

# WestConnex

## M4 East Project

### Ambient Air Quality and Weather Monitoring Validated Report

1<sup>st</sup> May 2019 – 31<sup>st</sup> May 2019

Report No.: DAT14642

Report issue date: 14<sup>th</sup> June 2019

Maintenance contract: MC2148

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## Executive Summary

The M4 East project is a component of the WestConnex scheme, a NSW Government initiative to connect Sydney's west and south-west with the Sydney Airport and the Port Botany precinct. The project includes the widening of the existing M4 between Homebush Bay Drive and Underwood Road. Two new three-lane tunnels of approximately 5.5 km will extend from west of Pomeroy Street, Homebush to Alt Street at Haberfield. Interchanges or ramps will be upgraded or installed to allow access to/from the tunnel at the following locations: Homebush Bay Drive, Concord Road, Wattle Street and Parramatta Road at Ashfield/Haberfield. Tunnel ventilation facilities will be installed within the existing M4 road reserve near Underwood Road, Homebush and at the corner of Parramatta Road and Wattle Street at Haberfield. Operational ancillary facilities will be installed at Cintra Park. Associated road works, particularly at Parramatta Road to the M4 at Powells Creek and modification of the intersection of the existing M4 and Parramatta Road will also be undertaken as part of the works.

Ecotech Pty Ltd has been commissioned by CPB Samsung John Holland Joint Venture for air quality monitoring, data collection and reporting at six external ambient air quality monitoring stations: Allen Street AQM (Air Quality Monitoring), Powells Creek AQM, St Lukes Park AQM, Concord Oval AQM, Ramsay Street AQM and Haberfield Public School AQM.

## 1.0 Introduction

Ecotech Pty Ltd was commissioned by CPB Samsung John Holland Joint Venture to provide monitoring and data reporting for the M4 East Project ambient air quality and weather monitoring network, located as detailed in Table 1. Ecotech commenced data collection in December 2017.

This report presents the available data for May 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

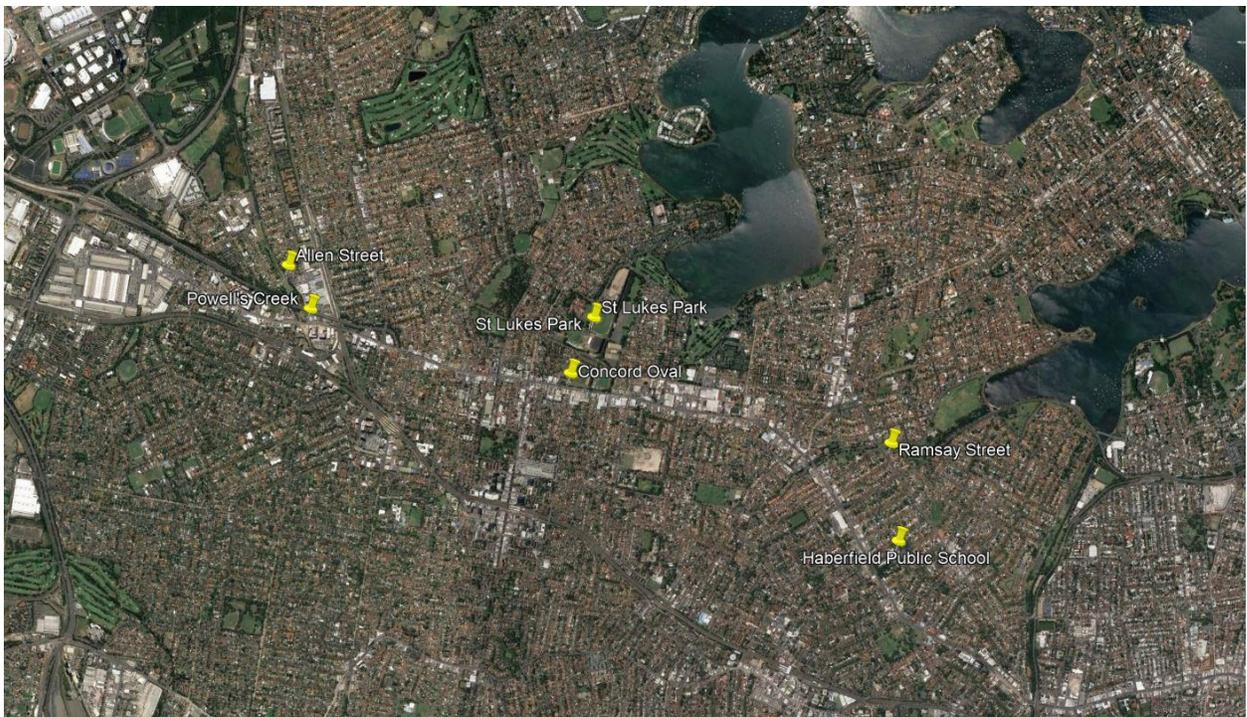
The WestConnex M4 East Project monitoring network consists of six ambient air quality and weather monitoring stations. The stations location and siting details are described below.

**Table 1: WestConnex M4 NSW East Project monitoring sites locations**

Site Name	Geographical Coordinates	Height Above Sea Level (m)
Allen Street	33°51'44.21"S, 151° 5'9.79"E	3
Concord Oval	33°52'8.60"S, 151° 6'28.97"E	7
Haberfield Public School	33°52'45.70"S, 151° 8'4.01"E	26
Powells Creek	33°51'53.80"S, 151° 5'16.50"E	10
Ramsay Street	33°52'26.20"S, 151° 8'1.50"E	5
Saint Lukes Park	33°51'55.04"S, 151° 6'35.88"E	4

A siting audit to assess sites for compliance with *AS/NZS 3580.1.1:2016* has been completed as follows:

- Allen Street on 14/11/2018 (Meteorological Siting Audit completed on 26/02/2019)
- Concord Oval on 14/11/2018 (Meteorological Siting Audit completed on 26/02/2019)
- Haberfield Public School on 02/10/2018
- Powells Creek on 14/11/2018
- Ramsay Street on 05/02/2019
- Saint Lukes Park on 09/11/2018



**Figure 1: M4 East Project Monitoring Station Locations**

2.2. Monitored Parameters

Table 2 below details the parameters monitored and the instruments used at the M4 East Project monitoring stations. Appendix 1 defines any abbreviated parameter names used throughout the report.

Table 2: Parameters measured at the M4 East Project monitoring stations

Station(s)	Parameter Measured	Instrument and Measurement Technique	Elevation
Allen Street Concord Oval Haberfield Public School Powells Creek Ramsay Street Saint Lukes Park	CO	Ecotech Serinus 30 – NDIR gas filter correlation infrared photometry	2 m
	NO, NO <sub>2</sub> , NO <sub>x</sub>	Ecotech Serinus 40 – gas phase chemiluminescence	2 m
	PM <sub>2.5</sub>	Met One BAM 1020 – Beta ray attenuation	2 m
	PM <sub>10</sub>	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 <sub>2</sub> , NO <sub>x</sub>	AS 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 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 <sub>10</sub> (TEOM)	AS/NZ 3580.9.8-2008	Methods for sampling and analysis of ambient air. Method 9.8: Determination of suspended particulate matter - PM <sub>10</sub> continuous direct mass method using a tapered element oscillating microbalance analyser.
	Ecotech Laboratory Manual	In-house method 7.3- Particulates - PM <sub>2.5</sub> , PM <sub>10</sub> by TEOM
PM <sub>2.5</sub> (BAM 1020)	AS/NZS 3580.9.12-2013 <sup>1</sup>	Methods for sampling and analysis of ambient Air - Method 9.12: Determination of suspended particulate matter—PM <sub>2.5</sub> beta attenuation monitors
	Ecotech Laboratory Manual	In-house method 7.5 – Measurement of PM <sub>10</sub> , PM <sub>2.5</sub> and TSP using Beta Attenuation Monitor
Vector Wind Speed (Horizontal)	AS 2923-1987 <sup>2</sup>	Methods for sampling and analysis of ambient air. Method 14: Meteorological monitoring for ambient air quality monitoring applications

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

<sup>2</sup> 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 <sup>3</sup>	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 <sup>3</sup>	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 <sup>3</sup>	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 used for monitoring PM<sub>10</sub> and PM<sub>2.5</sub> at the M4 East 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 PM<sub>10</sub> < PM<sub>2.5</sub> and this situation does not necessarily indicate a fault with either instrument.

