

WestConnex

New M5 Project

Ambient Air Quality and Weather Monitoring Validated Report

1st March 2019 – 31st March 2019

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Executive Summary

The New M5 project is the second stage of the 33km WestConnex motorway to connect Sydney's west and south-west with the Sydney Airport and the Port Botany precinct. The New M5 will provide twin underground motorway tunnels, nine kilometres long, from Kingsgrove to a new St Peters Interchange at the site of the old Alexandria landfill. The St Peters Interchange will provide motorists with connections to Alexandria and Mascot. It also includes connections to the future Sydney Gateway and M4-M5 Link. The New M5 tunnels will be marked for two lanes in each direction, with capacity to add a third and also include underground connection points for the M4-M5 Link and the proposed F6 Extension.

Ecotech Pty Ltd has been commissioned by CPB Dragados Samsung Joint Venture for air quality monitoring, data collection and reporting at eight external ambient air quality monitoring (AQM) stations: Arncliffe 1 (West Botany St) AQM, Arncliffe 2 (Eve St) AQM, St Barton Park AQM, Kingsgrove 1 (MOC1) AQM, Kingsgrove 2 (Kingsgrove Rd) AQM, St Peters 1 (Campbell St) AQM, St Peters 2 (SPI) AQM and St Peters 3 (St Peters St) AQM.

1.0 Introduction

Ecotech Pty Ltd was commissioned by CPB Dragados Samsung Joint Venture to provide monitoring and data reporting for the New M5 Project ambient air quality and weather monitoring network, located as detailed in Table 1. Ecotech commenced data collection in December 2018.

This report presents the available data for March 2019.

The data presented in this report:

- Describes air quality measurements;
- Compares monitoring results;
- Has been quality assured;
- Complies with NATA accreditation requirements, where applicable.

2.0 Monitoring and Data Collection

2.1. Siting Details

The WestConnex New M5 Project monitoring network consists of eight ambient air quality and weather monitoring stations. The stations location and siting details are described below.

Table 1: WestConnex New M5 NSW Project monitoring sites locations

Site Name	Geographical Coordinates	Height Above Sea Level (m)
Arncliffe 1 (West Botany St)	33°56'13.92"S, 151° 9'6.34"E	3
Arncliffe 2 (Eve St)	33°56'23.77"S, 151° 9'12.73"E	7
Barton Park	33°57'3.26"S, 151° 9'4.98"E	26
Kingsgrove 1 (MOC1)	33°56'27.60"S, 151° 5'36.24"E	10
Kingsgrove 2 (Kingsgrove Rd)	33°56'18.31"S, 151° 5'59.02"E	5
St Peters 1 (Campbell St)	33°54'44.71"S, 151° 10'43.76"E	4
St Peters 2 (SPI)	33°55'3.16"S, 151° 10'50.16"E	8
St Peters 3 (St Peters St)	33°54'46.19"S, 151° 10'31.91"E	12

Preliminary siting audits to assess for compliance with AS/NZS 3580.1.1:2016 have not yet been performed at St Peters 1 (Campbell St). Siting audits will be performed at the next suitable site visit. This is the Australian standard for siting of air quality monitoring stations and covers any specific requirements from AS2922-1987 and USEPA 454/R-99-005. The meteorological siting audit has not been performed at all sites yet and will be re-scheduled at the next suitable maintenance visits.

Siting audits to assess sites for compliance with *AS/NZS 3580.1.1:2016* have been completed as follows:

- Arncliffe 1 (West Botany St) on 18/02/2019
- Arncliffe 2 (Eve St) on 01/02/2019
- Barton Park on 05/02/2019
- Kingsgrove 1 on 22/03/19
- Kingsgrove 2 on 13/03/19
- St Peters 2 (SPI) on 11/02/2019
- St Peters 3 (St Peters St) on 04/02/2019

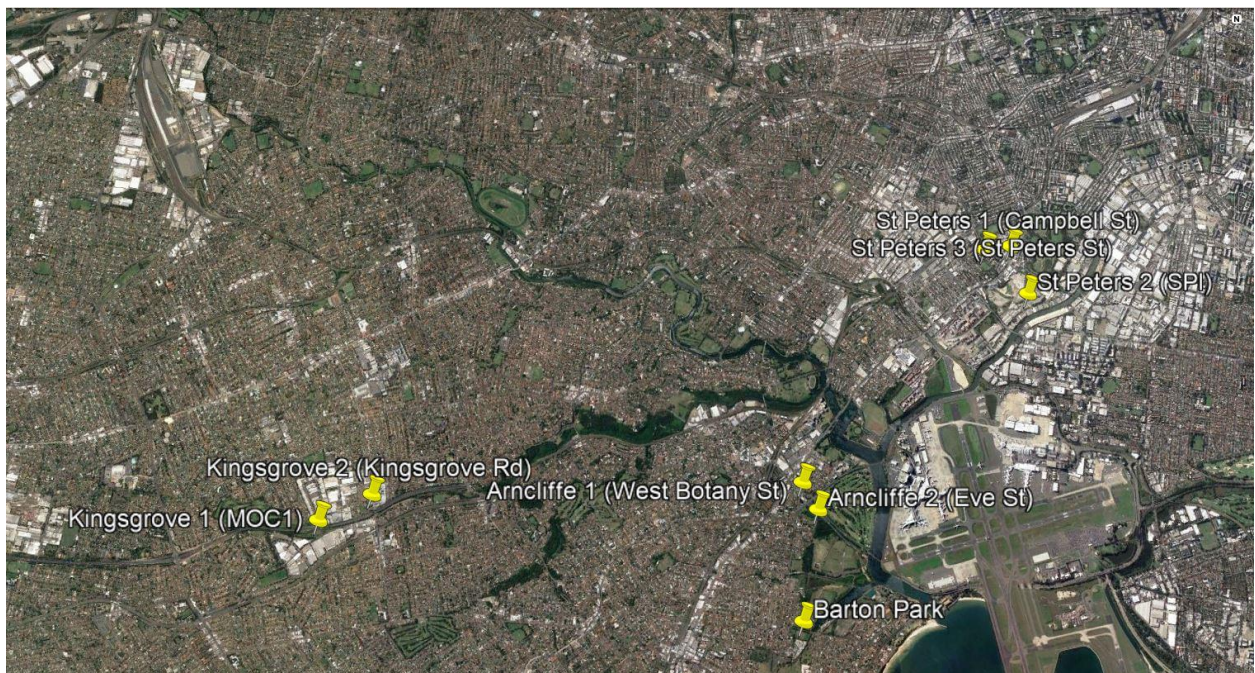


Figure 1: New M5 Project Monitoring Station Locations

2.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at the New M5 Project monitoring stations. Appendix 1 defines any abbreviated parameter names used throughout the report.

Table 2: Parameters measured at the New M5 Project monitoring stations

Station(s)	Parameter Measured	Instrument and Measurement Technique	Elevation
Arncliffe 1 (West Botany St) Arncliffe 2 (Eve St) Barton Park Kingsgrove 1 (MOC1) Kingsgrove 2 (Kingsgrove Rd) St Peters 1 (Campbell St) St Peters 2 (SPI) St Peters 3 (St Peters St)	CO	Ecotech Serinus 30 – NDIR gas filter correlation infrared photometry	2 m
	NO, NO ₂ , NO _x	Ecotech Serinus 40 – gas phase chemiluminescence	2 m
	PM _{2.5}	Met One BAM 1020 – Beta ray attenuation	2 m
	PM ₁₀	Thermo – 1400 ab TEOM (Tapered Element Oscillating Microbalance)	2m
	Differential Temperature (elevation 2m)	Met One 062MP	2 m
	Differential Temperature (elevation 10m)	Met One 062MP	10 m
	Wind Speed (Horizontal, elevation 10m)	Gill Windsonic Op3	10 m
	Wind Direction (elevation 10m)	Gill Windsonic Op3	10 m
	Sigma	Calculation	-

2.3. Data Collection Methods

Table 3 below shows the methods used for data collection.

Table 3: Methods

Parameter Measured	Data Collection Methods Used	Description of Method
NO, NO ₂ , NO _x	AS/NZS 3580.5.1 - 2011	Methods for sampling and analysis of ambient air - Method 5.1: Determination of oxides of nitrogen-Chemiluminescence method
	Ecotech Laboratory Manual	In-house method 6.1 - Oxides of nitrogen by chemiluminescence
CO	AS/NZS 3580.7.1 - 2011	Methods for sampling and analysis of ambient air. Method 7.1: Determination of carbon monoxide—Direct-reading instrumental method
	Ecotech Laboratory Manual	In-house method 6.3 – Carbon monoxide by gas filter correlation spectrophotometry
PM ₁₀ (TEOM)	AS/NZ 3580.9.8-2008	Methods for sampling and analysis of ambient air. Method 9.8: Determination of suspended particulate matter - PM ₁₀ continuous direct mass method using a tapered element oscillating microbalance analyser.
	Ecotech Laboratory Manual	In-house method 7.3- Particulates - PM _{2.5} , PM ₁₀ by TEOM
PM _{2.5} (BAM 1020)	AS/NZS 3580.9.12-2013 ¹	Methods for sampling and analysis of ambient Air - Method 9.12: Determination of suspended particulate matter—PM _{2.5} beta attenuation monitors
	Ecotech Laboratory Manual	In-house method 7.5 – Measurement of PM ₁₀ , PM _{2.5} and TSP using Beta Attenuation Monitor
Vector Wind Speed (Horizontal)	AS 2923-1987 ²	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications

¹ As approved by the Department of Planning and Environment on 8th September 2017.

² Superseded by AS/NZ 3580.14 2014 but specifically referenced in ministerial conditions.

