

Waterview Operational Air Quality Monitoring Report July 2017

Document No: [Subject]

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1 INTRODUCTION

1.1 OVERVIEW

The Waterview Tunnel opened on the 02 July 2017. This report includes analysis of the first month of validated air quality monitoring data for Waterview Tunnel Joint Operations (WTJO) for the period July 2017. This air quality monitoring report has been prepared in accordance with Waterview Connection BOI Operational Air Quality Condition OA.4.

1.2 WATERVIEW OPERATIONAL AIR QUALITY REQUIREMENTS

Waterview Connection BOI Operational Air Quality Conditions OA.2 – OA.8 (refer Appendix A) set out the requirements for ambient air quality monitoring of traffic emissions to confirm that required National Environmental Standards for air quality and Auckland Regional air quality targets are met. Relevant ambient air quality criteria are shown in Table 1.

Table 1. WTJO ambient air quality criteria

Pollutant	Threshold concentration	Averaging period
Fine particles (PM ₁₀)	50 µg/m ³ 20 µg/m ³	24-hour Annual
Fine particles (PM _{2.5})	25 µg/m ³ 10 µg/m ³	24-hour Annual
Nitrogen dioxide	200 µg/m ³ 200 µg/m ³ 100 µg/m ³ 40 µg/m ³	1-hour 1-hour (rolling)* 24-hour Annual

* the rolling 1-hour average NO₂ is also reported for the assessment criteria under Condition OA.8.

Two ambient air quality stations (one in the north and one in the south of the WTJO) and one portal analyser are required to be operated for a minimum period of 2 years. The two ambient stations require measurement of particulates (PM_{2.5} & PM₁₀), nitrogen dioxide (NO₂), wind speed and wind direction. The portal analyser requires measurement of NO₂.

This monitoring must continue until the Air Quality Peer Review Panel (required under condition OA.7) recommend that it is no longer necessary. Results are required to be reported monthly for the first 12 months and quarterly thereafter (OA.4).

1.3 MONITORED PARAMETERS AND LOCATIONS

Monitoring locations are shown in Appendix B. Locations and types of instrumentation have been agreed with Auckland Council and the Air Quality Peer Review Panel.

A portal monitoring station with Cavity Attenuated Phase Shift Spectroscopy (CAPS) NO₂ analyser has been installed at the rear of 93 Hendon Avenue near the Southern portal, to monitor NO₂ in accordance with the requirements of consent condition OA.2 and to demonstrate compliance with consent condition OA.8. The portal station is located approximately 80 m from the southern tunnel portal on the residential boundary (40 m from SH20). SH20 is screened from the nearest receptors within the southern approach trench.

Two ambient air quality monitoring stations have been installed to monitor particulates (BAM-1020 analysers, PM₁₀ and PM_{2.5}), nitrogen dioxide (Chemiluminescence NO_x analyser), wind speed and wind direction in accordance with conditions OA.2 and OA.3.

The southern ambient air quality station is located in the approximate location of the original pre-construction baseline monitoring for the WTJO, near to 5 Barrymore Road. The southern station is also located near to the residential boundary approximately 470 m from the southern tunnel portal (25 m from SH20) where SH20 achieves grade.

Under condition OA.2, the northern ambient air quality station should be located at Waterview School subject to agreement by the School; this agreement was not secured. The northern station is therefore located in the approximate location of the original pre-construction baseline monitoring for the WTJO, near to the operation maintenance building. This station is located approximately 100 m from the northern tunnel portal in the prevailing wind direction (25 m from SH20, 330 m SH16 and 20 m from Great North Road), with no obstruction between the adjacent traffic sources and air quality station. This location will experience higher levels than the proposed location at the School and is therefore considered conservative.

1.4 DATA MANAGEMENT

Data are downloaded and checked daily by suppliers Ecotech and monthly validated reports provided to the WTJO. A daily summary of results (unvalidated data) is provided to the WTJO and, in the event that WTJO air quality criteria are exceeded, email/text alerts are sent, so investigation can be initiated.

Ecotech calibrate the air quality stations on a monthly basis, and attend the site if a fault is detected during the daily checks. Calibration and equipment fault reports are forwarded to the WTJO.

The valid data exception report for July 2017 is attached as Appendix C.

2 MONITORING RESULTS AND ANALYSIS

2.1 SUMMARY STATISTICS

A comparison of the monitored levels of NO₂, PM_{2.5} and PM₁₀ against the WTJO air quality criteria are shown in Table 2 for July 2017. This shows that measured air quality concentrations were below the WTJO ambient air quality criteria, with the exception of the maximum daily average PM_{2.5} at the southern ambient air quality station. This is discussed in Section 2.2.

Monitoring sites used for compliance monitoring should achieve at least 95% data capture¹. All sites achieved at least 95% data capture during July 2017.

Table 2. Air quality monitoring results for July 2017

AQ Station	Description	% valid data capture	Concentration in µg/m ³	WTJO air quality criteria in µg/m ³
Northern ambient air quality station	Maximum 1-hour average NO ₂	95	96.8	200
	Maximum rolling 1-hour average NO ₂		97.5	200
	Maximum 24-hour average NO ₂	97	46.4	100
	Maximum daily average PM _{2.5}	100	24.8	25
	Maximum daily average PM ₁₀	100	31.0	50
Southern ambient air quality station	Maximum 1-hour average NO ₂	96	73.3	200
	Maximum rolling 1-hour average NO ₂		75.0	200
	Maximum 24-hour average NO ₂	98	38.2	100
	Maximum daily average PM _{2.5}	100	26.5	25
	Maximum daily average PM ₁₀	100	31.8	50
Portal air quality station	Maximum 1-hour average NO ₂	96	84.2	200
	Maximum rolling 1-hour average NO ₂		86.9	200
	Maximum 24-hour average NO ₂	96	46.0	100

2.2 EXCEEDENCES OF AIR QUALITY CRITERIA

The Waterview Connection BOI Operational Air Quality Condition OA.5 requires that when an exceedance of the WTJO air quality criteria occur, an investigation shall be undertaken into the cause of the exceedance and that this be reported to the Air Quality Peer Review Panel and Auckland Council.

On 16 July 2017, the southern area ambient air quality station measured a daily average PM_{2.5} of 26.5 µg/m³, exceeding the 25 µg/m³ criteria. This was due to elevated levels of PM_{2.5} overnight, on a night which had low temperatures and very little wind. The PM_{2.5} concentrations overnight were increasing at a time when the tunnel traffic flows were very low and indicated that tunnel traffic emissions were not the cause of the exceedance. The investigation concluded that the most likely cause for the elevated PM_{2.5} concentrations was domestic smoke, similar to elevated levels that had been seen during the baseline monitoring prior to the tunnel opening.

A report was sent to the Air Quality Peer Review Panel and Auckland Council on the 28 July 2017 and on 01 August 2017, Paul Crimmins of Auckland Council confirmed that the report adequately demonstrated that vehicles using the tunnel were not the cause of the measured PM_{2.5} exceedance.

¹ Ministry for the Environment. 2009. Good Practice Guide for Air Quality Monitoring and Data Management 2009. Wellington: Ministry for the Environment.

2.3 POLLUTION ROSES

Pollution roses illustrate the relationship between wind direction and air pollutant concentrations. They are a useful tool to visualise the upwind direction of air pollution courses. The main sources are in the direction of the wind directions that show the highest concentrations.

Pollution roses based on the hourly monitoring data are provided in Appendix D.

