



Air Noise Environment
Environmental Monitoring and Assessment

Independent Verification: Approval Condition E12

New M5 WestConnex

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**Prepared by:
Air Noise Environment**

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The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Air Noise Environment Pty Ltd for the purposes of this project is both complete and accurate.





Limitations of this Report

During the preparation of this audit report, Air Noise Environment has evaluated the monthly ambient air quality reports prepared by Ecotech for the New M5 project.

Air Noise Environment has specifically reviewed the second round of 6 months of ambient monitoring reports prepared by Ecotech. The July 2019 and December 2019 data was also selected for detailed review. With regards to the detailed review of data exclusion, the procedures adopted for the data validation and reporting by Ecotech for the July 2019 and December 2019 report are the same as for the previous five months. In our opinion, the sample of data reviewed is representative of the data processing procedures for the preceding months, hence provides a suitable verification approach for the 6 month dataset. Whilst the possibility of errors arising for other months of data cannot be entirely discounted, in our opinion the audit of the July 2019 and December 2019 data provides a suitable approach for data verification for the first 6 months of ambient air quality data.

The conclusions outlined in this audit report are professional opinions based solely upon Air Noise Environment's review and audit of the monthly reports and the data provided by Ecotech.





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1 Introduction

1.1 Background

The Instrument of Approval (IoA) conditions governing the New M5 WestConnex Project are defined in the IoA document SSI 6788 dated 20 April 2016. The IoA includes a number of performance requirements relating to air quality, both in-tunnel and ambient. The project construction contractor, CPB Dragados Samsung Joint Venture, is contractually responsible for meeting some of these requirements through the design and construction of the tunnel on behalf of the Project proponent – NSW Roads and Maritime Services (RMS).

The approval conditions also require that the air quality monitoring methodologies and air quality outcomes as defined in the IoA document are subject to verification by an approved Independent person or organisation. Air Noise Environment Pty Ltd was nominated by RMS to undertake the role of independent specialist in accordance with the IoA for the WestConnex New M5 project.

As the approved independent specialist, Air Noise Environment will complete review and auditing of compliance with the following air quality related Approval conditions:

- Condition E3 — verification and compliance auditing for in-tunnel air quality monitoring;
- Condition E12 — independent audit of ambient air quality monitoring results;
- Condition E28 — review and, if appropriate, approve the quality assurance and quality control measures for ambient monitoring.

1.2 Scope of Work

This report presents the independent verification of conformance with the requirements of Approval Condition E12 relating to the independent audit of ambient air quality data. Condition E12 is reproduced below:

'Condition E12

Monitoring results must be made publicly available and must be subject to an independent audit at six-monthly intervals (or at a longer interval, if approved by the Secretary). The auditor must be approved by the Secretary in consultation with the EPA and the AQCCC. The quality of the monitoring results must be assured through a NATA accredited process prior to the data being considered as a basis for compliance/auditing purposes.'

The scope for this report is restricted to an audit of 6 months of monitoring for the New M5 Project for the period July 2019 to December 2019. It is noted that an initial 6 month data review for the period January 2019 to June 2019 was completed by Air Noise Environment and outcomes were presented in an audit report issued on 26 November 2019¹.

¹ Air Noise Environment, Independent Verification – Approval Condition E12, New M5 WestConnex, 26 November 2019, Ref: 5539-E12-Nov19-Report01.1.odt.



1.3 Audit Team

The data audit was performed and prepared by Samuel Wong (Senior Environmental Engineer, BEng(Chem), Air Noise Environment Pty Ltd). Samuel Wong has over 12 years experience in Air Monitoring.





2 Audit Methodology

The audit consisted of a desktop review of published ambient air monitoring reports, and analysis of the raw data and validated data provided by Ecotech. There are a total of 8 monitoring stations associated with the New M5 Project. These include:

- Arncliffe 1 (West Botany Street);
- Arncliffe 2 (Eve Street);
- Barton Park;
- Kingsgrove 1 (MOC1);
- Kingsgrove 2 (Kingsgrove Road);
- St Peters 1 (Campbell Street);
- St Peters 2 (SPI);
- St Peters 3 (St Peters St).

Ambient monitoring data has been published on the New M5 website since January 2019. The scope of this assessment is to review data presented in the first 6 months from July 2019 to December 2019, as listed below:

- Ecotech Ambient Air quality and Weather Monitoring Validated Report, New M5 Project 1st July 2019 - 31st July 2019, Report No. DAT14873;
- Ecotech Ambient Air quality and Weather Monitoring Validated Report, New M5 Project 1st August 2019 - 31st August 2019, Report No. DAT14969;
- Ecotech Ambient Air quality and Weather Monitoring Validated Report, New M5 Project 1st September 2019 - 30th September 2019, Report No. DAT15073;
- Ecotech Ambient Air quality and Weather Monitoring Validated Report, New M5 Project 1st October 2019 - 31st October 2019, Report No. DAT15172;
- Ecotech Ambient Air quality and Weather Monitoring Validated Report, New M5 Project 1st November 2019 - 30th November 2019, Report No. DAT15269;
- Ecotech Ambient Air quality and Weather Monitoring Validated Report, New M5 Project 1st December 2019 - 31st December 2019, Report No. DAT15372.

In addition to the above, Ecotech has provided raw data and validated data spreadsheets for each month of monitoring and for each station.

Ambient station monitoring data should be validated and verified in a consistent manner ensuring the integrity of the reported data. Data reduction is the conversion of raw data into a more ordered, simplified, user-friendly form. For the New M5 monitoring stations, the data also needs to be summarised from collected 5 minute averages to hourly or daily (24 hourly) averages for reporting purposes. Data audits are a means to assure data integrity.



In completing the audit, a data audit trail was used to check for data recording/transfer errors. The data audit trail encompasses a check of data from the raw data through to the summarised validated data and ultimately the data presented in the report. Measurements are recorded by analysers and instruments at the ambient monitoring stations at 5 minute intervals. The data is then validated and checked for errors and faults. Validated data is then converted to hourly and then 24 hourly averages which is presented in the final monthly report for each station. This audit has followed sections of raw data as downloaded from the ambient station instruments, through the validation process, and then compares the calculated values determined from the raw data with the results of those reported by Ecotech in the monthly report. In summary, the following checks were made:

- accuracy of validated data compared to the raw data for July to December 2019 for all stations;
- appropriateness of data exclusion for two representative months (July 2019 and December 2019) for all stations;
- accuracy of conversion of 5-minute data to 1-hour and 24-hour averages for two representative months (July 2019 and December 2019) for all stations;
- review of unrealistic data exclusions; and
- reporting of exceedances.