<sup>3</sup> 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 WinAQMS logger (using WinAQMS® Version 2.0) 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 Tables.

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 six Microsoft Excel format files named

- *WestConnex\_M4\_Allen St\_ Monthly Data Report\_ May 2019.xls*
- *WestConnex\_M4\_Concord Oval\_ Monthly Data Report\_ May 2019.xls*
- *WestConnex\_M4\_Haberfield School\_ Monthly Data Report\_ May 2019.xls*
- *WestConnex\_M4\_Powells Creek\_ Monthly Data Report\_ May 2019.xls*
- *WestConnex\_M4\_Ramsay St\_ Monthly Data Report\_ May 2019.xls*
- *WestConnex\_M4\_St Lukes Park\_ Monthly Data Report\_ May 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 M4 East project ambient monitoring sites are based on SSI 6307 Planning Approval Condition E9. The air quality goals and criteria are shown in Table 4 below.

**Table 4: M4 East Project - Air Quality Goals**

Parameter	Time Period	Goal Level	Units
CO	8 hours (rolling, based on 1-hour averages)	9.0	ppm
NO <sub>2</sub>	1 hour	0.12	ppm
PM <sub>10</sub>	1 day	50	µg/m <sup>3</sup>
	1 year	25	µg/m <sup>3</sup>
PM <sub>2.5</sub>	1 day	25	µg/m <sup>3</sup>
	1 year	8	µg/m <sup>3</sup>

**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 E10, E11 and E12.

## 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 <sup>4</sup>
NO, NO <sub>x</sub> (S40)	ppm	0.001 ppm	±(6% of reading + 0.011ppm) k factor of 2.0	0 to 0.5 ppm LDL = 0.0004ppm
NO <sub>2</sub> (S40)	ppm	0.001 ppm	±(6% of reading + 0.011ppm) k factor of 2.0	0 to 0.5 ppm LDL = 0.0004ppm
CO (S30)	ppm	0.1 ppm	± (7% of reading + 0.8ppm) k factor of 2.0	0 to 50 ppm LDL = 0.04ppm
PM <sub>2.5</sub> (BAM1020)	µg/m <sup>3</sup>	1 µg/m <sup>3</sup>	24Hr: ± (5.5 % of reading + 4.0 µg/m <sup>3</sup> ) (in range 0 - 100 µg/m <sup>3</sup> )  Hr: ± (8 % of reading + 8.0 µg/m <sup>3</sup> )  k factor of 2.0	0 to 1000 µg/m <sup>3</sup>  LDL <sub>24hr</sub> =1.0µg/m <sup>3</sup>  LDL <sub>hr</sub> =4.8µg/m <sup>3</sup>
PM <sub>10</sub> (TEOM)	µg/m <sup>3</sup>	0.1 µg/m <sup>3</sup>	±5.0 µg/m <sup>3</sup> or 3.6% of reading, whichever is the greater K factor of 2.0	0 to 1 g/m <sup>3</sup>  LDL=5µg/m <sup>3</sup>
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: 0m/s

<sup>4</sup> Uncertainties may not be calculated based on the full measurement range.

Parameter	Units	Resolution	Uncertainty	Measurement Range <sup>4</sup>
Ambient Temperature	°C	0.1°C	± 0.6°C K factor of 2.0	-10°C to 50°C

## 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 6-11 indicate when the particulate and gas and meteorological equipment were last maintained/calibrated.

**Table 6: M4 East Project Allen Street Maintenance Table May 2019**

Parameter	Date of Last Maintenance	Maintenance Type <sup>5</sup>	Date of Last Calibration	Calibration Cycle
NO, NO <sub>2</sub> , NO <sub>x</sub>	15/05/2019	6 Monthly	15/05/2019	Monthly
CO	15/05/2019	6 Monthly	15/05/2019	Monthly
PM <sub>10</sub>	15/05/2019	6 Monthly	15/05/2019	6 Monthly
PM <sub>2.5</sub>	03/05/2019	6 Monthly	13/11/2018	Yearly
WS/WD/Sigma	15/05/2019	6 Monthly	06/10/2017	2 yearly
Differential Temperature 2m	15/05/2019	6 Monthly	15/05/2019	6 Monthly
Differential Temperature 10m	15/05/2019	6 Monthly	15/05/2019	6 Monthly

<sup>5</sup> Additional visits may have been made as required

**Table 7: M4 East Project Concord Oval Maintenance Table May 2019**

Parameter	Date of Last Maintenance	Maintenance Type <sup>6</sup>	Date of Last Calibration	Calibration Cycle
NO, NO <sub>2</sub> , NO <sub>x</sub>	09/05/2019	6 Monthly	09/05/2019	Monthly
CO	09/05/2019	6 Monthly	09/05/2019	Monthly
PM <sub>10</sub>	15/05/2019	6 Monthly	15/05/2019	6 Monthly
PM <sub>2.5</sub>	03/05/2019	6 Monthly	14/11/2018	Yearly
WS/WD/Sigma	09/05/2019	6 Monthly	06/10/2017	2 yearly
Differential Temperature 2m	09/05/2019	6 Monthly	09/05/2019	6 Monthly
Differential Temperature 10m	09/05/2019	6 Monthly	09/05/2019	6 Monthly

<sup>6</sup> Additional visits may have been made as required.

**Table 8: M4 East Project Haberfield Public School Maintenance Table May 2019**

Parameter	Date of Last Maintenance	Maintenance Type <sup>7</sup>	Date of Last Calibration	Calibration Cycle
NO, NO <sub>2</sub> , NO <sub>x</sub>	23/05/2019	6 Monthly	23/05/2019	Monthly
CO	23/05/2019	6 Monthly	23/05/2019	Monthly
PM <sub>10</sub>	09/05/2019	6 Monthly	19/05/2019	6 Monthly
PM <sub>2.5</sub>	03/05/2019	6 Monthly	03/05/2019	Yearly
WS/WD/Sigma	09/05/2019	6 Monthly	05/10/2017	2 yearly
Differential Temperature 2m	09/05/2019	6 Monthly	09/05/2019	6 Monthly
Differential Temperature 10m	09/05/2019	6 Monthly	09/05/2019	6 Monthly

<sup>7</sup> Additional visits may have been made as required.

**Table 9: M4 East Project Powells Creek Maintenance Table May 2019**

Parameter	Date of Last Maintenance	Maintenance Type <sup>8</sup>	Date of Last Calibration	Calibration Cycle
NO, NO <sub>2</sub> , NO <sub>x</sub>	08/05/2019	6 Monthly	21/05/2019	Monthly
CO	08/05/2019	6 Monthly	21/05/2019	Monthly
PM <sub>10</sub>	06/05/2019	6 Monthly	06/05/2019	6 Monthly
PM <sub>2.5</sub>	06/05/2019	6 Monthly	15/11/2018	Yearly
WS/WD/Sigma	06/05/2019	6 Monthly	06/10/2017	2 yearly
Differential Temperature 2m	06/05/2019	6 Monthly	06/05/2019	6 Monthly
Differential Temperature 10m	06/05/2019	6 Monthly	06/05/2019	6 Monthly

<sup>8</sup> Additional visits may have been made as required.

**Table 10: M4 East Project Ramsay Street Maintenance Table May 2019**

Parameter	Date of Last Maintenance	Maintenance Type <sup>9</sup>	Date of Last Calibration	Calibration Cycle
NO, NO <sub>2</sub> , NO <sub>x</sub>	23/05/2019	6 Monthly	23/05/2019	Monthly
CO	23/05/2019	6 Monthly	23/05/2019	Monthly
PM <sub>10</sub>	15/05/2019	6 Monthly	15/05/2019	6 Monthly
PM <sub>2.5</sub>	03/05/2019	6 Monthly	03/05/2019	Yearly
WS/WD/Sigma	15/05/2019	6 Monthly	05/10/2017	2 yearly
Differential Temperature 2m	15/05/2019	6 Monthly	15/05/2019	6 Monthly
Differential Temperature 10m	15/05/2019	6 Monthly	15/05/2019	6 Monthly

<sup>9</sup> Additional visits may have been made as required.

