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OUR REF: 803400.140429
YOUR REF: Email 260220/JH-RP

2 July 2020

Justin Hazelbrook
Community and Conditions Coordinator

PO Box 6008
Silverwater, NSW 2128

RE: Report on Ventilation Outlet Above-Limit Reading M4 East Motorway – 6 June 2020

Dear Justin,

SNC-Lavalin Atkins has been appointed by Fulton Hogan EGIS OM (FHEOM) Joint Venture to perform the Independent Air Quality Specialist roles for the M4 East Motorway, and were approved by the NSW Department of Planning, Industry and Environment (DPIE) on 14 May 2019.

In accordance with condition E16 of the Conditions of Approval, this letter provides SNC-Lavalin Atkins's review comments on the Ventilation Outlet Exceedance Causes/Contributors Report (VOECC) that has been prepared following the notification of a potential exceedance in the Parramatta Road Ventilation Facility (PRVF). The notification of an above-limit reading on 6 June 2020 was provided to the Secretary, EPA and NSW Health. The VOECC report was prepared to identify the cause of the above-limit reading and any other possible contributing factors and is required to be submitted to DPIE within 20 working days of the original notification.

Condition E16 states:

"…The notification must be followed up with a detailed report within 20 working days, which must be prepared by the Proponent, reviewed by a suitably qualified and experienced independent specialist(s), and submitted to the Secretary, on the cause and major contributor of the exceedance and the options available to prevent recurrence. The Secretary must approve the independent person/organisation prior to the commencement of operation, or at some other time prior to preparation of the report.
…"

The SNC-Lavalin Atkins Environment team have undertaken a review of the report and the below comments have been made:

1. The report and data identify a potential exceedance of the Volatile Organic Compound (VOC) concentration limit on 6 June 2020 at the PRVF. There were no other exceedances for any of the other recorded pollutants (solid particles, NO_x, NO_2, or CO).

2. The monitoring data shown in Section 2.25 of the VOECC report clearly outlines that on 6 June from around 0400hrs, a distinct and sharp increase is evident where above-limit reading concentrations for VOCs at the PRVF were recorded, followed by a distinct and sharp decrease shortly after. The specified limit for VOC concentrations in the ventilation

outlets is 4.0mg/m^3. The hourly average above-limit-reading recorded on 6 June 2020 was 29.1 mg/m^3 during the period 0400hrs – 0500hrs which is outside of standard peak hour periods.

3. During the period the above-limit-reading was recorded, a review of the same data for the URVF on the air quality monitoring website (https://www.linkt.com.au/sydney/using-toll-roads/about-sydney-toll-roads/westconnex-m4/tunnel-air-quality) shows no spikes. In addition, the VOECC report confirms in Section 2.2, that the measured CO, NO_2, and Visibility at both the PRVF and the URVF shows no spikes and readings were well below limits, suggesting this is a VOC specific issue solely at the PRVF.

4. The VOECC report, in Section 3.2 – 'Events Report', confirms that from the in-tunnel traffic data provided by the Operational Management Control System there were no emergencies or traffic congestion for the eastbound carriageway pre, during or post the above limit readings.

5. The VOECC report outlines that the multi-gas calibration system at the PRVF undergoes automatic zero and span calibrations. The VOECC report explains that the air quality analyser AQA15001 automatically calibrates at set time intervals and is required to do so by Australian Standards method AS3580 to pass validation criteria. Section 3.2.2 of the VOECC displays records of daily calibration times for AQA15001 on 6 June 2020 which indicates calibration initiation occurred at around the same time the VOC above-limit exceedance was recorded. During this time in which calibration was occurring, invalid calibration data was potentially uploaded to the Linkt website.

6. While the role of SNC-Lavalin Atkins is not to inspect or verify that the corrective actions identified have been implemented, we request a copy of appropriate evidence that demonstrates the successful implementation of the recommended improvements when actions have been completed (i.e. a copy of the established maintenance registers, confirmation of data filtering systems during instrument maintenance and calibration).

Based on the statements made in the VOECC report, and our review of the publicly available monitoring data:

- there were no reported exceedances of measured pollutant concentrations within the PRVF, other than VOCs
- in tunnel CO and NO_2 levels were well below concentration limits pre, during and post the VOC exceedances
- there were no exceptional events or excessive traffic pre, during or post the recorded VOC exceedances
- there was no malfunction in the tunnel ventilation system.