The standards also specify the data and parameters required for the reporting of measured results. The reporting requirements include:

- Reference to the relevant monitoring standard;
- The reporting organisation or company;
- The concentration of the components measured in correct units (ppm or $\mu\text{g}/\text{m}^3$);
- The full scale value of the instruments;
- Sampling location—all relevant details, including a coordinate reference and sampling height to within 100 m above ground level;
- The type of instrument;
- Any non-conformances with the standards;
- The uncertainty associated with the measurement along with the confidence interval and coverage factor;
- Any other relevant data, e.g. meteorological conditions.

The report format was reviewed in the initial audit, which showed that reporting requirements were met. It is not expected that reporting would be different for the July to December 2019 period, nonetheless, for certainty, the December 2019 report prepared by Ecotech has been checked against these requirements.



3 Audit Findings

3.1 Comparison of Raw Data

Raw data from each station for the period July to December 2019 was checked against the validated data Ecotech used for the reporting requirements. The raw data for each station was compared to the data presented in the validated Ecotech spreadsheet. Five minute raw and validated data was provided for all parameters except for PM_{2.5} and Sigma Theta. For PM_{2.5}, sampling is undertaken using the beta attenuation method; the last 10 minutes of each hour are a calibration cycle. Therefore, only one hour average data are provided for PM_{2.5} as sub 1-hour data is not relevant. In the case of sigma theta, this is a calculated value determined from the wind directions for the measurements completed during the previous hour. Overall, the review has identified that the validated data used for reporting matched the raw data from the instrumentation for all months and at all stations.

A more detailed review of two representative months of monitoring (July 2019 and December 2019) was undertaken to confirm the appropriateness of data exclusions to derive the final validated data. This review considered the valid data exception information provided in Section 6.0 of the Ecotech monitoring reports.

The audit findings and comparison results of the raw data are shown in Tables 3.1 to 3.16 below.

Overall, the exclusion of data matched the details specified in the monitoring report. Data was excluded for various reasons including scheduled maintenance, instrument faults, data transmission errors and span/background checks. There were some short periods (usually single 5-minute periods) where data was excluded but a reason was not provided in the monitoring report. Ecotech was contacted regarding these periods to confirm the reasons for exclusion (e.g. usually instrument errors or unrealistic data).



Table 3.1: July 2019 - Verification of Raw Data Compared to Validated Data - Arncliffe 1

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Field notes observed in relation to 72 hour background zero check for PM _{2.5} monitor. Maintenance for the period 14:00 - 16:00 on 8/7/19 and 10:00 16/7/19 - 15:00 on 16/7/19 was noted - no raw data available.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion associated with maintenance for the period 9:50 16/7/19 - 5:10 17/7/19 was noted. Erratic and unrealistic values (e.g. large negatives) were noted, reflective of maintenance occurring.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	Data exclusion from 12:40 - 13:50 on 16/7/19 was noted, due to maintenance.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	Data exclusion from 12:40 - 13:50 on 16/7/19 was noted, due to maintenance.

Table 3.2: July 2019 - Verification of Raw Data Compared to Validated Data - Arncliffe 2

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data excluded from 14:00-16:00 on 4/7/19 due to maintenance was noted (very high concentrations also observed during this period, reflective of maintenance occurring).
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data excluded from 9:40-12:30 on 8/7/19 due to maintenance, as indicated in report. Raw data concentrations were noted to be erratic and reflective of maintenance occurring.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted. Linear offsets applies for the relevant periods, as stated in the report.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted. Data excluded from 12:35-13:45 on 8/7/19 due to maintenance, as indicated in report. Raw data concentrations were noted to be erratic with negatives, and reflective of maintenance occurring.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for.



Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	DT @ 2 m	-	Data excluded from 13:55-14:10 on 16/7/19 was noted, during a period of maintenance, as indicated in monitoring report.
1/7/2019 - 31/7/2019	DT @ 10 m	-	Data excluded from 13:55-14:10 on 16/7/19 was noted, during a period of maintenance, as indicated in monitoring report.

Table 3.3: July 2019 - Verification of Raw Data Compared to Validated Data - Barton Park

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data excluded at 10:00-11:00 on 4/7/19 due to maintenance, as indicated in report.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data excluded at 11:05-13:55 on 4/7/19 due to maintenance, as indicated in report. Very large negative concentration values observed.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted. Linear offsets applies for the relevant periods, as stated in the report.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	Data excluded from 9:25-16:00 on 16/7/19 due to maintenance, as indicated in monitoring report.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	Data excluded from 9:25-16:00 on 16/7/19 due to maintenance, as indicated in monitoring report.

Table 3.4: July 2019 - Verification of Raw Data Compared to Validated Data - Kingsgrove 1

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusion from 10:00-11:00 on 11/7/19 due to flow audit was noted, as indicated in monitoring report. Very large concentration value reflective of maintenance was observed.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 12:20-14:10 10/7/19 due to maintenance was noted, as indicated in monitoring report. Zero concentration values were observed, reflective of maintenance occurring.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted. Data exclusion due to intermittent data transmission errors were noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted. One 5-minute period excluded in validated data at 6:05 23/7/19, but this data exclusion was not specified in monitoring report. Review of
1/7/2019 - 31/7/2019	NO ₂	Yes	



Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	NO _x	Yes	the data shows a negative value and data exclusion is appropriate.
1/7/2019 - 31/7/2019	WS	Yes	Maintenance period on 10/7/19 was observed, otherwise, all other data was accounted for.
1/7/2019 - 31/7/2019	WD	Yes	Maintenance period on 10/7/19 was observed, otherwise, all other data was accounted for.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for.