In summary, the pollution roses show that:

- The main sources of NO₂ influencing the northern station are located in the direction of the adjacent SH20 alignment to the west and south-west, SH16 to the north and Great North Road to the east. There are sources of PM₁₀ and PM_{2.5} in the direction of SH20 (and residential area of Waterview), but the highest concentrations are in the east-north-east and north-east direction, which is in the direction of Great North Road and the Mason Clinic and Unitec buildings across Great North Road. This source may therefore be largely attributed to emissions from heating appliances.
- The main source of NO₂ influencing the portal and southern stations is located in the direction of the adjacent SH20 alignment to the south-west. Sources of NO₂ concentrations can also be seen in the direction of Hendon Avenue to the north-east.
- The main source of PM₁₀ and PM_{2.5} influencing the southern station is located in the direction of the adjacent residential properties to the north-east on Hendon Avenue and Barrymore Road. There is also a source of PM₁₀ and PM_{2.5} in the direction of SH20 (and residential area on Methuen Avenue beyond) to the south west.
- The NO₂ pollution roses indicate that the main source of NO₂ is traffic emissions. The PM₁₀ and PM_{2.5} pollution roses indicate that the main sources are domestic heating emissions in addition to traffic emissions. Contributions from heating sources can be investigated further by analysing seasonal patterns as more data become available, as heating emissions will tend to occur predominantly in the cooler months.

2.4 TRAFFIC DATA AND POLLUTANT TRENDS

2.4a Diurnal trends

The weekday diurnal traffic flow through the Waterview tunnel during July 2017 is shown in Figure 1 below. The diurnal traffic flow shows a distinct morning and evening peak flow, with traffic flows dropping off significantly overnight. This diurnal pattern is similarly reflected in the NO₂ data as shown in Figure 2, indicating the contribution of traffic emissions to measured NO₂ concentrations. The diurnal pattern of PM₁₀ concentrations also shows a peak in the morning and evening, as shown in Figure 3. However, the evening peak is significantly later than the traffic peak, at a time when traffic flows are reducing, reflecting the influence of other background sources i.e. domestic smoke. This is particularly pronounced at the southern air quality station which is closer to residential properties.

