Fulton Hogan Egis Operations & Maintenance

WestConnex M8

In-Tunnel Eastbound and Westbound

Validated Air Quality Monitoring Report

1st October 2020 – 31st October 2020

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Revision History			
Revision	Report ID	Date	Analyst
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Executive Summary

The WestConnex – M8 tunnel runs from the King Georges Rd Interchange at Beverly Hills to a new interchange at St Peters. The St Peters Interchange connects to the local road network through Euston Rd, Campbell Rd and Gardeners Rd. It also connects to future projects such as the M4-M5 Link, M6 extension and Sydney Gateway. It comprises two new two-lane tunnels, with capacity to add a third, of approximately 9 km that feature various ventilation plant, equipment and air quality monitors to ensure pollutants do not exceed the targets and limits set by the Minster's Conditions of Approval (SSI 6788). The WestConnex M8 tunnel officially opened to the public on 5th July 2020.

M8 air quality is monitored by a large number of sensors and measures various pollutants across three main areas:

- *Ambient air* - air quality in the areas around the M8 tunnels
- *Ventilation* - air quality around the ventilation stacks
- *In Tunnel* - air quality inside the tunnels and portals (entrances to the tunnel)

This Monthly Air Quality Monitoring Report details the in-tunnel air quality measurements. It is part of the commitment to the Minister and the community to report air quality measurements in real time (raw data as the measurements occur) as well as validated reports. It is important to re-publish the data in reports because the raw data needs to be checked and collated by approved air quality experts and 'translated' into a format that is easy to understand and can be interpreted by both experts and lay people.

This report details validated results of the 20 in-tunnel air quality sensors between the 1st – 31st October 2020.

Report Summary

Overall percentage availability for Eastbound parameters and Westbound parameters at WestConnex M8 In-tunnel was above 95% during the reporting month as shown in Tables 8 and 9.

There were no exceedances of the air quality goals at the WestConnex M8 In-Tunnel Air Quality Network for the reporting month.

1.0 Introduction

Ecotech Pty Ltd was commissioned by Fulton Hogan Egis O&M Pty Ltd to undertake the continuous emission monitoring maintenance and data reporting for the WestConnex M8 In-tunnel sensors, located as detailed in Tables 1 and 2. Ecotech commenced data collection in July 2020.

This report presents the validated data for 1st – 31st October 2020.

The data presented in this report:

- Describes in-tunnel air quality measurements;
- Compares monitoring results;
- Reports any readings above the WestConnex M8 In-tunnel limits;
- Has been quality assured

2.0 Monitoring and Data Collection

2.1. Siting Details

The In-tunnel monitoring network consists of twenty air quality sensors attached to the walls of both eastbound and westbound tunnels. The asset IDs of the sensors are shown in Table 1 and Table 2, and the locations are shown in Figures 1-4.

Table 1: In-Tunnel Air Quality Sensors - Eastbound

Asset ID	Location Information
AQS31304	LEP31503
AQS31501	XP03 (STUB)
AQS31503	XP10
AQS31602	XP24
AQS31603	XP26
AQS31604	XP28
AQS31701	XP30
AQS31801	XP64
AQS32501	XP03 (mainline)
AQS32502	XP01

Table 2: In-Tunnel Air Quality Sensors - Westbound

Asset ID	Location Information
AQS31001	XP03 (STUB)
AQS31002	XP09 (STUB)
AQS31101	XP10 (mainline)
AQS31103	XP24
AQS31201	XP28
AQS31205	XP62
AQS31303	XP73
AQS31804	LEP31003
AQS32001	XP01
AQS32002	XP09A