Table 3.5: July 2019 - Verification of Raw Data Compared to Validated Data – Kingsgrove 2

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusion from 11:00-13:00 on 4/7/19 due to maintenance was noted, as indicated in monitoring report. Very large concentration value reflective of maintenance was observed.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 10:35-12:35 on 3/7/19 due to maintenance was noted, as indicated in monitoring report. Zero concentration values reflective of maintenance occurring was observed.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks and scheduled maintenance periods noted - data excluded for these periods. Data exclusion from 7:35-7:40 2/7/19 due to data transmission error was noted. Very high and unrealistic concentration value was observed.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks and scheduled maintenance periods noted - data excluded for these periods.
1/7/2019 - 31/7/2019	NO ₂	Yes	Data exclusion from 7:35-7:40 2/7/19 due to data transmission error was noted. Very high and unrealistic concentration values were observed.
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	Maintenance period on 31/7/19 was observed, otherwise, all other data was accounted for.
1/7/2019 - 31/7/2019	WD	Yes	Maintenance period on 31/7/19 was observed, otherwise, all other data was accounted for.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	Maintenance period on 31/7/19 was observed. Data exclusion intermittently from 4/7/19 - 30/7/19 was observed, as indicated in the report. Ecotech indicate this was considered unrealistic based on a comparison with measured temperatures at the other stations, which highlighted the unrealistic nature of the temperatures measured at Kingsgrove 2 (this data has been reviewed by the auditor, which confirms this observation).
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	Maintenance period on 31/7/19 was observed, otherwise, all other data was accounted for.



Table 3.6: July 2019 - Verification of Raw Data Compared to Validated Data - St Peters 1

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	All data accounted for, except for power outage on 12/7/19 with no raw data for a period of time.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Power outage on 12/7/19 noted with no raw data for a period of time. Data exclusion from 21:25-21:40 on 6/7/19 was noted due to unrealistic nature of data (large negative concentrations observed).
1/7/2019 - 31/7/2019	CO	-	Daily background checks noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for, except for maintenance on 17/7/19 and 18/7/19.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	Data exclusion intermittently from 4/7/19 - 8/7/19 was observed, as indicated in the report. Ecotech indicate this was considered unrealistic based on a comparison with measured temperatures at the other stations, which highlighted the unrealistic nature of the temperatures measured at St Petres 1 (this data has been reviewed by the auditor, which confirms this observation).

Table 3.7: July 2019 - Verification of Raw Data Compared to Validated Data - St Peters 2

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	All data accounted for, except for 1-hour of maintenance on 18/7/19 (data excluded for this hour).
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 11:25-13:05 on 18/7/19 due to maintenance was observed, as indicated in report. Erratic and large negative concentration values were observed for this period, reflective of maintenance occurring.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted. Linear offsets observed for the relevant periods, as indicated in the monitoring report.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 -	WD	Yes	All data accounted for.



Date	Parameter	Raw data matches validated data	Comments
31/7/2019			
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for, except for period 10:15-10:30 on 18/7/19. Data was excluded for this period due to maintenance.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for, except for period 10:15-10:30 on 18/7/19. Data was excluded for this period due to maintenance.

Table 3.8: July 2019 - Verification of Raw Data Compared to Validated Data – St Peters 3

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusion from 13:00 on 11/7/19 to 15:00 on 14/7/19 due to maintenance and background test was noted.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 10:20-12:30 on 10/7/19 due to maintenance was noted, as indicated in report. Large negative concentrations values were observed, reflective of maintenance occurring.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks and scheduled maintenance on 10/7/19 noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks and scheduled maintenance on 10/7/19 noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for, except for period of maintenance on 19/7/19.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for, except for period of maintenance on 19/7/19.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for, except for period of maintenance on 19/7/19.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for, except for period of maintenance on 19/7/19.

^a The monitoring report indicates that all parameters were affected by a power interruption on 4/7/19, however, this occurrence does not appear in the raw or validated data. Ecotech confirmed that all data on 4/7/19 was valid and no power interruption occurred.

Table 3.9: December 2019 - Verification of Raw Data Compared to Validated Data – Arncliffe 1

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	No raw or validated data was noted for a total of 4 hours between 3/12/19 to 5/12/19. Ecotech confirmed that this was due to a flow fault.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 20:50-21:15 on 1/12/19 was noted, but not identified in monitoring report. Ecotech confirmed the exclusion was due to unrealistic values (majority of concentration values were large negative values).
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.



Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for, except for period from 22:05 24/12/19 to end of year. Ecotech confirmed a calibration failure in January 2020, invalidated the data for this period at the end of December 2019.

Table 3.10: December 2019 - Verification of Raw Data Compared to Validated Data - Arncliffe 2

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusions intermittently from 3/12/19 - 10/12/19 was observed due to flow fault, as indicated in report.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 20:50-21:15 1/12/19 due to unrealistic values (large negatives) was observed, as indicated in monitoring report.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted. Linear offsets were observed for the relevant periods, as indicated in monitoring report. One 5-minute period was excluded at 23:45 25/12/19, but not mentioned in the monitoring report.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for, except for a data transmission error at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for, except for a data transmission error at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	DT @ 2 m	-	All data accounted for, except for a data transmission error at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	DT @ 10 m	-	All data accounted for, except for a data transmission error at 11:20 on 12/12/19.



Table 3.11: December 2019 - Verification of Raw Data Compared to Validated Data - Barton Park

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusion due to intermittent instrument faults was observed between 3/12/19 to 10/12/19.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 20:50-21:15 1/12/19 due to unrealistic values (large negatives) was observed, as indicated in monitoring report.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for.

Table 3.12: December 2019 - Verification of Raw Data Compared to Validated Data - Kingsgrove 1

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	All data accounted for, except for period of maintenance on 12/12/19 when data was excluded.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 22:20-23:10 on 29/12/19 due to unrealistic values (large negative values) was observed, as specified in monitoring report.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted. Data exclusion noted intermittently due to data transmission errors, as indicated in report.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	Either NO, NO ₂ , NO _x for 5 x 5-minute data periods were excluded, but no reason specified in monitoring report. Ecotech confirmed that data for these points should not have been excluded. However, given the infrequent nature of the exclusion, the exclusion would not affect the assessment of compliance with air quality goals.
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for, except for data transmission error period from 9:50-9:55 on 7/12/19.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for, except for data transmission error period from 9:50-9:55 on 7/12/19.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for, except for data transmission error period from 9:50-9:55 on 7/12/19.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for, except for data transmission error period from 9:50-9:55 on 7/12/19.