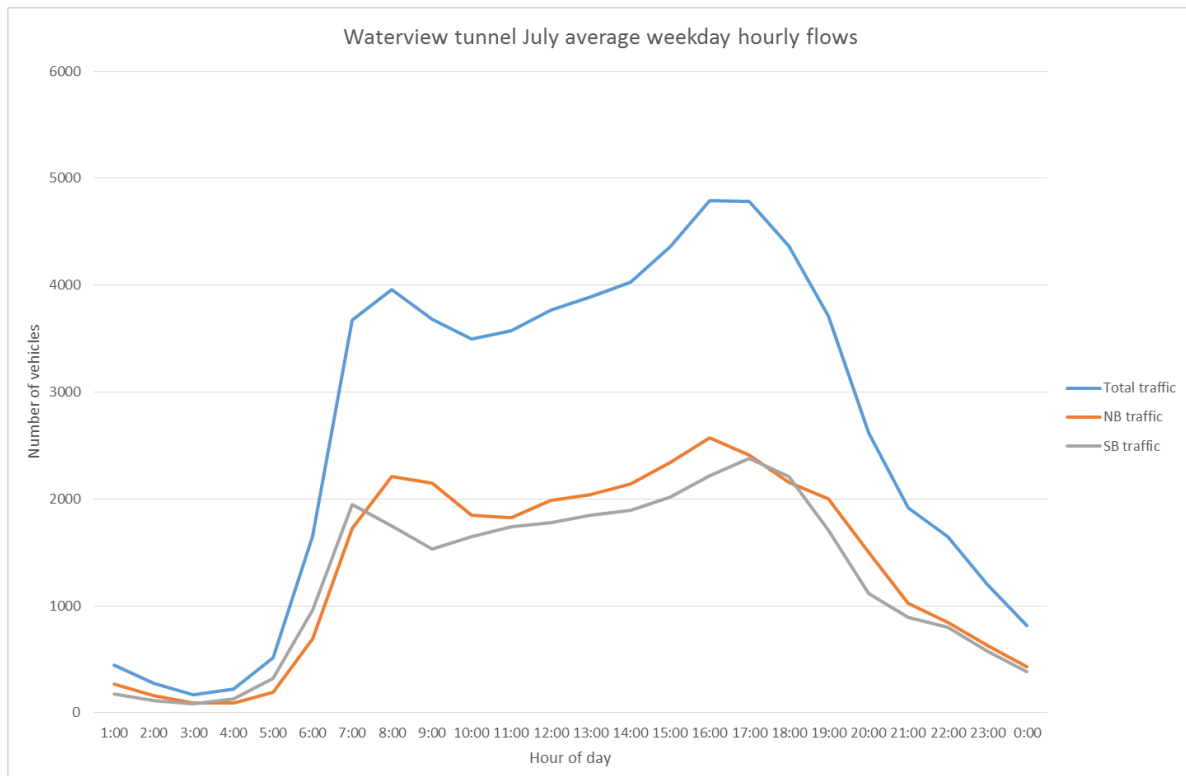


Figure 1: Waterview tunnel weekday diurnal traffic flow July 2017



Figure 2: Weekday diurnal trends for NO₂

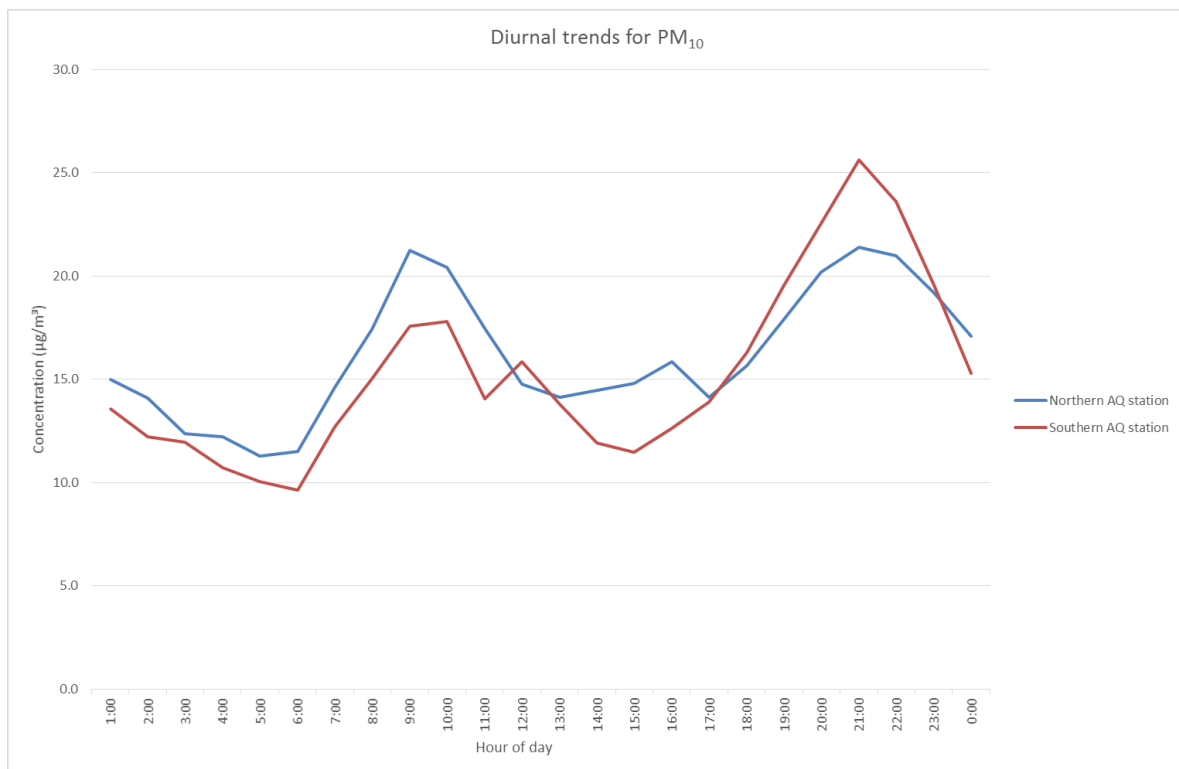


Figure 3: Weekday diurnal trends for PM₁₀

2.4b Pollutant Trends

Figure 4 shows the trend in daily PM₁₀ and PM_{2.5} concentrations at the northern and southern ambient air quality stations during July 2017. The two sites show a similar trend in pollutant concentrations for both PM₁₀ and PM_{2.5}, which indicate the main source of particulates is combustion sources, such as domestic heating and motor vehicles. The concentrations measured at the northern station are generally higher than the concentrations measured at the southern station.

Figure 5 similarly shows that the highest measured levels of NO₂ are recorded at the northern station. The northern and southern stations show similar NO₂ trends. The northern station is located closer to major traffic sources than the other two stations and has no obstruction between the adjacent traffic sources and air quality station.

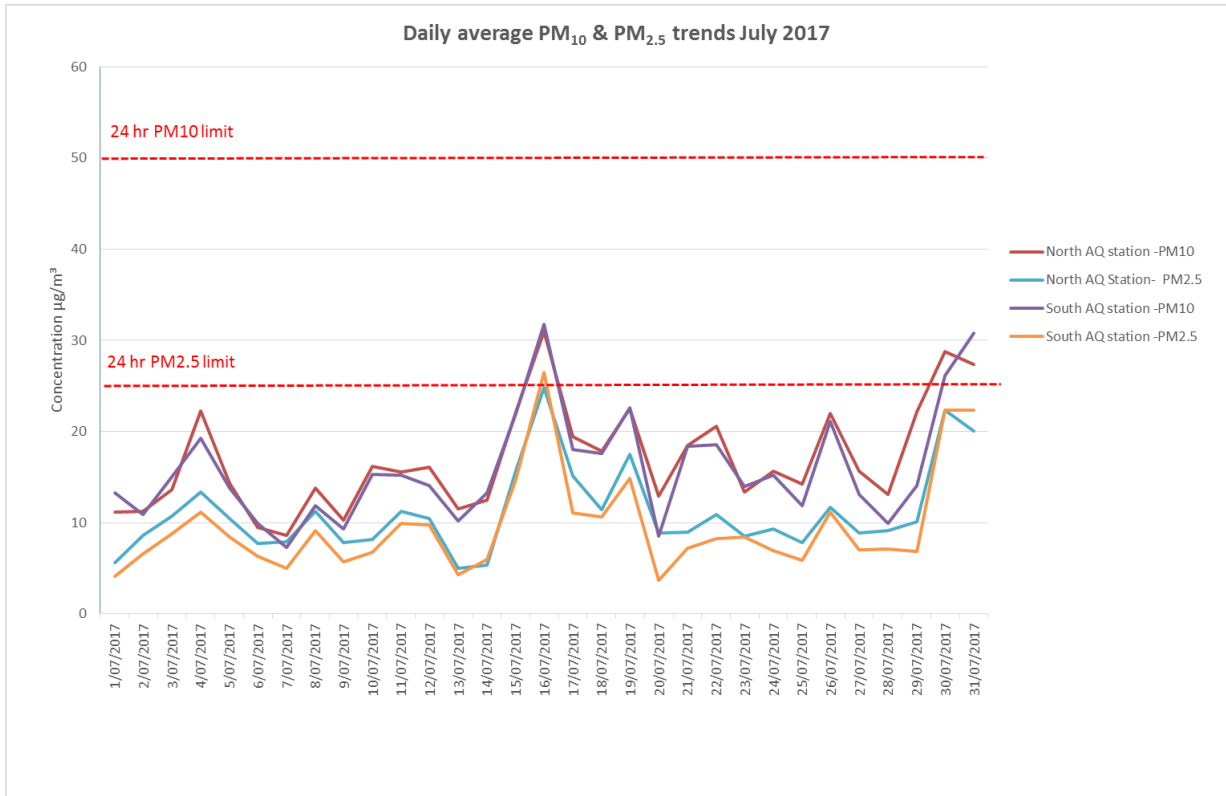


Figure 4: Daily average PM₁₀/PM_{2.5}

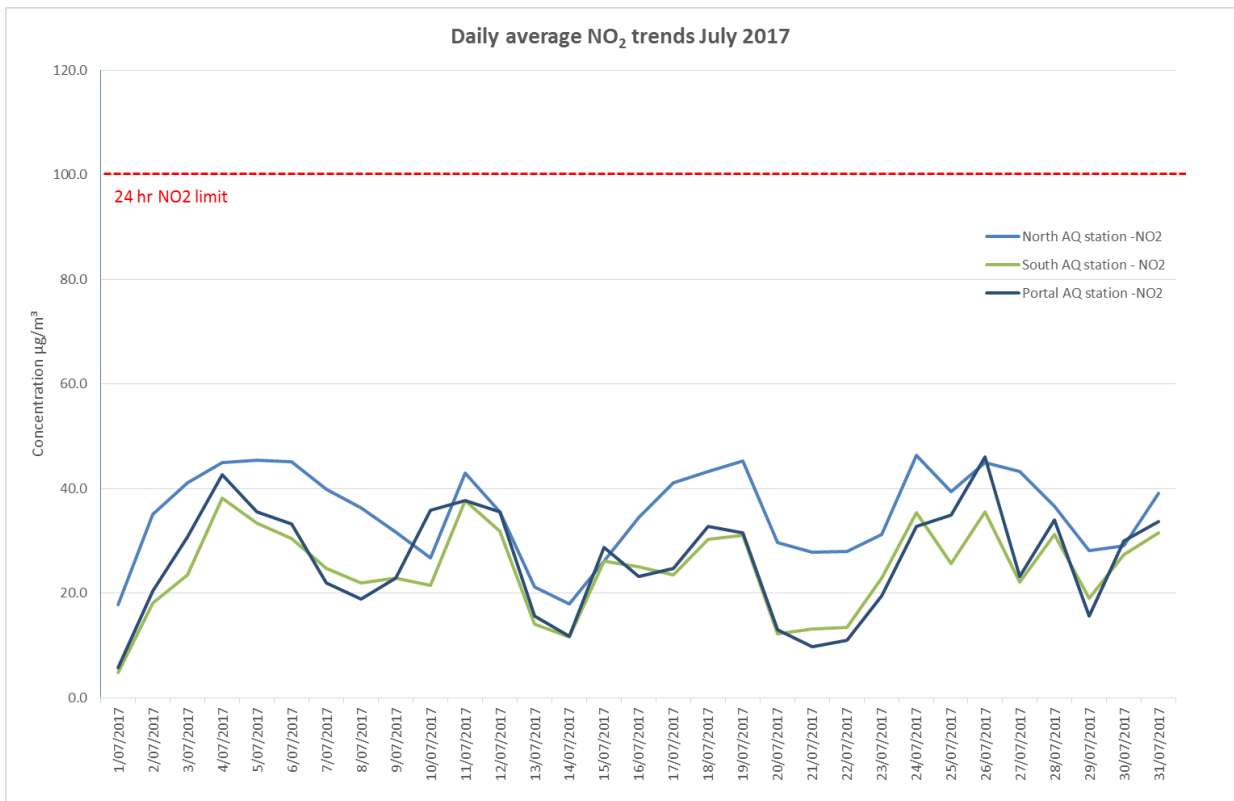


Figure 5: Daily average NO₂

3 CONCLUSION

This air quality monitoring report has been prepared in accordance with Waterview Connection BOI Operational Air Quality Condition OA.4, and includes analysis of the first month of validated data (July 2017) since the opening of the Waterview Tunnel.