Parameter Measured	Data Collection Methods Used	Description of Method
	Ecotech Laboratory Manual	In-house method 8.1 - Wind speed (Horizontal) by anemometer
Vector Wind Direction	AS 2923-1987 ³	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Ecotech Laboratory Manual	In-house method 8.3 - Wind direction by anemometer
Sigma	AS 2923-1987 ³	Methods of sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Ecotech Laboratory Manual	In-house method 8.3 Wind direction by anemometer
Atmospheric Temperature	USEPA (2000) EPA 454/R-99-005 ³	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications
	Ecotech Laboratory Manual	In-house method 8.4 – Temperature ambient by thermoelectric techniques

Note: Two different measurement techniques are being used for monitoring PM₁₀ and PM_{2.5} at the New M5 Project Stations. Studies conducted in Canada, the United States and other countries have found that the Tapered Element Oscillating Microbalance (TEOM) monitors can under report concentrations compared to the Beta Attenuation Monitors (BAM), especially when the air contains a large proportion of semi-volatile particulate matter, which may be the case during cooler seasons when the air contains less coarse dust and a greater proportion of semi-volatile organic compounds such as those associated with wood smoke. As a result, it is normal to see occasional periods where PM₁₀ < PM_{2.5} and this situation does not necessarily indicate a fault with either instrument.

³ Superseded by AS/NZ 3580.14 2014 but specifically referenced in ministerial conditions.

2.3.1. Data Acquisition

Data acquisition is performed using a PC based Congrego logger situated at each of the monitoring sites. Each logger is equipped with a 3G modem for remote data collection. The recorded data is remotely collected from the Air Quality Monitoring Station (AQMS) loggers on a daily basis (using Airodis™ version 5.1.0) and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in 5-minute intervals.

2.4. Data Validation and Reporting

2.4.1. Validation

The Ecotech ERS department performs daily data checks to ensure maximum data capture rates are maintained. Any equipment failures are communicated to the responsible field engineers for urgent rectification. Ecotech ERS maintains two distinct databases containing non-validated and validated data respectively.

The validated database is created by duplicating the non-validated database and then flagging data affected by instrument faults, calibrations and other maintenance activities. The data validation software requires the analyst to supply a valid reason (e.g. backed by maintenance notes, calibration sheets etc.) in the database for flagging any data as invalid.

Details of all invalid or missing data are recorded in the Valid Data Exception Reports.

Validation is performed by the analyst, and the validation is reviewed. Graphs and tables are generated based on the validated five minutes and one-hour data as appropriate.

2.4.2. Reporting

Data is reported in eight Microsoft Excel format files named

- NSW WestConnex_New M5_Arncliffe 1 (West Botany St) Monthly Data Report March 2019.xls
- NSW WestConnex_New M5_Arncliffe 2 (Eve St) Monthly Data Report March 2019.xls
- NSW WestConnex_New M5_Barton Park Monthly Data Report March 2019.xls
- NSW WestConnex_New M5_Kingsgrove 1 (MOC1) Monthly Data Report March 2019.xls
- NSW WestConnex_New M5_Kingsgrove 2 (Kingsgrove Rd) Monthly Data Report March 2019.xls
- NSW WestConnex_New M5_St Peters 1 (Campbell St) Monthly Data Report March 2019.xls
- NSW WestConnex_New M5_St Peters 2 (SPI) Monthly Data Report March 2019.xls

- NSW WestConnex_New M5_St Peters 3 (St Peters St) Monthly Data Report March 2019.xls

Each Excel file consists of 5 worksheets:

1. Cover
2. 5 Minute Data
3. 1 Hour Data
4. 24-hour Data
5. Valid Data Exception Report

The data contained in this report is based on Australian Eastern Standard Time.

All averages are calculated from the five-minute and the one-hour data. Averages are based on a minimum of 75% valid readings within the averaging period. Where data capture is low for a particular parameter, summary values (e.g. monthly maximum and minimum) may be based on less than 75% valid samples. The reader should use caution when interpreting these values as they may not be representative of conditions for the entire sample period.

Averaging periods of eight hours or less are reported for the end of the period, i.e. the hourly average 02:00am is for the data collected from 1:00am to 2:00am. One-hour averages are calculated based on a clock hour. One day averages are calculated based on calendar days.

3.0 Air Quality Goals

The air quality goals and criteria for pollutants monitored at the New M5 project ambient monitoring sites are based on SSI 6788 Planning Approval Condition E14. The air quality goals and criteria are shown in Table 4 below.

Table 4: New M5 Project - Air Quality Goals

Parameter	Time Period	Goal Level	Units
CO	8 hour rolling average	9.0	ppm
NO ₂	1 hour	0.12	ppm
PM ₁₀	1 day	50	µg/m ³
	1 year	25	µg/m ³
PM _{2.5}	1 day	25	µg/m ³
	1 year	8	µg/m ³

Note:

Exceptional events are excluded from this standard. As per the Ambient Air Quality NEPM, **Exceptional event** means a fire or dust occurrence that adversely affects air quality at a particular location and causes an exceedance of 1-day average standards in excess of normal historical fluctuations and background levels and is directly related to: bushfire; jurisdiction authorized hazard reduction burning; or continental scale windblown dust.

Ecotech will include any valid data identified as being associated with an exceptional event in all report tables and graphic representations. For this reason, and as the project monitoring results are part of the baseline monitoring regime, 1-day averages associated with exceptional events will not be counted as exceedances of the Air Quality goals. Monitoring and reporting of exceedances during the operational project will be in accordance with the Planning Approval Conditions E15, E16 and E17.

4.0 Calibrations and Maintenance

4.1 Units and Uncertainties

The uncertainties for each parameter have been determined by the manufacturer’s tolerance limits of the equipment’s parameters, and by the data collection standard method.

The reported uncertainties are expanded uncertainties, calculated using coverage factors which give a level of confidence of approximately 95%.

Table 5: Units and Uncertainties

Parameter	Units	Resolution	Uncertainty	Measurement Range ⁴
NO, NO _x (S40)	ppm	0.001 ppm	±1.3 ppm or 10% of reading, whichever is the greater k factor of 2.0	0 to 50 ppm
NO ₂ (S40)	ppm	0.001 ppm	± 1.7 ppm k factor of 2.0	0 to 50 ppm
CO (S30)	ppm	0.1 ppm	± 1 ppm or 10% of reading, whichever is the greater k factor of 2.0	0 to 50 ppm
PM _{2.5} (BAM1020)	µg/m ³	1 µg/m ³	±5.0 µg/m ³ + 5.4% of reading K factor of 2.0	5 to 1000 µg/m ³
PM ₁₀ (TEOM)	µg/m ³	0.1 µg/m ³	±5.0 µg/m ³ or 3.6% of reading, whichever is the greater K factor of 2.0	0 µg/m ³ to 1 g/m ³
Vector Wind Speed	m/s	0.1 m/s	±0.4 m/s or 2 % of reading, whichever is greater K factor of 2.0	0 to 30 m/s
Vector Wind Direction	deg	1 deg	±4 deg K factor of 2.0	0 to 360 deg Starting threshold: 0 m/s
Atmospheric Temperature	K	0.1 K	±0.6 K K factor of 2.0	273.15 to 323.15 K

⁴ Uncertainties may not be calculated based on the full measurement range.

4.2. Maintenance

4.2.1. Calibration & Maintenance Summary Tables

The last calibrations for the following parameters were performed on the indicated dates. Data supplied after this time is subject to further validation, to be performed at the next calibration cycle.

Note: Maintenance and calibration dates may differ, as calibrations may be less frequent than scheduled maintenance visits.

Tables 6-13 indicate when the particulate and gas and meteorological equipment were last maintained/calibrated.

Table 6: New M5 Project Arncliffe 1 (West Botany St) Maintenance Table March 2019

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	11/03/2019	Monthly	11/03/2019	Monthly
CO	11/03/2019	Monthly	11/03/2019	Monthly
PM ₁₀	11/03/2019	Monthly	19/12/2018	6 Monthly
PM _{2.5}	11/03/2019	Monthly	19/12/2018	Yearly
WS/WD/Sigma	11/03/2019	Monthly	19/12/2018	2 yearly
Differential Temperature 2m	11/03/2019	Monthly	19/12/2018	6 Monthly
Differential Temperature 10m	11/03/2019	Monthly	19/12/2018	6 Monthly

Table 7: New M5 Project Arncliffe 2 (Eve St) Maintenance Table March 2019

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	04/03/2019	Monthly	04/03/2019	Monthly
CO	04/03/2019	Monthly	04/03/2019	Monthly
PM ₁₀	04/03/2019	Monthly	19/12/2018	6 Monthly
PM _{2.5}	04/03/2019	Monthly	19/12/2018	Yearly
WS/WD/Sigma	04/03/2019	Monthly	19/12/2018	2 yearly
Differential Temperature 2m	04/03/2019	Monthly	19/12/2018	6 Monthly
Differential Temperature 10m	04/03/2019	Monthly	19/12/2018	6 Monthly

Table 8: New M5 Project Barton Park Maintenance Table March 2019

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	04/03/2019	Monthly	04/03/2019	Monthly
CO	28/03/2019	Unscheduled	04/03/2019	Monthly
PM ₁₀	04/03/2019	Monthly	20/01/2019	6 Monthly
PM _{2.5}	04/03/2019	Monthly	19/12/2018	Yearly
WS/WD/Sigma	04/03/2019	Monthly	19/12/2018	2 yearly
Differential Temperature 2m	04/03/2019	Monthly	19/12/2018	6 Monthly
Differential Temperature 10m	04/03/2019	Monthly	19/12/2018	6 Monthly

Table 9: New M5 Project Kingsgrove 1 (MOC1) Maintenance Table March 2019

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	23/03/2019	Unscheduled	23/03/2019	Monthly
CO	22/03/2019	Monthly	22/03/2019	Monthly
PM ₁₀	22/03/2019	Monthly	17/12/2018	6 Monthly
PM _{2.5}	22/03/2019	Monthly	17/12/2018	Yearly
WS/WD/Sigma	22/03/2019	Monthly	17/12/2018	2 yearly
Differential Temperature 2m	22/03/2019	Monthly	17/12/2018	6 Monthly
Differential Temperature 10m	22/03/2019	Monthly	17/12/2018	6 Monthly