Table 3.13: December 2019 - Verification of Raw Data Compared to Validated Data - Kingsgrove 2

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusion intermittently from 3/12/19 to 19/12/19 due to flow fault was observed. Typically, a high concentration of 985 µg/m ³ was observed during the flow fault.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusions during maintenance periods on 1/12/19, 9/12/19 and 12/12/19 was observed.
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted. Data exclusion from 9:45-12:55 on 19/12/19 due to maintenance was observed.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for.

Table 3.14: December 2019 - Verification of Raw Data Compared to Validated Data - St Peters 1

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusion intermittently from 3/12/19 to 19/12/19 due to flow fault was observed. Typically, a high concentration of 985 µg/m ³ was observed during the flow fault.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 20:55-21:25 on 1/12/19 due to unrealistic data was noted. Large negative concentration values were observed.
1/7/2019 - 31/7/2019	CO	-	Daily background checks noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted. Data exclusion from 9:45-12:55 on 19/12/19 due to maintenance was observed.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for, except for data transmission error period at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for, except for data transmission error period at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for, except for data transmission error period at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for, except for data transmission error period at 11:20 on 12/12/19.



Table 3.15: December 2019 - Verification of Raw Data Compared to Validated Data - St Peters 2

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusion intermittently from 3/12/19 to 10/12/19 due to flow fault was observed. Typically, a high concentration of 985 µg/m ³ was observed during the flow fault.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data exclusion from 15:40-15:50 6/12/19 due to maintenance was noted, as indicated in monitoring report. Data excluded at 20:55 on 1/12/19 and 9:15 on 17/12/19. No reason was given in report. Ecotech confirmed data was considered unrealistic (large negative values observed).
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for, except for a data transmission period at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for, except for a data transmission period at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for, except for a data transmission period at 11:20 on 12/12/19.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for, except for a data transmission period at 11:20 on 12/12/19.

Table 3.16: December 2019 - Verification of Raw Data Compared to Validated Data - St Peters 3

Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	PM _{2.5}	Yes	Data exclusion intermittently from 3/12/19 to 10/12/19 due to flow fault was observed. Typically, a high concentration of 985 µg/m ³ was observed during the flow fault.
1/7/2019 - 31/7/2019	PM ₁₀	Yes	Data excluded at 3:35 and 6:50 on 17/12/19. No reason was given in report. Ecotech confirmed data was considered unrealistic (large negative values observed).
1/7/2019 - 31/7/2019	CO	Yes	Daily background checks noted.
1/7/2019 - 31/7/2019	NO	Yes	Daily span and zero checks noted.
1/7/2019 - 31/7/2019	NO ₂	Yes	
1/7/2019 - 31/7/2019	NO _x	Yes	
1/7/2019 - 31/7/2019	WS	Yes	All data accounted for.
1/7/2019 - 31/7/2019	WD	Yes	All data accounted for.



Date	Parameter	Raw data matches validated data	Comments
1/7/2019 - 31/7/2019	DT @ 2 m	Yes	All data accounted for.
1/7/2019 - 31/7/2019	DT @ 10 m	Yes	All data accounted for.

3.2 Calculation of 1-hour and 24-hour Averages

Calculations and checks were also performed by Air Noise Environment to verify the Ecotech calculations are correct when converting from 5 minute raw data averages to the reported hourly and 24 hourly averages. The exception to this is for the PM_{2.5} data, where 1 hour data is provided and only requires conversion to a 24 hour average concentration.

For the purpose of this review, the conversion calculations have reviewed for two representative months (July and December 2019). It is noted that in the January to June 2019 audit, all months were reviewed which showed accurate conversion calculations. Given this background, a review of the July and December 2019 data set (along with the review of January to June 2019) is considered reflective of other months of the year.

Appendix B presents the results of the comparison for the December 2019 review. The results are based on a % value (reported to nearest whole %), defined as the reported result vs the ANE calculated result. 100% indicates the reported averages and ANE calculations are identical. A value higher than 100% shows that the reported result was higher than the ANE calculations and vice versa; lower than 100% shows that the reported results were lower. Minimum, maximum and average % values are shown.

Based on the outcomes presented in Appendix B, the reported 1-hour and 24-hour averages match the ANE calculated averages very closely. The only exception is that some 24-hour averages, including NO_x/NO₂/NO values, were calculated as up to 13% higher in December 2019 for St Peters 2 station, and 24-hour wind speeds and sigma theta values differed by 1-2% at some stations. Overall, these examples represent a very small proportion of the total data set and actual differences were very low (in the order of 0.1 m/s or 0.001 ppm).

3.3 Unrealistic Data

On a number of occasions, Ecotech flagged raw data as unrealistic and subsequently removed the data from the analysis. For the period of July to December 2019, these data periods were reviewed to confirm the appropriateness of the data exclusion. In some cases, data was removed intermittently over a period of time - for these periods, example data sets were reviewed only. In the majority of cases, the data that was removed was due to unrealistic negative values, and in the opinion of the reviewer, it is considered reasonable to remove such values prior to analysis.

Ecotech was queried with regards to their procedures for invalidating negative values for Tapered Element Oscillating Microbalance (TEOM) PM₁₀ data. Their approach was to maintain negative values in keeping with the requirements of AS 3580.9.8, which indicates that negative values are real



measurements and represent evaporation of water or volatiles (resulting in negative mass differences being sensed by the instrument). However, where very large negative values are observed, these data points are investigated and potentially removed. Ultimately, removing very large negative provides a conservative approach to assessing compliance, as maintaining these values have a potential to skew 24-hour averages towards lower concentrations. At the same time, the number of negative values is less than 1% and has limited influence on the 24-hour average calculations for assessing compliance.

3.4 Reporting of Exceedances

The Instrument of Approval (IoA) conditions governing the New M5 Project are defined in the IoA document SSI 6788 dated 20 April 2016. The Approval includes a number of performance requirements relating to air quality, both in-tunnel and ambient as well as limits.