The analysis of NO₂, PM_{2.5} and PM₁₀ data for the two ambient air quality stations and NO₂ data for the portal air quality station has shown that measured air quality concentrations were below the WTJO ambient air quality criteria during July 2017, with the exception of the maximum daily average PM_{2.5} at the southern ambient air quality station. The recommended data capture of 95% was achieved for all analysers.

The investigation of the PM_{2.5} exceedance at the southern air quality station on the 16 July 2017 concluded that the exceedance was not due to traffic emissions and the most likely cause for the elevated PM_{2.5} concentrations was domestic heating sources.

Highest measured concentrations of NO₂ and particulates were generally recorded at the northern station. This station is located closer to major traffic sources than the other two stations and has no obstruction between the adjacent sources and air quality station.

Analysis of NO₂ pollution roses indicate that the main source of NO₂ is traffic emissions. The PM₁₀ and PM_{2.5} pollution roses indicate that the main sources are domestic heating sources, in addition to traffic emissions. Contributions from heating sources can be investigated further by analysing seasonal patterns as more data become available, as heating emissions will tend to occur predominantly in the cooler months.

APPENDIX A: AIR QUALITY CONDITIONS

OA.1 The vents used to discharge emissions in the tunnels shall discharge vertically into air at a height of 15m, as follows: (a) The northern ventilation stack will be at a height of 15m. This height shall be calculated from the lowest existing ground level along the Great North Road boundary, adjacent to the ventilation stack; and (b) The southern ventilation stack will be at a height of 15m calculated from the post-construction ground level of the Alan Wood Reserve averaged at a distance of 10m from the exterior walls the ventilation stack location and shall not be impeded by any obstruction that may in the opinion of the Peer Review Panel (Condition OA. 7) decrease the vertical efflux velocity (in other words, the average velocity of material emitted into the atmosphere).

OA.2 Prior to the tunnels becoming operational, the NZTA shall establish two ambient air quality monitoring stations and one portal air quality monitoring station. The location and types of these monitoring stations shall be selected by the NZTA in consultation with the Auckland Council and Peer Review Panel (Condition OA.7), providing that one ambient monitoring station will be located within the Waterview Primary School (subject to agreement by the School).

Ambient air quality shall be monitored continuously in real time, to monitor potential effects associated with the operation of the ventilation system from the tunnels. Ambient monitoring shall include fine particulates (PM₁₀ and PM_{2.5}) and nitrogen dioxide. Portal monitoring shall include nitrogen dioxide. Results shall be compared with the relevant National Environmental Standards for air quality and Auckland Regional air quality targets (as identified in Chapter 4 of the Auckland Regional Plan: Air, Land and Water, 2010). Monitoring shall be undertaken at each site until the Peer Review Panel recommends that monitoring is no longer necessary. The locations, operation and maintenance schedules of the continuous monitors shall, as far as practicable, comply with the requirements of AS/NZ 3580.1.1: 2007 Method for Sampling and Analysis of Ambient Air – Guide to Siting Air Monitoring Equipment, and with methods specified in the National Environment Standards.

OA.3 Continuous monitoring of wind speed and direction shall be undertaken at each ambient air quality monitoring location as required by Condition OA.2. The locations of wind speed and direction monitors shall, as far as practicable, comply with the requirements of AS 2923:1987 Ambient Air – Guide for the Measurement of Horizontal Wind for Air Quality Applications.

OA.4 For the first 12 months of tunnel operation, the results of the ambient air quality monitoring shall be reported via validated reports and issued for information via the Project website (monthly). Following this period, and for a period of at least 12 months, reporting shall take place quarterly as follows: Quarter 1 (December to February) by 31 March, Quarter 2 (March to May) by 30 June, Quarter 3 (June to August) by 30 September and Quarter 4 (September to November) by 31 December.

OA.5. If the monitoring required by Condition OA.2 shows that concentrations of contaminants in ambient air at the monitoring locations exceeds the relevant National Environmental Standards for air quality, or Regional Air Quality Targets (as identified in Chapter 4 of the Auckland Regional Plan: Air, Land and Water), the NZTA shall undertake an investigation into the cause of the exceedance and report this to the Peer Review Panel (Condition OA.7) and the Major Infrastructure Team Manager, Auckland Council.

OA.6. The air quality monitoring shall be undertaken in general accordance with the Operational Air Quality Management Procedure (Appendix O of Technical Report G.1 Assessment of Air Quality Effects) submitted with this application.

OA.7. A Peer Review Panel shall be appointed by NZTA with the agreement of Major Infrastructure Team Manager, Auckland Council for the purpose of reviewing the ambient air quality monitoring programme and results. The Peer Review Panel shall consist of two independent experts in air quality with experience in ambient air quality monitoring and emissions from motor vehicles. The Peer Review Panel shall review all ambient monitoring, relevant traffic data and tunnel emissions and provide a summary report including any interpretation and recommendations to NZTA, Auckland Council and the Community Liaison Group(s) within 6 months of the tunnels becoming operational and annually thereafter.

O.A.8 The tunnel ventilation system shall be designed and operated to ensure that any air emitted from the tunnel portals does not cause the concentration of nitrogen dioxide (NO₂) in ambient air to exceed 200 micrograms per cubic metre, expressed as a rolling 1 hour average, at any point beyond the designation boundary that borders an air pollution sensitive land use.

Advice Note: The above standard reflects the National Environmental Standard for Nitrogen Dioxide (NO₂) concentration in ambient air.

