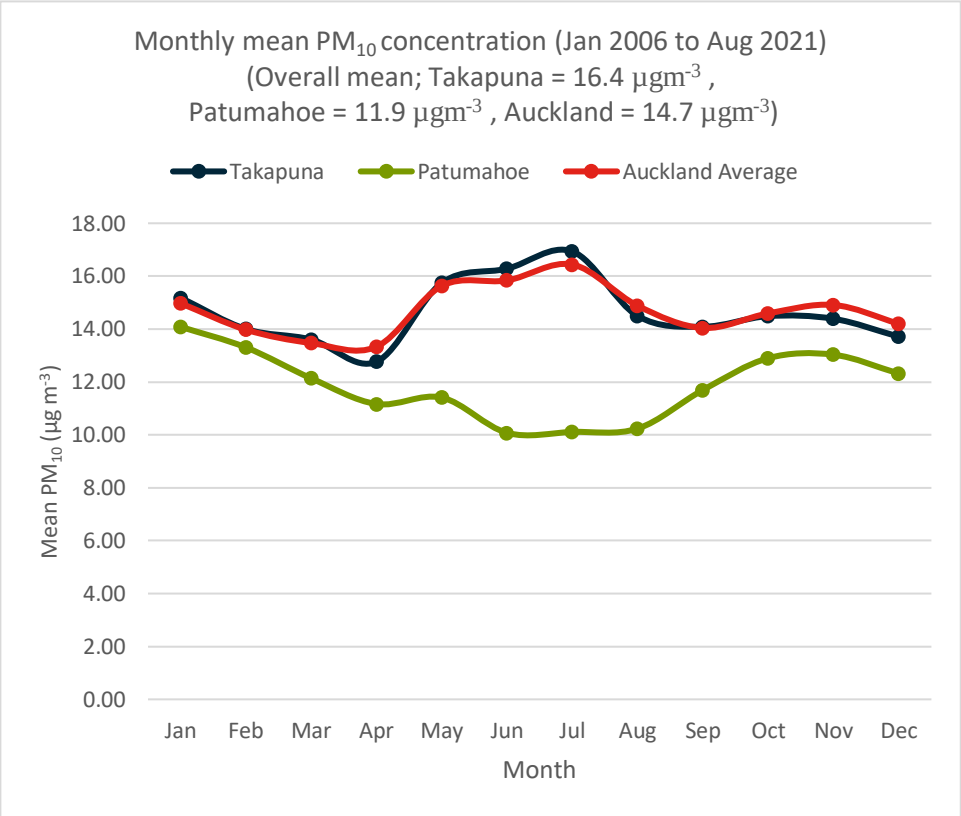

Figure 15. Temporal variation in monthly PM_{10} concentrations – Takapuna compared to Patumahoe (rural site) and Auckland average. Overall, Takapuna's average PM_{10} concentration is 12% and 38% higher than Auckland average and Patumahoe respectively.

