

REPORT

Ambient Air Quality Monitoring (AAQM) Report April 2023

West Gate Tunnel Project

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Executive Summary

Air quality monitoring for the West Gate Tunnel Project has been specifically established to develop a “baseline” of data from current local conditions. This baseline will be used to measure any changes once the tunnel opens. When the project opens, air quality monitoring will continue for up to 5 years.

The results of the West Gate Tunnel Project Ambient Air Quality Monitoring (AAQM) program for the period of 1 April 2023 to 30 April 2023 are presented below.

The following tables present the maximum measured concentration for each parameter at Stations 1, 2, 3, 4, 5 and 6 during the reporting period. The maximum concentration for each parameter is compared with the respective criteria.

Station 1 Summary April 2023

Parameter	Units	Averaging period	Maximum concentration	Air quality objective ^A	Exceedances ^B
PM _{2.5}	ug/m ³	24 hour	21	25	Nil
PM ₁₀	ug/m ³	24 hour	33	50	Nil

Note:

A – SEPP(AAQ) objective

B – Exceedances refers to the number of individual days the criterion was exceeded at any station

Station 2, Station 3, Station 5 and Station 6 Summary April 2023

Parameter	Units	Averaging period	Maximum concentration				Air quality objective ^A	Exceedances ^B
			Station 2	Station 3	Station 5	Station 6		
PM _{2.5}	ug/m ³	24 hour	23	21	21	27	36	Nil
PM ₁₀	ug/m ³	24 hour	37	28	38	33	60	Nil

Note:

A – SEPP(AQM) Intervention level

B – Exceedances refers to the number of individual days the criterion was exceeded at any station

Station 4 Summary April 2023

Parameter	Units	Averaging period	Maximum concentration	Air quality objective	Exceedances ^C
PM _{2.5}	ug/m ³	24 hour	22	36 ^A	Nil
PM ₁₀	ug/m ³	24 hour	39	60 ^A	Nil
NO ₂	ppb	1 hour	33	140 ^A	Nil
CO	ppm	1 hour	0.96	29 ^A	Nil
Benzene	ppb	24 hour	<0.5	3.0 ^B	Nil
Toluene	ppb	24 hour	1.3	1000 ^B	Nil
Total xylene isomers	ppb	24 hour	<1	250 ^B	Nil

Note:

A – SEPP(AQM) Intervention level

B – Air NEPM Monitoring investigation level

C – Exceedances refers to the number of individual days the criterion was exceeded at any station

April 2023 ambient air quality monitoring programme results did not exceed the respective air quality objectives for all parameters measured at all ambient air quality stations.

Data capture statistics for April 2023 were above 90 percent for all parameters at all stations except NO₂ at Station 4 (Primula Avenue) due to instrument faults.

A construction area (Millers Road exit ramp and noise wall relocation) is now adjacent Station 4, as a result, the measured pollutant concentrations may not be representative of traffic emissions.

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Important Information Relating to this Report

1.0 INTRODUCTION

Air quality monitoring for the West Gate Tunnel Project has been specifically established to develop a “baseline” of data from current local conditions. This baseline will be used to measure any changes once the tunnel opens. When the project opens, air quality monitoring will continue for up to 5 years.

The results of the West Gate Tunnel Project Ambient Air Quality Monitoring (AAQM) program for the period of 1 April 2023 to 30 April 2023, are contained in the following report.

The AAQM program was conducted in accordance with the Environmental Performance Requirement (EPR) AQP4 for the Project and consists of six AAQM stations (AAQMS) monitoring the following ambient air quality indicators:

- continuous measurement of particulate matter with an equivalent aerodynamic diameter less than 10 microns (PM₁₀)
- continuous measurement of particulate matter with an equivalent aerodynamic diameter less than 2.5 microns (PM_{2.5})
- continuous measurement of wind speed and wind direction.

Additionally, one of the specified AAQMS (Primula Avenue) monitors the following additional air quality indicators in combination with PM₁₀ and PM_{2.5}:

- continuous monitoring of oxides of nitrogen ([NO_x] comprising of nitrogen dioxide (NO₂) and nitric oxide [NO])
- continuous monitoring of carbon monoxide (CO)
- one in six day monitoring of benzene, toluene, ethylbenzene and xylene isomers (BTEX)
- continuous measurement of atmospheric pressure.

AAQMS Station 1 to Station 6 were installed and commissioned during the period 22/08/2018 to 12/10/2018. Specific installation dates can be found below in Section 2.1.

Details of the air quality indicators monitored at each AAQMS are provided in Table 1.

Table 1: AAQMS monitoring details

Site name	Location	Coordinates	Monitoring parameters
Station 1	Barbara Beyer Reserve, 2 Harris Street, Yarraville	-37.812730°S 144.900017°E	PM ₁₀ and PM _{2.5} Ambient temperature, relative humidity, wind speed and wind direction
Station 2	51-53 Francis Street	-37.821800°S 144.894383°E	PM ₁₀ and PM _{2.5} Ambient temperature, relative humidity, wind speed and wind direction
Station 3	Railway Lot 64, (part) 15 Goulburn Street, Yarraville	-37.814063°S 144.891320°E	PM ₁₀ and PM _{2.5} Ambient temperature, relative humidity, wind speed and wind direction
Station 4	44 Primula Avenue, Brooklyn	-37.824284°S 144.846425°E	PM ₁₀ and PM _{2.5} NO, NO ₂ , NO _x and CO BTEX – one in six day sampling (24 hour average) Ambient temperature, relative humidity, atmospheric pressure, wind speed and wind direction

Site name	Location	Coordinates	Monitoring parameters
Station 5	Donald McLean Reserve, Spotswood	-37.826442°S 144.882133°E	PM ₁₀ and PM _{2.5} Ambient temperature, relative humidity, atmospheric pressure, wind speed and wind direction
Station 6	44 Millers Road Brooklyn	-37.821252°S 144.848878°E	PM ₁₀ and PM _{2.5} Ambient temperature and relative humidity

2.0 AAQMS DETAILS

2.1 Site locations

AAQMS Station 1 to Station 5 were installed and commissioned during the period 22/08/2018 to 31/08/2018. AAQMS Station 6 (Millers Road) was commissioned on 12/10/2018. Meteorological sensors (wind speed and direction) were installed later due to delays in calibration from the instrument supplier. AAQMS commissioning dates are provided in Table 2. Figure 1 presents the locations of the AAQMS.

Table 2: AAQMS commissioning dates

Parameter	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
AAQMS	23/08/2018	22/08/2018	22/08/2018	22/08/2018	31/08/2018	12/10/2018
Wind speed & direction	07/09/2018	20/09/2018	14/09/2018	10/09/2018	17/09/2018	23/11/2018 ^A

A – wind sensor is not compliant with siting criteria specified in AS 3580.14

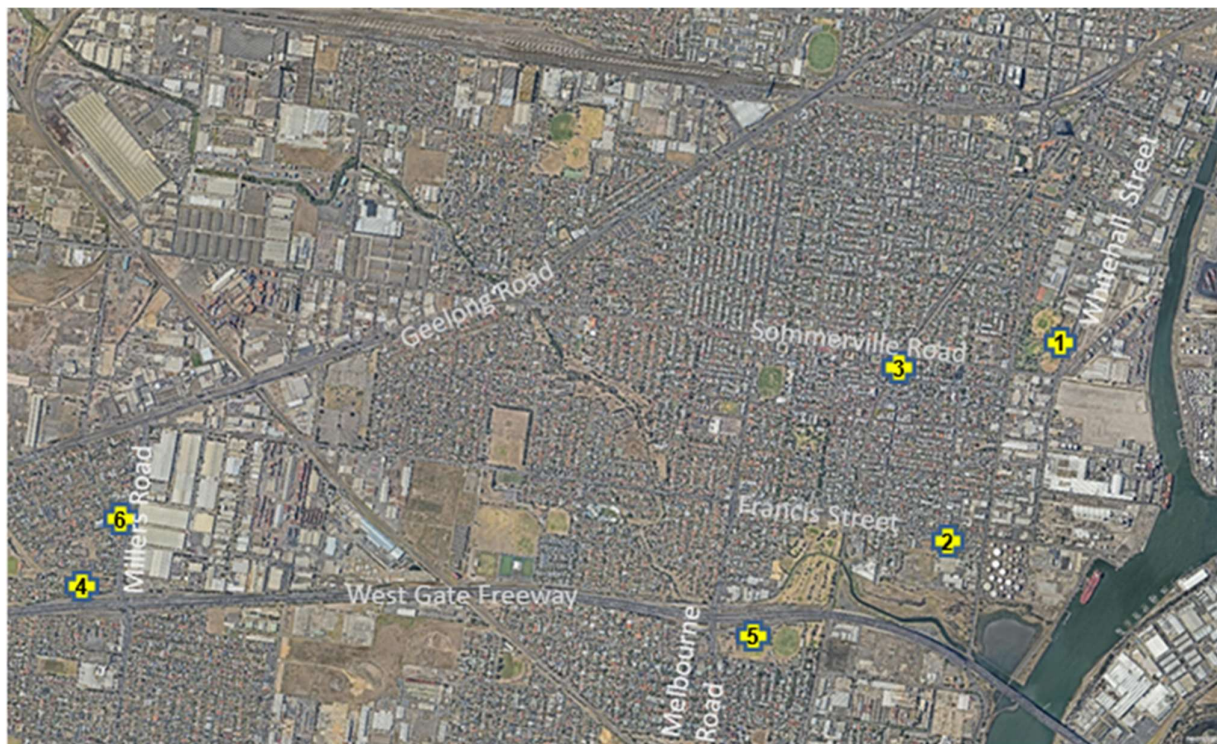


Figure 1: West Gate Tunnel AAQMS site locations

2.2 Siting assessment

Australian Standard AS/NZS 3580.1.1 “*Methods for Sampling and Analysis of Ambient Air – Part 1.1. Guide to Siting Air Monitoring Equipment*” provides general guidance for the siting of ambient air monitoring equipment and specific siting parameters for individual air pollutants. Table 3 provides a comparison between recommended criteria contained in the Standard for the parameters monitored at neighbourhood and peak monitoring stations with actual conditions at each AAQMS.

Table 3: Australian standard AAQMS siting criteria compliance

Station	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
Station type	Neighbourhood	Peak	Peak	Peak	Peak	Peak
Inlet height above ground level 1.0 m – 15 m	✓	✓	✓	✓	✓	✓
Clear sky angle 120° (Neighbourhood)	✓	-	-	-	-	-
Unrestricted 270° airflow around inlet (Neighbourhood)	✓	-	-	-	-	-
Unrestricted 180° airflow around inlet (Peak)	-	✓	✓	✓	✓	✓
Distance to supporting structure ≥ 1 m	✓	✓	✓	✓	✓	✓
10 m from drip line of trees	✓	✓	✓	✓	✓	✗ ^A
No extraneous sources nearby	✓	✓	✓	✗ ^B	✓	✗ ^C
Greater than 50 m from road (≤ 10,000 vehicles/day)	✓	-	-	-	-	-
Greater than 2 m from road (Peak station)	-	✓	✓	✓	✓	✓

Note:

- A Tree drip line is <3 m from sampler inlets and meteorological monitoring equipment
 B Temporary construction area for Millers Road noise wall and exit ramp relocation works
 C Residential chimney is <5 m from the sampler inlet.

2.3 Equipment specifications

Table 4 provides a list of the monitoring equipment installed at the AAQMS.