**Table 11: M4 East Project Saint Lukes Park Maintenance Table May 2019**

Parameter	Date of Last Maintenance	Maintenance Type <sup>10</sup>	Date of Last Calibration	Calibration Cycle
NO, NO <sub>2</sub> , NO <sub>x</sub>	01/05/2019	6 Monthly	08/05/2019	Monthly
CO	01/05/2019	6 Monthly	19/05/2019	Monthly
PM <sub>10</sub>	01/05/2019	6 Monthly	01/05/2019	6 Monthly
PM <sub>2.5</sub>	01/05/2019	6 Monthly	12/11/2018	Yearly
WS/WD/Sigma	08/05/2019	6 Monthly	09/10/2017	2 yearly
Differential Temperature 2m	08/05/2019	6 Monthly	08/05/2019	6 Monthly
Differential Temperature 10m	08/05/2019	6 Monthly	08/05/2019	6 Monthly

<sup>10</sup> Additional visits may have been made as required.

## 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 May 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 12: Data Capture for M4 East Project Ambient Air Quality Network

Parameter	Data Capture (%)					
	Allen Street	Concord Oval	Haberfield School	Powells Creek	Ramsay Street	Saint Lukes Park
PM <sub>2.5</sub>	98.5	98.1	99.7	98.3	99.5	99.6
PM <sub>10</sub>	99.1	95.0	99.6	98.3	99.8	99.5
CO	96.0	<b>94.2</b>	96.8	<b>80.9</b>	95.6	<b>92.7</b>
NO, NO <sub>2</sub> , NO <sub>x</sub>	96.8	<b>94.5</b>	96.0	<b>90.3</b>	96.6	<b>94.2</b>
WS, WD, Sigma	99.2	95.3	99.6	<b>82.2</b>	100.0	99.3
AT 2m	99.3	<b>68.5</b>	99.8	<b>80.8</b>	99.6	99.6
AT 10m	99.3	-	99.8	98.8	99.6	99.6

**5.2. Air Quality Monthly Summary**

Tables 13-18 below include a summary of any exceedances recorded at the M4 East Project stations during the reported period<sup>11</sup>.

**Table 13: M4 East Project Allen Street Exceedances Recorded for May 2019**

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO <sub>2</sub> (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM <sub>10</sub> (µg/m <sup>3</sup> )	24-hour	-	-
	Annual	-	-
PM <sub>2.5</sub> (µg/m <sup>3</sup> )	24-hour	34	21/05/2019
		29	24/05/2019
	Annual <sup>12</sup>	-	-

<sup>11</sup> Exceedances are based on the decimal places reported.

<sup>12</sup> Insufficient data to report annual average, any exceedances will be reported in December 2019.

Table 14: M4 East Project Concord Oval Exceedences Recorded for May 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO <sub>2</sub> (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM <sub>10</sub> (µg/m <sup>3</sup> )	24-hour	-	-
	Annual	-	-
PM <sub>2.5</sub> (µg/m <sup>3</sup> )	24-hour	34	21/05/2019
		28	24/05/2019
	Annual <sup>13</sup>	-	-

<sup>13</sup> Insufficient data to report annual average, any exceedences will be reported in December 2019.

Table 15: M4 East Project Haberfield Public School Exceedences Recorded for May 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO <sub>2</sub> (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM <sub>10</sub> (µg/m <sup>3</sup> )	24-hour	-	-
	Annual	-	-
PM <sub>2.5</sub> (µg/m <sup>3</sup> )	24-hour	34	21/05/2019
		28	22/05/2019
		30	24/05/2019
	Annual <sup>14</sup>	-	-

<sup>14</sup> Insufficient data to report annual average, any exceedences will be reported in December 2019.

Table 16: M4 East Project Powells Creek Exceedences Recorded for May 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO <sub>2</sub> (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM <sub>10</sub> (µg/m <sup>3</sup> )	24-hour	51.4	21/05/2019
	Annual	-	-
PM <sub>2.5</sub> (µg/m <sup>3</sup> )	24-hour	36	21/05/2019
		31	24/05/2019
	Annual <sup>15</sup>	-	-

<sup>15</sup> Insufficient data to report annual average, any exceedences will be reported in December 2019.

Table 17: M4 East Project Ramsay Street Exceedences Recorded for May 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO <sub>2</sub> (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM <sub>10</sub> (µg/m <sup>3</sup> )	24-hour	-	-
	Annual	-	-
PM <sub>2.5</sub> (µg/m <sup>3</sup> )	24-hour	34	21/05/2019
		32	24/05/2019
	Annual <sup>16</sup>	-	-

<sup>16</sup> Insufficient data to report annual average, any exceedences will be reported in December 2019.

Table 18: M4 East Project Saint Lukes Park Exceedences Recorded for May 2019

Parameter	Time Period	Value of Exceedence	Date of Exceedence
NO <sub>2</sub> (ppm)	1 hour	-	-
CO (ppm)	8-hour rolling	-	-
PM <sub>10</sub> (µg/m <sup>3</sup> )	24-hour	-	-
	Annual	-	-
PM <sub>2.5</sub> (µg/m <sup>3</sup> )	24-hour	31	21/05/2019
		28	24/05/2019
	Annual <sup>17</sup>	-	-

<sup>17</sup> Insufficient data to report annual average, any exceedences will be reported in December 2019.

5.3. Tabulated data

5.3.1. Annual average

Table 19 displays monthly averages of the PM<sub>2.5</sub> and PM<sub>10</sub> parameters collected at M4 East project ambient air monitoring stations for 2019. Averages shown are for the 2019 calendar year, up to the current reported month. Table requires at least 75% valid data to display a monthly average. Footer values are based on all available data for 2019 rather than the average of individual months. This gives an indication of performance against the annual objectives.

**Table 19: PM<sub>10</sub> and PM<sub>2.5</sub> averages at the WestConnex M4 ambient air monitoring stations 2019**

Month	Allen Street		Concord Oval		Haberfield school		Powells Creek		Ramsay Street		Saint Lukes Park	
	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )
Jan/19	24.6	10	26.1	9	24.2	13	30.1	12	27.4	11	23.9	9
Feb/19	20.1	6	21.7	5	21.2	7	24.5	7	24.0	7	18.7	6
Mar/19	19.4	7	20.8	5	20.0	8	24.5	9	21.7	8	18.9	7
Apr/19	19.6	9	19.4	7	19.5	10	23.2	11	21.5	11	18.2	10
May/19	21.2	11	20.2	10	21.0	13	24.1	12	20.3	14	18.2	11
<b>Average</b>	<b>21.0</b>	<b>8.6</b>	<b>21.7</b>	<b>7.4</b>	<b>21.2</b>	<b>9.7</b>	<b>25.3</b>	<b>10.0</b>	<b>23.0</b>	<b>10.1</b>	<b>19.6</b>	<b>8.6</b>

### 5.4. Graphic Representations

This section displays graphs of the pollutants and meteorological parameters monitored at the M4 East sites for May 2019. The graphs are based on validated 5 minutes or 1-hour data as appropriate.