Therefore, it is highly likely that the cause of the above-limit readings is a function of calibration error in the instrument whilst in calibration mode, and deficiency in the filtering of data to recognise readings that have been passed through during the calibration sequence.

Yours sincerely,

SNC-LAVALIN ATKINS

Richard Peterson
Director

Environment & Geoscience
Infrastructure

Report on Ventilation Outlet above-limit reading

WestConnex M4 East

To be submitted to DPE within 20 days of the Report of Above-Limit Reading

Details of the exceedance Attach relevant Notification of Above-limit Reading	This report has been prepared to address the requirements under MCoA E16: "Should the results of monitoring show that any of the ventilation outlet limits specified in condition E14 have been exceeded, the proponent must immediately notify the Secretary, EPA and NSW Health. The notification must be followed up with a detailed report within 20 working days, which must be prepared by the proponent, reviewed by a suitably qualified and experienced independent specialist(s), and submitted to the Secretary, on the cause and major contributor of the exceedance and the options available to prevent recurrence." The VOC parameter at Paramatta Ventilation Facility (PRVF), eastern ventilation facility, reported above-limit readings on 6th June 2020. The reading was as follows: - VOC –One hour block average of 29.1 ppm - Time – 4:00 to 5:00 am The immediate notification of ventilation outlet above-limit reading was issued to the Secretary, EPA and NSW Health. (refer to Section 1 of this report).
Was the data valid? If invalid, include any details or justifications for the invalidity	This report has been prepared to investigate the root cause of the above-limit reading and any other possible contributing factors. The data was invalid. The above-limit VOC reading at PRVF on 6th June 2020, 4 to 5 am, occurred due to VOC automatic calibration data uploading to the operational management control system (OMCS).
Comparison with long term monitoring trends and background air quality data	Not applicable for this report.
Cause or major contributor of the exceedance If the cause or major contributor are not able to be determined, then known facts of what was occurring at the time should be included (e.g. traffic information, ventilation outlet monitoring records etc)	Examination of all relevant data supports the conclusion that the Air Quality analysers at PRVF reported an exceedance during autocalibration. Sections 2 and 3 of the report provide supporting evidence that no other eastbound Air Quality monitoring parameters were abnormal and review of the OCMS reported no incidents (such as traffic congestions or accidents) occurring to accounted for the reported VOC exceedance. The autocalibration initiation time coincides with the above-limit exceedance time point.
Options to prevent recurrence This is to include consideration of improvements to the tunnel air quality management system to achieve compliance with the ambient air quality goals, including but not limited to installation of the additional ventilation management facilities allowed for under condition B5, and discussion of whether those improvements are feasible and reasonable	
Section 5 of this report details the recommendation to improve systems and prevent reporting invalid air quality exceedances to the M4 Tunnel website.	
Person responsible for report	Name: Peter Redwin
	Position: Head of Operations and Maintenance
	Organisation: WestConnex Transurban
	Date: 19.06.2020

Contents

1 Ventilation Outlet above-limit Reading Notification

WestConnex

Ventilation Outlet Notification and Report

Ventilation Outlet Monitoring Notification

Notification of Ventilation Outlet above-limit reading WestConnex M4 East To be notified immediately to Project Company and RMS. Project Company is to notify DPE, EPA and NSW Health immediately	
Date	6 June 2020
Time (start and finish)	04:00 – 05:00
Relevant location	☐ Western Ventilation Facility
	☒ Eastern Ventilation Facility
Relevant limit	☐ Solid particles – 1 hour averaging period
	☐ NO_2 or NO or both, as NO_2 equivalent – 1 hour block averaging period
	☐ NO_2 – 1 hour block averaging period
	☐ CO – 1 hour rolling averaging period
	☒ VOC – 1 hour rolling averaging period
Above-limit reading Detail the above-limit reading that was received	VOC – 1 hour block average result of 29.1 mg/m^3
Duration Detail the duration of the above-limit reading or event	1 hour
Nature of event Detail nature of the event that contributed to the above- limit reading	Overnight automatic calibration data has been uploaded to the OMCS and the project website. The reading was false and has been attributed to instrument error.
Was the data valid? If unknown at this stage, please indicate.	No.
Was there an emergency? Refer section 6.5 of this Plan. If this is unknown at this stage, please indicate.	No.
Measures employed Detail measures employed to minimise the concentration levels	None.
Commitment to prepare and submit a Report on Above-Goal Reading A Report on Above-Goal Reading will be prepared for this notification. Please note that a Report is not required in the event of an emergency.	
Person responsible for notification	Name: Peter Redwin
	Position: Head of Operations and Maintenance
	Organisation: WestConnex Transurban