Condition E14 lists the ambient air pollutants goals as follows:

- CO – 8 hour rolling average of 9.0 ppm (NEPM);
- NO₂ – One hour average of 0.12 ppm (245 µg/m³) (NEPM);
- PM₁₀ – 24 hour average of 50 µg/m³ (NEPM);
- PM_{2.5} – 24 hour average of 25 µg/m³ (NEPM);
- PM₁₀ – annual average of 25 µg/m³ (NEPM);
- PM_{2.5} – annual average of 8 µg/m³ (NEPM).

Ecotech has included a table in the monthly reports to highlight any exceedances that may occur above these goals. The Ecotech monthly reports clearly identify exceedances of the IoA criteria, and these are reproduced in Tables 3.17 to 3.24 below.

It is further noted that the number of reported exceedances match those detailed in the monitoring data spreadsheets provided by Ecotech.



Table 3.17: Arncliffe 1 - Exceedances for July 2019 to December 2019

Parameter	Averaging Time	July	August	September	October	November	December	Air Quality Goal
NO ₂ (ppm)	1 Hour	-	-	-	-	-	-	0.12
CO (ppm)	1 Hour	-	-	-	-	-	-	9.0
PM ₁₀ (µg/m ³)	24 hour	-	-	-	51.1 - 26/10 77.8 - 30/10 74.1 - 31/10	58.4 - 1/11 98.9 - 12/11 60.2 - 19/11 79.8 - 21/11 117.2 - 26/11 54.7 - 28/11 77.7 - 29/11	56.1 - 2/12 97.8 - 3/12 74.0 - 4/12 116.4 - 5/12 92.4 - 10/12 66.9 - 19/12 55.0 - 21/12 57.5 - 31/12	50
	Annual ^a	-	-	-	-	-	-	25
PM _{2.5} (µg/m ³)	24 Hour	-	-	-	62 - 30/10 60 - 31/10	39.6 - 1/11 31.8 - 2/11 25.4 - 3/11 30.9 - 11/11 41.2 - 12/11 46.8 - 19/11 57.0 - 21/11 37.4 - 26/11 43.8 - 29/11	57.0 - 2/12 51.7 - 3/12 50.0 - 4/12 70.7 - 5/12 36.4 - 6/12 31.9 - 7/12 73.7 - 10/12 47.3 - 19/12 36.8 - 21/12 38.4 - 31/12	25
	Annual ^a	-	-	-	-	-	-	8

^a Insufficient data to report annual average, any exceedances will be reported in January 2020.

Table 3.18: Arncliffe 2 - Exceedances for July 2019 to December 2019

Parameter	Averaging Time	July	August	September	October	November	December	Air Quality Goal
NO ₂ (ppm)	1 Hour	-	-	-	-	-	-	0.12
CO (ppm)	1 Hour	-	-	-	-	-	-	9.0
PM ₁₀ (µg/m ³)	24 hour	-	-	-	73.2 - 30/10 70.9 - 31/10	51.7 - 1/11 89.7 - 12/11 61.5 - 19/11 74.4 - 21/11 109.2 - 26/11 50.4 - 28/11 74.3 - 29/11	58.4 - 2/12 98.7 - 3/12 69.3 - 4/12 120.5 - 5/12 54.6 - 5/12 101.0 - 10/12 69.1 - 19/12 59.6 - 21/12 62.8 - 31/12	50
	Annual ^a	-	-	-	-	-	-	25
PM _{2.5} (µg/m ³)	24 Hour	-	-	-	64 - 30/10 61 - 31/10	39.4 - 1/11 32.1 - 2/11 25.1 - 3/11 33.1 - 11/11 44.5 - 12/11 53.6 - 19/11 62.6 - 21/11 27.8 - 22/11 29.5 - 25/11 43.3 - 26/11 27.6 - 28/11 48.4 - 29/11 25.1 - 30/11	61.5 - 2/12 55.2 - 3/12 54.9 - 4/12 72.6 - 5/12 39.5 - 6/12 33.6 - 7/12 82.4 - 10/12 50.5 - 19/12 40.5 - 21/12 37.9 - 31/12	25
	Annual ^a	-	-	-	-	-	-	8

^a Insufficient data to report annual average, any exceedances will be reported in January 2020.



Table 3.19: Barton Park - Exceedances for July 2019 to December 2019

Parameter	Averaging Time	July	August	September	October	November	December	Air Quality Goal
NO ₂ (ppm)	1 Hour	-	-	-	-	-	-	0.12
CO (ppm)	1 Hour	-	-	-	-	-	-	9.0
PM ₁₀ (µg/m ³)	24 hour	-	-	-	69.9 - 30/10 63.6 - 31/10	91.0 - 12/11 55.6 - 19/11 70.7 - 21/11 112.8 - 26/11 68.6 - 29/11	54.6 - 2/12 94.3 - 3/12 64.3 - 4/12 125.6 - 5/12 89.8 - 10/12 59.6 - 19/12 51.2 - 21/12 52.3 - 31/12	50
	Annual ^a	-	-	-	-	-	-	25
PM _{2.5} (µg/m ³)	24 Hour	-	-	-	62 - 30/10 58 - 31/10	37.6 - 1/11 29.4 - 2/11 31.3 - 11/11 41.8 - 12/11 49.9 - 19/11 57.6 - 21/11 25.1 - 25/11 39.8 - 26/11 45.3 - 29/11	58.6 - 2/12 50.3 - 3/12 51.9 - 4/12 79.5 - 5/12 35.4 - 6/12 30.9 - 7/12 75.4 - 10/12 42.9 - 19/12 37.3 - 21/12 35.7 - 31/12	25
	Annual ^a	-	-	-	-	-	-	8

^a Insufficient data to report annual average, any exceedances will be reported in January 2020.

^b There is a typographical error in the December report. The 26 November exceedance has been repeated in the December report.