Table 10: New M5 Project Kingsgrove 2 (Kingsgrove Rd) Maintenance Table March 2019

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	13/03/2019	Monthly	13/03/2019	Monthly
CO	16/03/2019	Unscheduled	16/03/2019	Monthly
PM ₁₀	13/03/2019	Monthly	17/12/2018	6 Monthly
PM _{2.5}	13/03/2019	Monthly	17/12/2018	Yearly
WS/WD/Sigma	13/03/2019	Monthly	17/12/2018	2 yearly
Differential Temperature 2m	13/03/2019	Monthly	17/12/2018	6 Monthly
Differential Temperature 10m	13/03/2019	Monthly	17/12/2018	6 Monthly

Table 11: New M5 Project St Peters 1 (Campbell St) Maintenance Table March 2019

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	30/03/2019	Unscheduled	30/03/2019	Monthly
CO	30/03/2019	Unscheduled	30/03/2019	Monthly
PM ₁₀	04/03/2019	Monthly	18/12/2018	6 Monthly
PM _{2.5}	04/03/2019	Monthly	18/12/2018	Yearly
WS/WD/Sigma	04/03/2019	Monthly	18/12/2018	2 yearly
Differential Temperature 2m	04/03/2019	Monthly	18/12/2018	6 Monthly
Differential Temperature 10m	04/03/2019	Monthly	18/12/2018	6 Monthly

Table 12: New M5 Project St Peters 2 (SPI) Maintenance Table March 2019

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	05/03/2019	Monthly	05/03/2019	Monthly
CO	05/03/2019	Monthly	05/03/2019	Monthly
PM ₁₀	05/03/2019	Monthly	18/12/2018	6 Monthly
PM _{2.5}	05/03/2019	Monthly	18/12/2018	Yearly
WS/WD/Sigma	05/03/2019	Monthly	18/12/2018	2 yearly
Differential Temperature 2m	05/03/2019	Monthly	18/12/2018	6 Monthly
Differential Temperature 10m	05/03/2019	Monthly	18/12/2018	6 Monthly

Table 13: New M5 Project St Peters 3 (St Peters St) Maintenance Table March 2019

Parameter	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
NO, NO ₂ , NO _x	07/03/2019	Monthly	07/03/2019	Monthly
CO	07/03/2019	Monthly	07/03/2019	Monthly
PM ₁₀	07/03/2019	Monthly	18/12/2018	6 Monthly
PM _{2.5}	07/03/2019	Monthly	18/12/2018	Yearly
WS/WD/Sigma	07/03/2019	Monthly	18/12/2018	2 yearly
Differential Temperature 2m	07/03/2019	Monthly	18/12/2018	6 Monthly
Differential Temperature 10m	07/03/2019	Monthly	18/12/2018	6 Monthly

5.0 Results

5.1. Data Capture

Valid data capture refers to the amount of valid data collected during the report period. It is based on 5-minute data, for gaseous and meteorological parameters and 1-hour data for particulate parameters.

The percentage of valid data captured is calculated using the following equation:

$$\text{Valid Data capture} = (\text{Reported air quality data} / \text{Total data}) \times 100\%$$

Where:

- Reported air quality data = Number of samples (instrument readings) which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, equipment failures, planned and unplanned maintenance.
- Total data = Total number of samples (instrument readings) expected for the sampling period. Total data is calculated based on the same averaging period as “reported air quality data” and the duration of the corresponding report period. e.g. for 5-minute data collected over a month of 31 days, the total data would be equal to 12 (5-minute samples in an hour) x 24 (hours in a day) x 31 (days in a month) = 8928 samples.

Table 12 below displays data capture statistics for March 2019. **Bold** values in the table indicate data capture below 95%.

Details of all invalid or missing data affecting data capture are included in the Valid Data Exception Tables, see section 6.0.

Table 14: Data Capture for New M5 Project Ambient Air Quality Network

Parameter	Data Capture (%)							
	Arncliffe 1 (West Botany St)	Arncliffe 2 (Eve St)	Barton Park	Kingsgrove 1 (MOC1)	Kingsgrove 2 (Kingsgrove Rd)	St Peters 1 (Campbell St)	St Peters 2 (SPI)	St Peters 3 (St Peters St)
PM _{2.5}	97.0	99.6	99.6	93.3	99.5	95.2	99.6	99.5
PM ₁₀	99.8	90.8	99.8	99.5	99.9	98.3	99.9	99.9
CO	95.9	94.8	88.0	96.5	94.8	94.3	96.1	92.9
NO, NO ₂ , NO _x	96.3	96.2	96.7	94.5	96.3	94.8	96.4	96.3
WS, WD, Sigma	100.0	100.0	100.0	99.9	100.0	98.6	100.0	100.0
AT 2m	100.0	100.0	100.0	99.9	100.0	98.6	100.0	100.0
AT 10m	100.0	100.0	100.0	99.9	100.0	39.1	100.0	100.0

5.2. Air Quality Monthly Summary

Tables 15-22 below include a summary of any exceedances recorded at the NEW M5 Project stations during the reported period⁵.

Table 15: New M5 Project Arncliffe 1 (West Botany St)

Exceedences Recorded for March 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ⁶	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ⁶	-	-

⁵ Exceedances are based on the decimal places reported.

⁶ Insufficient data to report annual average, any exceedences will be reported in March 2020. Any 'exceedences' recorded will not trigger E15-E17 until the first annual day 12 months following operation? (E14)

Table 16: New M5 Project Arncliffe 2 (Eve St)

Exceedences Recorded for March 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ⁷	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ⁷	-	-

⁷ Insufficient data to report annual average, any exceedences will be reported in March 2020.

**Table 17: New M5 Project Barton Park
Exceedences Recorded for March 2019**

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ⁸	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ⁸	-	-

⁸ Insufficient data to report annual average, any exceedences will be reported in March 2020.

Table 18: New M5 Project Kingsgrove 1 (MOC1)

Exceedences Recorded for March 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	54.8	04/03/2019
		60.0	05/03/2019
		110.8	06/03/2019
		63.9	08/03/2019
		68.7	12/03/2019
		52.6	26/03/2019
		65.2	28/03/2019
	61.8	29/03/2019	
	Annual ⁹	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ⁹	-	-

⁹ Insufficient data to report annual average, any exceedences will be reported in March 2020.

Table 19: New M5 Project Kingsgrove 2 (Kingsgrove Rd)

Exceedences Recorded for March 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ¹⁰	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ¹⁰	-	-

¹⁰ Insufficient data to report annual average, any exceedences will be reported in March 2020.

Table 20: New M5 Project St Peters 1 (Campbell St)

Exceedences Recorded for March 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	55.5	06/03/2019
		52.6	11/03/2019
	Annual ¹¹	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ¹¹	-	-

¹¹ Insufficient data to report annual average, any exceedences will be reported in March 2020.

**Table 21: New M5 Project St Peters 2 (SPI)
Exceedences Recorded for March 2019**

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	59.5	4/03/2019
		56.2	5/03/2019
		79.5	6/03/2019
		72.4	8/03/2019
		51.5	11/03/2019
		63.5	12/03/2019
		64.0	26/03/2019
		53.7	27/03/2019
	55.6	29/03/2019	
	Annual ¹²	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ¹²	-	-

¹² Insufficient data to report annual average, any exceedences will be reported in March 2020.

Table 22: New M5 Project St Peters 3 (St Peters St)

Exceedences Recorded for March 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO ₂ (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM ₁₀ (µg/m ³)	24-hour	-	-
	Annual ¹³	-	-
PM _{2.5} (µg/m ³)	24-hour	-	-
	Annual ¹³	-	-

¹³ Insufficient data to report annual average, any exceedences will be reported in March 2020.

5.3. Tabulated data

5.3.1. Annual average

Table 23 and 24 display monthly averages of the PM₁₀ and PM_{2.5} parameters collected at New M5 project ambient air monitoring stations data from the start of monitoring (17th-19th December 2018) to the end current reported month. Table requires at least 75% valid data to display a monthly average. Footer values are based on all available data rather than the average of individual months. This gives an indication of performance against the annual objectives. These figures should not be considered valid until 12 months monitoring have been completed.

Table 23: 12 months to date averages of PM₁₀ (µg/m³) at the WestConnex New M5 ambient air monitoring stations¹⁴

Month	Arncliffe 1 (West Botany St)	Arncliffe 2 (Eve St)	Barton Park	Kingsgrove 1 (MOC1)	Kingsgrove 2 (Kingsgrove Rd)	St Peters 1 (Campbell St)	St Peters 2 (SPI)	St Peters 3 (St Peters St)
Dec/18 ¹⁵	24.5	23.1	16.8	25.5	21.2	26.2	26.6	24.7
Jan/19	29.1	27.3	20.3	42.6	24.9	31.3	41.5	29.1
Feb/19	20.5	22.4	15.7	33.7	19.8	27.8	40.2	24.8
Mar/19	21.7	21.2	15.8	33.9	19.7	25.4	35.9	22.3
Apr/18	-	-	-	-	-	-	-	-
May/18	-	-	-	-	-	-	-	-
Jun/18	-	-	-	-	-	-	-	-
Jul/18	-	-	-	-	-	-	-	-
Aug/18	-	-	-	-	-	-	-	-
Sep/18	-	-	-	-	-	-	-	-
Oct/18	-	-	-	-	-	-	-	-
Nov/18	-	-	-	-	-	-	-	-
Average	23.7	23.7	17.2	36.8	21.5	28.2	39.2	25.4

¹⁴ Note: data collection commenced in December 2018; therefore, 12 consecutive months of data have not yet been recorded.