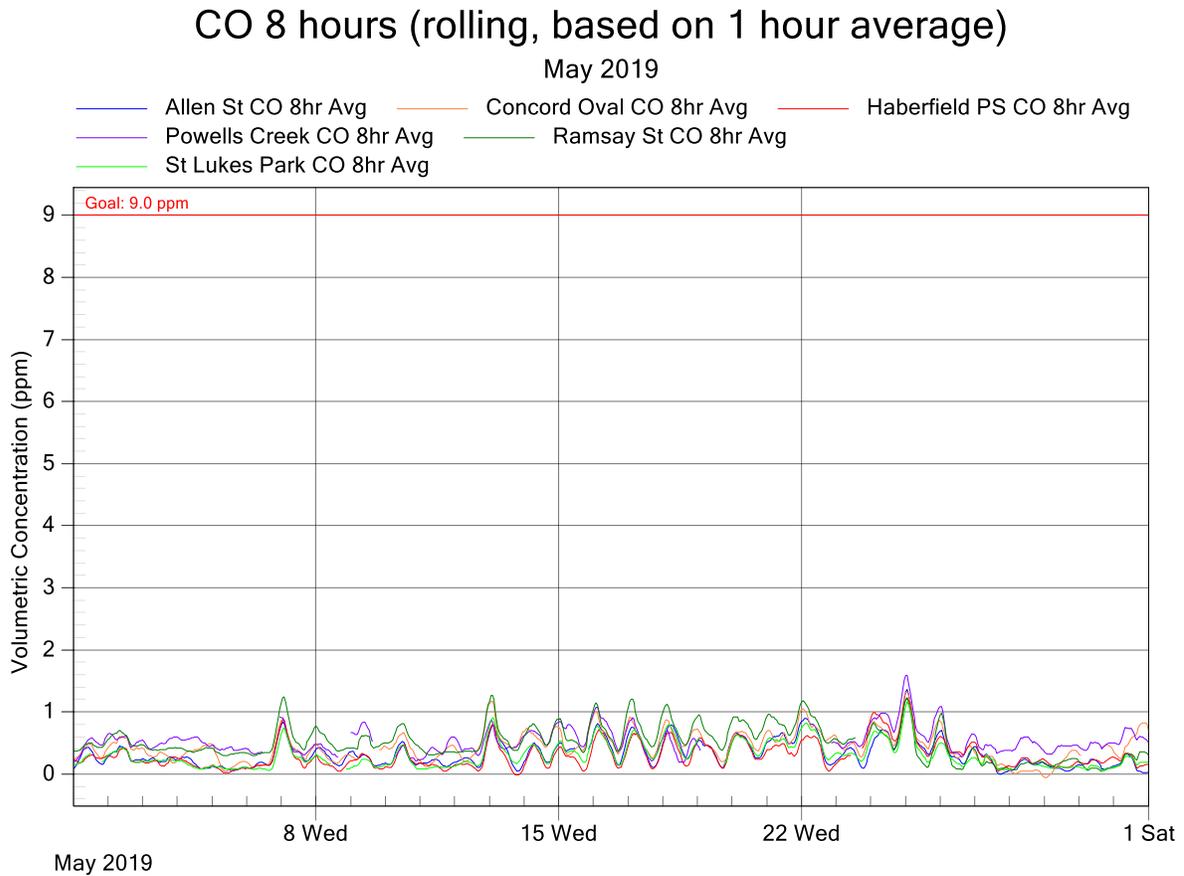
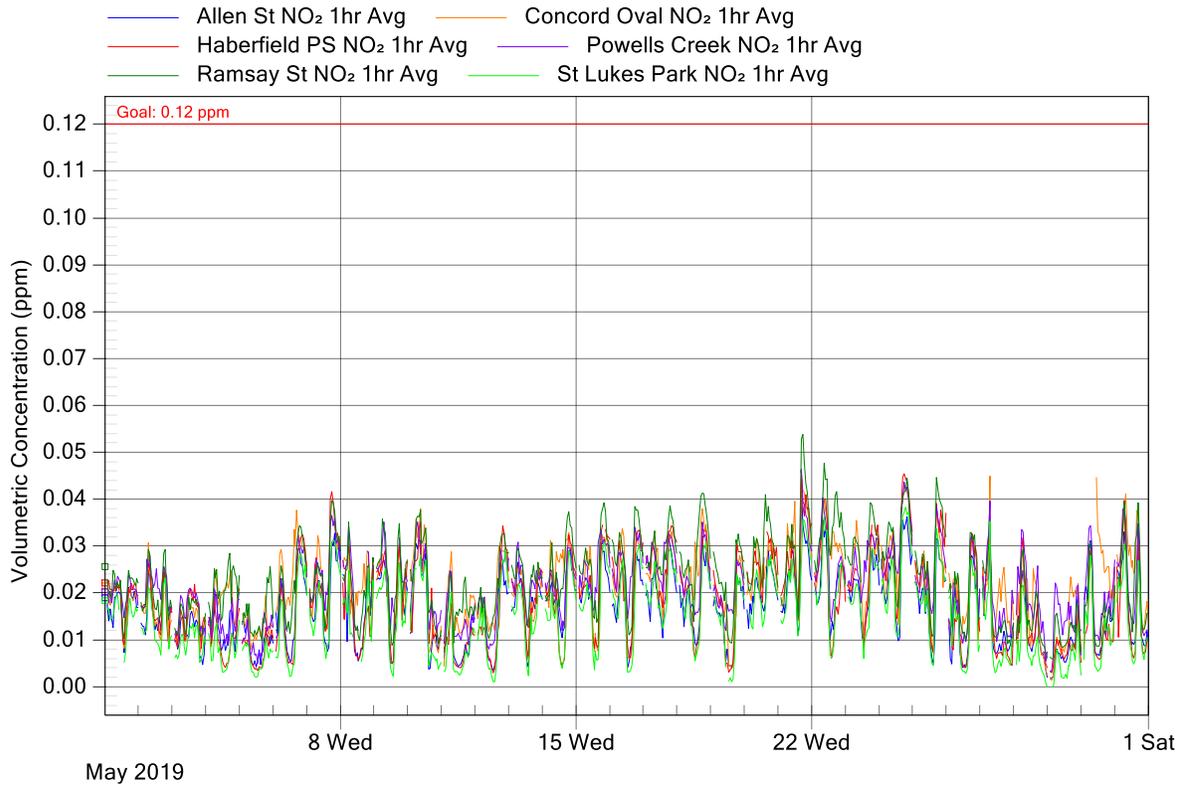


Figure 2: M4 East Project Air Monitoring Stations - CO 8 hours Rolling graph for May 2019

### NO<sub>2</sub> 1 hour average

May 2019



**Figure 3: M4 East Project Air Monitoring Stations - NO<sub>2</sub> graph for May 2019**

### PM<sub>10</sub> 24 hour average

May 2019

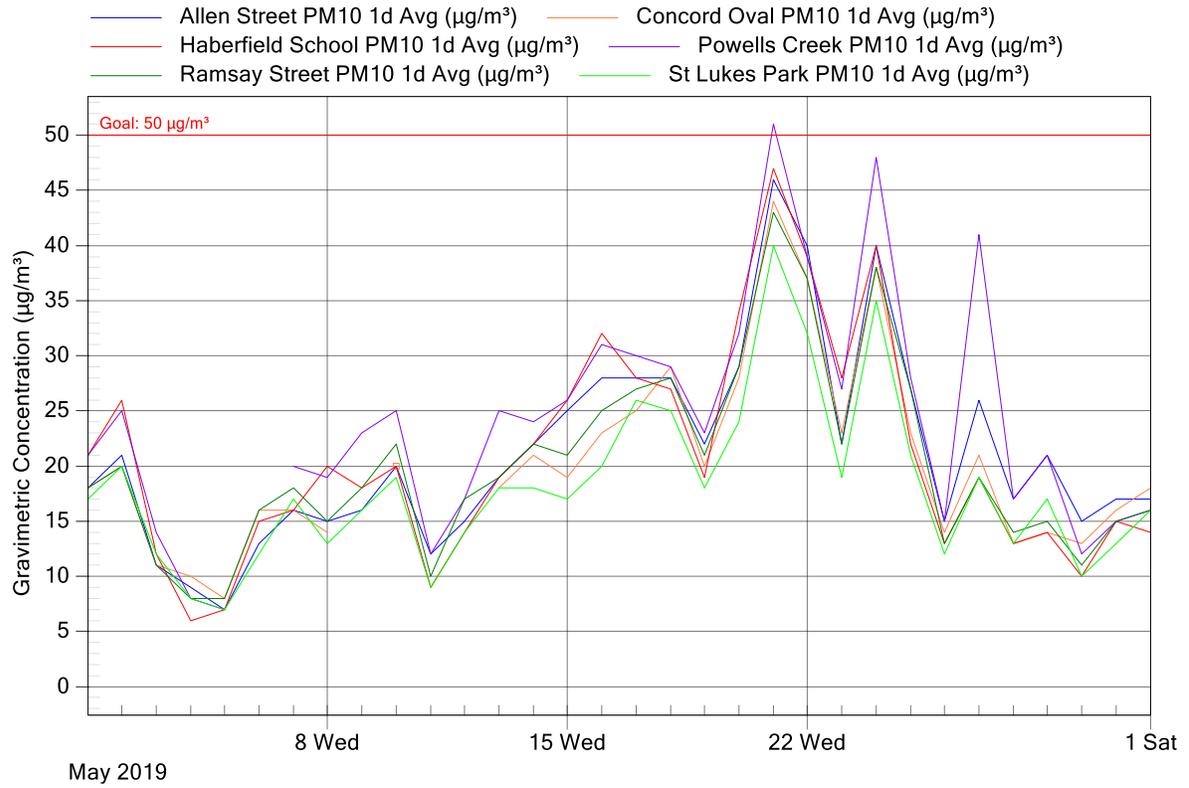


Figure 4: M4 East Project Air Monitoring Stations - PM<sub>10</sub> 24 Hour graph for May 2019