APPENDIX B: MONITORING LOCATIONS

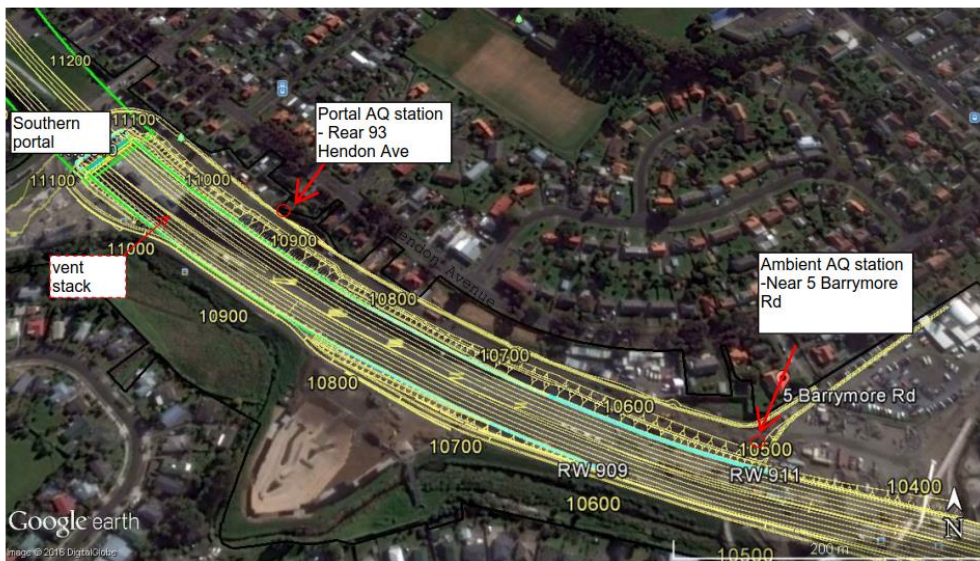


Figure B 1: Southern area stations



Figure B 2: Northern area station

APPENDIX C: VALID DATA EXCEPTION REPORT

North ambient air quality station

Start Date	End Date	Reason
01/07/2017 0:00	31/07/2017 23:55	Static offset of 2.410µg/m ³ applied to correct negative baseline
01/07/2017 1:00	17/07/2017 1:25	Automatic overnight span calibration check from approximately 1:00 - 1:25
04/07/2017 14:35	04/07/2017 16:10	Non-scheduled maintenance - remote NO _x calibration
04/07/2017 16:15	17/07/2017 11:40	Linear multiplier of A = 1.00 and B = 1.07 applied to data to correct for span drift
17/07/2017 11:45	17/07/2017 12:20	Scheduled maintenance - data affected intermittently
18/07/2017 1:00	31/07/2017 1:40	Automatic overnight span calibration check from approximately 1:00 - 1:40

South ambient air quality station

Start Date	End Date	Reason
01/07/2017 0:00	31/07/2017 23:55	Static offset of 0.803µg/m ³ applied to correct negative baseline
01/07/2017 1:00	31/07/2017 1:30	Automatic overnight span calibration check from approximately 1:00 - 1:30
17/07/2017 12:40	17/07/2017 13:20	Scheduled maintenance
19/07/2017 12:25	19/07/2017 12:30	Unrealistic data - negative NO ₂ value due to rapidly changing NO _x conditions

Portal air quality station

Start Date	End Date	Reason
01/07/2017 0:45	31/07/2017 0:45	Automatic background check, nightly for 5 minutes
01/07/2017 2:00	04/07/2017 2:55	Automatic overnight span calibration check from approximately 2:00 - 2:55
04/07/2017 13:45	04/07/2017 14:25	Non-scheduled maintenance - remote calibration
05/07/2017 2:00	31/07/2017 2:45	Automatic overnight span calibration check from approximately 2:00 - 2:45
17/07/2017 13:25	17/07/2017 13:30	Scheduled maintenance - calibration
20/07/2017 9:35	20/07/2017 10:05	Brief power interruption and subsequent instrument stabilisation