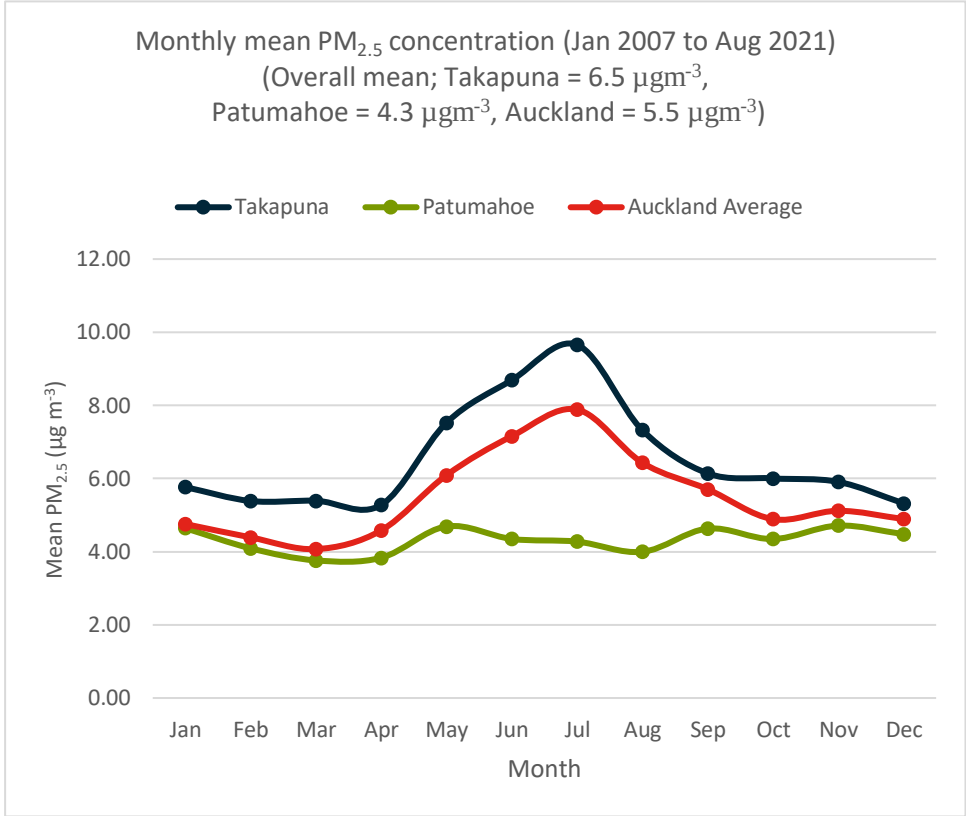

Figure 16. Temporal variation in monthly $PM_{2.5}$ concentrations – Takapuna compared to a rural site and Auckland average. Overall, Takapuna's $PM_{2.5}$ average concentration is 18% and 51% higher than Auckland average and Patumahoe respectively.