### PM<sub>2.5</sub> 24 hour average

May 2019

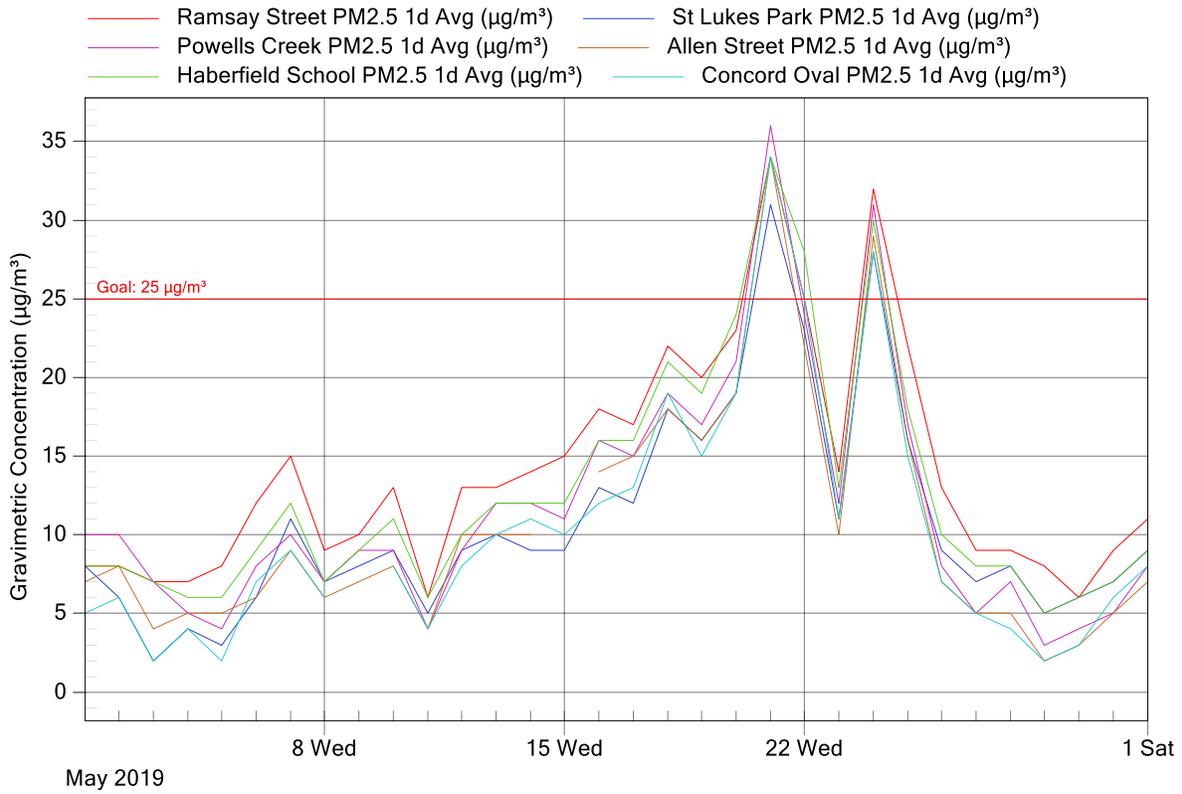


Figure 5: M4 East Project Air Monitoring Stations - PM<sub>2.5</sub> 24 Hour graph May 2019

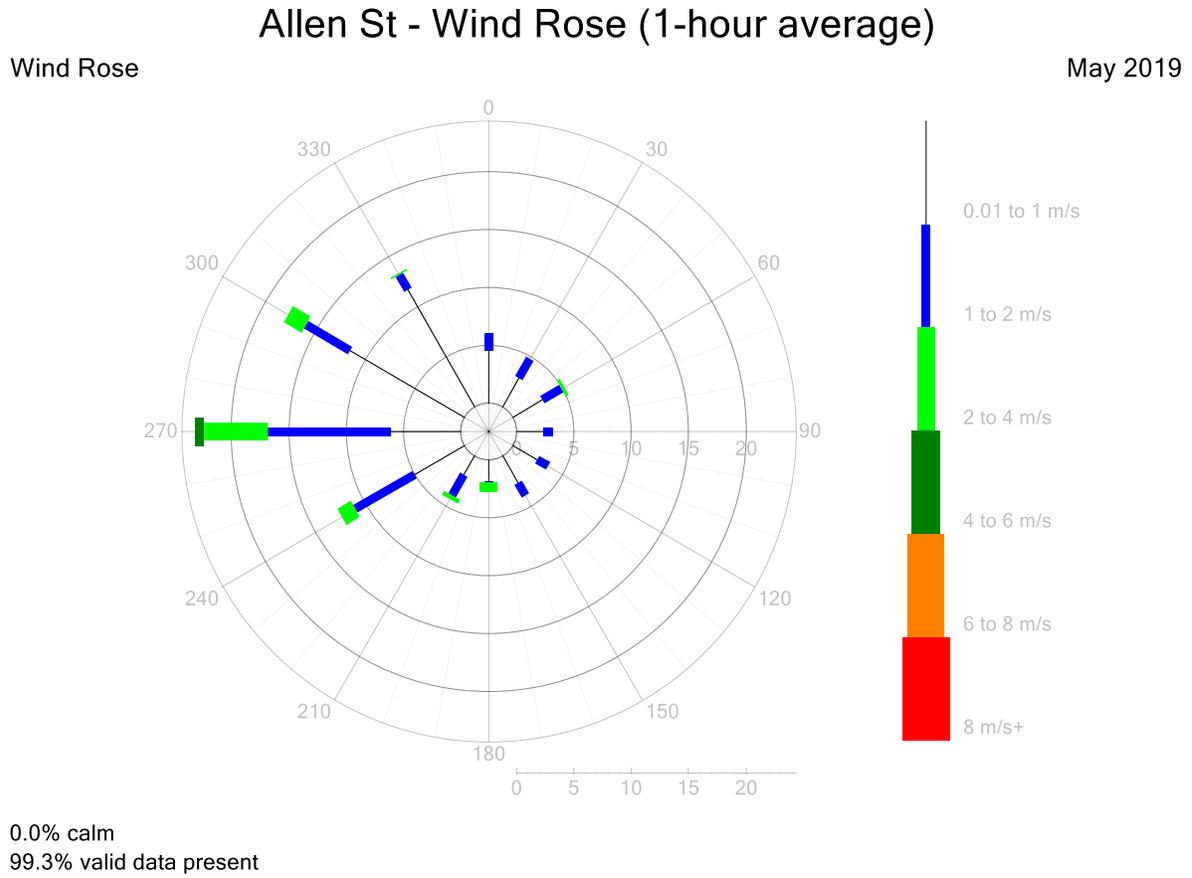
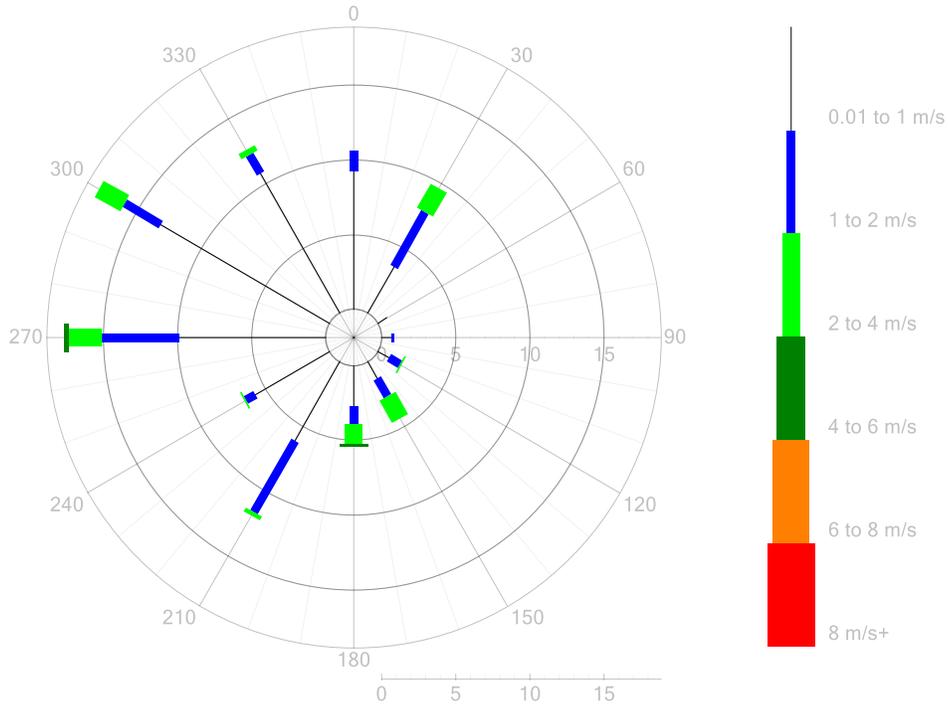