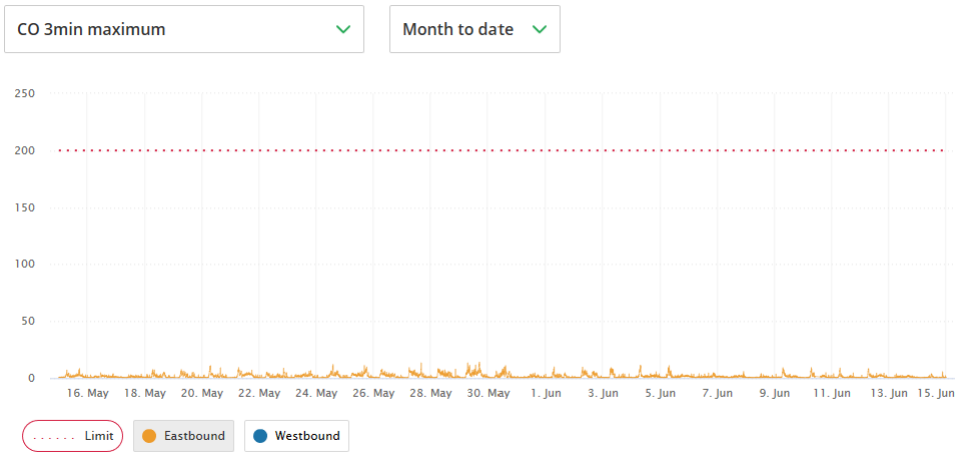
2 Air Quality Monitoring Results – Linkt Website

2.1 In Tunnel

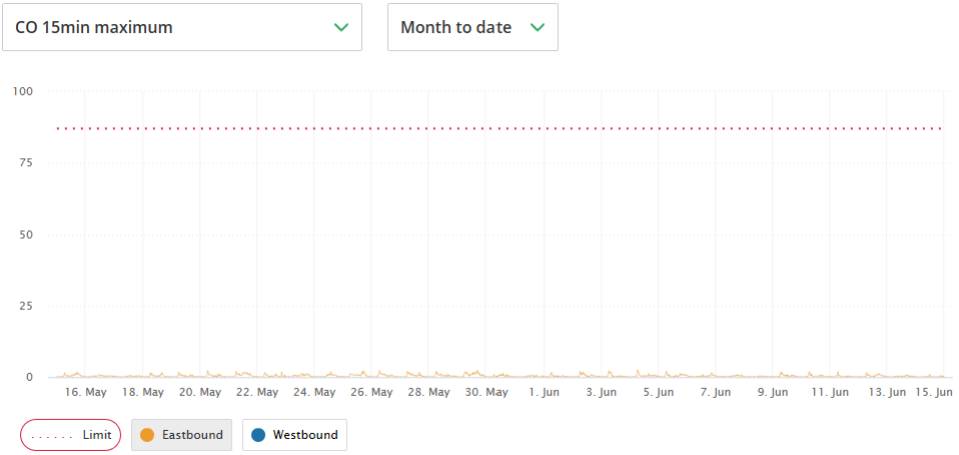
The following diagrams were captured from the official website for Air Monitoring on M4E. In tunnel data from 16/5/2020 to 15/6/202 are displayed. Readings for Carbon monoxide (CO), Nitrogen dioxide (NO_2) and visibility, eastbound (yellow), showed no limit exceedances across this date range. Similarly, no in tunnel exceedances for air quality parameters were recorded in tunnel westbound.

(https://www.linkt.com.au/sydney/using-toll-roads/about-sydney-toll-roads/westconnex-m4/tunnel-air-quality)