¹⁵ Less than 75% data available for December 2018

Table 24: 12 months to date averages of PM_{2.5} (µg/m³) at the WestConnex New M5 ambient air monitoring stations¹⁶

Month	Arncliffe 1 (West Botany St)	Arncliffe 2 (Eve St)	Barton Park	Kingsgrove 1 (MOC1)	Kingsgrove 2 (Kingsgrove Rd)	St Peters 1 (Campbell St)	St Peters 2 (SPI)	St Peters 3 (St Peters St)
Dec/18 ¹⁷	11	8	9	11	9	11	10	8
Jan/19	10	9	11	14	11	15	12	15
Feb/19	9	8	7	11	6	10	10	10
Mar/18	7	9	8	13	7	11	11	9
Apr/18	-	-	-	-	-	-	-	-
May/18	-	-	-	-	-	-	-	-
Jun/18	-	-	-	-	-	-	-	-
Jul/18	-	-	-	-	-	-	-	-
Aug/18	-	-	-	-	-	-	-	-
Sep/18	-	-	-	-	-	-	-	-
Oct/18	-	-	-	-	-	-	-	-
Nov/18	-	-	-	-	-	-	-	-
Average	9	9	9	13	8	12	11	11

¹⁶ Note: data collection commenced in December 2018; therefore, 12 consecutive months of data have not yet been recorded.

¹⁷ Less than 75% data available for December 2018

5.4. Graphic Representations

This section displays graphs of the pollutants and meteorological parameters monitored at the New M5 sites for March 2019. The graphs are based on validated 5 minutes or 1-hour data as appropriate.

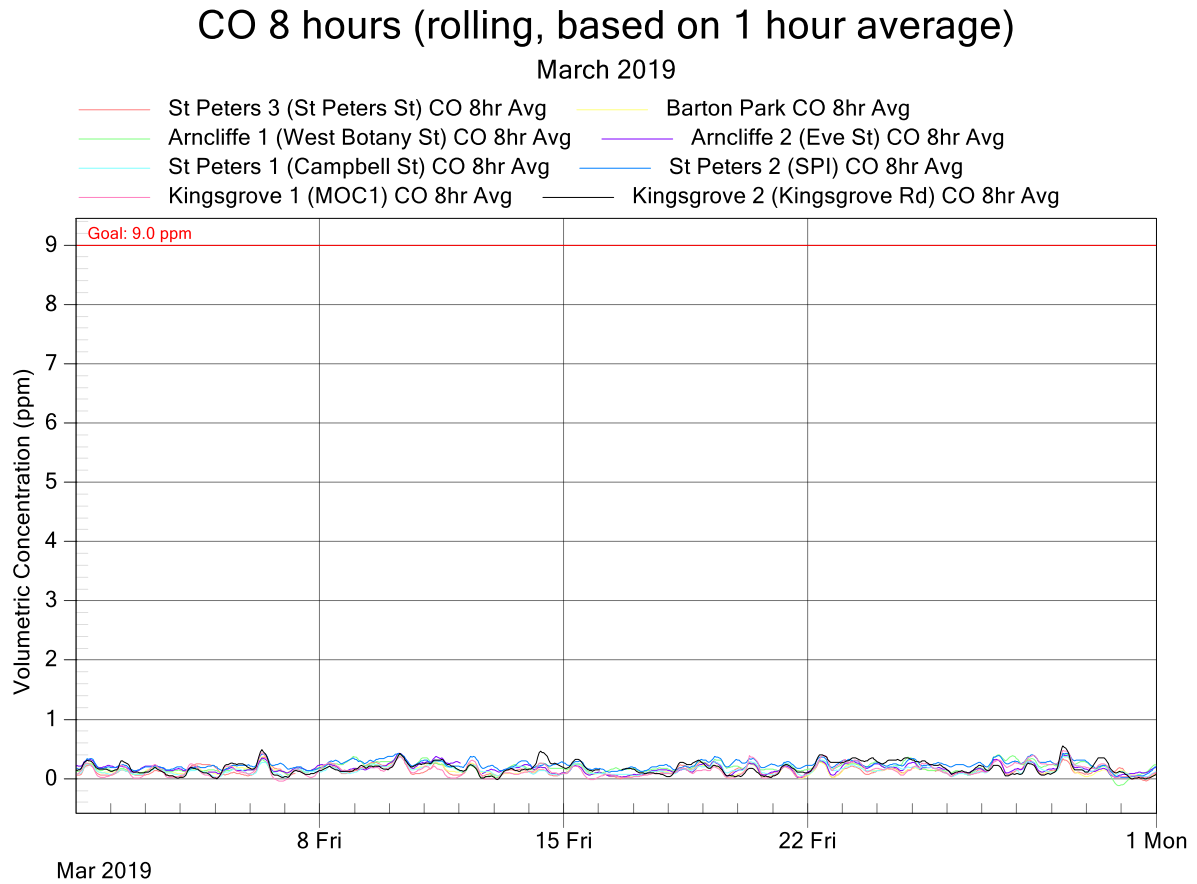


Figure 2: New M5 Project Air Monitoring Stations - CO 8 hours rolling graph for March 2019