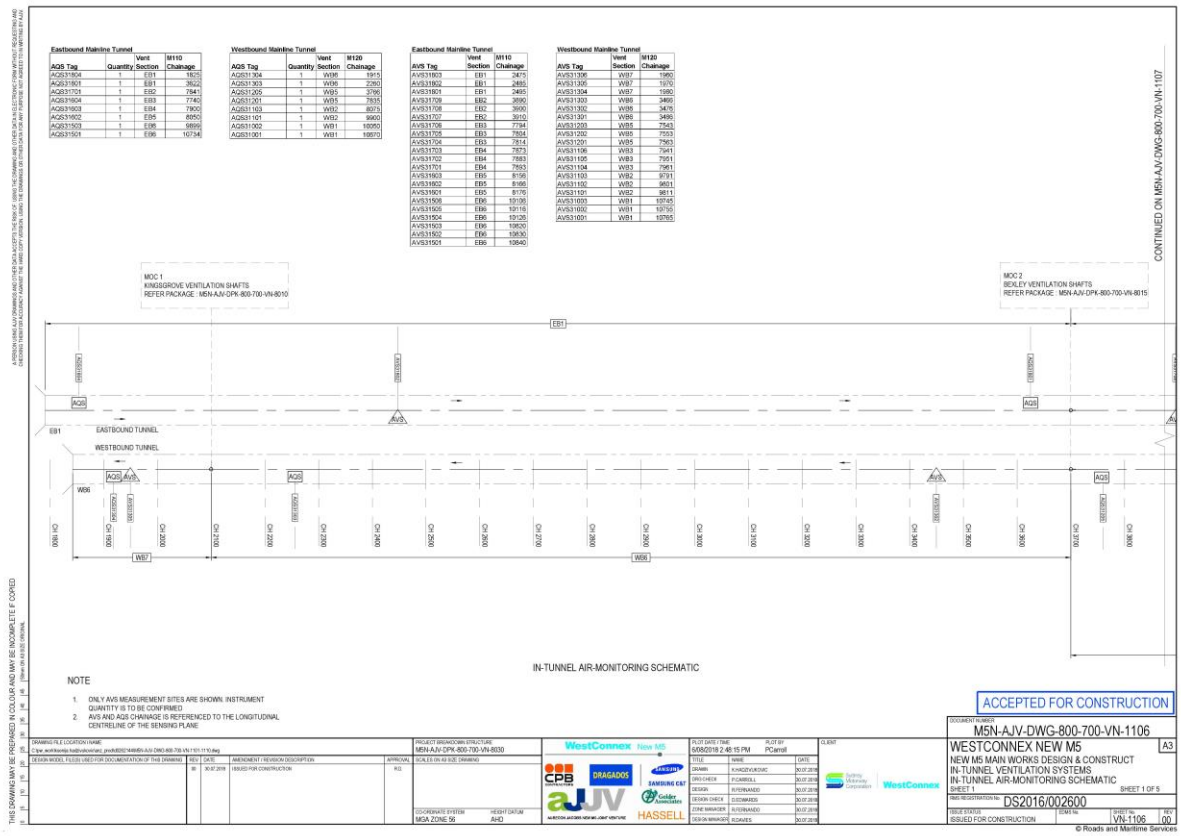

Figure 1: WestConnex M8 In-Tunnel AQS Network Diagram 1

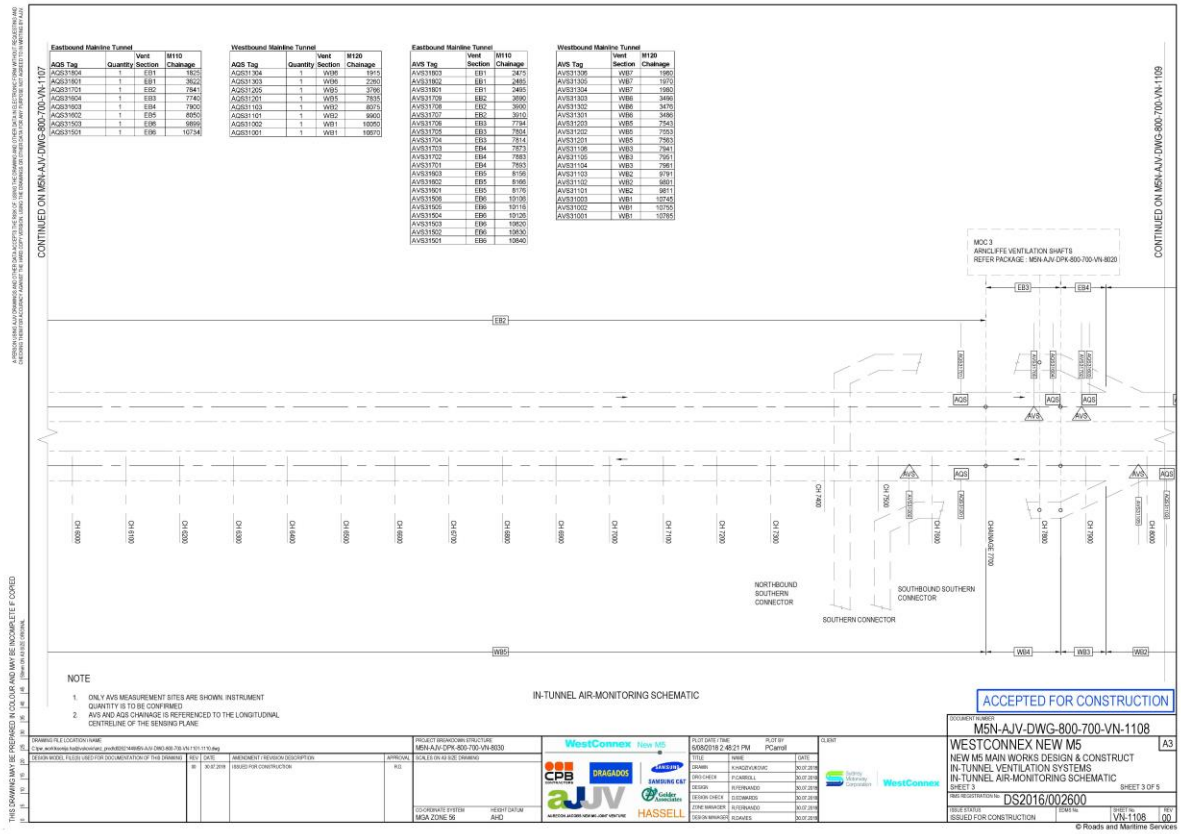

Figure 2: WestConnex M8 In-Tunnel AQS Network Diagram 2

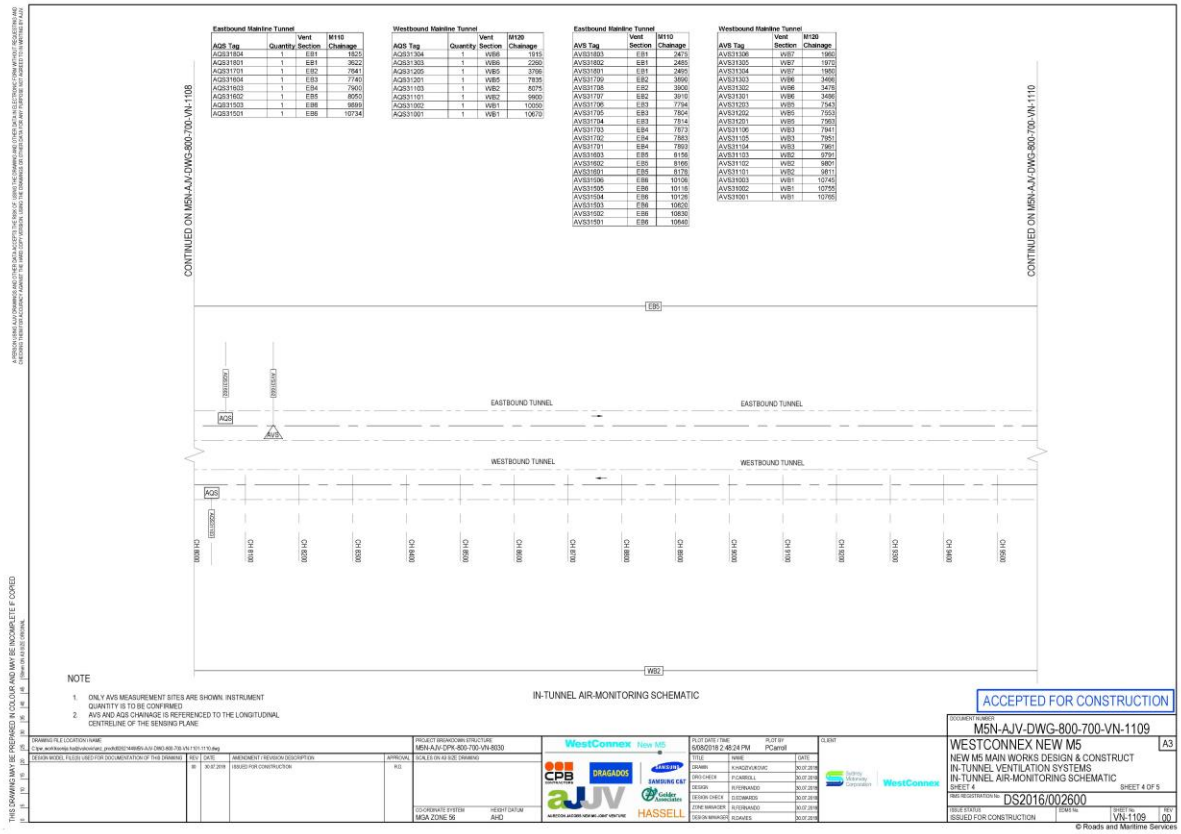

Figure 3: WestConnex M8 In-Tunnel AQS Network Diagram 3

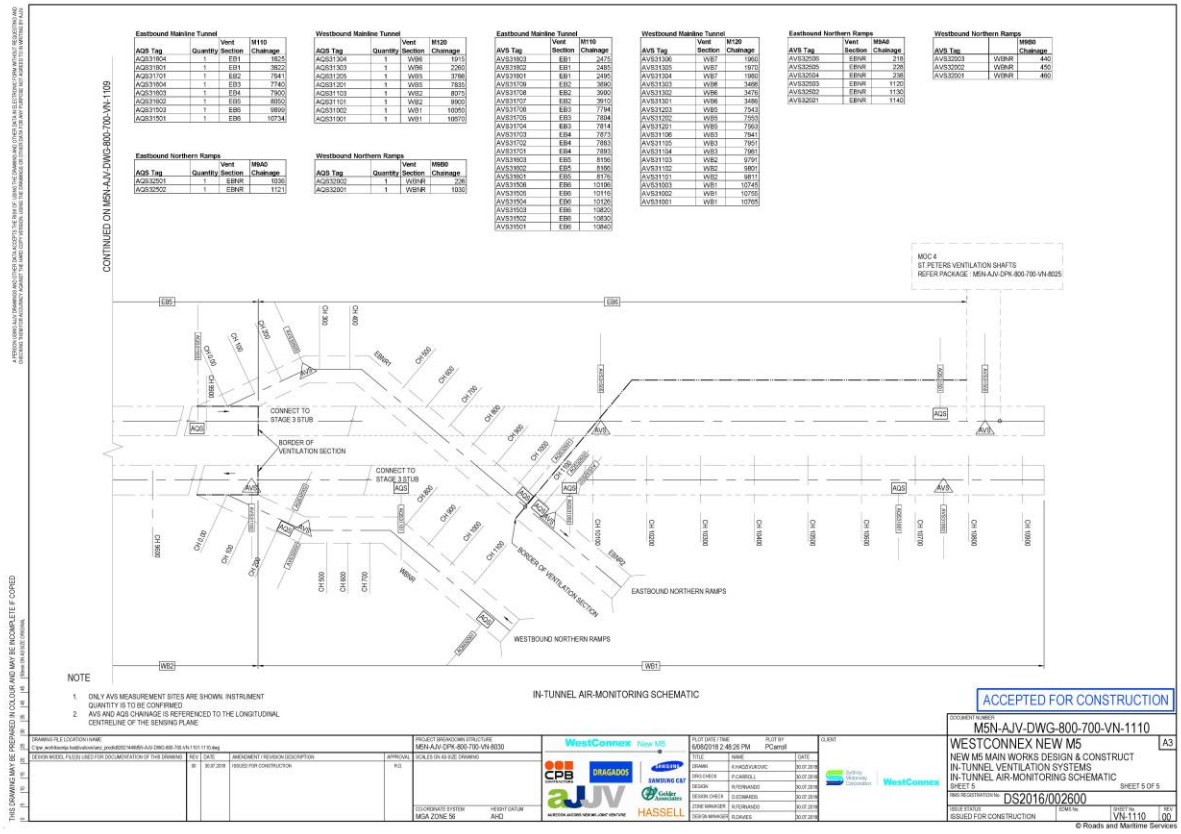

Figure 4: WestConnex M8 In-Tunnel AQS Network Diagram 4

2.2. Monitored Parameters

Table 3 below details the parameters monitored and the instruments used at the monitoring network. Appendix 1 defines any abbreviated parameter names used throughout the report.

Table 3: Parameters measured at the West Connex M8 In-tunnel Air Quality Network

Parameter Measured	Instrument Type	Units	Resolution
Visibility	VICONOX-5	m^{-1}	0.0001 m^{-1}
CO	VICONOX-5	ppm	0.1 ppm
NO_2	VICONOX-5	ppm	0.01 ppm

2.3. Data Collection Methods

Table 4 below shows the methods used for data collection. Any deviations from the stated methods are detailed in section 2.3.1.