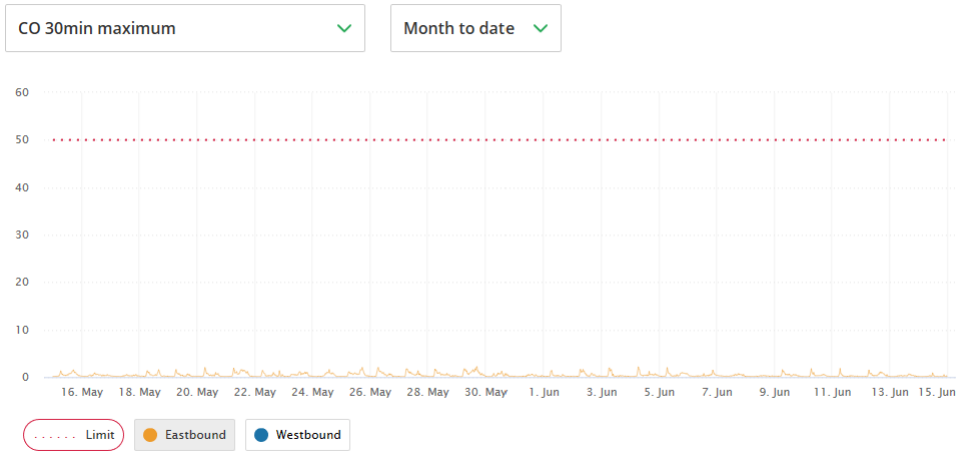
2.1.1 CO (ppm) – 3 min maximum



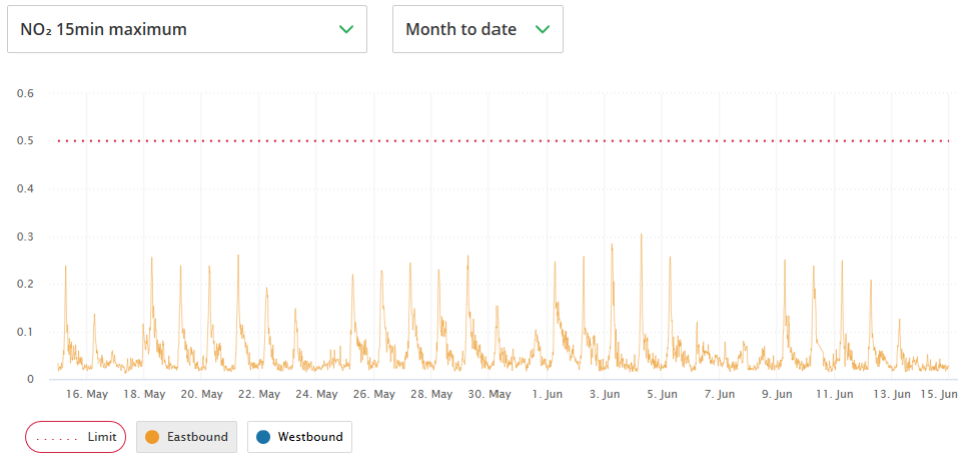
2.1.2 CO (ppm) – 15 min maximum



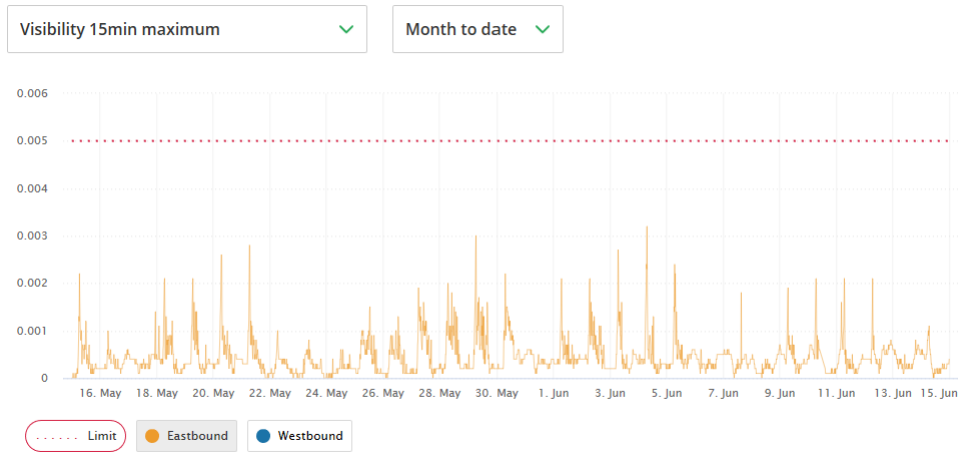
2.1.3 CO (ppm) – 30 min maximum



2.1.4 NO_2 (ppm) – 15 min maximum



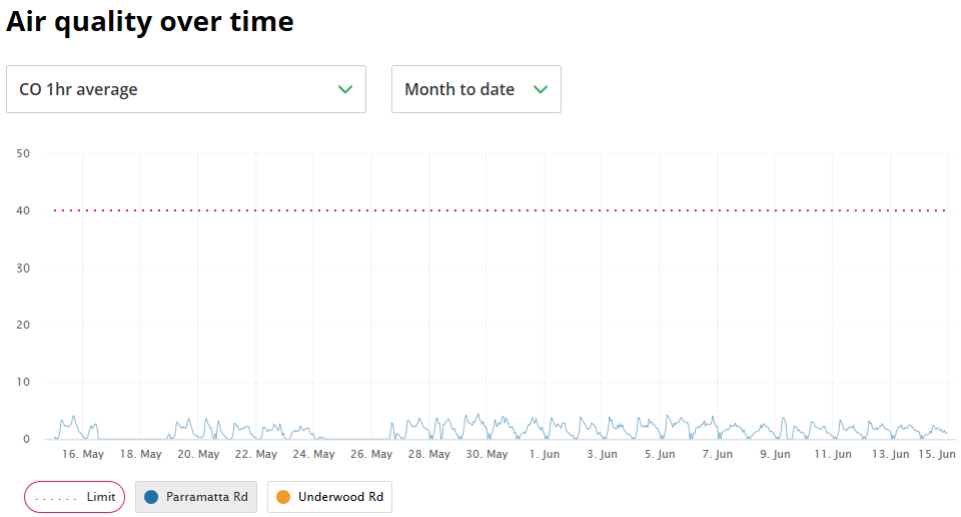
2.1.5 Visibility (per m) – 15 min maximum



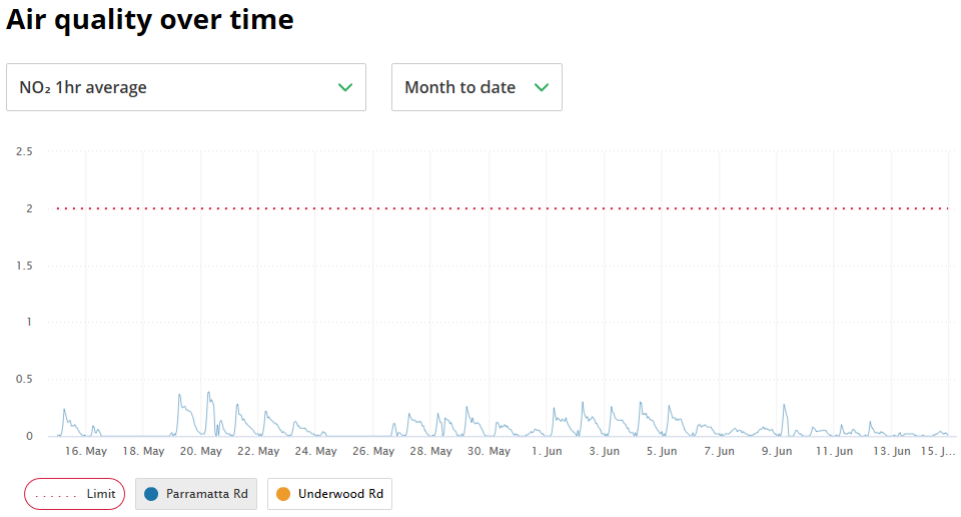
2.2 Ventilation Outlet Paramatta Rd (Eastern Ventilation facility)

The following diagrams were captured from the official website for Air Monitoring on M4E ventilation outlet from 16/5/2020 to 15/6/202. The reported VOC exceedance is shown in 2.2.5, all other air quality parameters measured during the same time- period were below limit. These parameters include Carbon Monoxide, Nitrogen Dioxide, Nitrogen Oxides and Solid Particles.