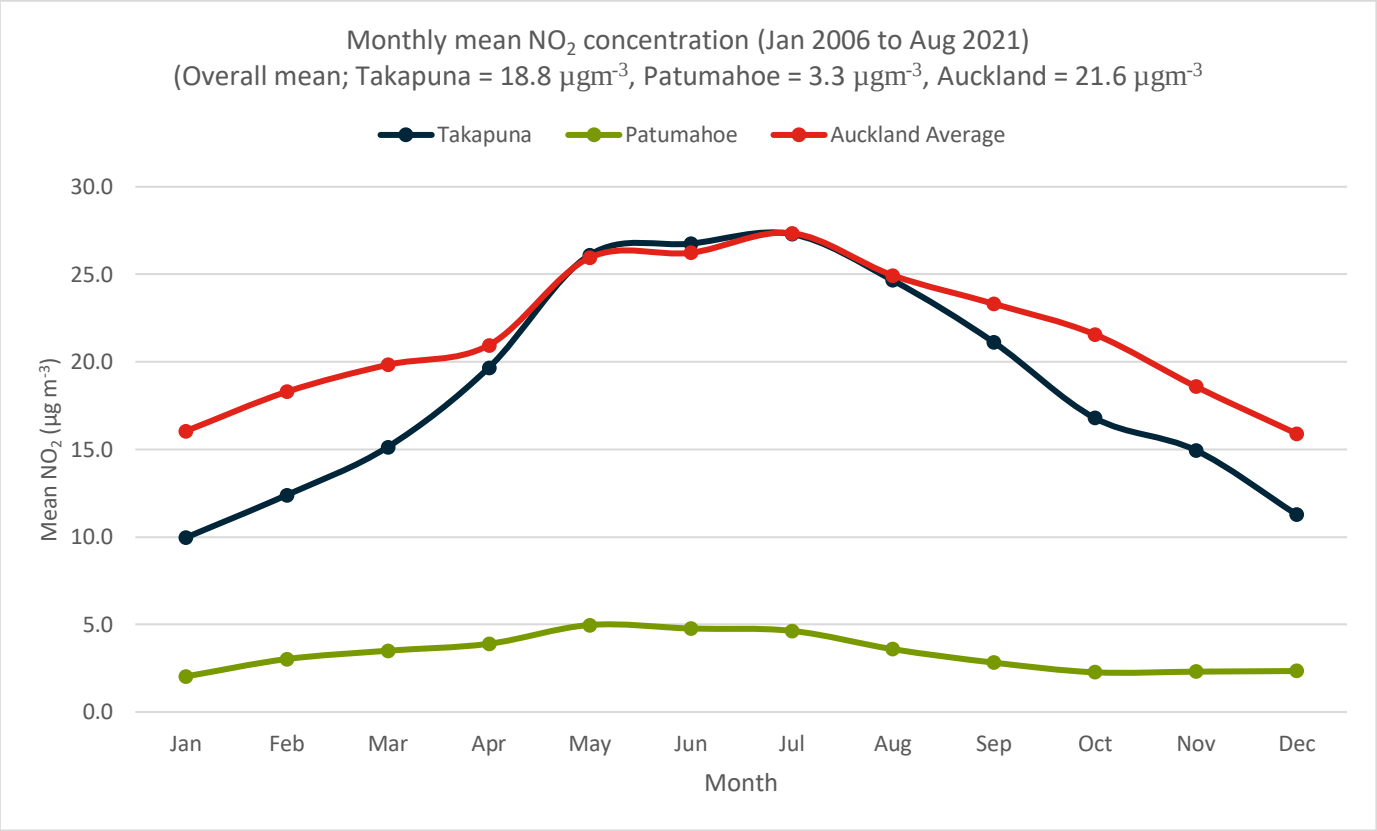

Figure 17. Temporal variation in monthly NO_2 concentrations – Takapuna compared to Patumahoe (rural site) and Auckland average. Overall, Takapuna's NO_2 average concentration is 13% lower than Auckland's average and approximately 5 - folds more than Patumahoe.