Table 4: Methods

Parameter Measured	Data Collection Methods Used	Description of Method
Visibility	VICONOX Manual	Open path visibility measurement using light transmission opacity technique
CO	VICONOX Manual	Open path infrared spectroscopy technique for CO measurement
NO_2	VICONOX Manual	Open path direct optical measurement of nitrogen dioxide (NO_2) using differential absorption

2.3.1. Data Acquisition

Data acquisition is performed using the WestConnex M8 Tunnel Control System. The recorded data is supplied to Ecotech by the customer and stored at Ecotech's Environmental Reporting Services (ERS) department in Melbourne, Australia. Data samples are logged in one-second intervals and provided to Ecotech as one record per minute.

2.4. Data Validation and Reporting

2.4.1. Validation

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 one-minute data.

3.0 Air Quality Goals

The air quality goals and criteria for pollutants monitored at the WestConnex – M8 In-Tunnel are based on CoA SSI 6788 E2-E9 and E23-E30. The In-Tunnel air quality criteria are shown in Table 5 below.

Table 5: WestConnex – M8 In-Tunnel Air Quality Criteria

Parameter	No. Monitoring Points	Time Period	Goal Level	Units
CO	Single Point	Rolling 3-minute	200	ppm
	Average along length of tunnel	Rolling 15-minute	87	ppm
	Average along length of tunnel	Rolling 30-minute	50	ppm
NO_2	Average along length of tunnel	Rolling 15-minute	0.5	ppm
Visibility	Average along length of tunnel	Rolling 15-minute	0.005	m^{-1}

4.0 Calibrations and Maintenance

4.1. 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 and 7 indicate when the monitoring equipment was last maintained/calibrated.

Table 6: WestConnex – M8 In-Tunnel Eastbound Maintenance Table October 2020

Asset ID	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
AQS31304	26/05/20	Commissioning	26/05/20	Yearly
AQS31501	25/05/20	Commissioning	25/05/20	Yearly
AQS31503	06/04/20	Commissioning	06/04/20	Yearly
AQS31602	11/05/20	Commissioning	11/05/20	Yearly
AQS31603	28/10/20	Removed for repair	11/05/20	Yearly
AQS31604	28/10/20	Scheduled	28/10/20	Yearly
AQS31701	28/10/20	Scheduled	28/10/20	Yearly
AQS31801	27/10/20	Scheduled	27/10/20	Yearly
AQS32501	22/05/20	Commissioning	22/05/20	Yearly
AQS32502	29/10/20	Unscheduled	29/10/20	Yearly

Table 7: WestConnex – M8 In-Tunnel Westbound Maintenance Table October 2020

Asset ID	Date of Last Maintenance	Maintenance Type	Date of Last Calibration	Calibration Cycle
AQS31001	25/05/20	Commissioning	25/05/20	Yearly
AQS31002	06/05/20	Commissioning	06/05/20	Yearly
AQS31101	01/04/20	Commissioning	01/04/20	Yearly
AQS31103	26/05/20	Commissioning	26/05/20	Yearly
AQS31201	20/05/20	Commissioning	20/05/20	Yearly
AQS31205	03/04/20	Commissioning	03/04/20	Yearly
AQS31303	20/05/20	Commissioning	20/05/20	Yearly
AQS31804	27/10/20	Scheduled	27/10/20	Yearly
AQS32001	07/05/20	Commissioning	07/05/20	Yearly
AQS32002	06/05/20	Commissioning	06/05/20	Yearly

5.0 Results

5.1. Data Capture

Valid data capture is based on one-minute data, and refers to the amount of valid data collected during the report period.

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

Valid data capture = (Reported air quality data / Total data) x 100%

Where:

- Reported air quality data = Number of instrument readings which have been validated through a quality assured process and excludes all data errors, zero data collection due to calibration, failures and planned and unplanned maintenance.
- Total data = Total number of 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 1-minute data collected over a month of 31 days, the total data would be equal to 60 (one-minute samples in an hour) x 24 (hours in a day) x 31 (days in a month) = 44,640 samples.

Tables 8 and 9 display data capture statistics for October 2020. **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 Table in section 6.0.