Table 3.20: Kingsgrove 1 - Exceedances for July 2019 to December 2019

Parameter	Averaging Time	July	August	September	October	November	December	Air Quality Goal
NO ₂ (ppm)	1 Hour	-	-	-	-	-	-	0.12
CO (ppm)	1 Hour	-	-	-	-	-	-	9.0
PM ₁₀ (µg/m ³)	24 hour	53.9 - 01/07 58.1 - 02/07 73.6 - 11/07 123.2 - 12/07 69.6 - 13/07 50.4 - 16/07 63.1 - 17/07 55.6 - 22/07 65.4 - 23/07	52.0 - 7/8 94.1 - 8/8 134.6 - 9/8 54.3 - 16/8 87.7 - 19/8 57.2 - 20/8 70.7 - 21/8 65.3 - 22/8 61.2 - 24/8	57.4 - 4/9 131.9 - 6/9 103.3 - 7/9 77.2 - 12/9 87.7 - 16/9 101.9 - 27/9	78.7 - 2/10 94.3 - 3/10 122.9 - 4/10 94.7 - 17/10 68.9 - 19/10 62.3 - 23/10 109.5 - 25/10 113.8 - 26/10 85.2 - 29/10 98.7 - 30/10 94.5 - 31/10	64.0 - 1/11 75.2 - 2/11 64.0 - 5/11 89.6 - 7/11 91.4 - 8/11 79.0 - 11/11 201.8 - 12/11 60.0 - 13/11 56.8 - 14/11 74.4 - 15/11 57.0 - 18/11 93.4 - 19/11 121.8 - 21/11 63.4 - 22/11 57.7 - 25/11 153.7 - 26/11 79.8 - 28/11 104.4 - 29/11	132.6 - 2/12 146.9 - 3/12 126.7 - 4/12 187.7 - 5/12 66.3 - 6/12 64.6 - 7/12 58.1 - 9/12 132.0 - 10/12 76.6 - 18/12 96.2 - 19/12 64.0 - 21/12 69.2 - 31/12	50
	Annual ^a	-	-	-	-	-	-	-
PM _{2.5} (µg/m ³)	24 Hour	-	-	-	30 - 25/10 25 - 29/10 62 - 30/10 64 - 31/10	29.2 - 1/11 32.4 - 2/11 40.4 - 11/11 54.7 - 12/11 25.7 - 18/11 49.6 - 19/11 72.0 - 21/11 25.4 - 22/11 26.9 - 25/11 42.6 - 26/11 25.8 - 28/11 48.8 - 29/11 26.1 - 30/11	64.8 - 2/12 52.8 - 4/12 103.0 - 5/12 38.2 - 6/12 34.2 - 7/12 92.0 - 10/12 25.0 - 15/12 48.4 - 19/12 35.3 - 21/12 38.7 - 31/12	25
	Annual ^a	-	-	-	-	-	-	8

^a Insufficient data to report annual average, any exceedances will be reported in January 2020.



Table 3.21: Kingsgrove 2 - Exceedances for July 2019 to December 2019

Parameter	Averaging Time	July	August	September	October	November	December	Air Quality Goal
NO ₂ (ppm)	1 Hour	-	-	-	-	-	-	0.12
CO (ppm)	1 Hour	-	-	-	-	-	-	9.0
PM ₁₀ (µg/m ³)	24 hour	-	-	-	78.8 - 30/10 76.0 - 31/10	108.3 - 12/11 66.0 - 19/11 77.8 - 21/11 120.9 - 26/11 76.8 - 29/11	66.0 - 2/12 109.4 - 3/12 79.3 - 4/12 131.8 - 5/12 50.5 - 6/12 101.8 - 10/12 65.3 - 19/12 55.1 - 21/12 58.9 - 31/12	50
	Annual ^a	-	-	-	-	-	-	25
PM _{2.5} (µg/m ³)	24 Hour	-	-	-	59 - 30/10 62 - 31/10	29.5 - 1/11 27.6 - 2/11 35.6 - 11/11 44.8 - 12/11 46.7 - 19/11 66.8 - 21/11 37.0 - 26/11 45.7 - 29/11	58.4 - 2/12 73.4 - 3/12 52.5 - 4/12 69.5 - 5/12 34.2 - 6/12 29.9 - 7/12 47.8 - 10/12 34.6 - 19/12 32.6 - 21/12 34.3 - 31/12	25
	Annual ^a	-	-	-	-	-	-	8

^a Insufficient data to report annual average, any exceedances will be reported in January 2020.

Table 3.22: St Peters 1 - Exceedances for July 2019 to December 2019

Parameter	Averaging Time	July	August	September	October	November	December	Air Quality Goal
NO ₂ (ppm)	1 Hour	-	-	-	-	-	-	0.12
CO (ppm)	1 Hour	-	-	-	-	-	-	9.0
PM ₁₀ (µg/m ³)	24 hour	50.2 - 2/7 65.2 - 19/7 50.5 - 22/7	63.0 - 8/8 52.37 - 15/8	-	56.3 - 4/10 52.7 - 24/10 61.0 - 25/10 65.3 - 26/10 100.3 - 30/10 86.4 - 31/10	58.2 - 1/11 53.0 - 2/11 53.6 - 7/11 102.9 - 12/11 52.7 - 15/11 80.2 - 19/11 76.4 - 21/11 67.0 - 22/11 117.7 - 26/11 60.1 - 28/11 81.0 - 29/11	55.2 - 2/12 87.8 - 3/12 89.5 - 4/12 107.6 - 5/12 88.5 - 6/12 63.7 - 7/12 149.3 - 10/12 53.6 - 13/12 53.5 - 16/12 91.3 - 19/12 71.9 - 21/12 64.9 - 31/12	50
	Annual ^a	-	-	-	-	-	32.0	25
PM _{2.5} (µg/m ³)	24 Hour	-	-	-	29 - 25/10 68 - 30/10 61 - 31/10	41.5 - 1/11 34.8 - 2/11 29.9 - 3/11 32.8 - 11/11 44.5 - 12/11 60.7 - 19/11 65.8 - 21/11 29.9 - 22/11 28.9 - 25/11 45.8 - 26/11 29.0 - 28/11 48.6 - 29/11 26.2 - 30/11	58.2 - 2/12 66.5 - 3/12 52.7 - 4/12 68.8 - 5/12 44.3 - 6/12 36.1 - 7/12 83.6 - 10/12 63.9 - 19/12 40.9 - 21/12 39.3 - 31/12	25
	Annual ^a	-	-	-	-	-	14.0	8

^a Insufficient data to report annual average, any exceedances will be reported in January 2020.