Figure 6: Allen Street – Wind Rose for May 2019

### Concord Oval - Wind Rose (1-hour average)

Wind Rose

May 2019



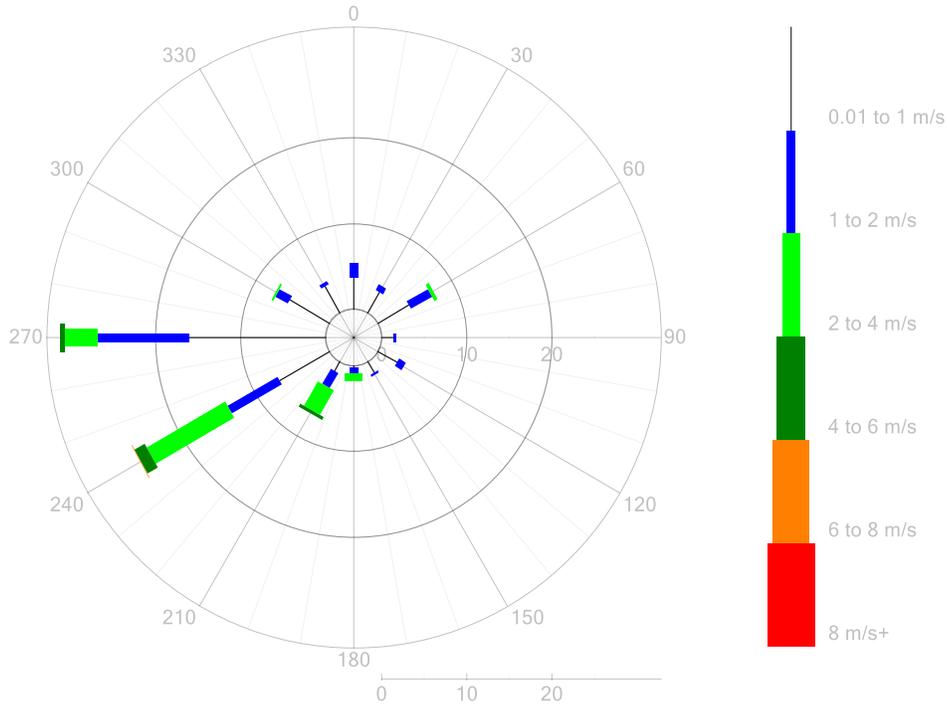
0.0% calm  
95.2% valid data present

**Figure 7: Concord Oval – Wind Rose for May 2019**

### Haberfield Public School - Wind Rose (1-hour average)

Wind Rose

May 2019



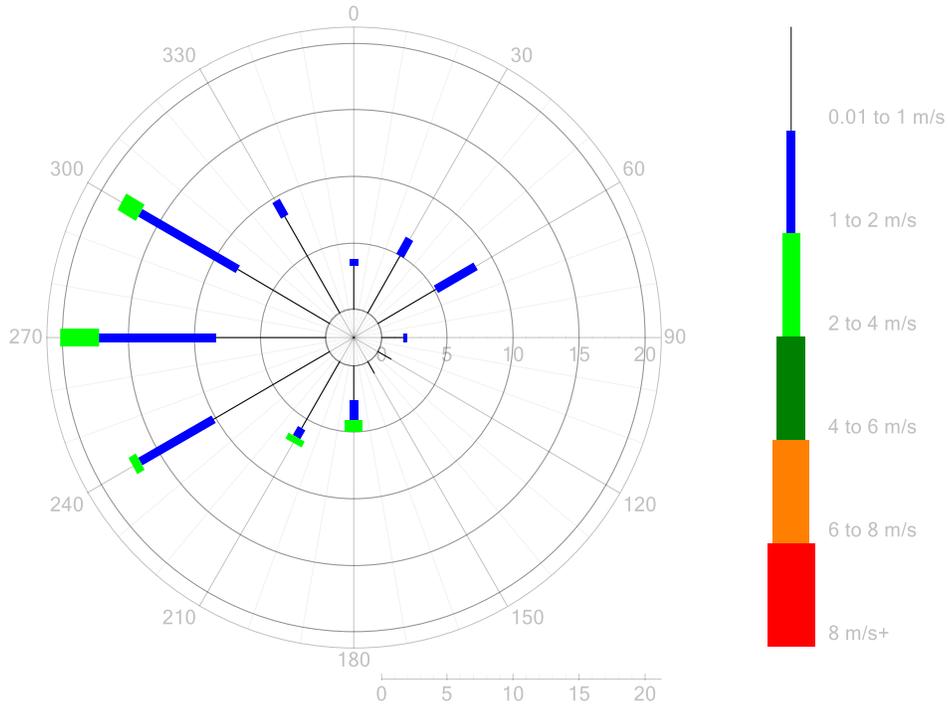
0.0% calm  
99.5% valid data present

**Figure 8: Haberfield Public School – Wind Rose for May 2019**

### Powells Creek - Wind Rose (1-hour average)

Wind Rose

May 2019



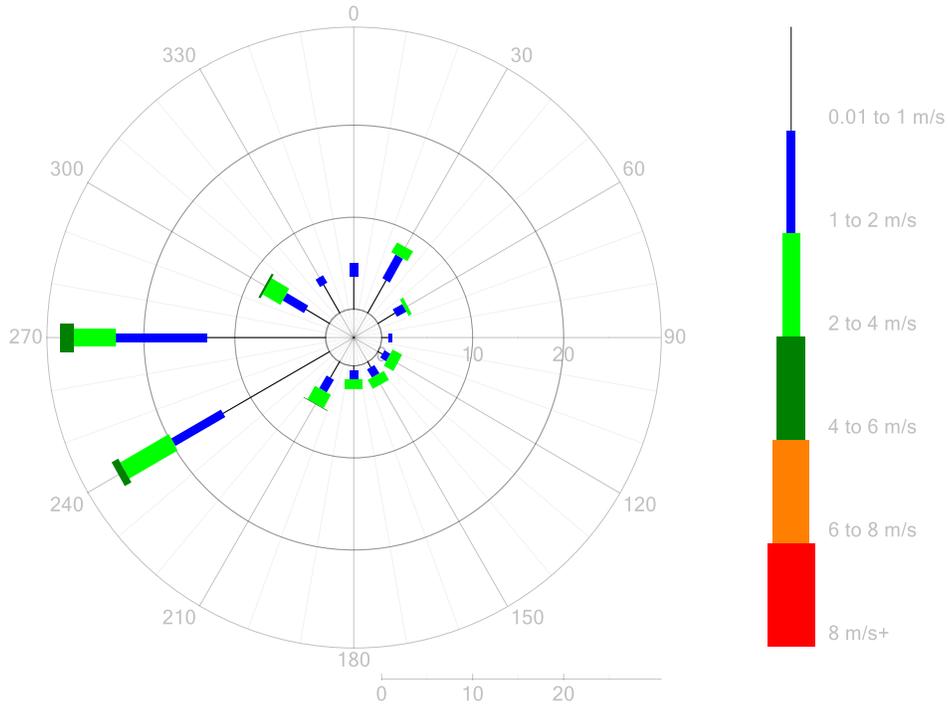
0.0% calm  
82.0% valid data present

Figure 9: Powells Creek – Wind Rose for May 2019

### Ramsay St - Wind Rose (1-hour average)

Wind Rose

May 2019



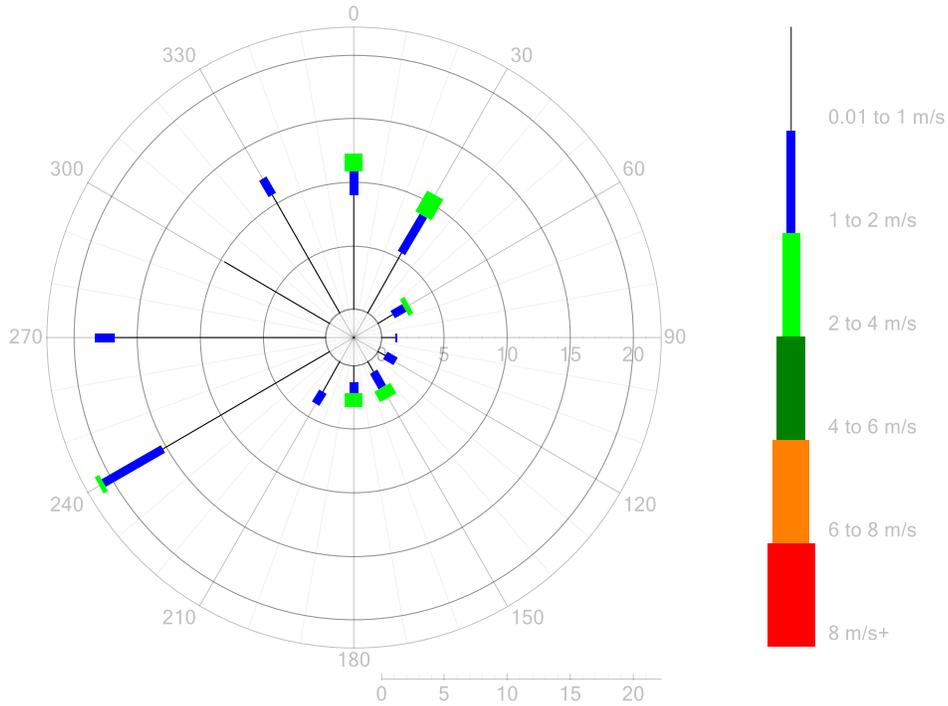
0.0% calm  
100.0% valid data present

**Figure 10: Ramsay Street – Wind Rose for May 2019**

### St Lukes Park - Wind Rose (1-hour average)

Wind Rose

May 2019



0.0% calm  
99.3% valid data present

Figure 11: Saint Lukes Park – Wind Rose for May 2019

## 6.0 Valid Data Exception Tables

Tables 20 to 25 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 20: Allen Street Valid Data Exception Table**

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/05/19 01:00	31/05/19 01:35	Automatic span and zero checks once daily for 35 - 45 minutes	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
01/05/19 23:45	31/05/19 23:50	Background checks once daily for 5 - 10 minutes	CO	AA	12/06/2019
02/05/19 01:35	02/05/19 23:40	Linear offset of A= 0.000ppm and B= 0.255ppm applied to correct baseline drift	CO	AA	12/06/2019
03/05/19 08:00	03/05/19 10:00	Scheduled 6 monthly maintenance commenced followed by instrument stabilisation	PM <sub>2.5</sub> , PM <sub>10</sub>	AA	12/06/2019
05/05/19 01:40	05/05/19 23:40	Linear offset of A= 0.000ppm and B= - 0.300ppm applied to correct baseline drift	CO	AA	12/06/2019
15/05/19 10:55	15/05/19 17:00	Scheduled 6 monthly maintenance finalised, followed by instrument stabilisation	All parameters	AA	12/06/2019
18/05/19 10:25	24/05/19 13:35	Intermittent suspected brief power interruptions followed by instrument stabilisation	CO, NO, NO <sub>2</sub> , NO <sub>x</sub> , PM <sub>10</sub> , WS, WD, Sigma, AT 10m, AT 2m	AA	12/06/2019
20/05/19 12:30	20/05/19 12:50	Instrument fault followed by instrument stabilisation	PM <sub>10</sub>	AA	12/06/2019
27/05/19 01:40	27/05/19 23:40	Linear offset of A= 0.000ppm and B= - 0.480ppm applied to correct baseline drift	CO	AA	12/06/2019