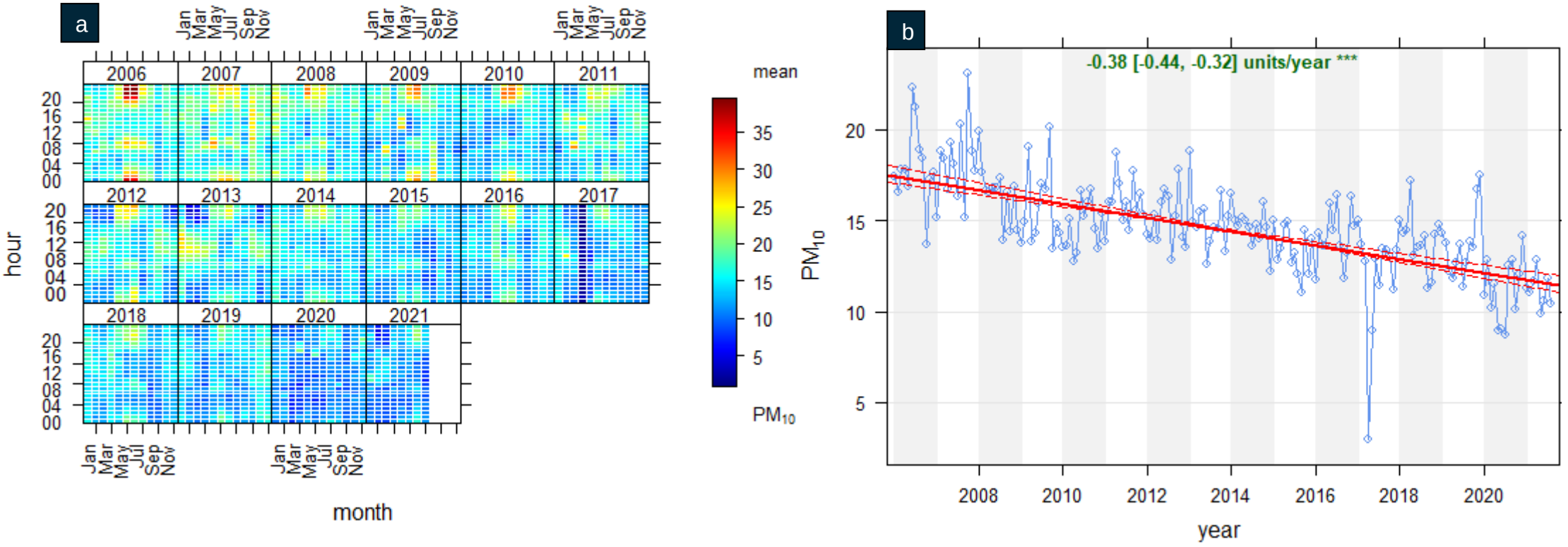

Figure 18. Long-term trends in PM_{10} at Takapuna (2006 to August 2021). Plot a is a trend heat map showing the variation in PM_{10} concentrations by year and hour of the day. Plot b presents the deseasonalised trend in PM_{10} concentrations showing that there was a significant decreasing trend (95 % confidence interval) over the monitoring period.

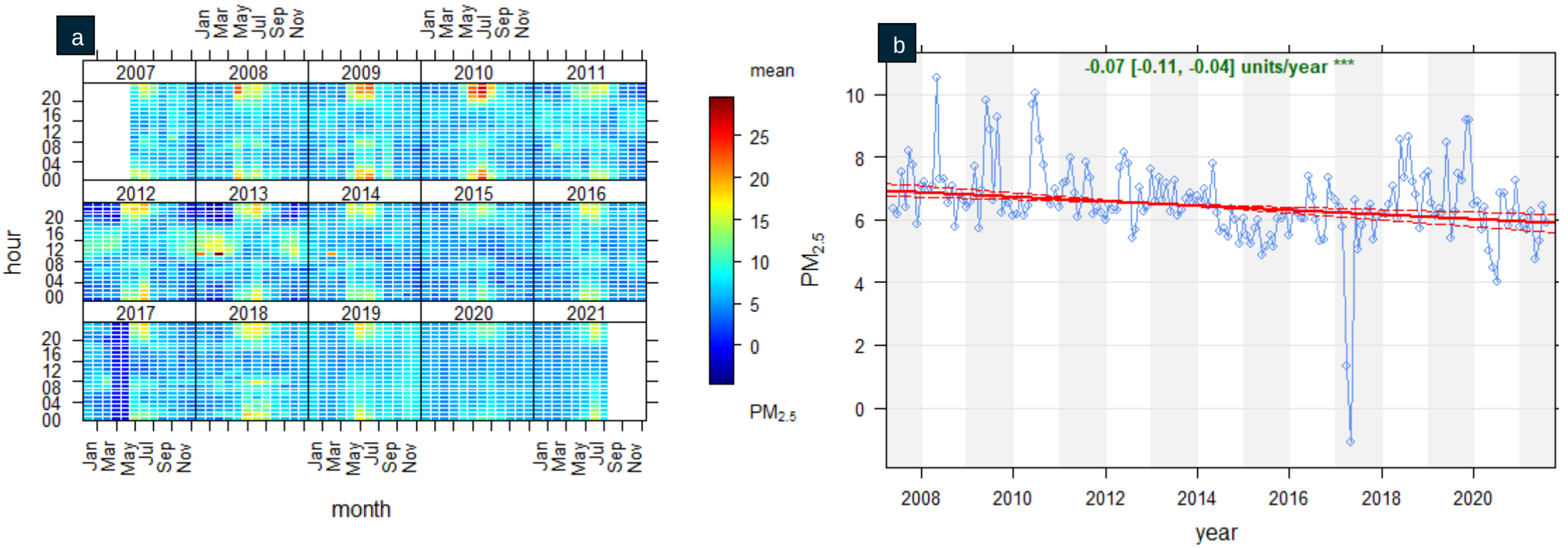

Figure 19. Long-term trends in $PM_{2.5}$ at Takapuna (2008 to August 2021). Plot a is a trend heat map showing the variation in $PM_{2.5}$ concentrations by year and hour of the day. Plot b presents the deseasonalised trend in $PM_{2.5}$ concentrations showing that there was a significant decreasing trend (95 % confidence interval) over the monitoring period.