Table 8: Monthly Data Capture for WestConnex M8 In-Tunnel Eastbound Sensors

Asset ID	Parameter	Data Capture (%)
AQS31304	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31501	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31503	CO	98.4
	NO_2	98.4
	Visibility	98.4
AQS31602	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31603	CO	**89.0**
	NO_2	**89.0**
	Visibility	**89.0**
AQS31604	CO	98.7
	NO_2	98.7
	Visibility	98.7
AQS31701	CO	98.7
	NO_2	98.7
	Visibility	98.7
AQS31801	CO	98.7
	NO_2	98.7
	Visibility	98.7
AQS32501	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS32502	CO	**9.4**
	NO_2	**9.4**
	Visibility	**9.4**
Eastbound Overall	**CO**	**98.8**
	NO_2	**98.8**
	Visibility	**98.8**

Table 9: Monthly Data Capture for WestConnex M8 In-Tunnel Westbound Sensors

Asset ID	Parameter	Data Capture (%)
AQS31001	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31002	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31101	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31103	CO	98.8
	NO_2	**92.7**
	Visibility	98.8
AQS31201	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31205	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31303	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS31804	CO	98.7
	NO_2	98.7
	Visibility	98.7
AQS32001	CO	98.8
	NO_2	98.8
	Visibility	98.8
AQS32002	CO	98.8
	NO_2	98.8
	Visibility	98.8
Westbound Overall	**CO**	**98.8**
	NO_2	**98.8**
	Visibility	**98.8**

5.2. Air Quality Monthly Summary

Tables 10 and 11 below include a summary of exceedances (if any) recorded by the WestConnex M8 In-tunnel sensors during the reported period.

Table 10: WestConnex M8 In-Tunnel Eastbound Exceedance Summary

Parameter	Time Period	Value of Exceedance	Date of Exceedance
CO	Rolling 3-minute	-	-
	Rolling 15-minute	-	-
	Rolling 30-minute	-	-
NO_2	Rolling 15-minute	-	-
Visibility	Rolling 15-minute	-	-

Table 11: WestConnex M8 In-Tunnel Westbound Exceedance Summary

Parameter	Time Period	Value of Exceedance	Date of Exceedance
CO	Rolling 3-minute	-	-
	Rolling 15-minute	-	-
	Rolling 30-minute	-	-
NO_2	Rolling 15-minute	-	-
Visibility	Rolling 15-minute	-	-

5.3. Graphic Representations

Validated one-minute data was used to construct the following monthly graphic representations.