Table 4: AAQMS instrumentation

Parameter	Equipment item	Manufacturer	Model
PM _{2.5}	Beta Attenuation Monitor (BAM)	Thermo Fisher Scientific Inc.	5014i
PM ₁₀	Beta Attenuation Monitor (BAM)	Thermo Fisher Scientific Inc.	5014i
Oxides of Nitrogen	Chemiluminescence	Thermo Fisher Scientific Inc.	42i
Carbon Monoxide	Infra-red gas filter correlation	Thermo Fisher Scientific Inc.	48i
Temperature	Pt100 resistive platinum sensor	Thermo Fisher Scientific Inc.	5014i
BTEX	Summa canister	Restek	6 litre
Relative humidity	Capacitive thin film sensor	Thermo Fisher Scientific Inc.	5014i

Parameter	Equipment item	Manufacturer	Model
Atmospheric Pressure	Beta Attenuation Monitor (BAM)	Thermo Fisher Scientific Inc.	5014i
Wind speed and wind direction	Ultrasonic anemometer	RM Young	Model 86000

3.0 AIR QUALITY CRITERIA

The ambient air quality criteria applicable to the West Gate Tunnel Project were derived from the State Environment Protection Policies (SEPPs); Ambient Air Quality (SEPP(AAQ)), Air Quality Management (SEPP(AQM)) and the National Environment Protection (Air Toxics) Measure Monitoring Investigation Levels (MILs).

As part of the implementation of the Environment Protection Act 2017 (Act) which came into effect on 1 July 2021, the SEPP(AAQ) and SEPP(AQM) have been discontinued and some of their content has been replaced by the “Environment Reference Standard” (ERS), publication S245. In addition, some elements of the SEPP’s will ultimately be replaced by proposed guidelines.

EPA publication 1998 – June 2021 “Compliance Code for Victoria’s Big Build Projects” states for the West Gate Tunnel Project, the obligations under Section 25(1) of the Act for General Environmental Duty (GED) are met during design and construction by complying with the West Gate Tunnel Project Environmental Performance Requirements (EPRs), which include undertaking ambient air quality monitoring in accordance with SEPP(AAQ) and SEPP(AQM). This report therefore continues to make reference to the SEPP(AAQ) and SEPP(AQM).

SEPP (AAQ)

The SEPP(AAQ) sets out the environmental indicators and objectives for ambient air quality that seek to achieve or maintain environmental values in Victoria. The SEPP(AAQ) adopts the requirements of the *National Environment Protection (Ambient Air Quality) Measure* (Air NEPM) and its environmental quality objectives (EQOs) for CO, NO₂, and particles (as PM₁₀ and PM_{2.5}). The SEPP(AAQ) EQOs apply to air quality within a region or sub-region considered to be representative of exposure of the general population in Victoria. These objectives have been adopted for the purposes of comparison with results from background/ neighbourhood monitoring stations for the West Gate Tunnel Project and are relevant to Station 1 (Yarraville Gardens).

SEPP(AQM)

The SEPP(AQM) sets out legislative requirements for managing and assessing air emissions in Victoria. The aim of the SEPP(AQM) is to ensure that prescribed air quality objectives are met and protect the beneficial uses of the air environment. Schedule B lists intervention levels which are used in the assessment of local or neighbourhood air monitoring data. Consistent with assessment of impacts described in the Environment Effects Statement for the West Gate Tunnel Project, the SEPP(AQM) intervention levels will continue to be adopted for purposes of comparison with results from peak monitoring stations for the West Gate Tunnel Project. These AQO are applicable to Station 2 (Francis Street), Station 3 (Railway Reserve), Station 4 (Primula Avenue), Station 5 (Donald McLean Reserve) and Station 6 (Millers Road).

NEPM (Air Toxics)

The aim of the Air Toxics NEPM is to gain a greater understanding of the levels of air toxics at specific locations where elevated concentrations are likely to occur and where the potential for significant human exposure exists. The Air Toxics NEPM established monitoring investigation levels (MILs) relevant for the West Gate Tunnel Project for benzene, toluene and xylene isomers. The MILs are used purposes of comparison with results from the air toxics monitored at Station 4 (Primula Avenue). Table 5 presents the air quality indicators and objectives for each AAQMS for the West Gate Tunnel Project.

Table 5: Air quality indicators and objectives

Location	Pollutant	Units	Air Quality Objective	Averaging period
Station 1	PM ₁₀	µg/m ³	50	24 hour
			20	Annual
	PM _{2.5}		25	24 hour
			8	Annual
Station 2 Station 3 Station 4 Station 5 Station 6	PM ₁₀	µg/m ³	60	24 hour
	PM _{2.5}		36	
Station 4	CO	ppm	29	1 hour
	NO ₂	ppb	140	1 hour
	Benzene	ppb	3	Annual
	Toluene	ppb	1000	24 hour
			100	Annual
	Ethylbenzene	ppb	NA	24 hour
	Xylene isomers	ppb	250	24 hour
			200	Annual

4.0 TEST METHODS

4.1 Particulate matter (PM_{2.5})

PM_{2.5} concentrations are determined using a Beta Attenuation Monitor (BAM).

Suspended particulate matter in ambient air is measured using the attenuation of beta rays as a surrogate for continuous mass determination. Beta rays are high energy electrons generated from the radioactive decay of the radon isotope Rn-222. When contacting particulate matter beta rays are either absorbed or their energy level is diminished. The relationship between the attenuation of beta rays between the source and detector is used to determine the mass density.

The BAM is equipped with a flow control and measurement system. The flow control system volumetrically controls the flowrate to 16.7 l/min. The flowrate is used with the mass density to calculate the particulate matter concentration.

The sampler is fitted with a size selective inlet, which separates particles with an equivalent aerodynamic diameter greater than 10 microns from the sample stream. An in-line PM_{2.5} particle size separator is also fitted to further separate particles; only those with an equivalent aerodynamic diameter less than 2.5 microns can pass through the particle size separator to the filter for mass determination.

The PM_{2.5} monitoring method is based on the requirements contained within Australian Standard AS/NZS 3580.9.12 “*Methods for Sampling and Analysis of Ambient Air – Method 9.12: Determination of Suspended Particulate Matter – PM_{2.5} Beta Attenuation Monitors*” (NATA Laboratory Accreditation No. 1910).

4.2 Particulate matter (PM₁₀)

PM₁₀ concentrations are determined using a continuous BAM without an in-line PM_{2.5} particle size separator. All other measurement processes remain the same as for the PM_{2.5} test method.

The PM₁₀ monitoring method is based on the requirements contained within Australian Standard AS/NZS 3580.9.11:2016 *“Methods for Sampling and Analysis of Ambient Air – Method 9.11: Determination of Suspended Particulate Matter – PM₁₀ Beta Attenuation Monitors”* (NATA Laboratory Accreditation No. 1910).

4.3 Nitrogen dioxide (NO₂)

Oxides of nitrogen concentrations were determined using a 42i Thermo Scientific chemiluminescence gas analyser.

Automatic calibrations are carried out daily against a NATA certified reference gas mixture. Manual calibrations are conducted at one month intervals.

The oxides of nitrogen (NO, NO₂ and NO_x) monitoring method is based on the requirements of Australian Standard AS 3580.5.1, *“Determination of Oxides of Nitrogen – Chemiluminescence Method”*.

4.4 Carbon monoxide (CO)

Carbon monoxide concentrations are determined using a 48i Thermo Scientific infra-red gas filter correlation analyser.

Automatic calibrations are carried out daily against a NATA certified reference gas mixture. Manual calibrations are conducted at one month intervals.

The carbon monoxide monitoring method is based on the requirements of Australian Standard AS 3580.7.1, *“Determination of Carbon Monoxide – Direct Reading Instrumental Method”*.

4.5 Volatile organic compounds (BTEX)

A sample is collected in an evacuated electro-polished and passivated stainless steel canister. Analysis involves separation by gas chromatography (GC) and measurement by mass selective (MS) detector.

The procedure for sampling Volatile Organic Compounds (VOCs) using evacuated canisters, and for the subsequent analysis, is described in USEPA Method TO-15 *“Determination of Volatile Organic Compounds (VOCs) in air collected in specially-prepared canisters and analysed by Gas Chromatography/Mass Spectrometry (GC/MS)”*.

Samples were analysed by Queensland Health (NATA Laboratory Accreditation No. 41) based on USEPA method TO-15. The test method used was in accordance with Golder Source Test Method C9, *“Canister (Evacuated) Sampling for VOC: In Ambient Air and Source Emissions”*.

4.6 Meteorological parameters

Monitoring of meteorological parameters; wind speed/direction, temperature, relative humidity, solar radiation and rainfall was conducted in accordance with Australian Standard AS 3580.14 *“Methods for Sampling and Analysis of Ambient Air – Part 14: Meteorological Monitoring for Ambient Air Quality Monitoring Applications”* (NATA Laboratory Accreditation No. 1910).

5.0 MEASUREMENT UNCERTAINTY

5.1 PM_{2.5}

The measurement uncertainty for PM_{2.5} by BAM is published by Thermo-Fisher as $\pm 2 \mu\text{g}/\text{m}^3$ (24 hour average).

5.2 PM₁₀

The measurement uncertainty for PM_{2.5} by BAM is published by Thermo-Fisher as $\pm 2 \mu\text{g}/\text{m}^3$ (24 hour average).

5.3 NO₂

The measurement uncertainty for NO, NO₂ and NO_x by Chemiluminescence is published in AS3580.5.1 as $\pm 10\%$ (24 hour average).

5.4 CO

The measurement uncertainty for CO by Infra-red gas filter correlation is published in AS3580.7.1 as $\pm 10\%$ (24 hour average).

5.5 Benzene

USEPA Method TO-15 cites the accuracy and precision for two ambient air quality studies conducted in the United States of America. The average replicate precision for a range of 16 compounds in both studies was 15%. Replicate precision was defined as the ratio of the average difference between replicates to the average value of replicates.

The reported accuracies for both studies ranged between $\pm 4\%$ and $\pm 31\%$. The average accuracy for both studies for the range of 16 compounds was $\pm 11\%$. Accuracy is defined as the ratio of the difference between expected and observed audit results to the expected audit result.

5.6 Meteorological parameters

The estimated measurement uncertainty for each of the parameters is presented in Table 6.

Table 6: Meteorological parameters measurement uncertainty

Parameter	Measurement uncertainty ^A
Wind speed	Greater of $\pm 0.6 \text{ m/s}$ or 5%
Wind direction	$\pm 5^\circ$
Barometric pressure	$\pm 3 \text{ hPa}$
Temperature	$\pm 6\%$
Relative humidity	$\pm 5 - 7\% \text{RH}$

Note:

A Measurement uncertainty estimates are as published in AS3580.14 "Methods for Sampling and Analysis of Ambient Air – Part 14 Meteorological Monitoring for Ambient Air Quality Monitoring Applications".

5.7 Calibration and maintenance

Sample flow rate calibration was conducted on a monthly basis using a NATA calibrated primary standard flowmeter. Calibration details for the reporting period are presented in Table 7.

Table 7: Calibrations

Location	Parameter	Last Calibration Date	Calibration Type
Station 1	PM ₁₀	26/04/2023	Monthly
	PM _{2.5}	26/04/2023	Monthly
	Wind speed and direction	25/08/2022	Two yearly
Station 2	PM ₁₀	25/04/2023	Monthly
	PM _{2.5}	25/04/2023	Monthly
	Wind speed and direction	20/08/2022	Two yearly
Station 3	PM ₁₀	25/04/2023	Monthly
	PM _{2.5}	25/04/2023	Monthly
	Wind speed and direction	12/10/2022	Two yearly
Station 4	PM ₁₀	27/04/2023	Monthly
	PM _{2.5}	27/04/2023	Monthly
	NO / NO ₂ / NO _x	27/04/2023	Monthly
	CO	27/04/2023	Monthly
	BTEX	NA	Flow-controllers and canisters certified by lab
	Wind speed and direction	11/09/2022	Two yearly
Station 5	PM ₁₀	26/04/2023	Monthly
	PM _{2.5}	26/04/2023	Monthly
	Wind speed and direction	10/10/2022	Two yearly
Station 6	PM ₁₀	26/04/2023	Monthly
	PM _{2.5}	26/04/2023	Monthly

6.0 RESULTS

The monitoring results for 1 April 2023 to 30 April 2023 are presented in the following sections.