Table 3.23: St Peters 2 - Exceedances for July 2019 to December 2019

Parameter	Averaging Time	July	August	September	October	November	December	Air Quality Goal
NO ₂ (ppm)	1 Hour	-	-	-	-	-	-	0.12
CO (ppm)	1 Hour	-	-	-	-	-	-	9.0
PM ₁₀ (µg/m ³)	24 hour	82.8 - 2/7 62.4 - 19/7 90.4 - 22/7 57.8 - 23/7 78.0 - 24/7 58.1 - 26/7	54.1 - 2/8 55.2 - 7/8 84.1 - 8/8 68.6 - 9/8 55.0 - 15/8 55.9 - 16/8 55.33 - 17/8 61.7 - 19/8 61.3 - 21/8 64.4 - 22/8 50.4 - 24/8	94.1 - 6/9 56.4 - 16/9	62.4 - 2/10 67.7 - 3/10 80.7 - 4/10 84.1 - 17/10 67.3 - 19/10 51.8 - 23/10 88.9 - 25/10 96.2 - 26/10 64.3 - 29/10 94.3 - 30/10 92.8 - 31/10	76.6 - 1/11 80.4 - 2/11 86.6 - 7/11 88.3 - 8/11 74.9 - 11/11 144.7 - 12/11 58.1 - 14/11 96.7 - 15/11 73.5 - 18/11 117.9 - 19/11 115.4 - 21/11 63.5 - 22/11 58.6 - 25/11 142.8 - 26/11 81.6 - 28/11 89.9 - 29/11	116.2 - 2/12 117.6 - 3/12 91.0 - 4/12 138.6 - 5/12 75.8 - 6/12 60.5 - 7/12 100.0 - 9/12 156.3 - 10/12 100.2 - 18/12 119.1 - 19/12 85.1 - 21/12 65.4 - 31/12	50
	Annual ^a	-	-	-	-	-	41.9	25
PM _{2.5} (µg/m ³)	24 Hour	-	-	-	27 - 25/10 62 - 30/10 57 - 31/10	30.3 - 1/11 30.9 - 2/11 27.3 - 3/11 29.6 - 11/11 43.5 - 12/11 60.8 - 19/11 62.6 - 21/11 25.5 - 22/11 26.7 - 25/11 43.7 - 26/11 27.1 - 28/11 44.2 - 29/11	56.5 - 2/12 63.3 - 3/12 52.7 - 4/12 60.1 - 5/12 39.6 - 6/12 32.4 - 7/12 79.9 - 10/12 60.8 - 19/12 37.8 - 21/12 36.2 - 31/12	25
	Annual ^a	-	-	-	-	-	13.3	8

^a Insufficient data to report annual average, any exceedances will be reported in January 2020.



Table 3.24: St Peters 3 - Exceedances for July 2019 to December 2019

Parameter	Averaging Time	July	August	September	October	November	December	Air Quality Goal
NO ₂ (ppm)	1 Hour	-	-	-	-	-	-	0.12
CO (ppm)	1 Hour	-	-	-	-	-	-	9.0
PM ₁₀ (µg/m ³)	24 hour	-	-	-	58.9 - 29/10 76.5 - 30/10 65.7 - 31/10	99.1 - 12/11 68.6 - 19/11 68.2 - 21/11 115.5 - 26/11 69.4 - 29/11	58.4 - 2/12 83.2 - 3/12 73.6 - 4/12 105.1 - 5/12 51.6 - 6/12 131.4 - 10/12 85.0 - 19/12 59.7 - 21/12 57.7 - 31/12	50
	Annual ^a	-	-	-	-	-	25.2	25
PM _{2.5} (µg/m ³)	24 Hour	-	-	-	27 - 25/10 63 - 30/10 56 - 31/10	39.1 - 1/11 34.2 - 2/11 29.3 - 3/11 31.2 - 11/11 41.2 - 12/11 57.7 - 19/11 61.9 - 21/11 26.9 - 22/11 26.6 - 25/11 44.4 - 26/11 27.0 - 28/11 46.2 - 29/11	57.6 - 2/12 67.2 - 3/12 60.2 - 4/12 66.7 - 5/12 41.9 - 6/12 35.2 - 7/12 100.0 - 10/12 63.4 - 19/12 40.3 - 21/12 38.9 - 31/12	25
	Annual ^a	-	-	-	-	-	14.3	8

^a Insufficient data to report annual average, any exceedances will be reported in January 2020.

3.5 Reporting Requirements

For each parameter sampled, the relevant Australian Standard defines specific reporting requirements for the way data is reported and presented. As mentioned earlier, the report format was reviewed in the initial audit, which showed that reporting requirements were met. It is not expected that reporting would be different for the July to December 2019 period, nonetheless, for certainty, the December 2019 report prepared by Ecotech has been checked against these requirements, as presented in Table 3.25 below. Based on the analysis presented in Table 3.25, the Ecotech reports comply with the reporting requirements.

Table 3.25: Compliance With Required Reporting Details as Listed in the Relevant Australian Standards

Reporting Requirements	Report Compliance
Reference to the relevant Standard	The relevant standard for each parameter is noted in Table 3 of the report
The reporting organisation or company address and certification details.	Details of Ecotech are included in the report. The NATA certification number is also included.
The concentration of the components measured in correct units (ppm or µg/m ³)	The concentrations of the components are correctly labelled in the report. NO ₂ and CO are reported as ppm. PM ₁₀ and PM _{2.5} are correctly reported as µg/m ³ .
The dates, time and period of sampling	The sampling dates and times and period identified in the report in the various results tables tables and graphs. (Figures 2 - 13 and Tables 15 - 22).



Reporting Requirements	Report Compliance
	Consideration to the averaging period is also included when referencing the air quality goals in Table 4.
The full scale value of the instruments.	This information is provided in Table 5.
Sampling location—all relevant details, including a coordinate reference including height to within 100 m above ground level and classification of area.	Site sampling name, geographical location and height above sea level is included in the report in Table 1.
The type of instrument.	The instrument types and brands are detailed in Table 2
Any non-conformances with the standards.	Details referred to in Section 2.3.1 of report.
The uncertainty associated with the measurement along with the confidence interval and coverage factor.	The measurement uncertainties are detailed for each parameter in Table 5.