30/05/19 01:40	30/05/19 23:40	Linear offset of A= -0.030ppm and B= - 0.320ppm applied to correct baseline drift	CO	AA	12/06/2019
30/05/19 16:40	30/05/19 16:40	Data transmission error	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019

**Table 21: Concord Oval Valid Data Exception Table**

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/05/19 00:00	09/05/19 07:15	Calibration found out of tolerance during 6 monthly maintenance	AT 2m, AT 10m	AA	12/06/2019
01/05/19 00:10	31/05/19 23:40	Intermittent data transmission errors	AT 2m, PM <sub>10</sub> , WS, WD, Sigma, CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
01/05/19 01:00	31/05/19 01:30	Automatic span and zero checks once daily for 35 - 45 minutes	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
01/05/19 09:00	01/05/19 11:00	Scheduled 6 monthly maintenance commenced, followed by instrument stabilisation	PM <sub>2.5</sub>	AA	12/06/2019
01/05/19 23:45	31/05/19 23:50	Background checks once daily for 5 - 10 minutes	CO	AA	12/06/2019
03/05/19 11:00	03/05/19 13:00	Scheduled 6 monthly maintenance continued, followed by instrument stabilisation	PM <sub>2.5</sub>	AA	12/06/2019
09/05/19 07:00	09/05/19 14:30	Scheduled 6 monthly maintenance continued, followed by instrument stabilisation	All parameters	AA	12/06/2019
09/05/19 14:30	01/06/19 00:00	Data is not included in this report as further investigation is undergoing due to the instrument performance and calibration. Data will be issued on completion of investigation.	AT 10m	AA	12/06/2019
11/05/19 07:40	12/05/19 10:45	Logger fault - Only CO, NO, NO <sub>2</sub> , NO <sub>x</sub> and PM <sub>2.5</sub> data was recoverable directly from the instruments	AT 2m, PM <sub>10</sub> , WS, WD, Sigma	AA	12/06/2019
15/05/19 07:35	15/05/19 10:30	Scheduled 6 monthly maintenance finalised, followed by instrument stabilisation	PM <sub>10</sub> , PM <sub>2.5</sub> , WS, WD, Sigma	AA	12/06/2019
27/05/19 12:00	27/05/19 12:00	Beta data gap manually filled up according to 5-minute readings	PM <sub>2.5</sub>	AA	12/06/2019
28/05/19 15:05	31/05/19 20:40	Intermittent data wrongly flagged by the logger revalidated as it tracks with other sites	CO	AA	12/06/2019
30/05/19 01:40	30/05/19 10:20	Instrument fault - instrument stuck in calibration mode	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019

Start Date	End Date	Reason	Change Details	User Name	Change Date
30/05/19 10:25	30/05/19 10:40	Unscheduled remote maintenance performed followed by instrument stabilisation - instrument fault fixed	AT 2m, WS, WD, Sigma, CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019