6.1 Particulate matter (BAM PM_{2.5} & PM₁₀)

PM_{2.5} and PM₁₀ were continuously monitored and 5-minute averages logged. The 5-minute average data was transformed to 24 hour averages for reporting.

PM_{2.5} and PM₁₀ concentration statistics from the reporting period for Station 1 to Station 6 are presented in Table 8 to Table 13. The 24 hour average plots for Station 1 to Station 6 are presented in Figure 2 to Figure 7.

6.1.1 Station 1 – Yarraville Gardens

Table 8: Station 1 (Yarraville Gardens AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	21	19	17	13	12	10	5.9	25
PM ₁₀	33	30	27	21	20	17	13	50

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AAQ) Objective

Values rounded to two significant figures.

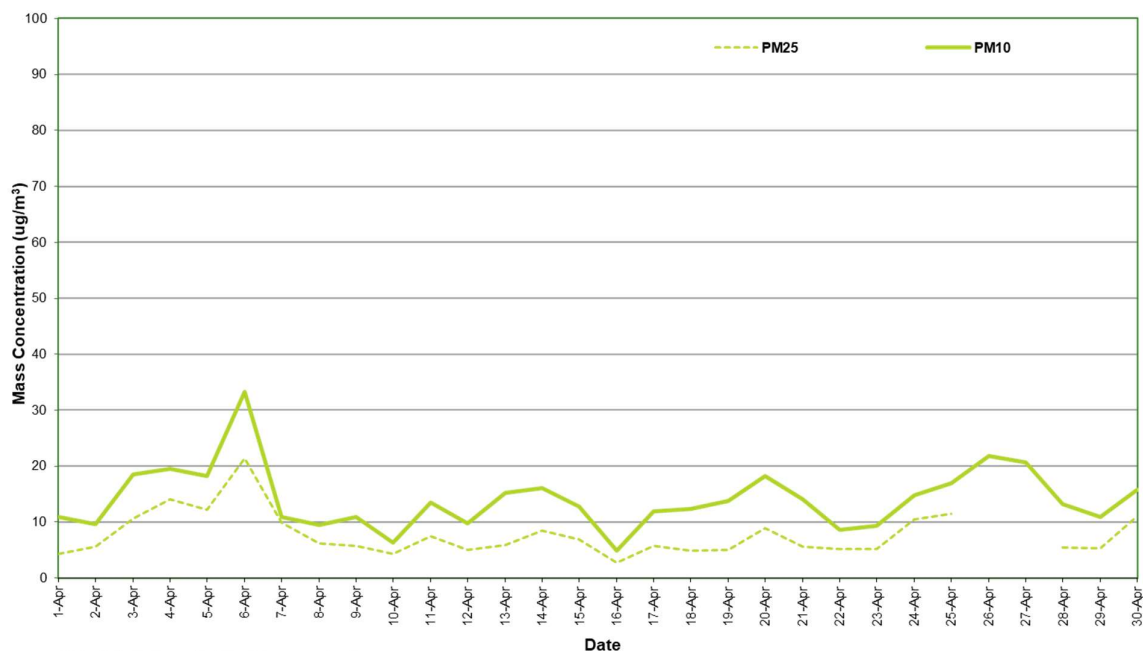


Figure 2: Station 1 PM_{2.5} and PM₁₀ concentration (24 hour average) – April 2023

6.1.2 Station 2 – Francis Street

Table 9: Station 2 (Francis Street AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	23	20	18	13	12	9.5	8.0	36
PM ₁₀	37	35	32	27	23	19	17	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level

Values rounded to two significant figures.

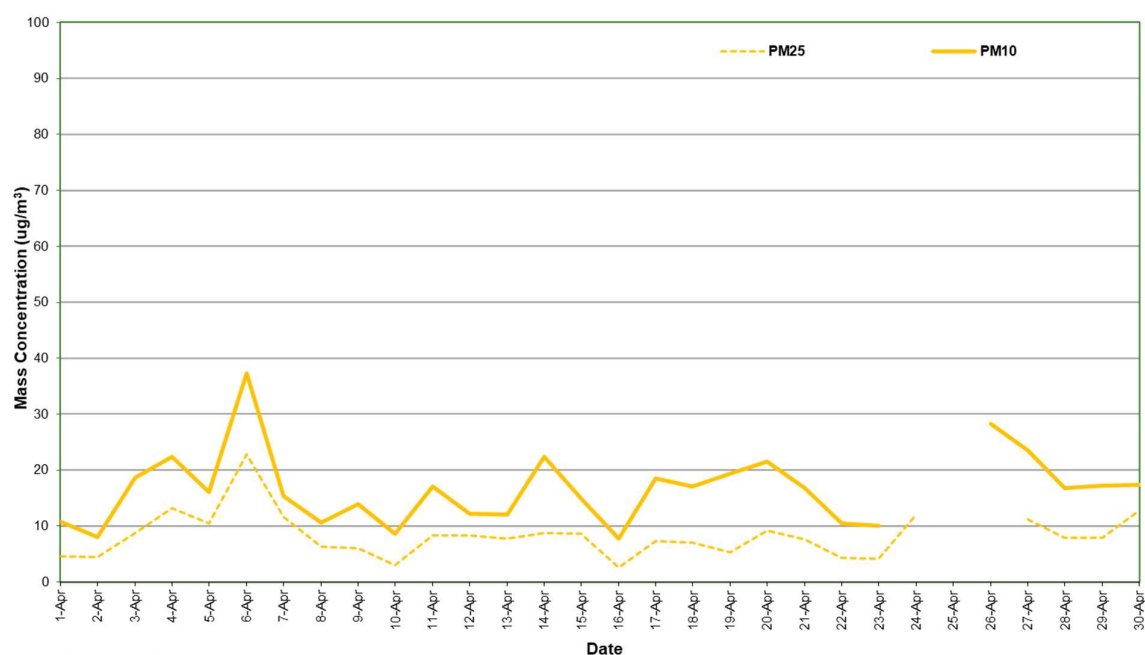


Figure 3: Station 2 PM_{2.5} and PM₁₀ concentration (24 Hour Average) – April 2023

6.1.3 Station 3 – Railway Reserve

Table 10: Station 3 (Railway Reserve AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	21	19	17	13	11	8.8	6.7	36
PM ₁₀	28	25	23	19	19	16	13	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level

Values rounded to two significant figures.

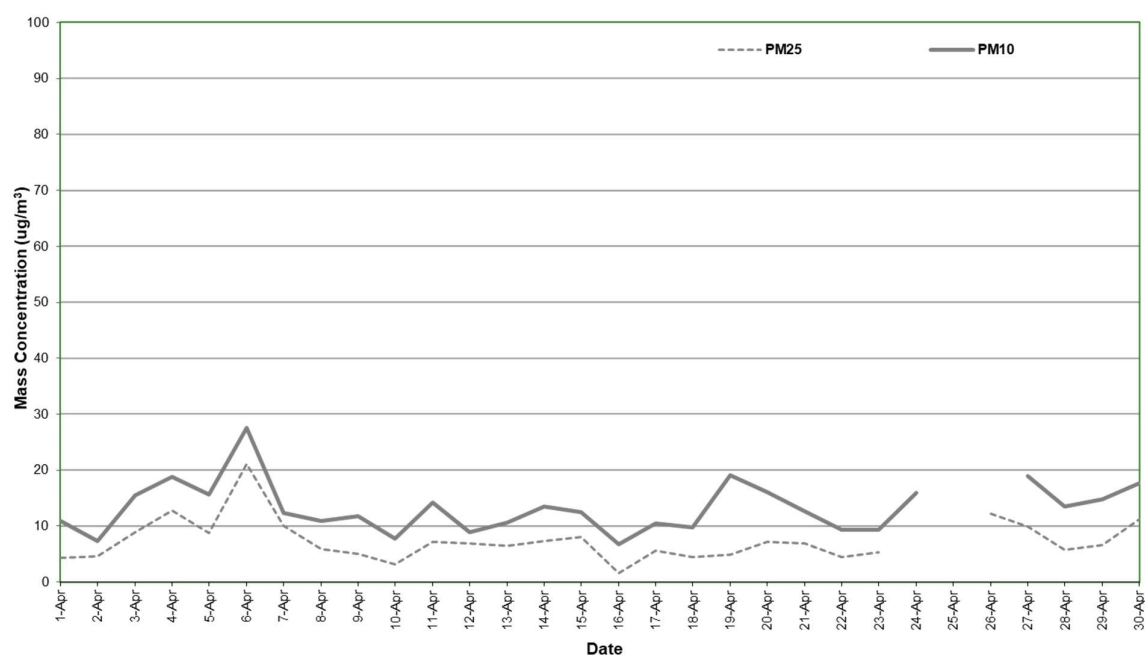


Figure 4: Station 3 PM_{2.5} and PM₁₀ concentration (24 hour average) – April 2023

6.1.4 Station 4 – Primula Avenue

Table 11: Station 4 (Primula Avenue AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	(µg/m ³)
PM _{2.5}	22	19	17	13	12	9.7	7.1	36
PM ₁₀	39	37	35	30	23	20	17	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level

Values are rounded to two significant figures.

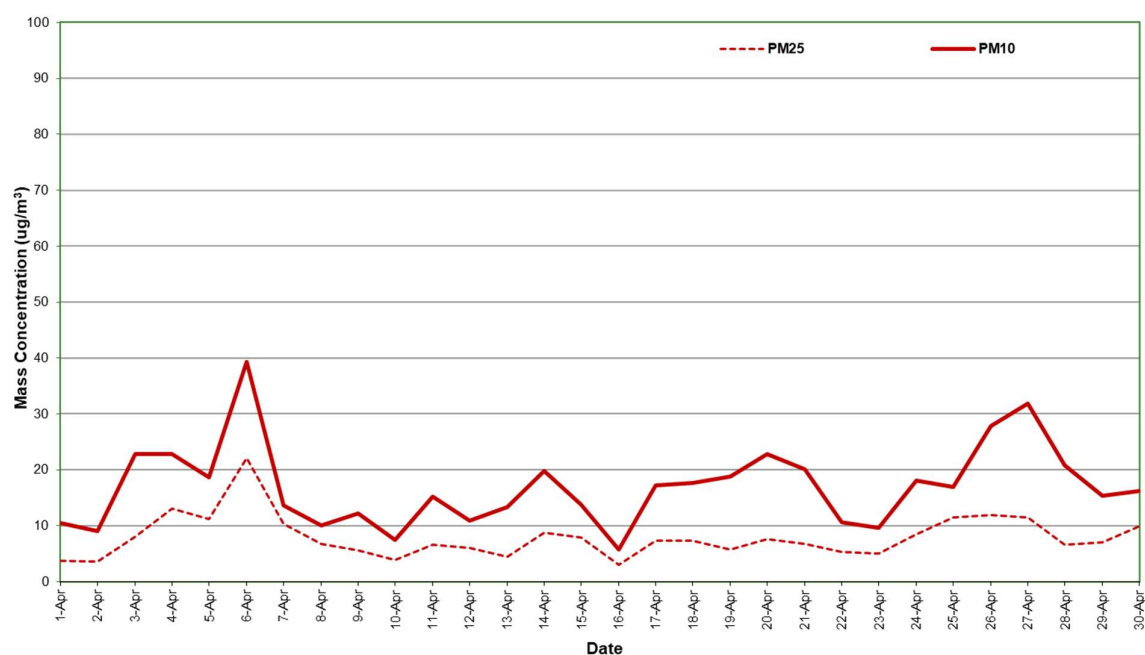


Figure 5: Station 4 PM_{2.5} and PM₁₀ concentration (24 hour average) – April 2023

6.1.5 Station 5 – Donald McLean Reserve

Table 12: Station 5 (Donald McLean Reserve AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	(µg/m ³)
PM _{2.5}	21	19	17	13	11	9.6	7.2	36
PM ₁₀	38	38	37	36	24	19	16	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level

Values rounded to two significant figures.