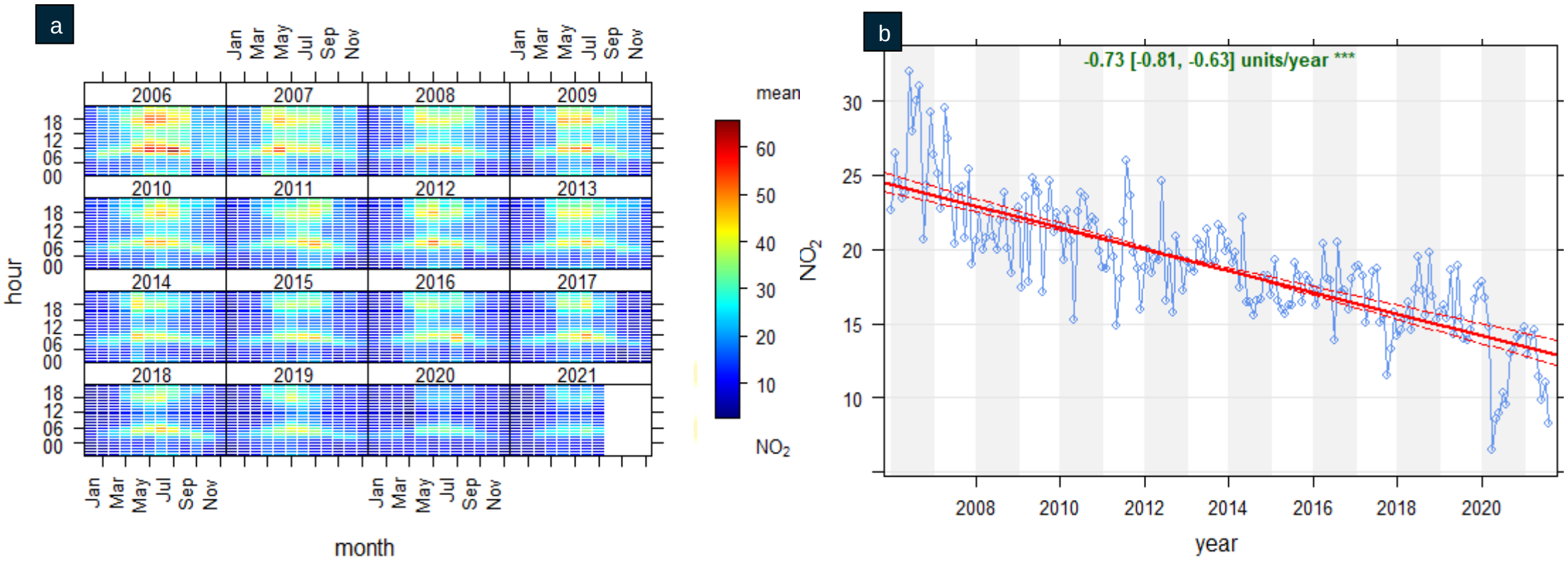

Figure 20. Long-term trends in NO_2 at Takapuna (2008 to August 2021). Plot a is a trend heat map showing the variation in NO_2 concentrations by year and hour of the day. Plot b presents the deseasonalised trend in NO_2 concentrations showing that there was a significant decreasing trend (95 % confidence interval) over the monitoring period.