NO₂ 1 hour average

March 2019

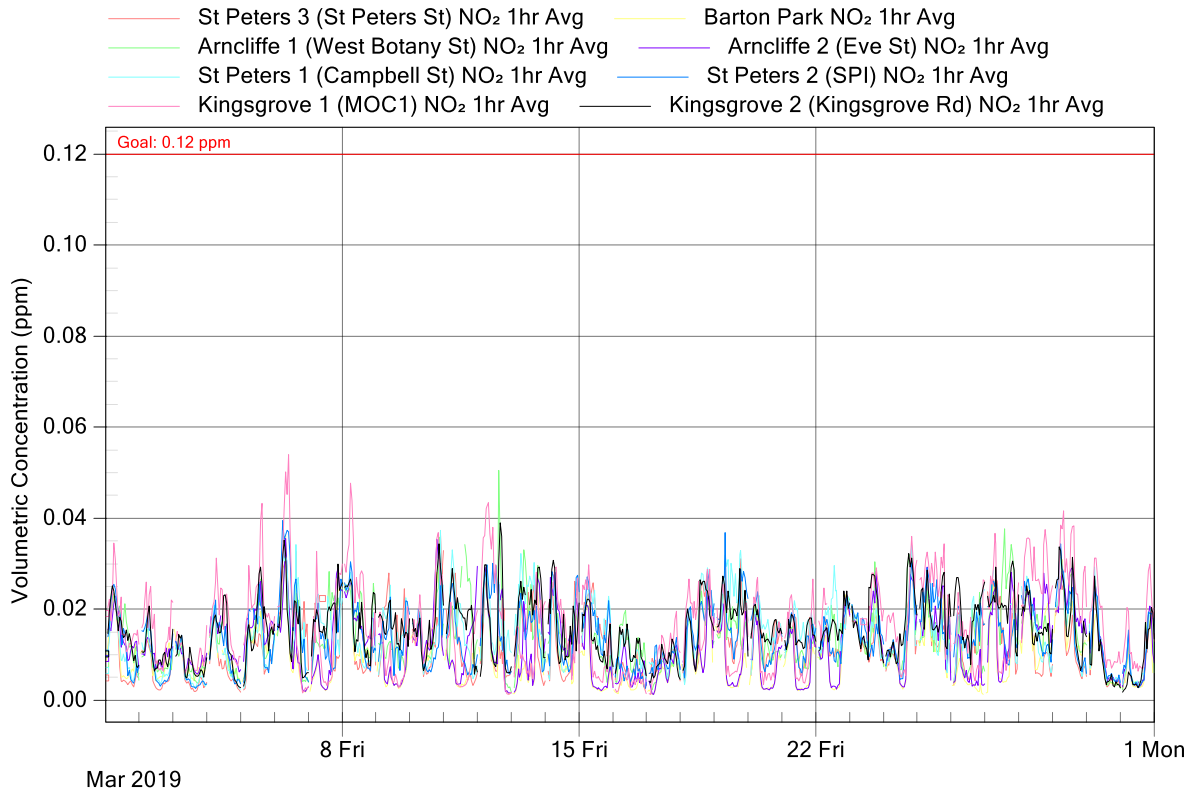


Figure 3: New M5 Project Air Monitoring Stations - NO₂ graph for March 2019

PM₁₀ 24 hour average

March 2019

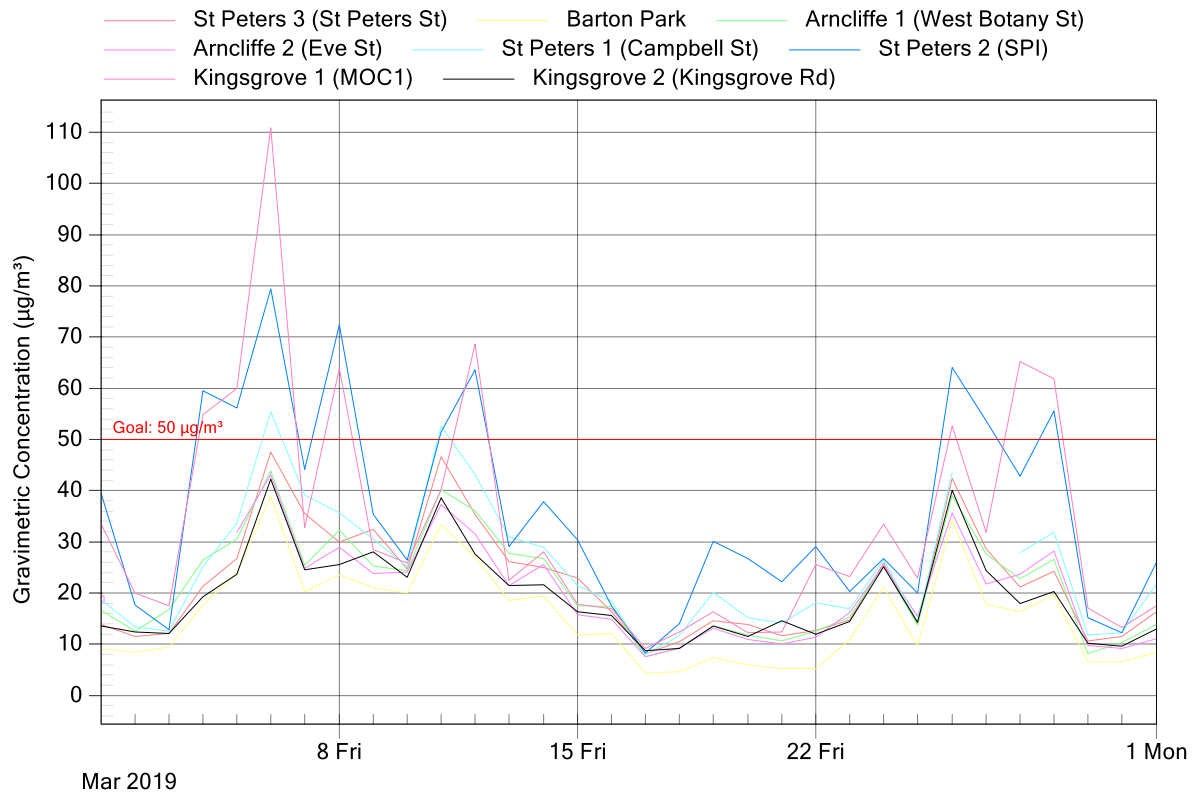


Figure 4: New M5 Project Air Monitoring Stations - PM₁₀ 24 Hour graph for March 2019

PM_{2.5} 24 hour average

March 2019

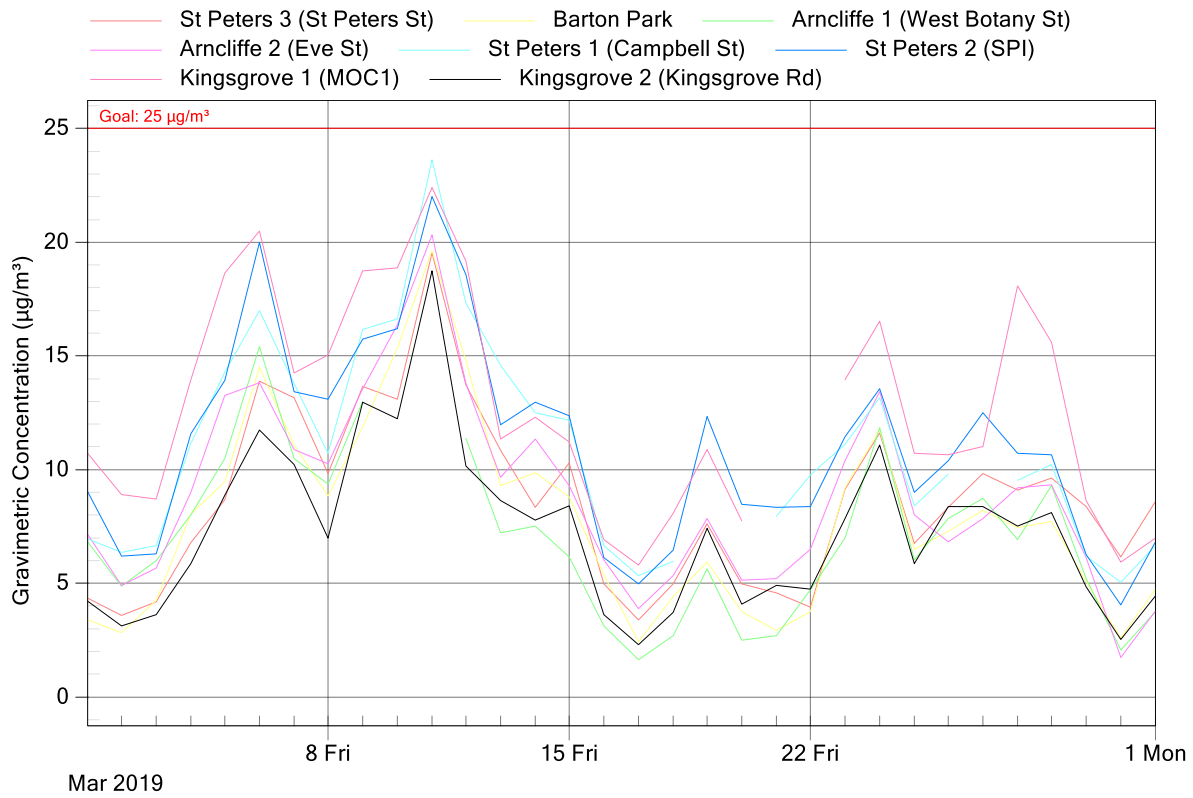


Figure 5: New M5 Project Air Monitoring Stations - PM_{2.5} 24 Hour graph March 2019

Arnccliffe 1 (West Botany St) - Wind Rose (1-hour average)
Wind Rose March 2019

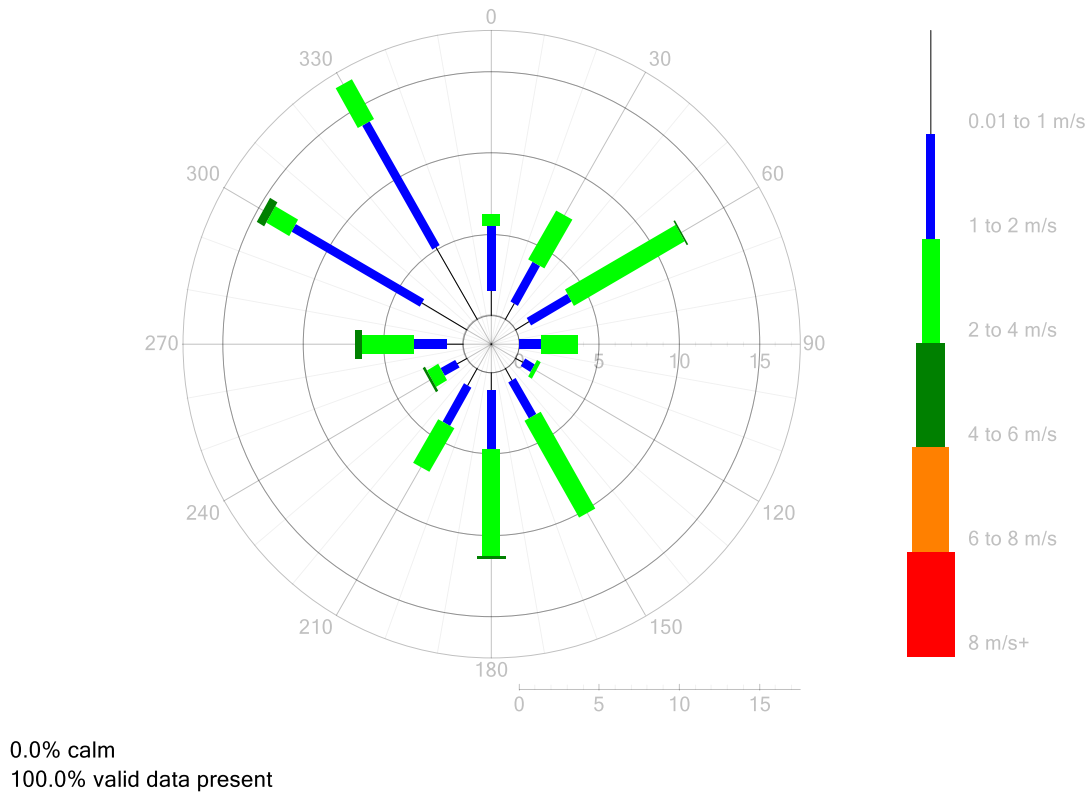
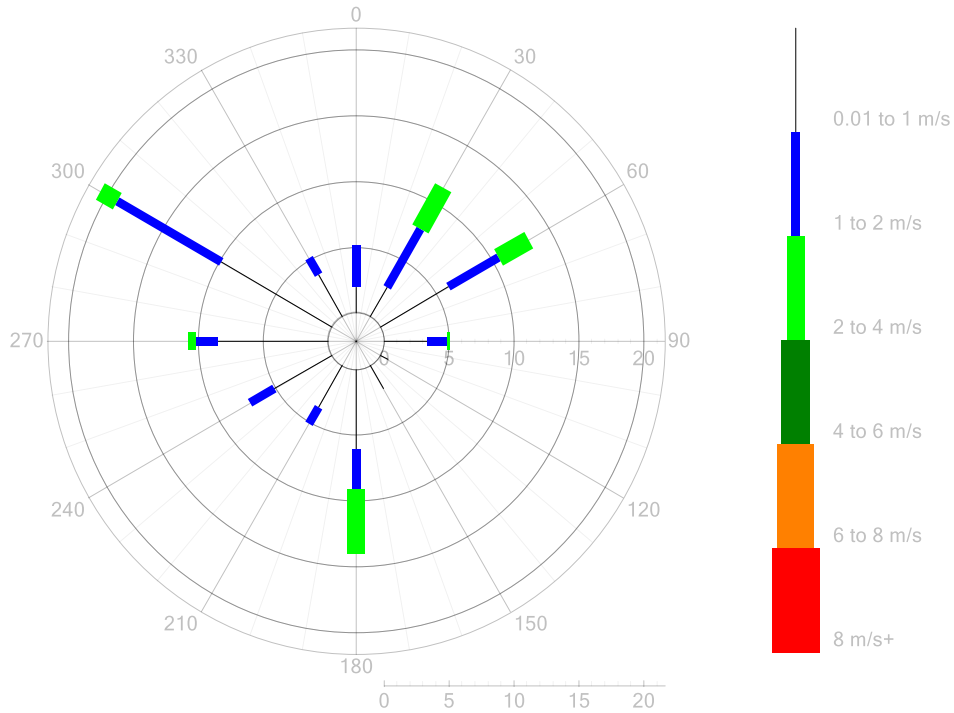