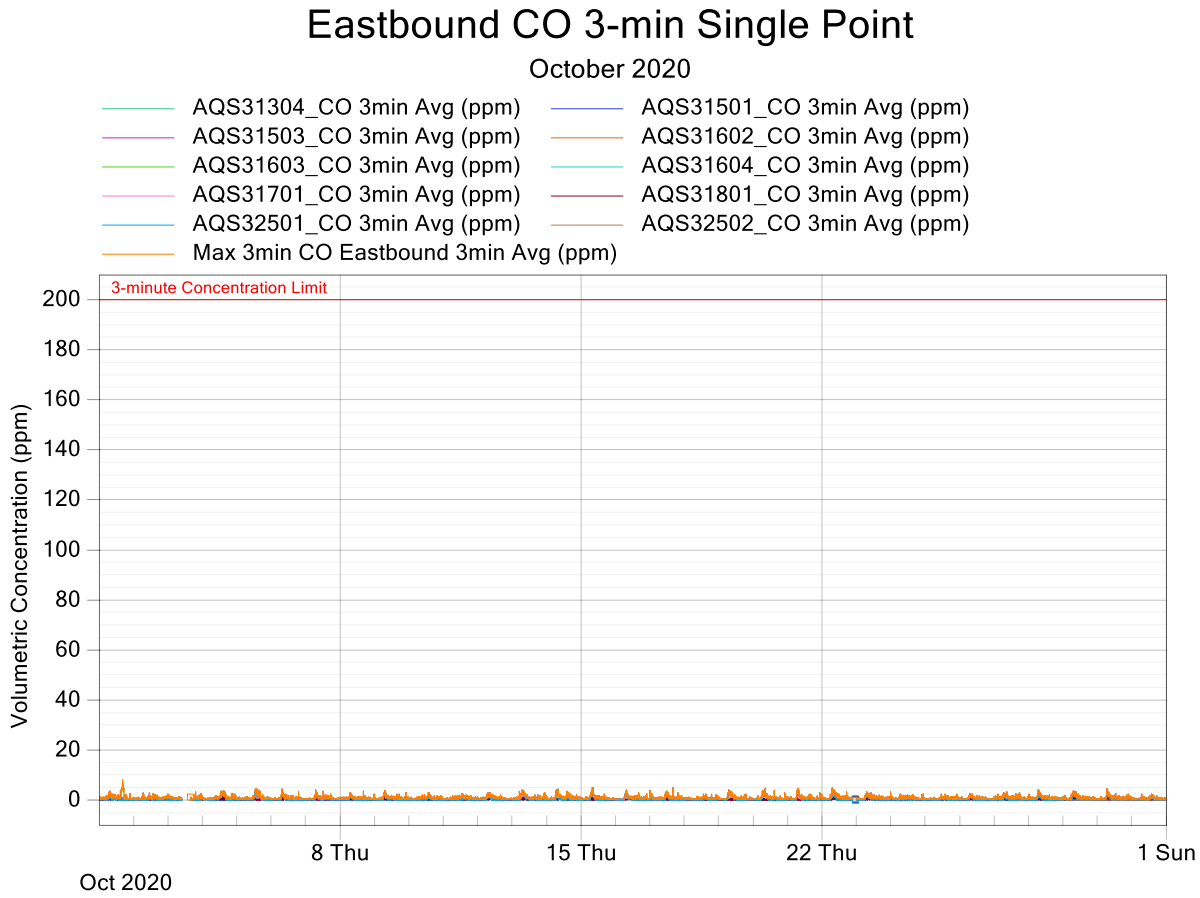

Figure 5: CO 3-minute data October 2020 - Eastbound

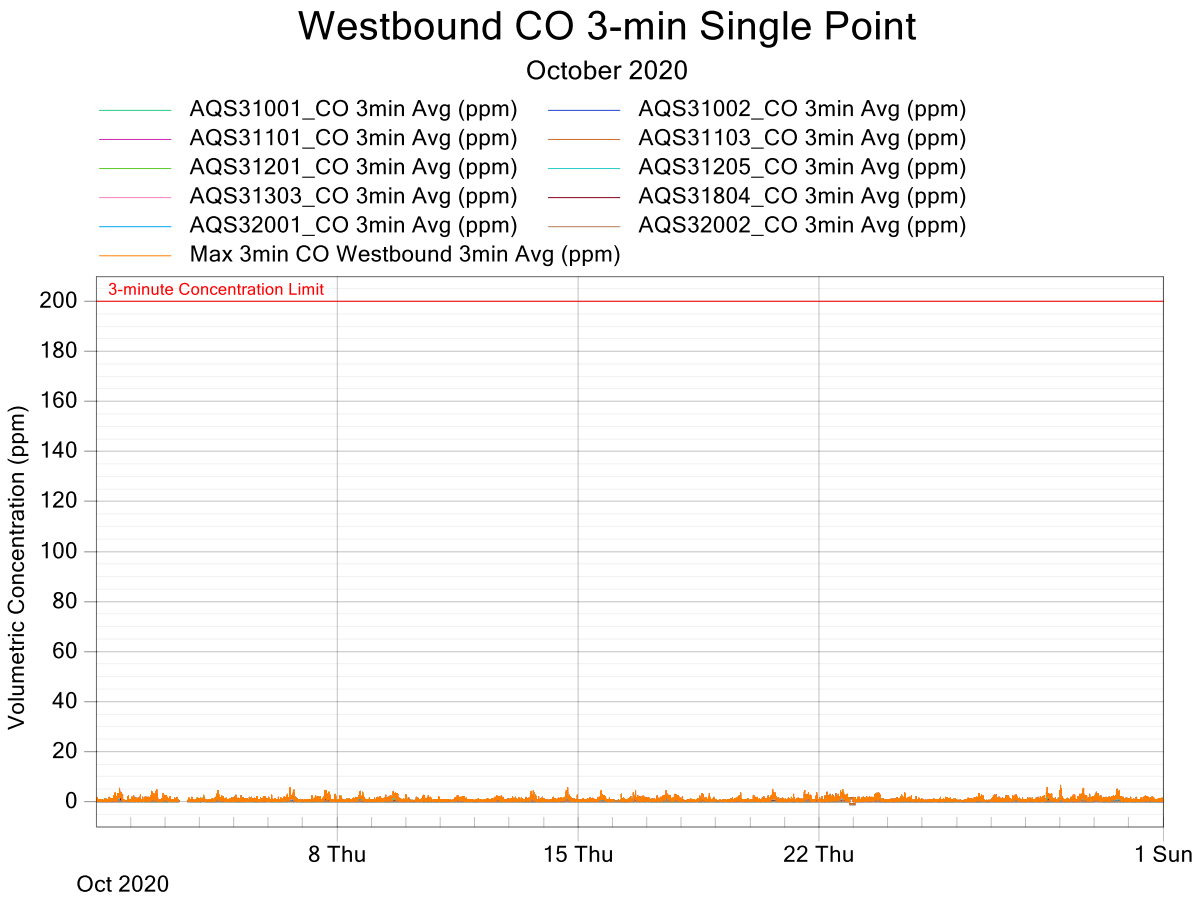