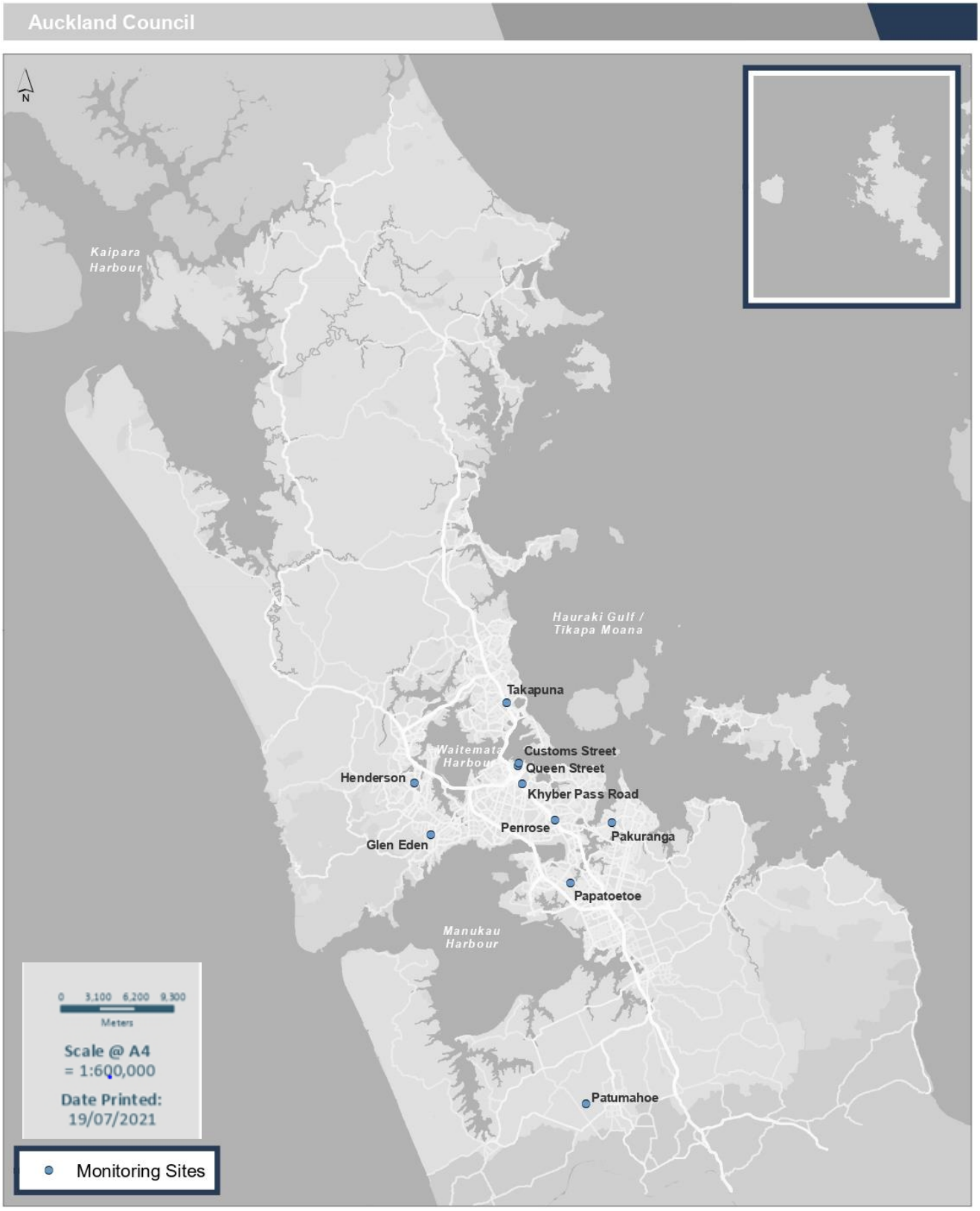

Figure 21. Auckland Council air quality monitoring sites

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