4 Conclusions

The monthly ambient air quality data for the period July to December 2019 has been reviewed, and the July and December 2019 periods have been selected for detailed review. The procedures adopted for the data validation and reporting by Ecotech for the July and December 2019 reports are the same as the other four months. In our opinion, the sample of data reviewed is representative of the data processing procedures for the preceding months, hence provides a suitable verification approach for the 6 month dataset.

Overall, the raw data from July to December 2019 matched the validated data. Furthermore, the calculation procedures for converting 5-minute average data to 1-hour and 24-hour average data are considered accurate. In terms of the detailed review of July and December 2019, the data exception details provided in the monitoring report matched the raw data analysis very closely. It is noted that clarification has been sought from Ecotech regarding exclusion of a small number of data points for which the monitoring reports do not provide information on. Ecotech has confirmed the reasons data exclusion for these periods (usually unrealistic data or data transmission errors).

The data results were also compared to the compliance limits for the project. The results show full compliance for carbon monoxide (CO) and nitrogen dioxide (NO₂) for the 6 month period. Exceedances for the 24 hour PM₁₀ and PM_{2.5} were noted on several occasions over the 6 month period, primarily in November and December 2019. The Ecotech reports accurately report the periods of exceedance as reflected in the analysed data.

The reporting of the ambient air quality monitoring data complied with the relevant requirements.



Appendix A - Air Quality Glossary





APPENDIX B: GLOSSARY OF AIR QUALITY TERMINOLOGY

Conversion of ppm to mg/m ³	Where R is the ideal gas constant; T, the temperature in kelvin (273.16 + T°C); and P, the pressure in mm Hg, the conversion is as follows: $\text{mg m}^{-3} = (P/RT) \times \text{Molecular weight} \times (\text{concentration in ppm})$ $= \frac{P \times \text{Molecular weight} \times (\text{concentration in ppm})}{62.4 \times (273.2 + T^{\circ}\text{C})}$
g/s	Grams per second
mg/m ³	Milligrams (10 ⁻³) per cubic metre.
µg/m ³	Micrograms (10 ⁻⁶) per cubic metre.
ppb	Parts per billion.
ppm	Parts per million.
PM ₁₀ , PM _{2.5} , PM ₁	Fine particulate matter with an equivalent aerodynamic diameter of less than 10, 2.5 or 1 micrometres respectively. Fine particulates are predominantly sourced from combustion processes. Vehicle emissions are a key source in urban environments.
50th percentile	The value exceeded for 50 % of the time.
NO _x	Oxides of nitrogen – a suite of gaseous contaminants that are emitted from road vehicles and other sources. Some of the compounds can react in the atmosphere and, in the presence of other contaminants, convert to different compounds (eg, NO to NO ₂).
VOC	Volatile Organic Compounds. These compounds can be both toxic and odorous.



Appendix B – Calculation Comparison





Table B1: Comparison of ANE and Ecotech Calculations - Arncliffe 1 (West Botany Street)

Month	AVG Period	Parameter	PM ₁₀ (µg/m ³)	CO (ppm)	CO 8 Hr Rolling (ppm)	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	WS (m/s)	WD (°)	Sigma	AT 2m (K)	AT 10m (K)	
July 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Dec 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table B2: Comparison of ANE and Ecotech Calculations - Arncliffe 2 (Eve Street)

Month	AVG Period	Parameter	PM ₁₀ (µg/m ³)	CO (ppm)	CO 8 Hr Rolling (ppm)	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	WS (m/s)	WD (°)	Sigma	AT 2m (K)	AT 10m (K)	
July 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Dec 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%



Table B3: Comparison of ANE and Ecotech Calculations – Barton Park

Month	AVG Period	Parameter	PM ₁₀ (µg/m ³)	CO (ppm)	CO 8 Hr Rolling (ppm)	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	WS (m/s)	WD (°)	Sigma	AT 2m (K)	AT 10m (K)	
July 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	101%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	116%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Dec 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table B4: Comparison of ANE and Ecotech Calculations – Kingsgrove 1 (MOC1)

Month	AVG Period	Parameter	PM ₁₀ (µg/m ³)	CO (ppm)	CO 8 Hr Rolling (ppm)	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	WS (m/s)	WD (°)	Sigma	AT 2m (K)	AT 10m (K)	
July 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Dec 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%



Table B5: Comparison of ANE and Ecotech Calculations – Kingsgrove 2 (Kingsgrove Rd)

Month	AVG Period	Parameter	PM ₁₀ (µg/m ³)	CO (ppm)	CO 8 Hr Rolling (ppm)	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	WS (m/s)	WD (°)	Sigma	AT 2m (K)	AT 10m (K)	
July 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	98%	100%	100%
Dec 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table B6: Comparison of ANE and Ecotech Calculations – St Peter 1 (Campbell St)

Month	AVG Period	Parameter	PM ₁₀ (µg/m ³)	CO (ppm)	CO 8 Hr Rolling (ppm)	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	WS (m/s)	WD (°)	Sigma	AT 2m (K)	AT 10m (K)	
July 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Dec 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%



Table B7: Comparison of ANE and Ecotech Calculations – St Peter 2 (Campbell St)

Month	AVG Period	Parameter	PM ₁₀ (µg/m ³)	CO (ppm)	CO 8 Hr Rolling (ppm)	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	WS (m/s)	WD (°)	Sigma	AT 2m (K)	AT 10m (K)	
July 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	101%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Dec 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	105%	105%	105%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	101%	113%	113%	113%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table B8: Comparison of ANE and Ecotech Calculations – St Peter 3 (SPI)

Month	AVG Period	Parameter	PM ₁₀ (µg/m ³)	CO (ppm)	CO 8 Hr Rolling (ppm)	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	WS (m/s)	WD (°)	Sigma	AT 2m (K)	AT 10m (K)	
July 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	98%	100%	99%	100%	100%
Dec 2019	1 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%	
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	-	100%	100%
	24 hour	Avg	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Max	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
		Min	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%