APPENDIX D: POLLUTION ROSES FOR JULY 2017

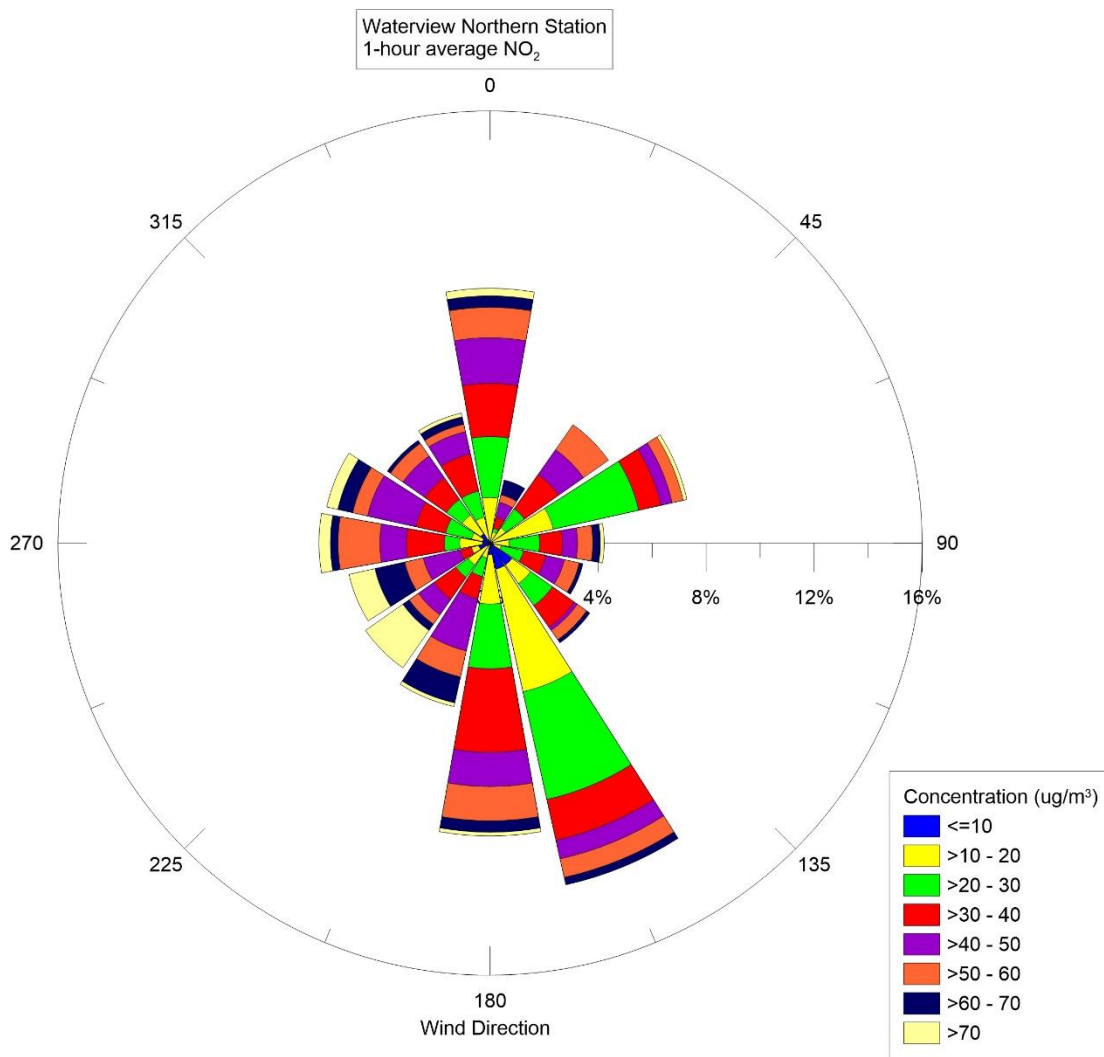


Figure D 1: Northern station 1-hour average NO₂

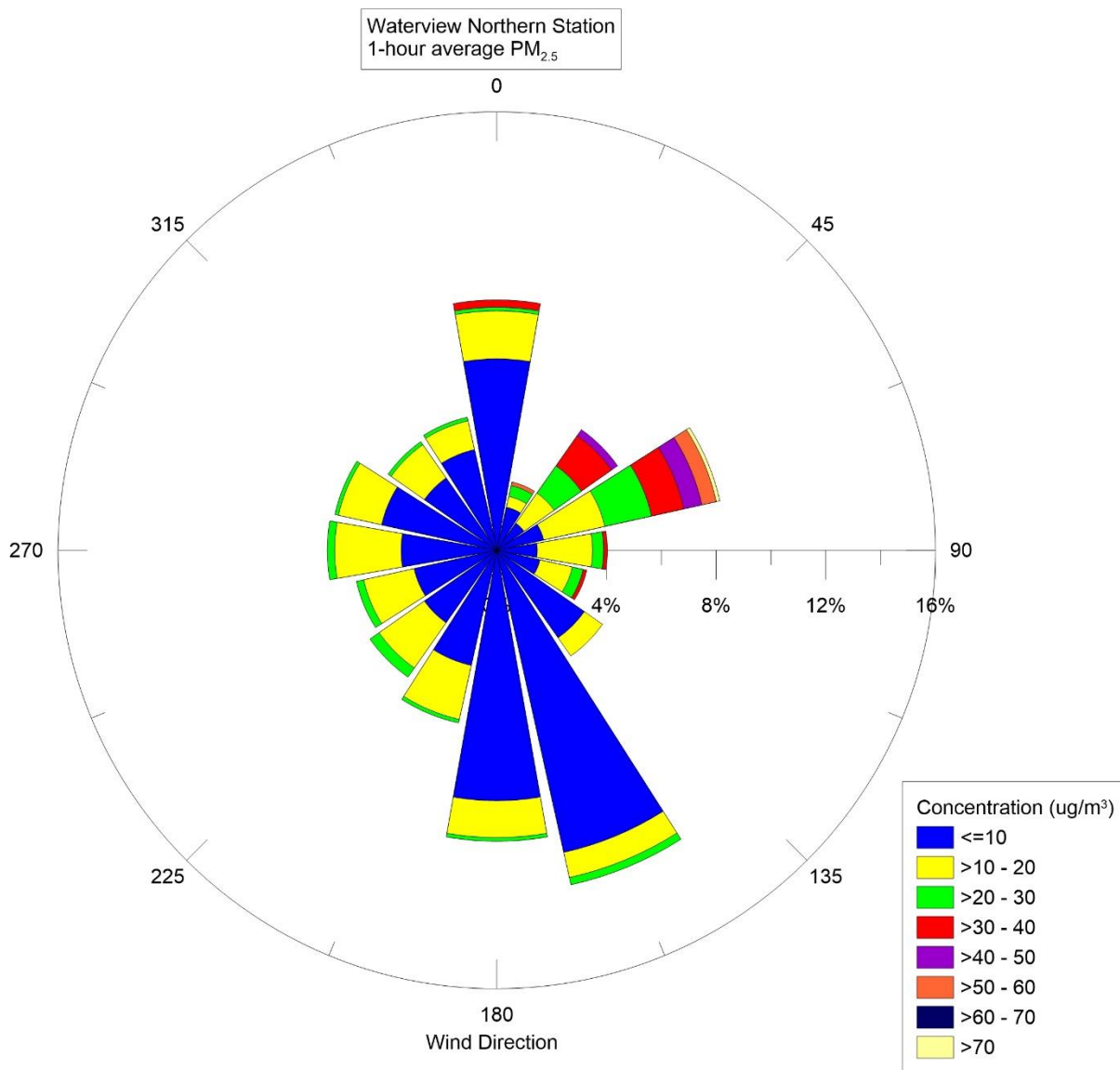


Figure D 2: Northern station 1-hour average PM_{2.5}