Figure 6: Arnccliffe 1 (West Botany St) – Wind Rose for March 2019

Arncliffe 2 (Eve St) - Wind Rose (1-hour average)

Wind Rose

March 2019



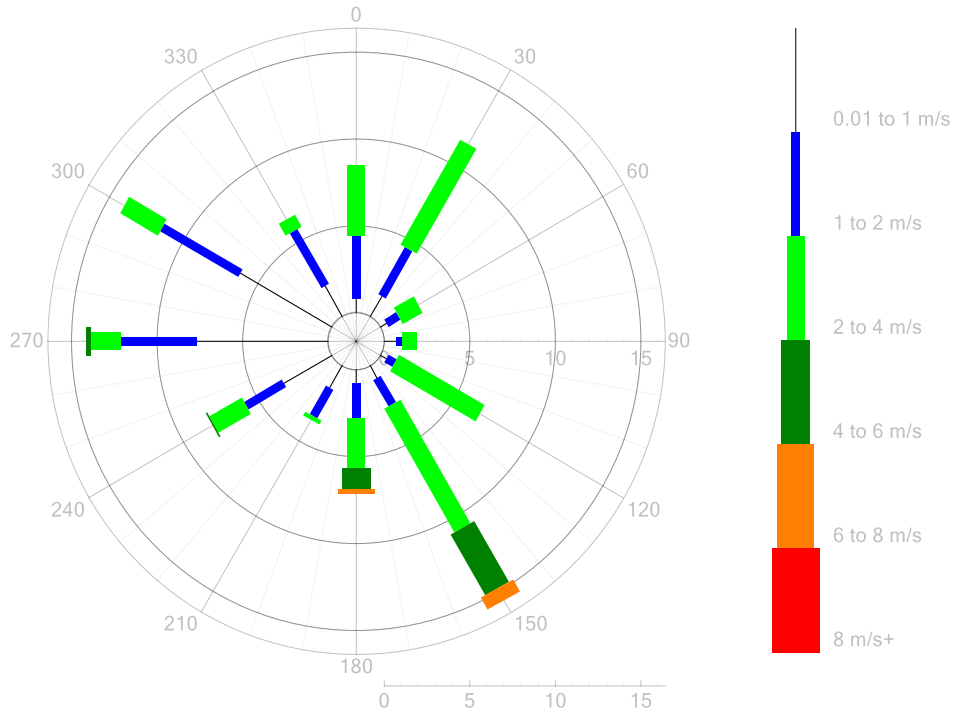
0.0% calm
100.0% valid data present

Figure 7: Arncliffe 2 (Eve St) – Wind Rose for March 2019

Barton Park - Wind Rose (1-hour average)

Wind Rose

March 2019



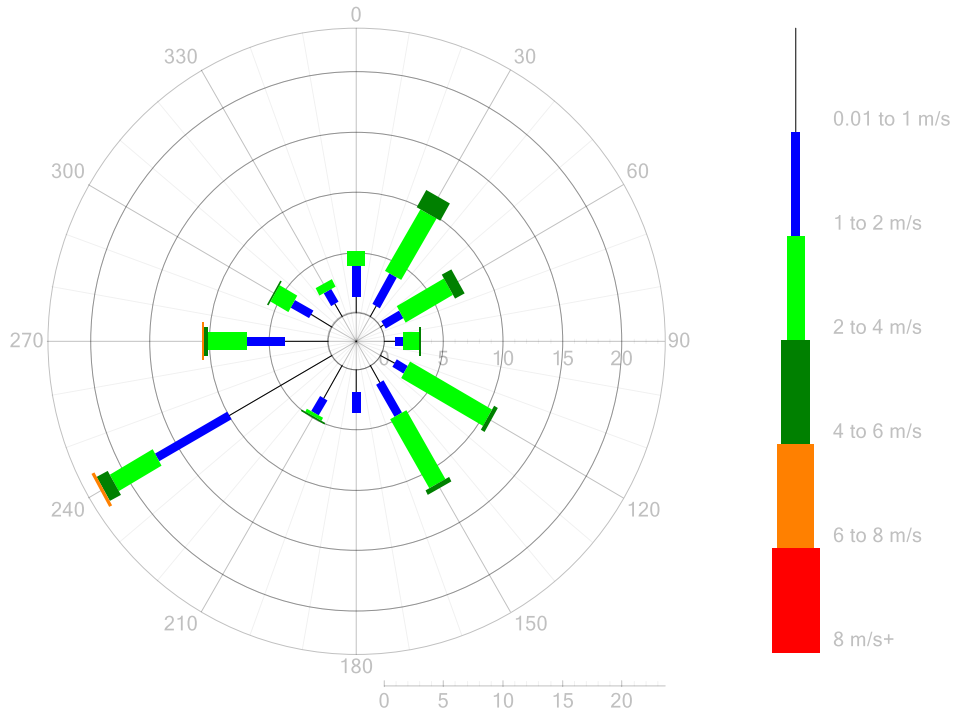
0.0% calm
100.0% valid data present

Figure 8: Barton Park – Wind Rose for March 2019

Kingsgrove 1 (MOC1) - Wind Rose (1-hour average)

Wind Rose

March 2019



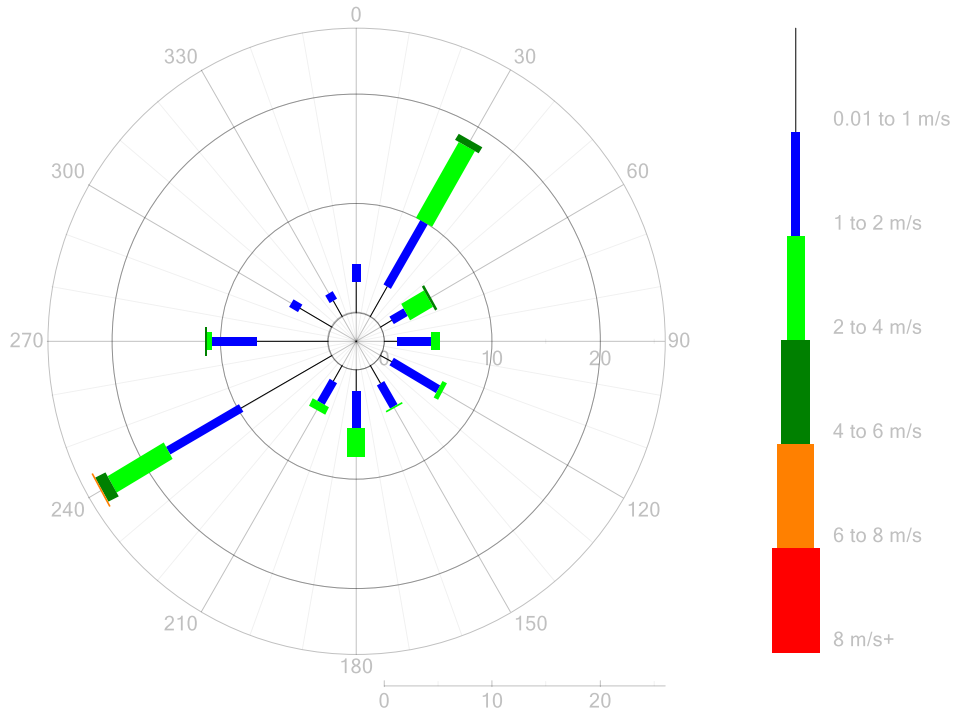
0.0% calm
100.0% valid data present

Figure 9: Kingsgrove 1 (MOC1) – Wind Rose for March 2019

Kingsgrove 2 (Kingsgrove Rd) - Wind Rose (1-hour average)