2.2.1 CO 1 hr average

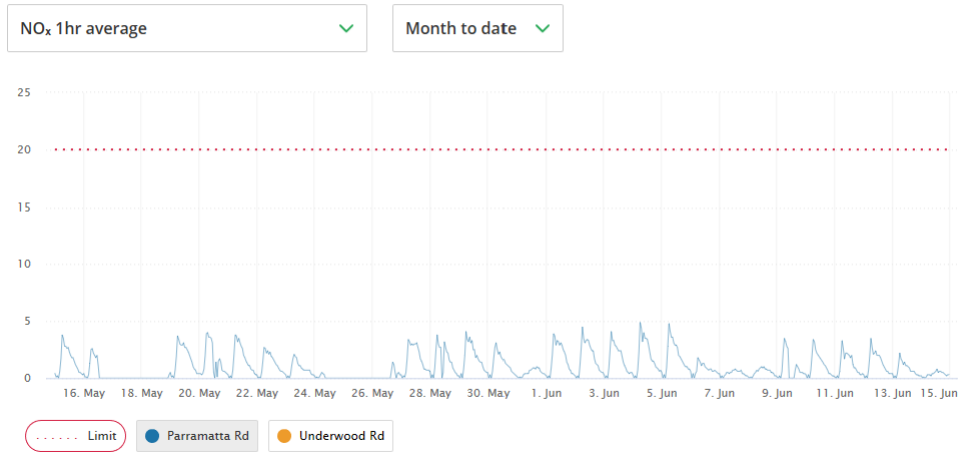


2.2.2 NO2 1 hr average



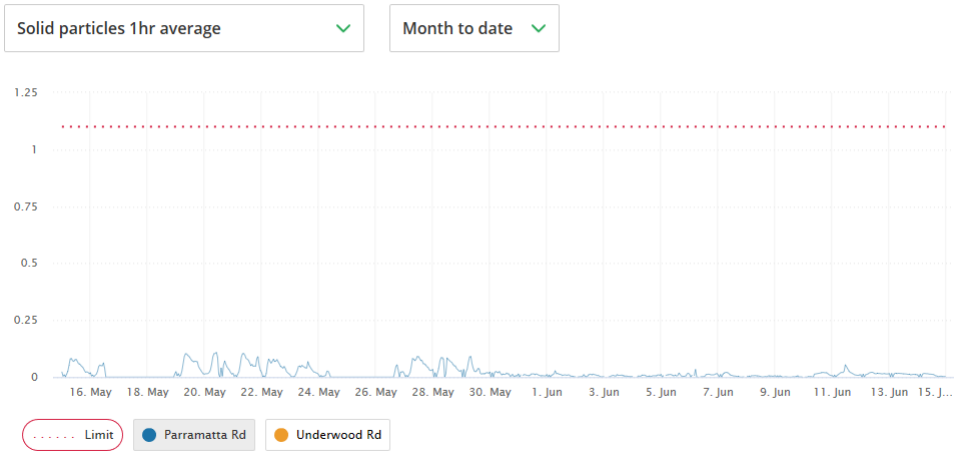
2.2.3 NOx 1 hr average

Air quality over time



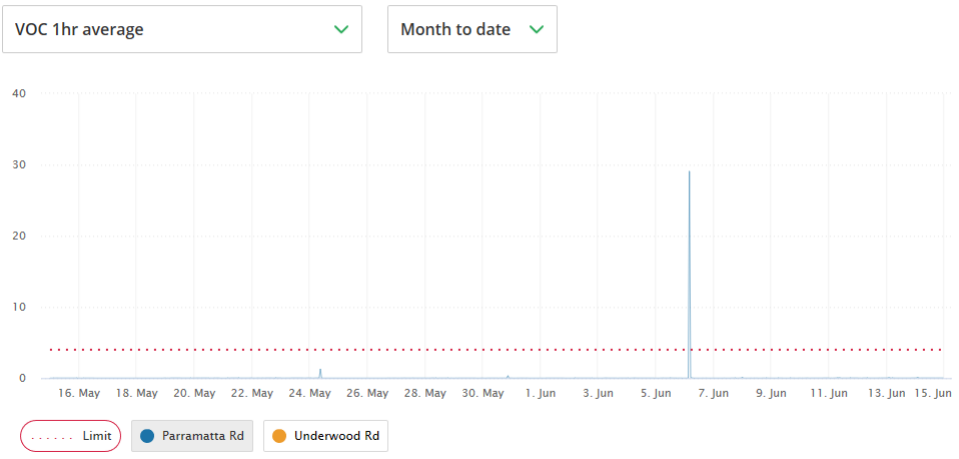
2.2.4 Solid Particles 1 hr average

Air quality over time



2.2.5 VOC 1 hr average

Air quality over time



3 Operations Management Control System (OMCS) Reports

The Operations Management Control System (OMCS) is the overall governing control system that ensures; the motorway operates safely, mitigates the effects of incidents, safeguards from damage and improve situational awareness. The OMCS encompasses the following:

- Traffic Monitoring and Control System (TMCS) – represents the hardware and software systems and equipment that monitor and control all traffic-related devices on the Motorway, in real time. The TMCS enables the operators to control and observe the status of traffic control devices
- Plant Monitoring and Control System (PMCS) – represents the hardware and software systems and equipment that monitor and control Motorway plant, sub-systems and equipment in real time. The PMCS enables the MCC Operator to observe the status and control of tunnel including pumps, lighting, ventilation, drainage and fire protection systems as required to provide effective response to incidents.
- Incident Management System (IMS) – provided as part of the PMCS/TMCS control system software. The IMS provides the interface through which operators will manage events. The system will:
    - Ensure that an operator's actions are consistent with agreed pre-planned ITPs and TCPs
    - Automate operator tasks
    - Control sub-systems
    - Record details of actions and incident information for incident de-briefing

3.1 Calibration Records on OMCS

Parramatta Road Ventilation Facility (PRVF) uses computerized multi-gas calibration system which is a computer controlled, state-of-the-art instrument for dynamic calibration of air analysers. It automatically performs zero and span calibrations using N, NO, CO, O3 and CH4. The air quality analyser responsible for recording the above-limit data was the thermo-scientific 55i VOC analyser.