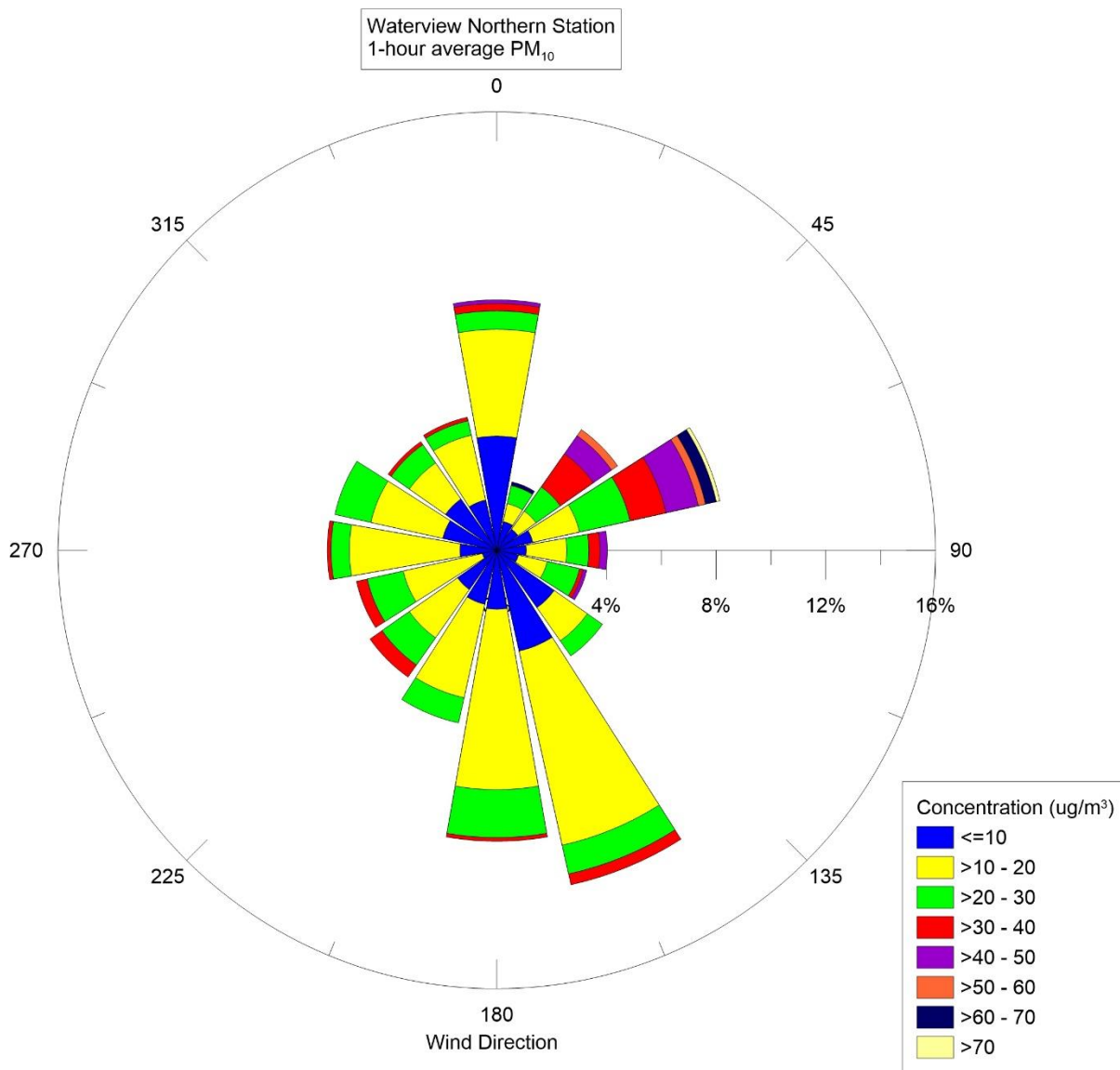


Figure D 3: Northern station 1-hour average PM₁₀

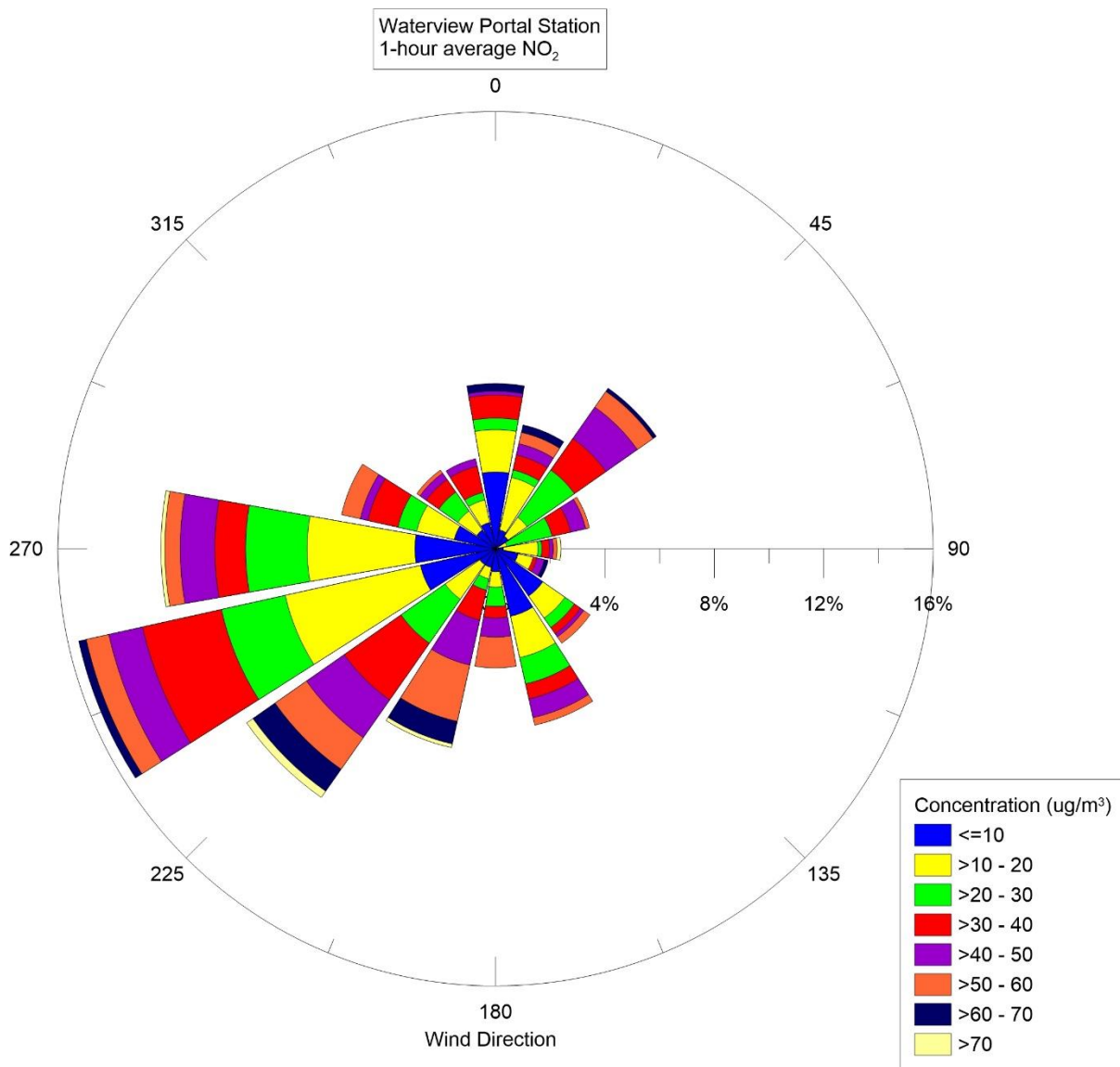


Figure D 4: Portal station 1-hour average NO₂

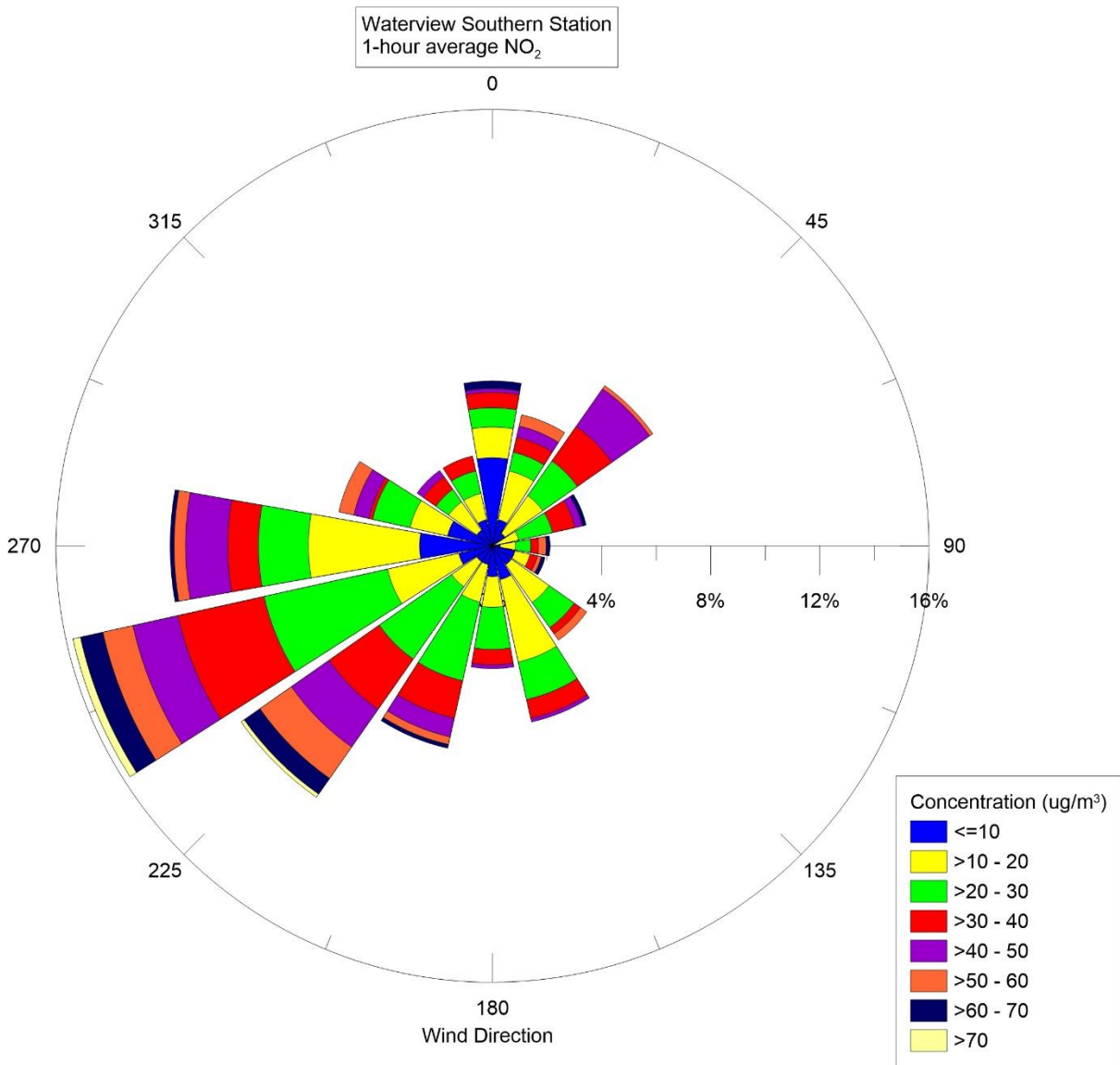