Wind Rose

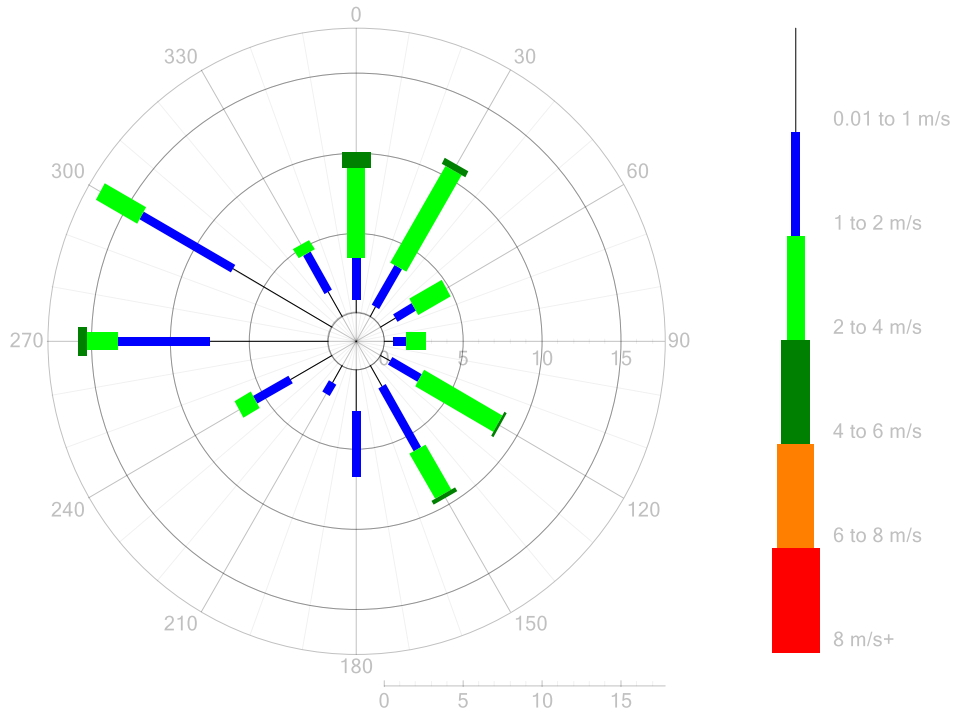
March 2019



0.0% calm
100.0% valid data present

Figure 10: Kingsgrove 2 (Kingsgrove Rd) – Wind Rose for March 2019

St Peters 1 (Campbell St) - Wind Rose (1-hour average)
Wind Rose March 2019



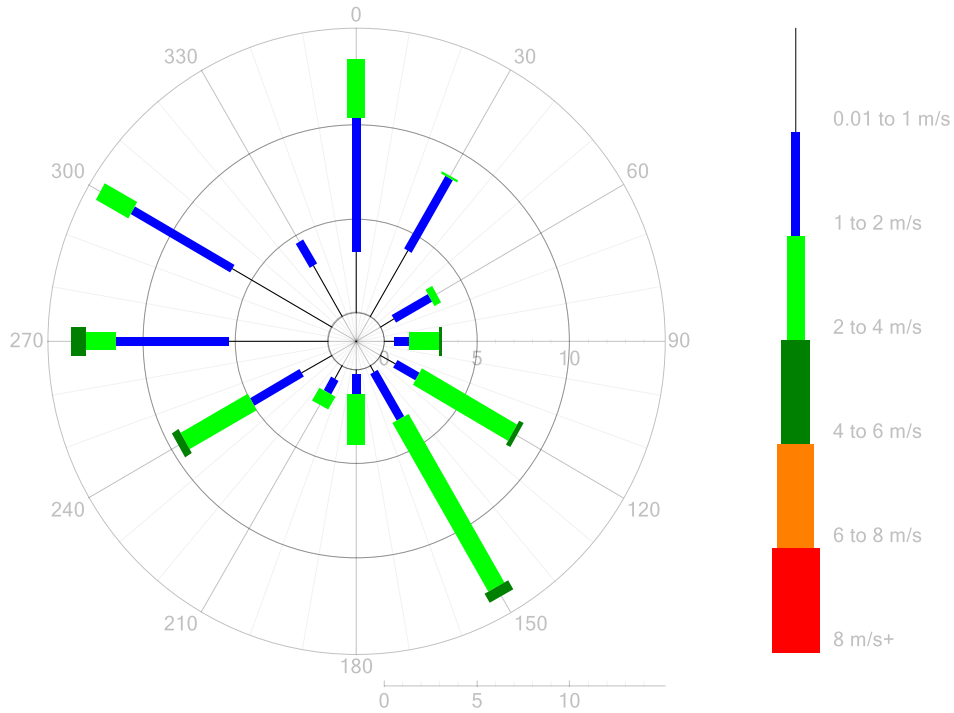
0.0% calm
98.5% valid data present

Figure 11: St Peters 1 (Campbell St) – Wind Rose for March 2019

St Peters 2 (SPI) - Wind Rose (1-hour average)

Wind Rose

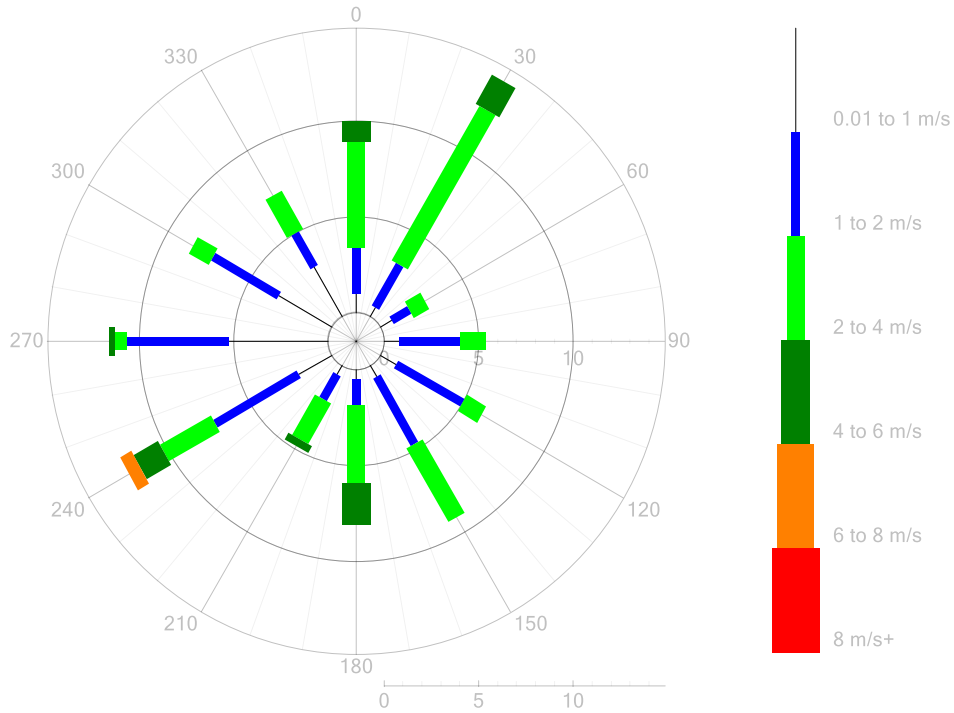
March 2019



0.0% calm
100.0% valid data present

Figure 12: St Peters 2 (SPI) – Wind Rose for March 2019

St Peters 3 (St Peters St) - Wind Rose (1-hour average)
Wind Rose March 2019



0.0% calm
100.0% valid data present

Figure 13: St Peters 3 (St Peters St) – Wind Rose for March 2019

6.0 Valid Data Exception Tables

Tables 25 to 32 below detail all changes made to the raw data set during the validation process. An explanation of reasons given in the table can be found in Appendix 2.

Table 25: Arncliffe 1 (West Botany St) Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/03/19 01:00	31/03/19 01:45	Automatic span and zero checks once daily for 40-45 minutes	CO, NO, NO ₂ , NO _x	DD	26/04/2019
01/03/19 10:50	17/03/19 09:10	Intermittent data transmission errors	CO, NO, NO ₂ , NO _x , AT2m, AT10m, WS, WD, Sigma, PM ₁₀	DD	26/04/2019
01/03/19 23:45	31/03/19 23:45	Background checks once daily for 5 - 10 minutes	CO	DD	26/04/2019
10/03/19 17:00	11/03/19 12:00	Instrument tape fault	PM _{2.5}	DD	26/04/2019
11/03/19 12:00	11/03/19 15:25	Scheduled maintenance/ Instrument stabilisation following maintenance, data intermittently affected	CO, NO, NO ₂ , NO _x , PM ₁₀ , PM _{2.5}	DD	26/04/2019
14/03/19 22:00	14/03/19 22:00	Instrument flow fault	PM _{2.5}	DD	26/04/2019
25/03/19 23:50	26/03/19 23:50	Static offset of +0.15 ppm applied to correct baseline step change	CO	DD	26/04/2019

Table 26: Arncliffe 2 (Eve St) Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/03/19 01:00	31/03/19 01:45	Automatic span and zero checks once daily for 50-55 minutes	CO, NO, NO ₂ , NO _x	DD	26/04/2019
01/03/19 09:25	30/03/19 14:00	Intermittent unrealistic data	PM ₁₀	DD	26/04/2019
01/03/19 21:05	04/03/19 11:05	Noisy data	PM ₁₀	DD	26/04/2019
01/03/19 23:45	31/03/19 23:45	Background checks once daily for 5 - 10 minutes	CO	DD	26/04/2019
04/03/19 11:10	04/03/19 16:25	Scheduled maintenance - performed calibration and replaced TEOM analyser (97-0583 OUT, 05-0563 IN), data intermittently affected	CO, NO, NO ₂ , NO _x , PM ₁₀ , PM _{2.5}	DD	26/04/2019
04/03/19 13:40	04/03/19 23:50	Static offset of -0.10 ppm applied to correct baseline step change	CO	DD	26/04/2019
12/03/19 01:50	12/03/19 10:05	Instrument status error	CO	DD	26/04/2019

Table 27: Barton Park Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/03/19 00:00	31/03/19 00:40	Automatic span and zero checks once daily for 40 minutes	CO, NO, NO ₂ , NO _x	DD	26/04/2019
01/03/19 23:45	31/03/19 23:45	Background checks once daily for 5 minutes	CO	DD	26/04/2019
04/03/19 08:00	04/03/19 10:25	Scheduled maintenance/ Instrument stabilisation following maintenance, data intermittently affected	CO, NO, NO ₂ , NO _x , PM ₁₀	DD	26/04/2019
14/03/19 19:10	30/03/19 13:45	Intermittent unrealistic data	PM ₁₀	DD	26/04/2019
25/03/19 15:35	28/03/19 07:05	Instrument reference failure	CO	DD	26/04/2019
28/03/19 07:10	28/03/19 07:50	Unscheduled maintenance - adjusted instrument input pot, data intermittently affected	CO, NO, NO ₂ , NO _x	DD	26/04/2019