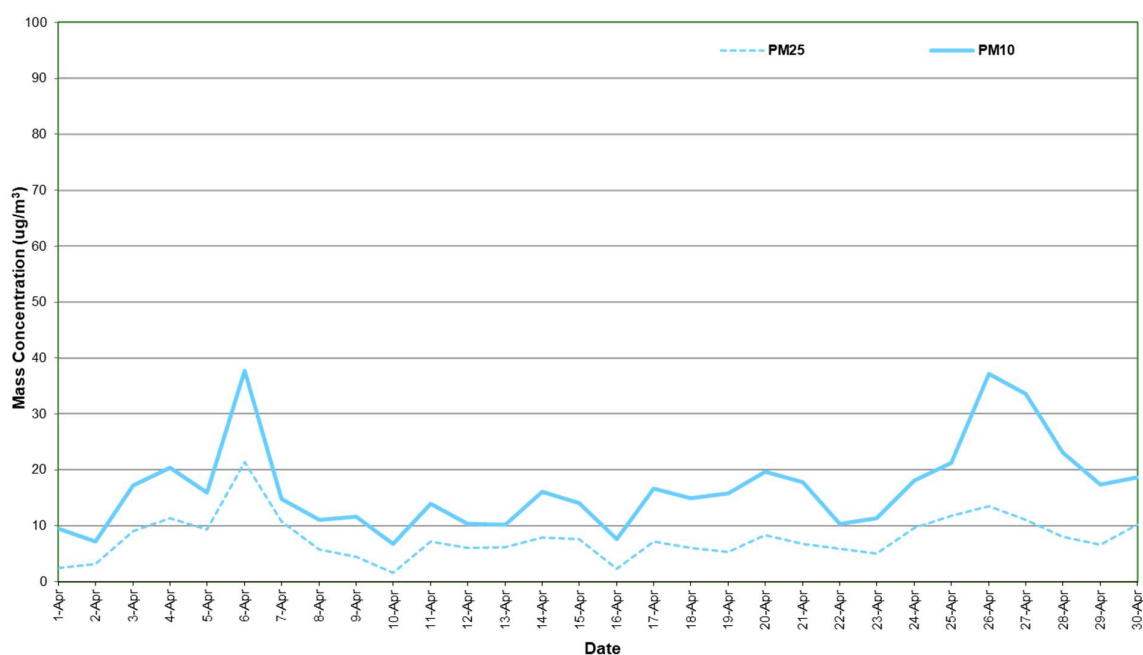


Figure 6: Station 5 PM_{2.5} and PM₁₀ concentration (24 hour average) – April 2023

6.1.6 Station 6 – Millers Road

Table 13: Station 6 (Millers Road AAQMS) PM_{2.5} and PM₁₀ percentiles (24 hour average)

Parameter	Concentration (µg/m ³) ^A							Air quality objective ^B (µg/m ³)
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	
PM _{2.5}	27	23	19	13	12	11	7.1	36
PM ₁₀	33	31	28	24	23	20	15	60

Note:

A Micrograms per cubic metre at 0°C and 101.3 kPa

B SEPP(AQM) Intervention level

Values rounded to two significant figures.

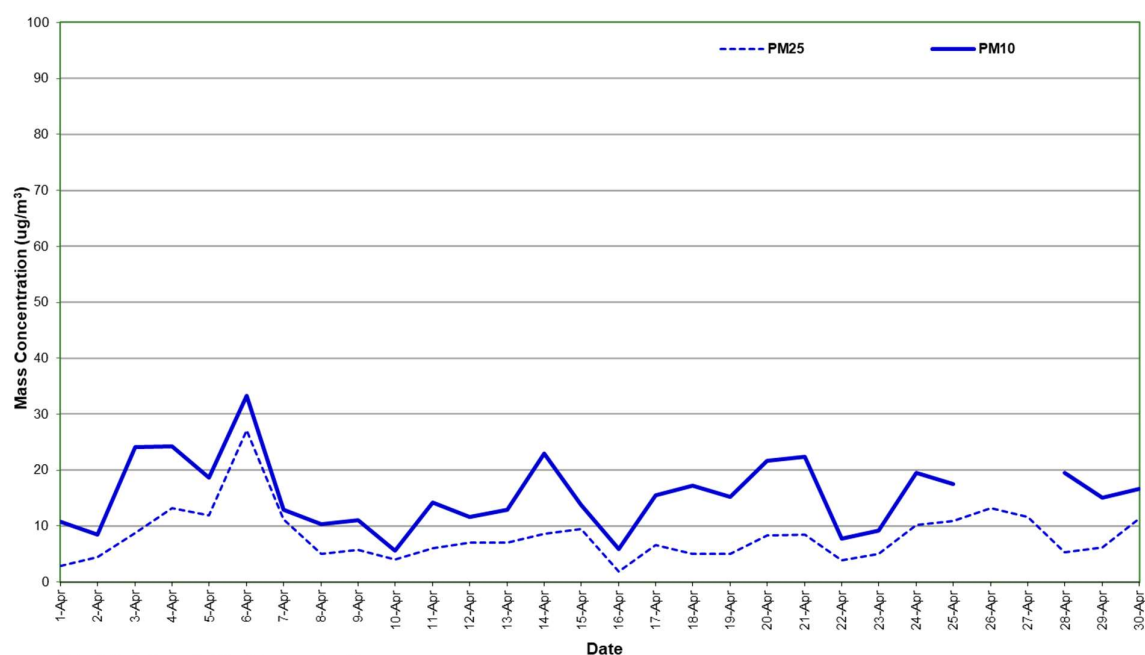


Figure 7: Station 6 PM_{2.5} and PM₁₀ concentration (24 hour average) – April 2023

6.1.7 Combined PM_{2.5} mass concentrations

Combined plots of the AAQMS PM_{2.5} and PM₁₀ are presented in Figure 8 and Figure 9 respectively.