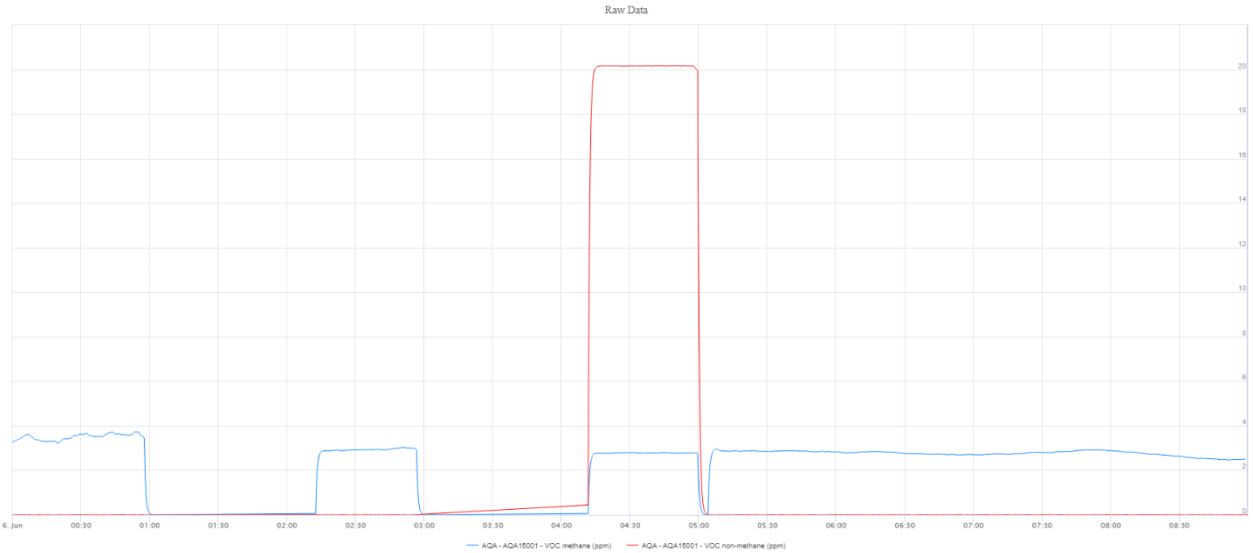
The calibration data consists of a comparison of desired versus actual flow over the full dynamic range of the instrument with linear interpolation between points. Calibration data is transferred to the OMCS for monitoring.

The computerized calibration system allows automatic calculation of dilution and span gas flows based on commanded concentration and eliminates the need for manual computation and allows rapid transition from point to point.

The following graph (3.2.1) below displays raw data captured from the OMCS AQA15001 two hours before, during and two hours after the exceedance event on 6th June 2020. The blue line represents VOC methane and red line represents VOC non-methane and indicates that the above-limit exceedance was related to non-methane gas readings.

A record showing the daily calibration times for AQA15001 on 6th June 2020 is displayed (3.2.2). Calibration initiation occurred at 4:11 am, which correspondence to the exact start time of the VOC over-limit exceedance. The 1 status denotes calibration initiation.

3.1.1 Raw data from OCMS from AQA15001 VOC (ppm) 6.6.2020



3.1.2 OCMS Daily Report for Calibration hours – VOC instrument

WestConnex

Generation date: 2020-06-22 15:28:36
User:

Grouping period: Raw data
Start Date: 2020-06-05 00:00:00
End Date: 2020-06-08 00:00:00

Date	AQA AQA15001 Analyser calibration status
2020-06-05 00:00:00	0
2020-06-05 00:57:32	1
2020-06-05 02:12:37	0
2020-06-05 02:56:32	1
2020-06-05 04:11:37	0
2020-06-06 00:57:36	1
2020-06-06 02:12:30	0
2020-06-06 02:56:35	1
2020-06-06 04:11:35	0
2020-06-07 00:58:17	1
2020-06-07 02:13:16	0
2020-06-07 02:57:15	1
2020-06-07 04:12:16	0

3.2 Events report

The events report extracted from the OMCS on M4E eastbound on the 6th June 2020, 1300 hrs to 0900 hrs was examined. This period covers primarily the lead up to the exceedance and four hours after the exceedance. Free flow traffic was recorded suggesting no incidents, including traffic congestion, stopped vehicles, vehicle accidents or spills, occurred at the time of the reported VOC exceedance.