Table 28: Kingsgrove 1 (MOC1) Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/03/19 00:00	01/04/19 00:00	Static offset of -5 µg/m ³ applied to correct baseline	PM _{2.5}	DD	26/04/2019
01/03/19 01:00	31/03/19 01:40	Automatic span and zero checks once daily for 30 - 40 minutes	CO, NO, NO ₂ , NO _x	DD	26/04/2019
01/03/19 02:20	29/03/19 08:00	Intermittent data transmission errors	CO	DD	26/04/2019
01/03/19 23:45	31/03/19 23:45	Background checks once daily for 5 - 10 minutes	CO	DD	26/04/2019
04/03/19 10:40	28/03/19 21:10	Intermittent unrealistic data	NO, NO ₂ , NO _x	DD	26/04/2019
06/03/19 19:05	14/03/19 19:35	Intermittent unrealistic data	PM ₁₀	DD	26/04/2019
10/03/19 10:00	29/03/19 08:00	Intermittent instrument flow fault	PM _{2.5}	DD	26/04/2019
20/03/19 19:00	22/03/19 07:00	Instrument tape fault	PM _{2.5}	DD	26/04/2019
22/03/19 08:00	22/03/19 11:15	Scheduled maintenance/ Instrument stabilisation following maintenance, data intermittently affected	All channels	DD	26/04/2019
22/03/19 10:30	23/03/19 09:25	Instrument overnight span out of tolerance	NO, NO ₂ , NO _x	DD	26/04/2019
22/03/19 11:10	22/03/19 23:40	Static offset of +0.15 ppm applied to correct baseline step change	CO	DD	26/04/2019
23/03/19 09:30	23/03/19 12:00	Unscheduled maintenance - performed calibration, data intermittently affected	CO, NO, NO ₂ , NO _x	DD	26/04/2019
26/03/19 01:35	26/03/19 23:40	Static offset of +0.10 ppm applied to correct baseline step change	CO	DD	26/04/2019
27/03/19 07:00	27/03/19 08:25	Power interruption / Instrument stabilisation following power interruption, data intermittently affected	All channels	DD	26/04/2019
27/03/19 08:30	27/03/19 23:50	Static offset of -0.40 ppm applied to correct baseline step change	CO	DD	26/04/2019

Table 29: Kingsgrove 2 (Kingsgrove Rd) Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/03/19 01:00	31/03/19 01:45	Automatic span and zero checks once daily for 45-50 minutes	CO, NO, NO ₂ , NO _x	DD	26/04/2019
01/03/19 23:45	31/03/19 23:45	Background checks once daily for 5 - 10 minutes	CO	DD	26/04/2019
13/03/19 11:25	13/03/19 15:00	Scheduled maintenance/ Instrument stabilisation following maintenance, data intermittently affected	All channels	DD	26/04/2019
16/03/19 01:55	16/03/19 09:40	Instrument fault	CO	DD	26/04/2019
16/03/19 09:50	16/03/19 10:05	Unscheduled maintenance - restarted instrument	CO	DD	26/04/2019

Table 30: St Peters 1 (Campbell St) Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/03/19 00:00	24/03/19 08:00	Intermittent unrealistic data	AT 10m	DD	26/04/2019
01/03/19 01:00	31/03/19 01:45	Automatic span and zero checks once daily for 40-45 minutes	CO, NO, NO ₂ , NO _x	DD	26/04/2019
01/03/19 23:45	31/03/19 23:45	Background checks once daily for 5 - 10 minutes	CO	DD	26/04/2019
04/03/19 09:10	04/03/19 12:00	Scheduled maintenance/ Instrument stabilisation following maintenance, data intermittently affected	All channels	DD	26/04/2019
14/03/19 19:20	14/03/19 19:35	Unrealistic data	PM ₁₀	DD	26/04/2019
19/03/19 12:00	20/03/19 11:00	Intermittent instrument flow fault	PM _{2.5}	DD	26/04/2019
21/03/19 06:35	21/03/19 06:35	Unrealistic data	NO, NO ₂ , NO _x	DD	26/04/2019
27/03/19 06:00	27/03/19 20:00	Power interruption / Instrument stabilisation following power interruption, data intermittently affected	All channels	DD	26/04/2019
30/03/19 12:00	30/03/19 12:50	Unscheduled maintenance - checked overnight span system and performed calibration	CO, NO, NO ₂ , NO _x	DD	26/04/2019

Table 31: St Peters 2 (SPI) Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/03/19 01:00	31/03/19 01:45	Automatic span and zero checks once daily for 40-45 minutes	CO, NO, NO ₂ , NO _x	DD	26/04/2019
01/03/19 23:45	31/03/19 23:45	Background checks once daily for 5 - 10 minutes	CO	DD	26/04/2019
05/03/19 08:40	05/03/19 11:00	Scheduled maintenance/ Instrument stabilisation following maintenance, data intermittently affected	CO, NO, NO ₂ , NO _x , PM ₁₀ , PM _{2.5}	DD	26/04/2019
14/03/19 13:40	14/03/19 13:45	Data transmission error due to logger fault	CO, NO, NO ₂ , NO _x , AT2m, AT10m, WS, WD, Sigma, PM ₁₀	DD	26/04/2019
25/03/19 23:50	26/03/19 23:40	Static offset of +0.20 ppm applied to correct baseline step change	CO	DD	28/04/2019
28/03/19 16:55	28/03/19 16:55	Unrealistic data	NO, NO ₂ , NO _x	DD	26/04/2019

Table 32: St Peters 3 (St Peters St) Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/03/19 01:00	31/03/19 01:45	Automatic span and zero checks once daily for 40-45 minutes	CO, NO, NO ₂ , NO _x	DD	26/04/2019
01/03/19 23:45	31/03/19 23:45	Background checks once daily for 5 - 10 minutes	CO	DD	26/04/2019
07/03/19 07:00	07/03/19 11:50	Scheduled maintenance/ Instrument stabilisation following maintenance, data intermittently affected	CO, NO, NO ₂ , NO _x , PM ₁₀ , PM _{2.5}	DD	26/04/2019
07/03/19 11:55	07/03/19 23:50	Instrument stabilisation following maintenance	CO	DD	26/04/2019
18/03/19 01:50	18/03/19 23:50	Static offset of -0.40 ppm applied to correct baseline step change	CO	DD	26/04/2019
25/03/19 01:50	25/03/19 10:10	Instrument fault	CO	DD	26/04/2019
25/03/19 10:15	25/03/19 23:50	Static offset of +0.20 ppm applied to correct baseline step change	CO	DD	26/04/2019

7.0 Report Summary

- Percentage availability for some parameters at New M5 Project was below 95%, refer to Table 14, and Tables 25-32 for details.
- There were nineteen recorded readings over the air quality goals at the WestConnex New M5 Ambient Air Quality Monitoring Network for the reporting month. Please refer to Tables 15-22 in Section 5.2 – Air Quality Monthly Summary for further information.

Appendix 1 - Definitions & Abbreviations

ERS	Environmental Reporting Services
AQMS	Air Quality Monitoring Station
AQM	Air Quality Monitor
BAM	Beta Attenuation Monitors
TEOM	Tapered Element Oscillating Microbalance
°	Degrees (True North)
K	Kelvin
µg/m ³	Micrograms per cubic metre at standard temperature and pressure (0°C and 101.3 kPa)
AT	Ambient Temperature
calm	Wind conditions where the wind speed is below the operating range of the wind sensor
CO	Carbon monoxide
mg/m ³	Milligrams per cubic metre at standard temperature and pressure (0°C and 101.3 kPa)
mm	Millimeters
NO	Nitric oxide
NO ₂	Nitrogen dioxide
NO _x	Oxides of nitrogen
PM ₁₀	Particulate less than 10 microns in equivalent aerodynamic diameter
PM _{2.5}	Particulate less than 2.5 microns in equivalent aerodynamic diameter
ppb	Parts per billion

ppm	Parts per million
RH	Relative Humidity
WD	Vector Wind Direction
WS	Vector Wind Speed

Appendix 2 - Explanation of Exception Table

Automatic background check refers to when analyser samples zero air and measures the level of the concentration voltage. This voltage is taken as the zero signal level and this value is subtracted from any subsequent readings as an active zero compensation. This is the analyser's fine zero measurement.

Automatic span/zero check. The E-Sampler is programmed to perform a zero calibration check whereby air is passed through filter element, removing particulates, before entering the sensor in the analyser. Data is invalidated when these checks occur.

Beta count failure refers to a fault in the functioning of the EBAM. A one minute beta count was less than the maximum acceptable counts during operation.

Calibration check outside tolerance refers to when the calibration values are outside the tolerance limits set for the precision check.

Calibration correction factor applied to data refers to an offset or multiplier applied to the data. This operation may be performed for a number of reasons including: (a) when a clear trend / drift outside the tolerance limit can be demonstrated by repeated operation precision checks, (b) when a correction is required on previously logged data due to a calibration check being outside the allowable tolerance

Commissioning refers to the initial setup and calibration of the instrument when it is first installed. For some instruments there may be a stabilisation period before normal operation commences.

Data transmission error refers to a period of time when the instrument could not transmit data. This may be due to interference, or a problem with the phone line or modem.

Equipment malfunction/instrument fault refers to a period of time when the instrument was not in the normal operating mode and did not measure a representative value of the existing conditions.

Gap in data/data not available refers to a period of time when either data has been lost or could not be collected.

Instrument Alarm refers to an alarm produced by the instrument. A range of alarms can be produced depending on how operation of the instrument is being affected.

Instrument out of service refers to a lack of data due to an instrument being shut down for repair, maintenance, or factory calibration.

Linear offset or multiplier refers to when an offset or multiplier has been applied between two points where the values of the offset or multiplier are different and the correction is interpolated between the two points.

Logger error refers to when an error occurs and instrument readings are not correctly recorded by the logger.

Maintenance refers to a period of time when the logger/instrument was switched off due to maintenance.

Overnight span/zero out of tolerance refers to when the span/zero reading measured by the analyser during an automatic precision check falls outside of the expected concentration limits.

Overnight zero out of tolerance refers to when the automatic zero reading measured by the analyser falls outside the expected limits.

Power Interruption refers to no power to the station therefore no data was collected at this time.

Remote Calibration refers to when a technician remotely connects to the station and manually performs a span check.

Static offset or multiplier refers to when a single offset or multiplier has been applied to the data between two points either to increase or decrease the measured value.

Tape break refers to the breaking of the EBAM/BAM sample tape during operation.

Stabilisation after power interruption refers to the startup period of an instrument after power has been restored.

Comparison of WestConnex new M5 sites with EPA sites

PM2.5 24hour average