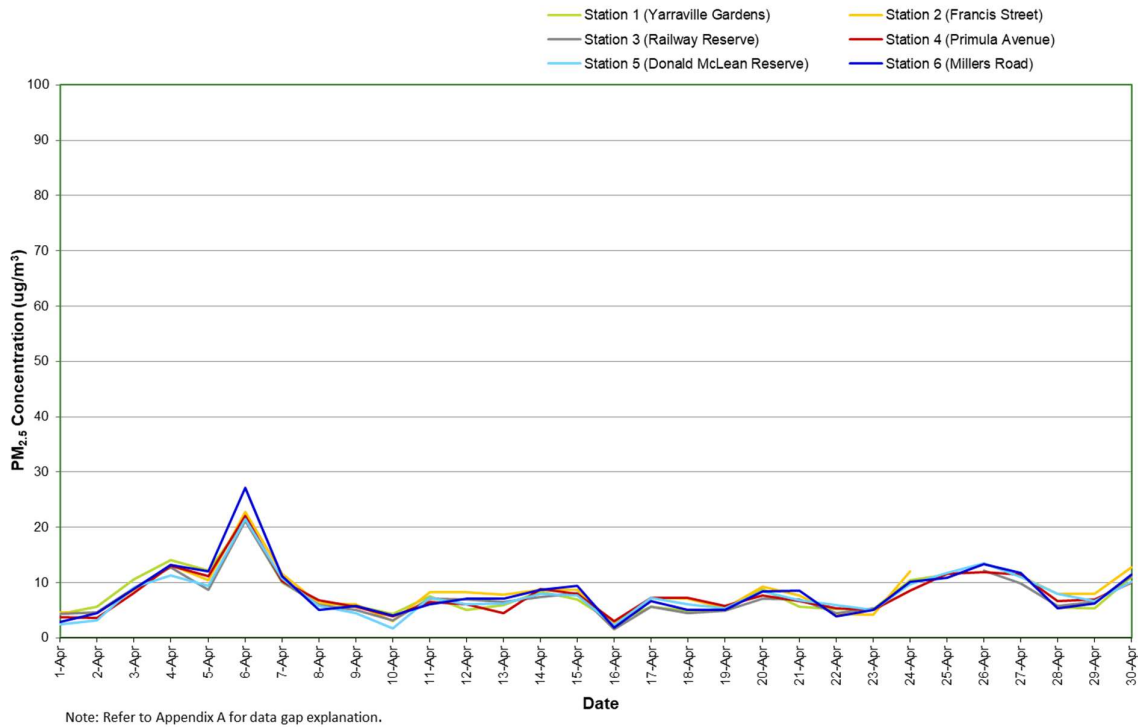


Figure 8: Combined PM_{2.5} concentration (24 hour average) – April 2023

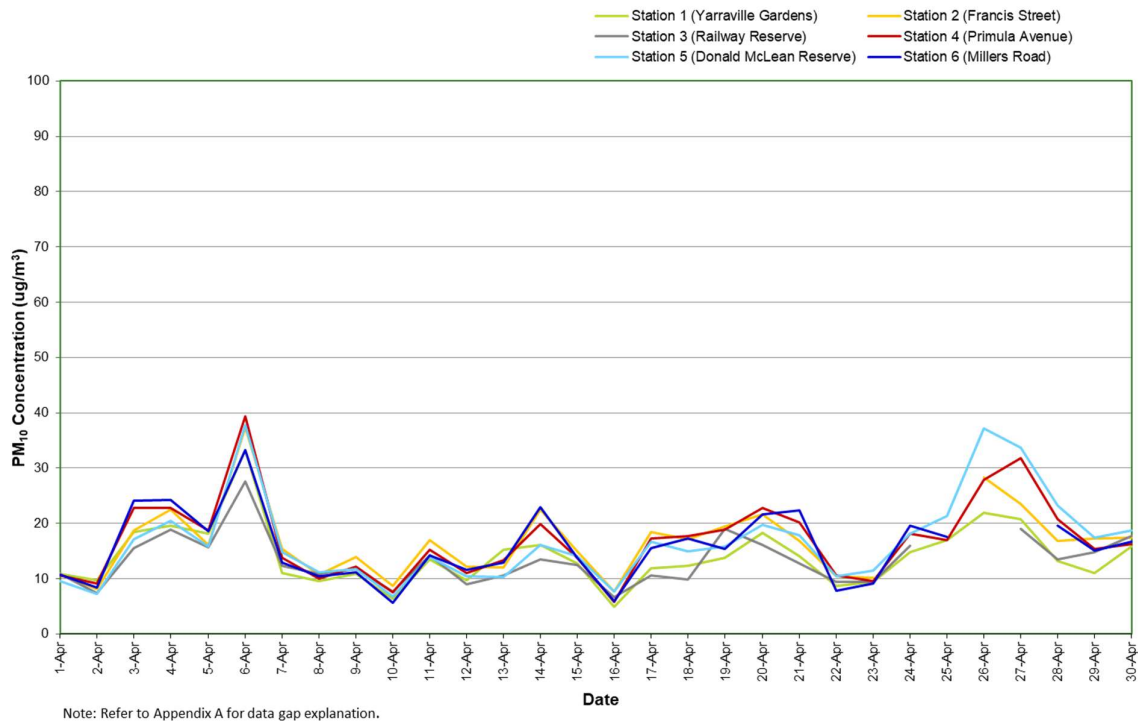


Figure 9: Combined PM₁₀ concentration (24 hour average) – April 2023

6.2 Nitrogen dioxide (NO₂)

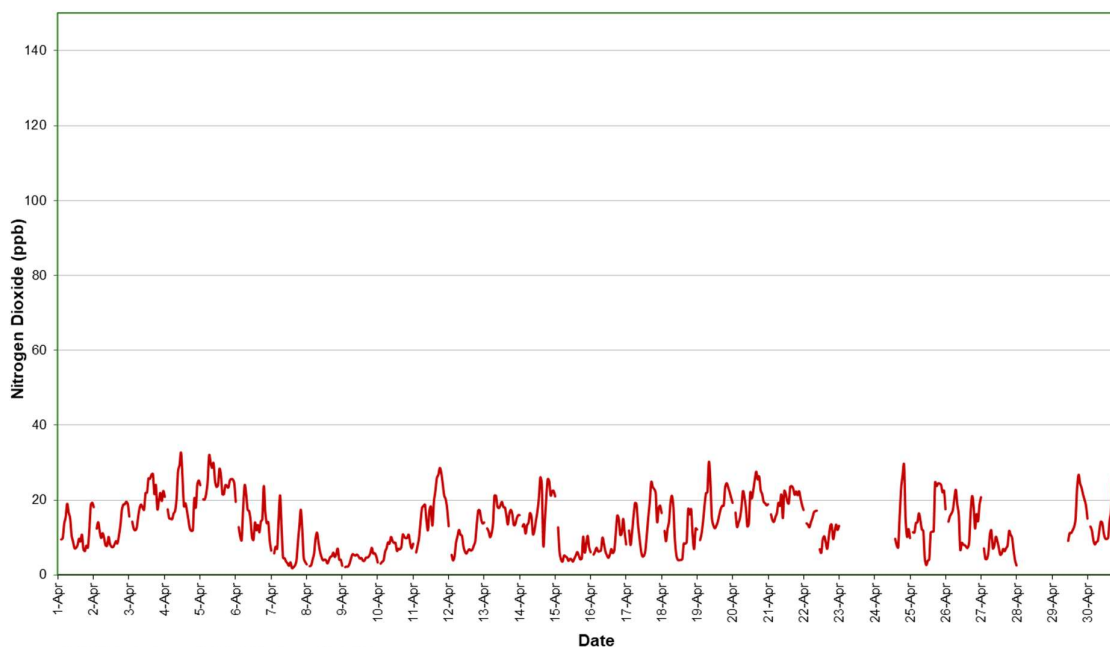
NO₂ (1 hour average) mass concentration statistics for the reporting period are given in Table 14. A plot of NO₂ (1 hour average) mass concentration for the reporting period is presented in Figure 10.

Table 14: Station 4 (Primula Avenue AAQMS) NO₂ percentiles (1 hour average)

Parameter	Concentration (ppb) ^A							SEPP (AQM) intervention level
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	(ppb)
NO ₂	33	29	28	26	24	19	13	140

Note:

A Parts per billion



Note: Refer to Appendix A for data gap explanation.

Figure 10: Station 4 NO₂ concentration (1 hour average) – April 2023

6.3 Carbon monoxide (CO)

CO (1 hour average) mass concentration statistics for the reporting period are given in Table 15. A plot of CO (1 hour average) concentration for the reporting period is presented in Figure 11.

Table 15: Station 4 (Primula Avenue AAQMS) CO percentiles (1 hour average)

Parameter	Concentration (ppm) ^A							SEPP (AQM) intervention level
	Maximum	99 th	98 th	95 th	90 th	75 th	50 th	(ppm)
CO	0.96	0.68	0.62	0.49	0.43	0.34	0.27	29

Note:

A Parts per million

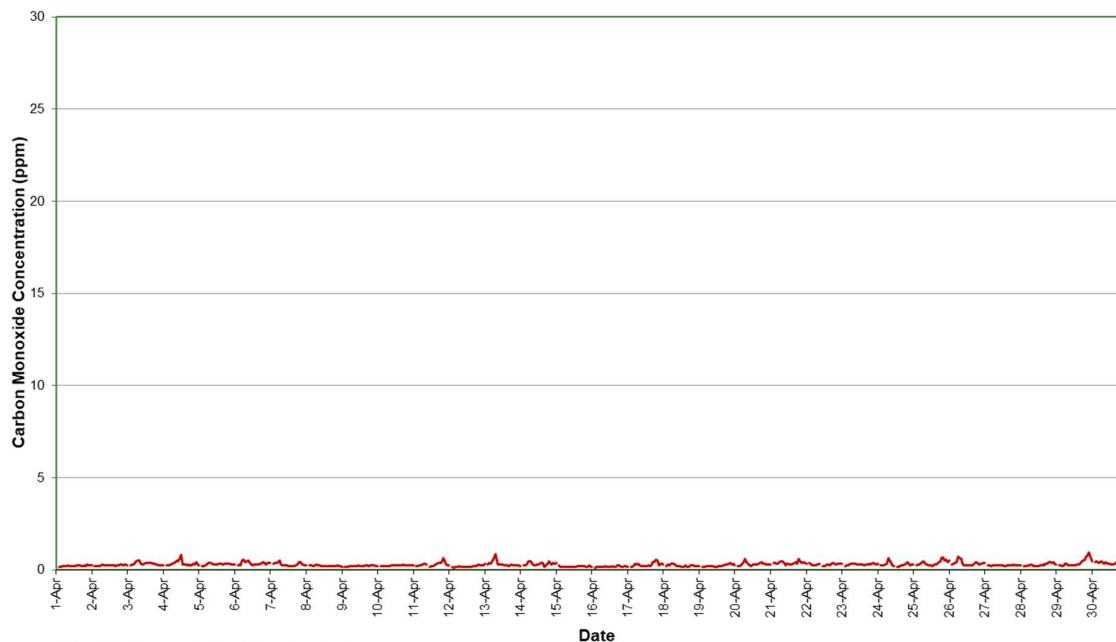


Figure 11: Station 4 CO concentration (1 hour average) – April 2023

6.4 Volatile organic compounds (BTEX)

VOC samples were collected from Station 4 (Primula Avenue), in an evacuated electro-polished and passivated stainless steel canister. Analysis involves separation by gas chromatography (GC) and measurement by mass selective (MS) detector

The procedure for sampling Volatile Organic Compounds (VOCs) using evacuated canisters, and for the subsequent analysis, is described in USEPA Method TO-15 "Determination of Volatile Organic Compounds (VOCs) in air collected in specially-prepared canisters and analysed by Gas Chromatography/Mass Spectrometry (GC/MS)".

Samples were analysed by Queensland Health (NATA Laboratory Accreditation No. 41) based on USEPA method TO-15 (Laboratory Report Nos. SSP83343, SSP83452, SSP83622).

The test method used was in accordance with Golder Source Test Method C9, "Canister (Evacuated) Sampling for VOC: In Ambient Air and Source Emissions".

BTEX (24 hour average) mass concentration statistics for the reporting period are given in Table 16. Laboratory certificates are presented in Appendix B.

Table 16: Station 4 – Primula Avenue AAQMS BTEX concentrations (24 hour average)

Date	Sample no.	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Total xylene isomers (ppb)
6/04/2023	23-412	<0.5	1.3	<0.5	<1
12/04/2023	23-413	<0.5	1.1	<0.5	<1
18/04/2023	23-464	<0.5	<0.5	<0.5	<1
24/04/2023	23-465	<0.5	0.5	<0.5	<1
30/04/2023	23-519	<0.5	1.1	<0.5	<1
NEPM MIL ^A		3.0 ^B	1000	NA	250

Note:

A National Environment Protection Measure (Air Toxics) Monitoring Investigation Level

B Annual average

Sample analysis conducted by Queensland Health, NATA Accreditation No. 41/ Eurofins Pty Ltd, NATA Accreditation No. 1261.

Analysis dates: 20/04/2023 (23-412, 23-413); 4/05/2023 (23-464, 23-465); 16/05/2023 (23-519).

6.5 Meteorological parameters

6.5.1 Ambient temperature

Ambient Temperature data for all AAQMS sites are presented in Figure 12 for the reporting period.

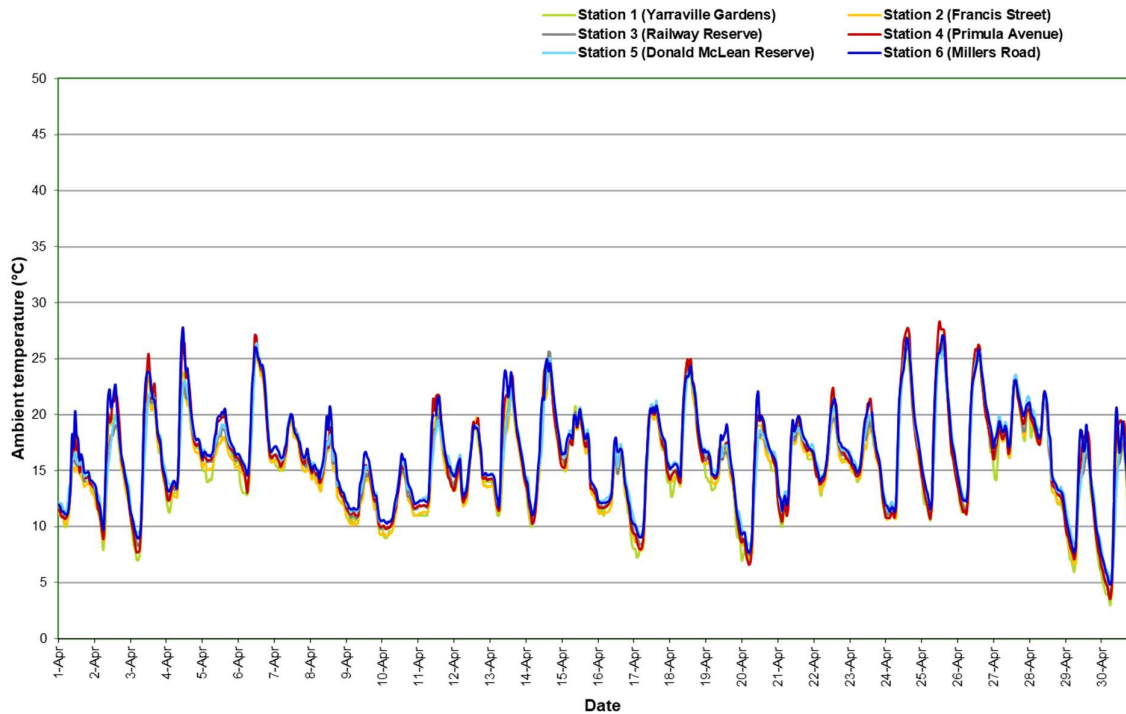


Figure 12: Ambient temperature (1 hour average) All AAQMS – April 2023

6.5.2 Relative humidity

Relative Humidity data for all AAQMS sites are presented in Figure 13 for the reporting period.

Relative Humidity at Station 1 (Yarraville Gardens) is periodically impacted by the gardens sprinkler system.

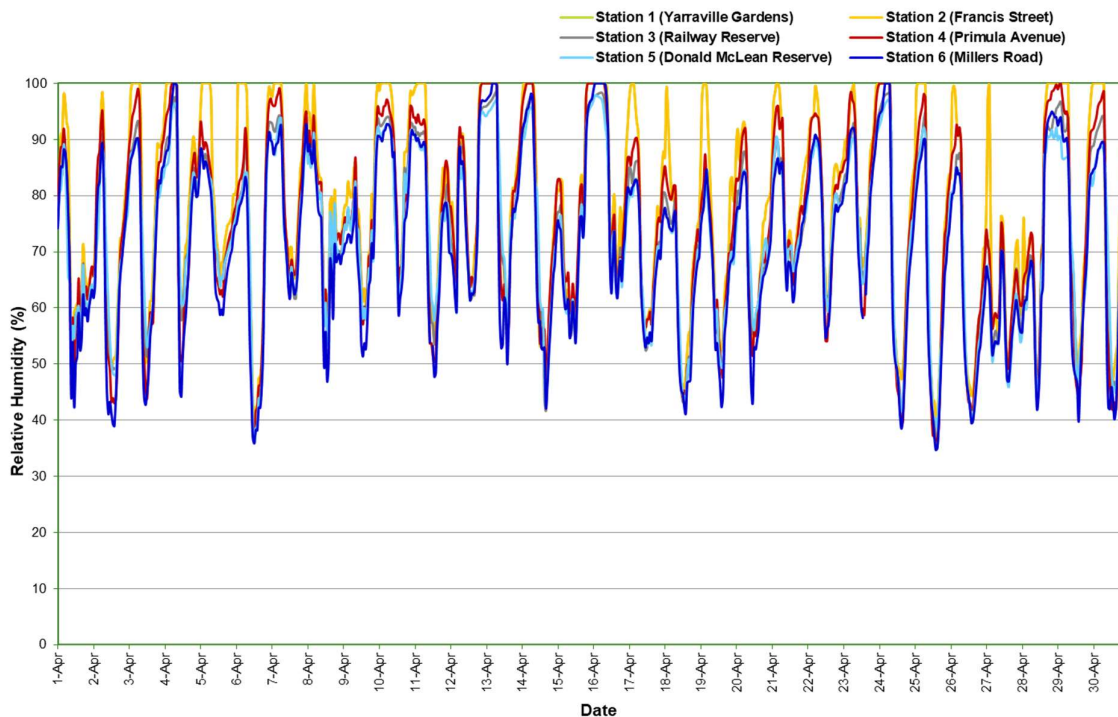


Figure 13: Relative humidity (1 hour average) All AAQMs – April 2023

6.5.3 Atmospheric pressure

Atmospheric pressure data for Station 4 (Primula Avenue AAQMS) is presented in Figure 14 for the reporting period.