**Table 22: Haberfield Public School Valid Data Exception Table**

Start Date	End Date	Reason	Change Details	User Name	Change Date
1/05/2019 1:00	31/05/2019 1:25	Automatic span and zero checks once daily for 25 - 30minutes	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
1/05/2019 5:05	31/05/2019 22:40	Intermittent data transmission errors	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
1/05/2019 23:45	31/05/2019 23:45	Background checks once daily for 5 - 10 minutes	CO	AA	12/06/2019
3/05/2019 11:00	3/05/2019 12:00	Scheduled 6 monthly maintenance commenced followed by instrument stabilisation	PM <sub>2.5</sub>	AA	12/06/2019
9/05/2019 10:50	9/05/2019 16:15	Scheduled 6 monthly maintenance continued followed by instrument stabilisation	WS, WD, Sigma, AT 2m, AT 10m, PM <sub>10</sub>	AA	12/06/2019
23/05/2019 9:05	23/05/2019 12:35	Scheduled 6 monthly maintenance finalised, followed by instrument stabilisation	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
27/05/2019 1:30	27/05/2019 23:40	Linear offset of A=0.000ppm and B=-0.330ppm applied to correct baseline drift	CO	AA	12/06/2019
27/05/2019 23:55	1/06/2019 0:00	Static offset of -0.192 applied to correct baseline drift	CO	AA	12/06/2019

**Table 23: Powells Creek Valid Data Exception Table**

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/05/19 00:00	06/05/19 14:25	Calibration found out of tolerance during 6 monthly maintenance	AT 2m	AA	11/06/2019
01/05/19 00:55	31/05/19 23:55	Intermittent data transmission errors	CO, NO, NO <sub>2</sub> , NO <sub>x</sub> , WS, WD, Sigma, AT 2m, AT 10m, PM <sub>10</sub>	AA	11/06/2019
01/05/19 01:00	31/05/19 01:35	Automatic span and zero check, once daily for 35 - 45 minutes	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	11/06/2019
01/05/19 01:40	01/06/19 00:00	Static offset of -0.300ppm applied to correct zero baseline	CO	AA	11/06/2019
01/05/19 15:30	31/05/19 15:30	Background checks, once daily for 5 - 10 minutes	CO	AA	11/06/2019
03/05/19 12:00	03/05/19 12:00	Instrument fault - flow fault	PM <sub>2.5</sub>	AA	11/06/2019
06/05/19 10:45	06/05/19 17:40	Scheduled 6 monthly maintenance commenced, followed by instrument stabilisation	All parameters	AA	11/06/2019
06/05/19 20:25	01/06/19 00:00	Intermittent additional background checks followed by instrument stabilisation	CO	AA	11/06/2019
08/05/19 14:00	08/05/19 18:35	Scheduled 6 monthly maintenance continued, followed by instrument stabilisation	All parameters	AA	11/06/2019
09/05/19 14:00	09/05/19 17:45	Unscheduled maintenance	All parameters	AA	11/06/2019
09/05/19 17:50	10/05/19 00:55	Instrument fault - instrument stuck in calibration mode	CO	AA	11/06/2019
12/05/19 08:35	17/05/19 11:45	Instrument fault	WS, WD, Sigma	AA	11/06/2019
17/05/19 08:25	17/05/19 15:20	Linear offset of A= 0.000ppm and B= 0.968ppm applied to correct baseline drift	CO	AA	11/06/2019
18/05/19 01:40	18/05/19 15:20	Linear offset of A= 0.000ppm and B= 0.990ppm applied to correct baseline drift	CO	AA	11/06/2019
19/05/19 01:40	21/05/19 14:25	Instrument fault	CO	AA	11/06/2019

Start Date	End Date	Reason	Change Details	User Name	Change Date
20/05/19 01:40	21/05/19 14:25	Instrument fault - automatic calibration out of tolerance	NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	11/06/2019
21/05/19 14:30	21/05/19 15:50	Unscheduled maintenance followed by instrument stabilisation	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	11/06/2019
21/05/19 15:55	22/05/19 15:20	Instrument fault - automatic zero check out of tolerance	CO	AA	11/06/2019
29/05/19 05:15	29/05/19 05:30	Suspected power interruption followed by instrument stabilisation	CO, NO, NO <sub>2</sub> , NO <sub>x</sub> , WS, WD, Sigma, AT 2m, AT 10m, PM <sub>10</sub>	AA	11/06/2019

**Table 24: Ramsay Street Valid Data Exception Table**

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/05/19 01:00	31/05/19 01:40	Automatic span and zero checks, once daily for 40 - 45 minutes	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	11/06/2019
01/05/19 23:45	31/05/19 23:45	Background checks, once daily for 5 - 10 minutes	CO	AA	11/06/2019
02/05/19 10:45	31/05/19 00:50	Intermittent data transmission errors	CO	AA	11/06/2019
03/05/19 13:00	03/05/19 14:00	Scheduled 6 monthly maintenance commenced	PM <sub>2.5</sub>	AA	11/06/2019
15/05/19 10:25	15/05/19 14:55	Scheduled 6 monthly maintenance continued	AT 2m, AT 10m, PM <sub>10</sub>	AA	11/06/2019
15/05/19 15:00	15/05/19 16:00	Unrealistic negative readings	PM <sub>2.5</sub>	AA	11/06/2019
19/05/19 01:50	19/05/19 02:00	Suspected brief power interruption followed by instrument stabilisation	AT 2m, AT 10m, PM <sub>10</sub> , CO, WS, WD, Sigma, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	11/06/2019
23/05/19 12:40	23/05/19 15:50	Scheduled 6 monthly maintenance finalised, followed by instrument stabilisation	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	11/06/2019

Table 25: Saint Lukes Park Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/05/19 01:00	31/05/19 01:40	Automatic span and zero checks, once daily for 40 - 45 minutes	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
01/05/19 09:40	31/05/19 11:35	Intermittent data transmission errors	CO, NO, NO <sub>2</sub> , NO <sub>x</sub> , PM <sub>10</sub> , AT 2m, AT 10m, WS, WD, Sigma	AA	12/06/2019
01/05/19 11:20	01/05/19 15:45	Scheduled 6 monthly maintenance commenced followed by instrument stabilisation	CO, NO, NO <sub>2</sub> , NO <sub>x</sub> , PM <sub>10</sub> , PM <sub>2.5</sub>	AA	12/06/2019
01/05/19 23:50	31/05/19 23:50	Background checks, once daily for 5 - 10 minutes	CO	AA	12/06/2019
02/05/19 04:35	29/05/19 03:30	Intermittent unrealistic negative readings	NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
08/05/19 09:55	08/05/19 15:00	Scheduled 6 monthly maintenance finalised	All parameters	AA	12/06/2019
19/05/19 01:45	19/05/19 11:50	Instrument fault	CO	AA	12/06/2019
19/05/19 11:55	19/05/19 12:15	Unscheduled maintenance followed by instrument stabilisation	CO, NO, NO <sub>2</sub> , NO <sub>x</sub>	AA	12/06/2019
26/05/19 13:15	26/05/19 13:25	Suspected brief power interruption followed by instrument stabilisation	CO, NO, NO <sub>2</sub> , NO <sub>x</sub> , PM <sub>10</sub> , AT 2m, AT 10m, WS, WD, Sigma	AA	12/06/2019
28/05/19 01:45	28/05/19 11:00	Instrument fault followed by instrument stabilisation	CO	AA	12/06/2019

## **7.0 Report Summary**

- Percentage availability for some parameters at M4 East Project was below 95%, refer to Table 12, and Tables 20-25 for details.
- There were two PM<sub>2.5</sub> recorded readings over the Exceedence Levels for the reporting period which occurred in all the sites. Please refer to Tables 13-18 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
LDL	Lower Detectable Limit
µg/m <sup>3</sup>	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 <sup>3</sup>	Milligrams per cubic metre at standard temperature and pressure (0°C and 101.3 kPa)
mm	Millimeters
NO	Nitric oxide
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>x</sub>	Oxides of nitrogen
PM <sub>10</sub>	Particulate less than 10 microns in equivalent aerodynamic diameter
PM <sub>2.5</sub>	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 filter tape advance** refers to the movement of the filter paper by the analyser to an unused spot.

**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.

**Warm up after power interruption** refers to the startup period of an instrument after power has been restored.