4 Root Cause

The air quality analyser AQA15001 automatically calibrates at set time intervals and is required to do so by Australian Standards method AS3580 to pass validation criteria. Previously, Ecotech, technical specialists, have reported and corrected technical faults with the air quality analysers at Parramatta Road and Underwood Road ventilation facilities.

Investigation of OMCS data from AQA15001 suggest that the above-limit VOC exceedance occurred at the exact time as a daily automatic calibration sequence. From examining calibration time points and the raw data generated from AQA15001 on the 6th June 2020 (Section 3), the analyser appears to be functioning correctly at all calibration time points examined, except for the time point when the above-limit exceedance occurred. It is suggestive the relay responsible for triggering a calibration sequence has temporarily malfunctioned.

5 Recommendations

System engineers are continually working on the back end of the OMCS to recognise when a calibration sequence is active and flag the data as invalid and hence prevent uploading invalid data to the Linkt website. Since the completion of rectification works by Ecotech and system engineers, this investigation suggests that air quality analyser AQA15001 overall undergoes routine calibration without uploading invalid data to the linkt website and the one-off VOC above-limit at calibration time 4:11 am on 6th June 2020 was atypical. At this stage, continued monitoring of calibration data for drifting or fault issues and necessary adjustments by specialist technicians in compliance with Australian Standard methods is recommended.

6 Conclusion

The above-limit VOC reading at Parramatta Road Ventilation Facility of 29.1mg/m^3 on the 6th of June 2020 can be attributed to invalid calibration data uploading to the operational management control system (OMCS).

In-tunnel CO, NO_2 and visibility readings were all below the limits specified. No incident event reports prior, during and following the reported above-limit reading were observed. Overnight calibration coincides with the time of the exceedance. The conclusion is that the above-limit exceedance event is not attributed to a valid exceedance but due to calibration data uploading to the system.

The immediate notification of ventilation outlet above-limit reading was issued to Secretary, EPA and NSW Health on 6th June 2020, as outlined in the requirements under MCoA E16.

Continued monitoring of AQA15001 to detect further instrumental error or necessary calibration adjustments is recommended.

7 Definition and Acronyms

	Description
AQA	Air Quality Analyser
AQS	Air Quality Sensor
NOx	The total concentration of all nitrogen oxide gases.
NO2	Nitrogen Dioxide
OMCS	Operations Management Control System
PMCS	Plant Monitoring and Control System
PRVF	Parramatta Road Ventilation Facility
TMCS	Traffic Monitoring and Control System
URVF	Underwood Road Ventilation Facility
VOC	Volatile Organic Compounds, including Methane, Benzene, Toluene, Xylenes, 1,3-Butadiene, Formaldehyde and Acetaldehyde

8 Reference Documents

Document Number	Document Title	Rev.
M4E-CP-OPM-PWD-09062	M4 East Operation & Maintenance Manual (Vol. 5) - Part 1. OMCS – SIDERA	B
M4E-CP-OPM-PWD-09950	M4 East Operation & Maintenance Manual (Vol. 5) - Part 4.1. PMCS – Tunnel Ventilation System	B
M4E-CP-OPM-PWD-08774	M4 East Operation & Maintenance Manual (Vol. 4) - Part 6. Tunnel Ventilation System	B
M4E-CP-OPM-PWD-08726	M4 East Operation & Maintenance Manual (Vol. 2) - Part 11. Air Quality Monitoring System	B
M4E-60-657a-T015-00003-A-PD6	Operation and Maintenance Manual (Tunnel Sensors)	V1.5
M4E-60-673-T012-00005-00	Envista ARM Software	
M4E-60-673-T015-00001-00	Ventilation Stack Monitoring Operation and Maintenance Manual – Continuous Emission Monitoring Systems (CEMS)	0
M4E-60-673-T012-00003-00	Environics 6100 Gas Dilution Calibrator	
AS3580.9.11	Methods for sampling and analysis of ambient air - Part 9.11: Determination of suspended particulate matter - PM10 beta attenuation monitors	