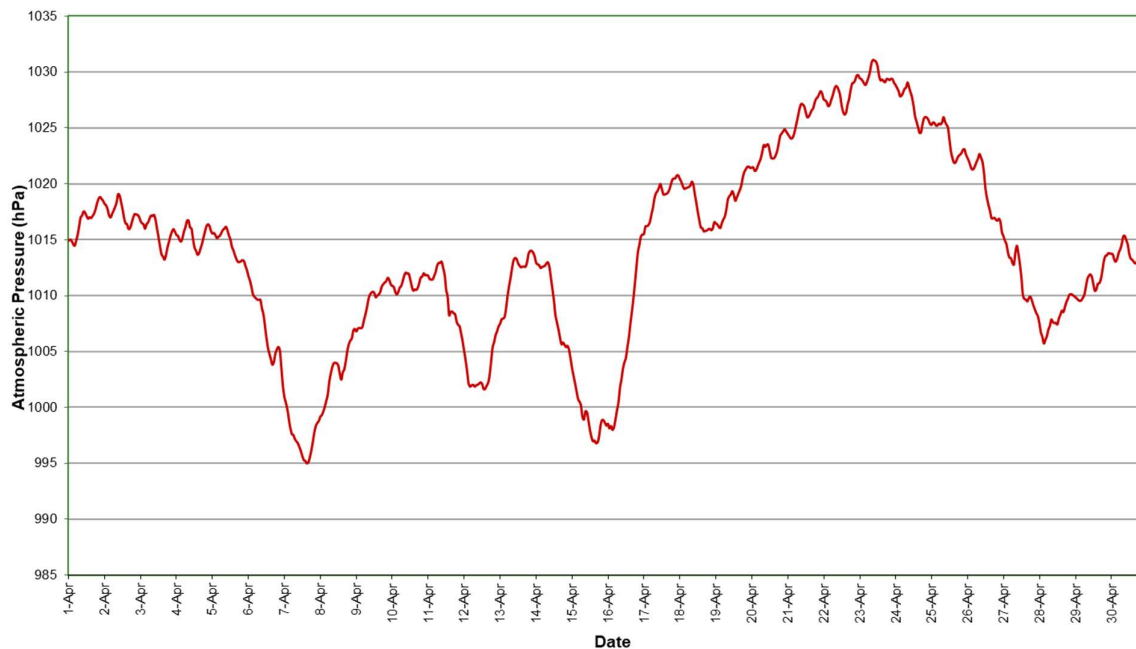


Figure 14: Atmospheric pressure (1 hour average) Station 4 Primula Avenue – April 2023

6.5.4 Wind speed

Wind Speed data for all AAQMS sites are presented in Figure 15 for the reporting period.

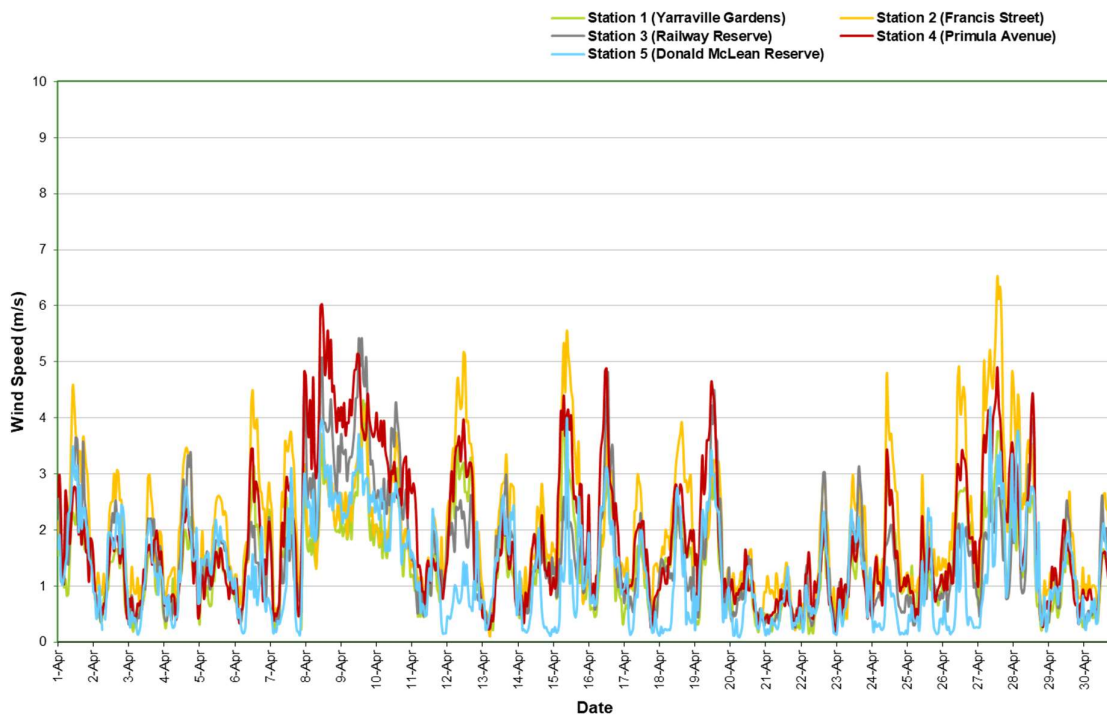


Figure 15: Wind speed (1 hour average) All AAQMs – April 2023

6.5.5 Wind rose – Station 1 (Yarraville Gardens)

A wind rose (1 hour average) for Yarraville Gardens AAQMS is presented in Figure 16.

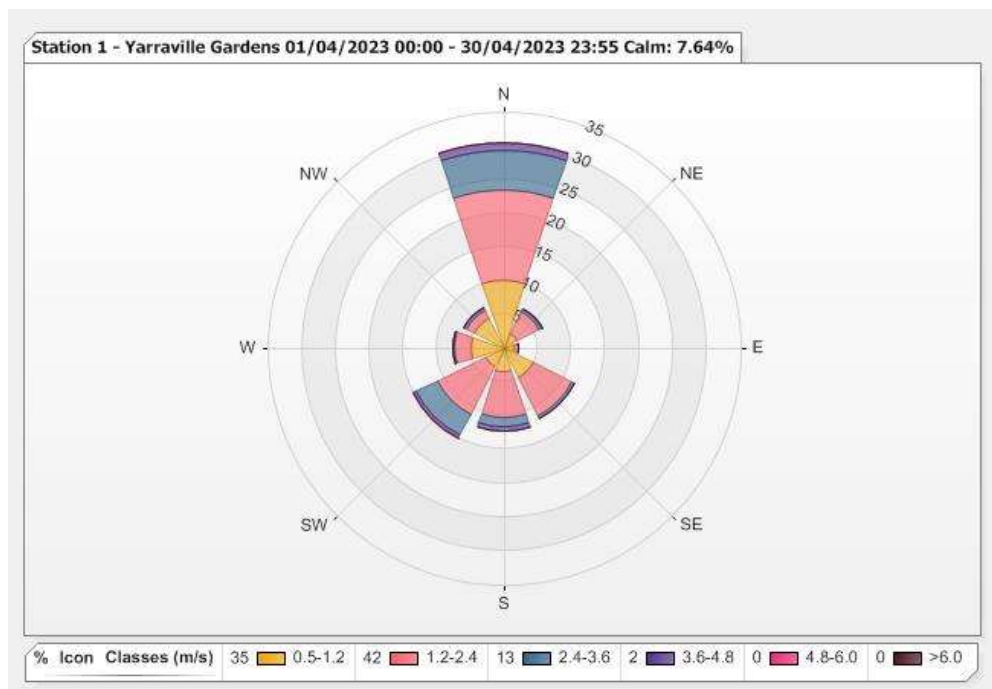


Figure 16: Wind speed (1 hour average) Station 1 – Yarraville Gardens

6.5.6 Wind rose – Station 2 (Francis Street)

A wind rose (1 hour average) for Station 2 (Francis Street AAQMS) is presented in Figure 17.

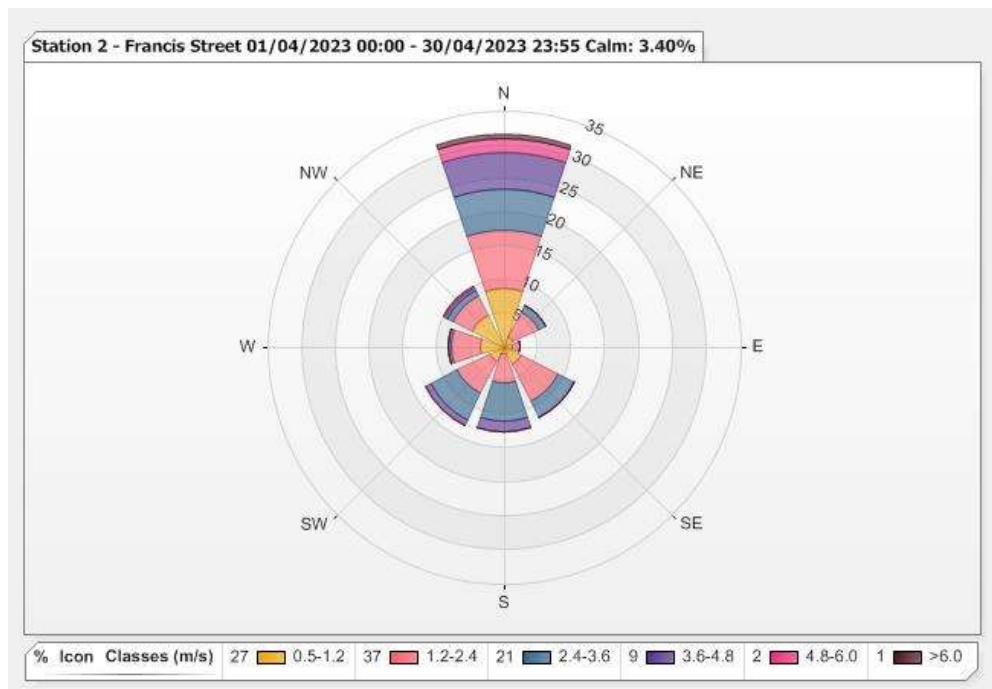


Figure 17: Wind speed (1 hour average) Station 2 – Francis Street

6.5.7 Wind rose – Station 3 (Railway Reserve)

A wind rose (1 hour average) for Station 3 (Railway Reserve AAQMS) is presented in Figure 18.