Figure D 5: Southern station 1-hour average NO₂

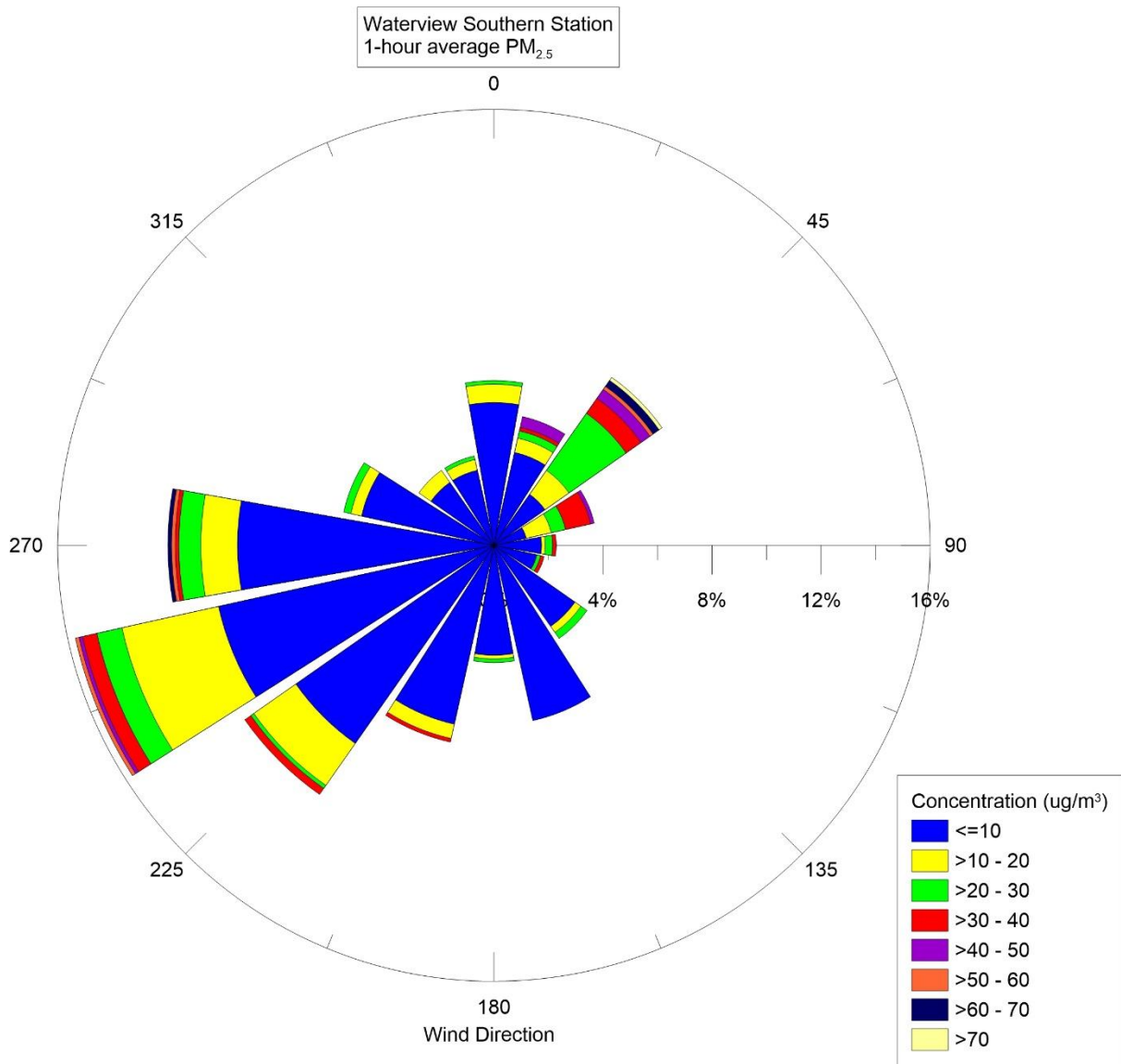


Figure D 6: Southern station 1-hour average PM_{2.5}

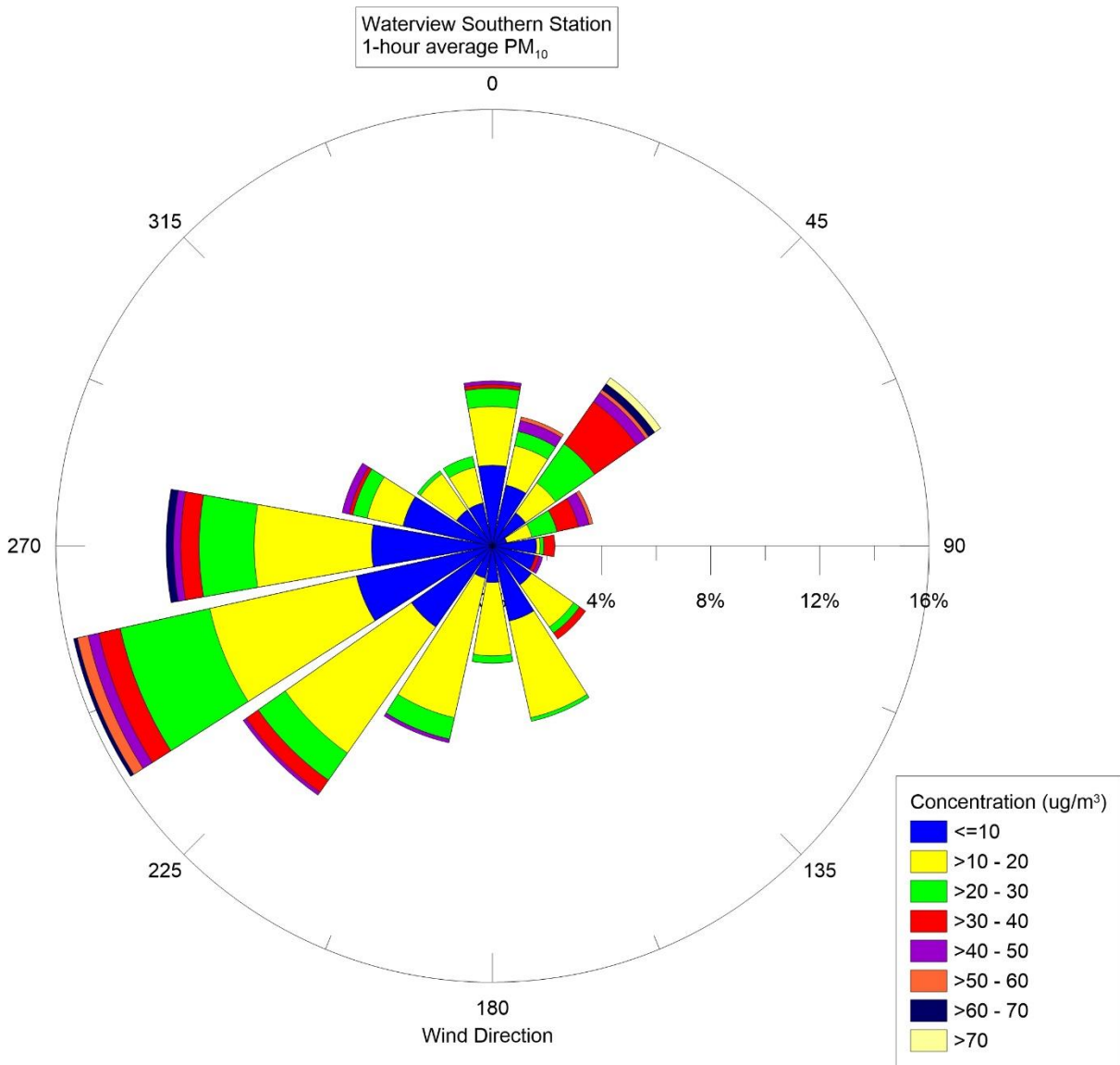


Figure D 7: Southern station 1-hour average PM_{10}