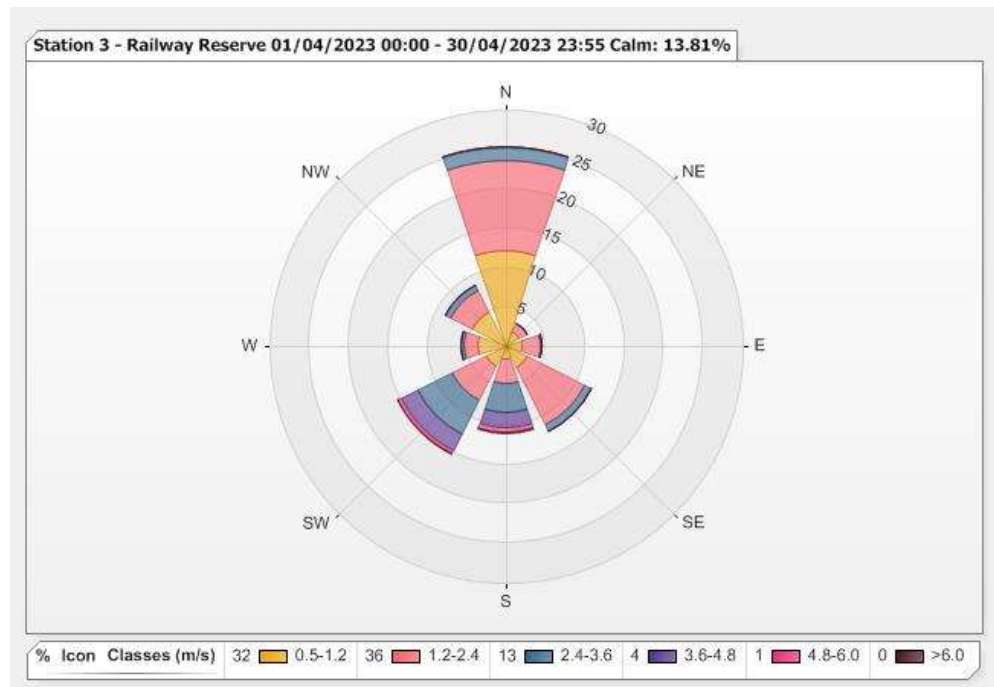


Figure 18: Wind speed (1 hour average) Station 3 – Railway Reserve

6.5.8 Wind rose – Station 4 (Primula Avenue)

A wind rose (1 hour average) for Station 4 (Primula Avenue AAQMS) is presented in Figure 19.

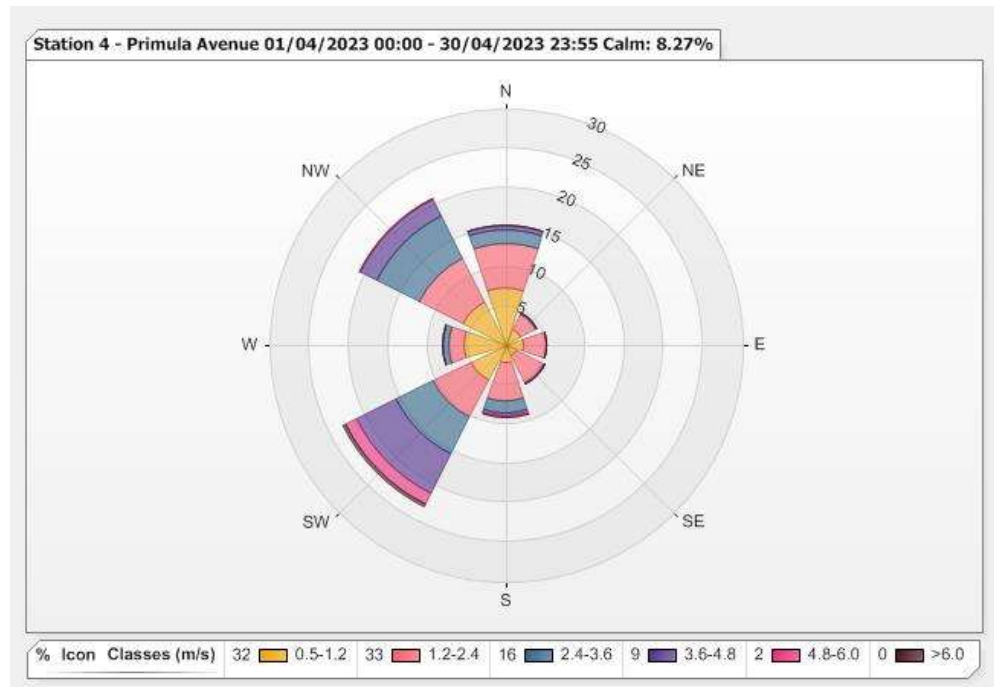


Figure 19: Wind speed (1 hour average) Station 4 – Primula Avenue

6.5.9 Wind rose – Station 5 (Donald McLean Reserve)

A wind rose (1 hour average) for Station 5 (Donald McLean Reserve AAQMS) is presented in Figure 20.

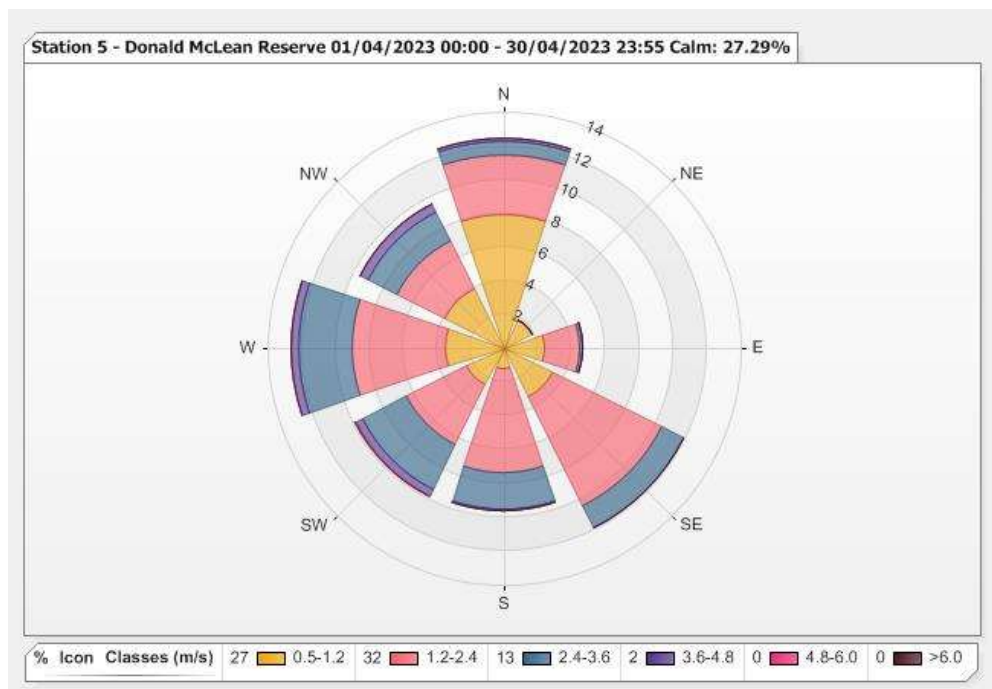


Figure 20: Wind speed (1 hour average) Station 5 – Donald McLean Reserve

7.0 QUALITY ASSURANCE

7.1 Data capture

Data capture is defined as the number of valid data periods collected divided by the number of available data periods. Valid data excludes periods where the instrument is unavailable due to calibration and maintenance and excludes periods where the data has been rejected due to quality assurance/data validation procedures.

Automatic calibrations are conducted for NO₂ and CO daily to monitor and correct instrument drift where necessary. NO₂ and CO automatic calibrations are conducted once per day between 01:00 and 01:45 hours.

Data capture statistics for the reporting period 1 April to 30 April 2023 are shown in Table 17.

Averages were only collected for those periods where the 5 minute data constituted 75% data capture.

Data capture statistics for April 2023 were above 90 percent for all parameters at all stations except NO₂ at Station 4 (Primula Avenue) due to instrument faults.

Table 17: Data Capture

Parameter	Averaging period	Station	Collected periods	Available periods	Data capture ¹
PM _{2.5}	24 hour	1 – Yarraville Gardens	28	30	93%
	24 hour	2 – Francis Street	28	30	93%
	24 hour	3 – Railway Reserve	28	30	93%
	24 hour	4 – Primula Avenue	30	30	100%
	24 hour	5 – Donald McLean Reserve	30	30	100%
	24 hour	6 – Millers Road	30	30	100%
PM ₁₀	24 hour	1 – Yarraville Gardens	30	30	100%
	24 hour	2 – Francis Street	28	30	93%
	24 hour	3 – Railway Reserve	28	30	93%
	24 hour	4 – Primula Avenue	30	30	100%
	24 hour	5 – Donald McLean Reserve	30	30	100%
	24 hour	6 – Millers Road	28	30	93%
NO ₂	1 hour	4 – Primula Avenue	623	720	87%
CO	1 hour	4 – Primula Avenue	688	720	96%
Ambient temperature & relative humidity	1 hour	1 – Yarraville Gardens	720	720	100%
	1 hour	2 – Francis Street	720	720	100%
	1 hour	3 – Railway Reserve	720	720	100%
	1 hour	4 – Primula Avenue	720	720	100%
	1 hour	5 – Donald McLean Reserve	720	720	100%
	1 hour	6 – Millers Road	719	720	100%

Parameter	Averaging period	Station	Collected periods	Available periods	Data capture ¹
Atmospheric pressure	1 hour	4 – Primula Avenue	720	720	100%
Wind speed and direction	1 hour	1 – Yarraville Gardens	720	720	100%
	1 hour	2 – Francis Street	720	720	100%
	1 hour	3 – Railway Reserve	720	720	100%
	1 hour	4 – Primula Avenue	720	720	100%
	1 hour	5 – Donald McLean Reserve	720	720	100%

Note:

1 Rounded to two significant figures

7.2 Data validation

Data contained in this report has been validated against performance and calibration requirements for each instrument. Data during commissioning, maintenance and calibration periods has been removed from the validated data sets. Appendix A lists the data exceptions for all AAQMS. Missing data periods during automatic calibrations of the gaseous atmospheric contaminants NO₂ and CO are not shown.

8.0 DISCUSSION

Table 18 presents the maximum measured concentration during the reporting period at Station 1 for PM_{2.5} and PM₁₀ compared with the respective criteria.

Table 18: Station 1 Summary – April 2023

Parameter	Units	Averaging period	Maximum concentration	Air quality objective ^A	Exceedances ^B
PM _{2.5}	ug/m ³	24 hour	21	25	Nil
PM ₁₀	ug/m ³	24 hour	33	50	Nil

Note:

A – SEPP(AAQ) objective

B – Exceedances refers to the number of individual days the criterion was exceeded at any station.

Table 19 presents the maximum measured concentration during the reporting period at Station 2, Station 3, Station 5 and Station 6 for PM_{2.5} and PM₁₀ compared with the respective criteria.

Table 19: Station 2, Station 3, Station 5 and Station 6 Summary – April 2023

Parameter	Units	Averaging period	Maximum concentration				Air quality objective ^A	Exceedances ^B
			Station 2	Station 3	Station 5	Station 6		
PM _{2.5}	ug/m ³	24 hour	23	21	21	27	36	Nil
PM ₁₀	ug/m ³	24 hour	37	28	38	33	60	Nil

Note:

A – SEPP(AQM) Intervention level

B – Exceedances refers to the number of individual days the criterion was exceeded at any station.

Table 20 presents maximum measured concentration during the reporting period at Station 4 for PM_{2.5}, PM₁₀, NO₂, CO and BTEX compared with the respective criteria.

Table 20: Station 4 Summary – April 2023

Parameter	Units	Averaging period	Maximum concentration	Air quality objective	Exceedances ^C
PM _{2.5}	ug/m ³	24 hour	22	36 ^A	Nil
PM ₁₀	ug/m ³	24 hour	39	60 ^A	Nil
NO ₂	ppb	1 hour	33	140 ^A	Nil
CO	ppm	1 hour	0.96	29 ^A	Nil
Benzene	ppb	24 hour	<0.5	3.0 ^B	Nil
Toluene	ppb	24 hour	1.3	1000 ^B	Nil
Total xylene isomers	ppb	24 hour	<1	250 ^B	Nil

Note:

A – SEPP(AQM) Intervention level

B – Air NEPM Monitoring investigation level

C – Exceedances refers to the number of individual days the criterion was exceeded at any station.

April 2023 ambient air quality monitoring programme results did not exceed the respective air quality objectives for all parameters measured at all ambient air quality stations.

Data capture statistics for April 2023 were above 90 percent for all parameters at all stations except NO₂ at Station 4 (Primula Avenue) due to instrument faults.

A construction area (Millers Road exit ramp and noise wall relocation) is now adjacent Station 4, as a result, the measured pollutant concentrations may not be representative of traffic emissions.

9.0 IMPORTANT INFORMATION RELATING TO THIS REPORT

Your attention is drawn to the document titled – “Important Information Relating to this Report”, which is included in Appendix C of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

Signature Page

Golder Associates Pty Ltd



Anthony Myszka
Environmental Technician



Mark Tulau
Principal Environmental Scientist – Air and Noise

AM/MDT/sje

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APPENDIX A

Data Exceptions

Date from	Date to	Station	Parameters	Reason
1/04/2023 00:05	1/04/2023 04:00	1	PM _{2.5}	Invalid data ¹
4/04/2023 12:10	4/04/2023 15:00	4	PM ₁₀ , PM _{2.5}	Invalid data ¹
4/04/2023 13:05	4/04/2023 17:00	1	PM ₁₀ , PM _{2.5}	Invalid data ¹
5/04/2023 23:00	6/04/2023 4:35	6	PM _{2.5}	Invalid data ¹
8/04/2023 13:15	8/04/2023 17:35	6	PM _{2.5}	Invalid data ¹
11/04/2023 10:05	11/04/2023 10:55	4	CO	Maintenance / calibration
11/04/2023 11:10	11/04/2023 13:55	6	PM ₁₀ , PM _{2.5}	Maintenance / calibration
11/04/2023 11:25	11/04/2023 11:50	6	2m Temperature / RH	Maintenance / calibration
23/04/2023 01:55	24/04/2023 13:50	4	NO, NO ₂ , NO _x	Vacuum pump failed
24/04/2023 12:30	24/04/2023 13:05	4	CO	Maintenance / calibration
24/04/2023 15:10	25/04/2023 19:00	3	PM _{2.5}	Yearly zero test
24/04/2023 15:30	25/04/2023 15:00	2	PM ₁₀	Yearly zero test
25/04/2023 13:40	26/04/2023 14:00	2	PM _{2.5}	Yearly zero test
25/04/2023 13:45	26/04/2023 19:00	3	PM ₁₀	Yearly zero test
26/04/2023 12:10	26/04/2023 13:00	5	PM ₁₀ , PM _{2.5}	Maintenance / calibration
26/04/2023 13:15	26/04/2023 13:40	1	PM ₁₀ , PM _{2.5}	Maintenance / calibration
26/04/2023 13:15	27/04/2023 08:50	1	PM _{2.5}	Yearly zero test
26/04/2023 14:10	26/04/2023 19:00	6	PM _{2.5}	Maintenance / calibration
26/04/2023 14:10	27/04/2023 10:00	6	PM ₁₀	Yearly zero test
27/04/2023 22:40	28/04/2023 2:00	6	PM _{2.5}	Invalid data ¹
28/04/2023 01:05	29/04/2023 10:50	4	NO, NO ₂ , NO _x	Invalid data - Span drift
29/04/2023 10:00	29/04/2023 15:00	6	PM _{2.5}	Invalid data ¹

Note: 1 – In the opinion of the data reviewer

APPENDIX B

Laboratory Certificates

CERTIFICATE OF ANALYSIS

CLIENT: WSP Golder Associates
Building 7, Botanica Corporate Park
570 - 588 Swan Street
Richmond VIC 3121

ATTN: Anthony Evans

Laboratory Reference : SSP83343
Client Order Number : n/a
Quote Number : n/a
Client Project : n/a
Client Batch Reference : n/a
Date Received : 20-Apr-2023
Date Commenced : 20-Apr-2023
Laboratory Number/s : 23KS920-921

CC: Anthony Myszk

Submitting Authority : Golder Associates

Number of Samples : Two (2) Summa canisters

Reason for Analysis : Analysis of Volatile Organic Compounds (VOCs) in air

Method/s of Analysis : QIS28237 – Identification, confirmation and quantitation of Volatile Organic Compounds (VOCs) by GCMS using an in-house method as per EPA method TO15

Remarks : Sample details and results are summarised in Table 1.



.....
David Pass
Senior Chemist, Organics Laboratory
26th April 2023



NATA Accredited
Laboratory 41
Accredited for compliance
with ISO/IEC 17025 -
Testing

SSP83343

This report overrides all previous reports. The results relate solely to the sample/s as received and are limited to the specific tests undertaken as listed on the report. The results of this report are confidential and are not to be used or disclosed to any other person or used for any other purpose, whether directly or indirectly, unless that use is disclosed or the purpose is expressly authorised in writing by Queensland Health and the named recipient on this report. To the fullest extent permitted by law, Queensland Health will not be liable for any loss or claim (including legal costs calculated on an indemnity basis) which arise because of (a) problems related to the merchantability, fitness or quality of the sample/s, or (b) any negligent or unlawful act or omissions by Queensland Health that is connected with any activities or services provided by Queensland Health under this agreement (including the timing and/or method under which the sample/s were taken, stored or transported).

Enquiries David Pass
Phone (+61 7) 3096 2854
Email David.Pass@health.qld.gov.au

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Fax (+61 7) 3096 2977
Email FSS@health.qld.gov.au

CERTIFICATE OF ANALYSIS

Laboratory Reference: SSP83343
Laboratory Number: 23KS920-921

Table 1: Results for Summa canister analysis

Client Reference				23-412	23-413
Sample Type				Silco Canister #2399	Silco Canister #1727
Sampling Time / Date				n/a	n/a
Sample Description				ambient air	ambient air
Method	Volatile Organic Compounds (VOCs) by GCMS	Units	Reporting Limit	23KS920	23KS921
28237	Benzene	ppbv	0.5	< LOR	< LOR
28237	Toluene	ppbv	0.5	1.3	1.1
28237	Ethylbenzene	ppbv	0.5	< LOR	< LOR
28237	m- & p-Xylene	ppbv	0.5	< LOR	< LOR
28237	o-Xylene	ppbv	0.5	< LOR	< LOR

Temperature and atmospheric pressure at time of sampling unavailable

This report overrides all previous reports. The results relate solely to the sample/s as received and are limited to the specific tests undertaken as listed on the report. The results of this report are confidential and are not to be used or disclosed to any other person or used for any other purpose, whether directly or indirectly, unless that use is disclosed or the purpose is expressly authorised in writing by Queensland Health and the named recipient on this report. To the fullest extent permitted by law, Queensland Health will not be liable for any loss or claim (including legal costs calculated on an indemnity basis) which arise because of (a) problems related to the merchantability, fitness or quality of the sample/s, or (b) any negligent or unlawful act or omissions by Queensland Health that is connected with any activities or services provided by Queensland Health under this agreement (including the timing and/or method under which the sample/s were taken, stored or transported).

SSP83343

CERTIFICATE OF ANALYSIS

CLIENT: WSP Golder Associates
Building 7, Botanicca Corporate Park
570 - 588 Swan Street
Richmond VIC 3121

ATTN: Anthony Evans

Laboratory Reference : SSP83344
Client Order Number : n/a
Quote Number : n/a
Client Project : n/a
Client Batch Reference : n/a
Date Received : 20-Apr-2023
Date Commenced : 20-Apr-2023
Laboratory Number/s : 23KS922-923

CC: Anthony Myszk

Submitting Authority : Golder Associates

Number of Samples : Two (2) Summa canisters

Reason for Analysis : Analysis of Volatile Organic Compounds (VOCs) in air

Method/s of Analysis : QIS28237 – Identification, confirmation and quantitation of Volatile Organic Compounds (VOCs) by GCMS using an in-house method as per EPA method TO15

Remarks : Sample details and results are summarised in Table 1.



David Pass
Senior Chemist, Organics Laboratory
26th April 2023



SSP83344

This report overrides all previous reports. The results relate solely to the sample/s as received and are limited to the specific tests undertaken as listed on the report. The results of this report are confidential and are not to be used or disclosed to any other person or used for any other purpose, whether directly or indirectly, unless that use is disclosed or the purpose is expressly authorised in writing by Queensland Health and the named recipient on this report. To the fullest extent permitted by law, Queensland Health will not be liable for any loss or claim (including legal costs calculated on an indemnity basis) which arise because of (a) problems related to the merchantability, fitness or quality of the sample/s, or (b) any negligent or unlawful act or omissions by Queensland Health that is connected with any activities or services provided by Queensland Health under this agreement (including the timing and/or method under which the sample/s were taken, stored or transported).

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CERTIFICATE OF ANALYSIS

Laboratory Reference: SSP83344
Laboratory Number: 23KS922-923

Table 1: Results for Summa canister analysis

Client Reference				2023-358	2023-359
Sample Type				Silco Canister #1733	Silco Canister #2880
Sampling Time / Date				n/a	n/a
Sample Description				ambient air	ambient air
Method	Volatile Organic Compounds (VOCs) by GCMS	Units	Reporting Limit	23KS780	23KS781
28237	Benzene	ppbv	0.5	< LOR	< LOR
28237	Toluene	ppbv	0.5	0.7	< LOR
28237	Ethylbenzene	ppbv	0.5	< LOR	< LOR
28237	m- & p-Xylene	ppbv	0.5	< LOR	< LOR
28237	o-Xylene	ppbv	0.5	< LOR	< LOR

Temperature and atmospheric pressure at time of sampling unavailable

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SSP83344

CERTIFICATE OF ANALYSIS

CLIENT: WSP Golder Associates
Building 7, Botanica Corporate Park
570 - 588 Swan Street
Richmond VIC 3121

ATTN: Anthony Evans

Laboratory Reference : SSP83622
Client Order Number : n/a
Quote Number : n/a
Client Project : n/a
Client Batch Reference : n/a
Date Received : 15-May-2023
Date Commenced : 16-May-2023
Laboratory Number/s : 23KS1053-1054

CC: Anthony Myszka

Submitting Authority : Golder Associates

Number of Samples : Two (2) Summa canisters

Reason for Analysis : Analysis of Volatile Organic Compounds (VOCs) in air

Method/s of Analysis : QIS28237 – Identification, confirmation and quantitation of Volatile Organic Compounds (VOCs) by GCMS using an in-house method as per EPA method TO15

Remarks : Sample details and results are summarised in Table 1.



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David Pass
Senior Chemist, Organics Laboratory
17th May 2023

**SSP83622**

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CERTIFICATE OF ANALYSIS

Laboratory Reference: SSP83622
Laboratory Number: 23KS1053-1054

Table 1: Results for Summa canister analysis

Client Reference				2023-519	2023-520
Sample Type				Silco Canister #1745	Silco Canister #1737
Sampling Time / Date				n/a	n/a
Sample Description				ambient air	ambient air
Method	Volatile Organic Compounds (VOCs) by GCMS	Units	Reporting Limit	23KS1053	23KS1054
28237	Benzene	ppbv	0.5	< LOR	< LOR
28237	Toluene	ppbv	0.5	1.1	0.6
28237	Ethylbenzene	ppbv	0.5	< LOR	< LOR
28237	m- & p-Xylene	ppbv	0.5	< LOR	< LOR
28237	o-Xylene	ppbv	0.5	< LOR	< LOR

Temperature and atmospheric pressure at time of sampling unavailable

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APPENDIX C

**Important Information Relating to
this Report**

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