Figure 6: CO 3-minute data for October 2020 - Westbound

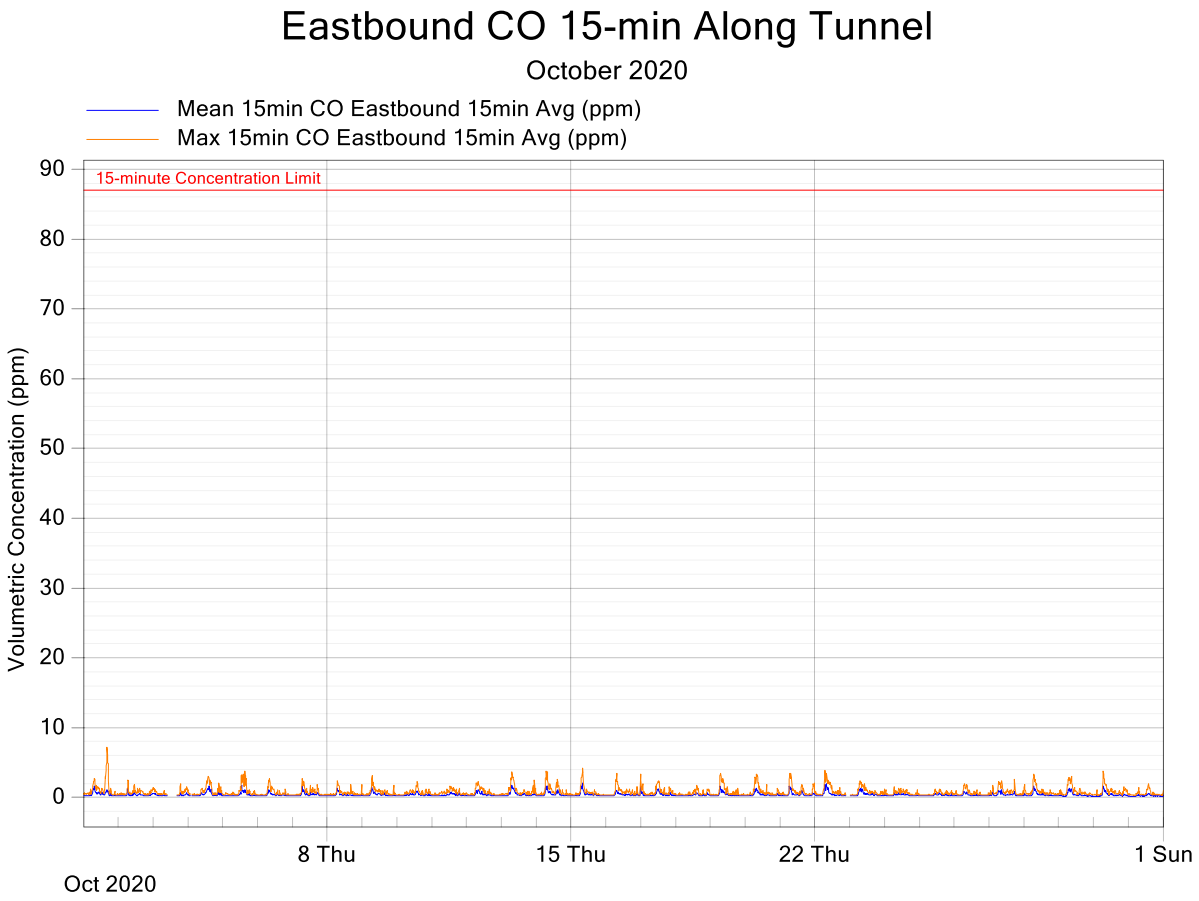

Figure 7: CO 15-minute data for October 2020 - Eastbound

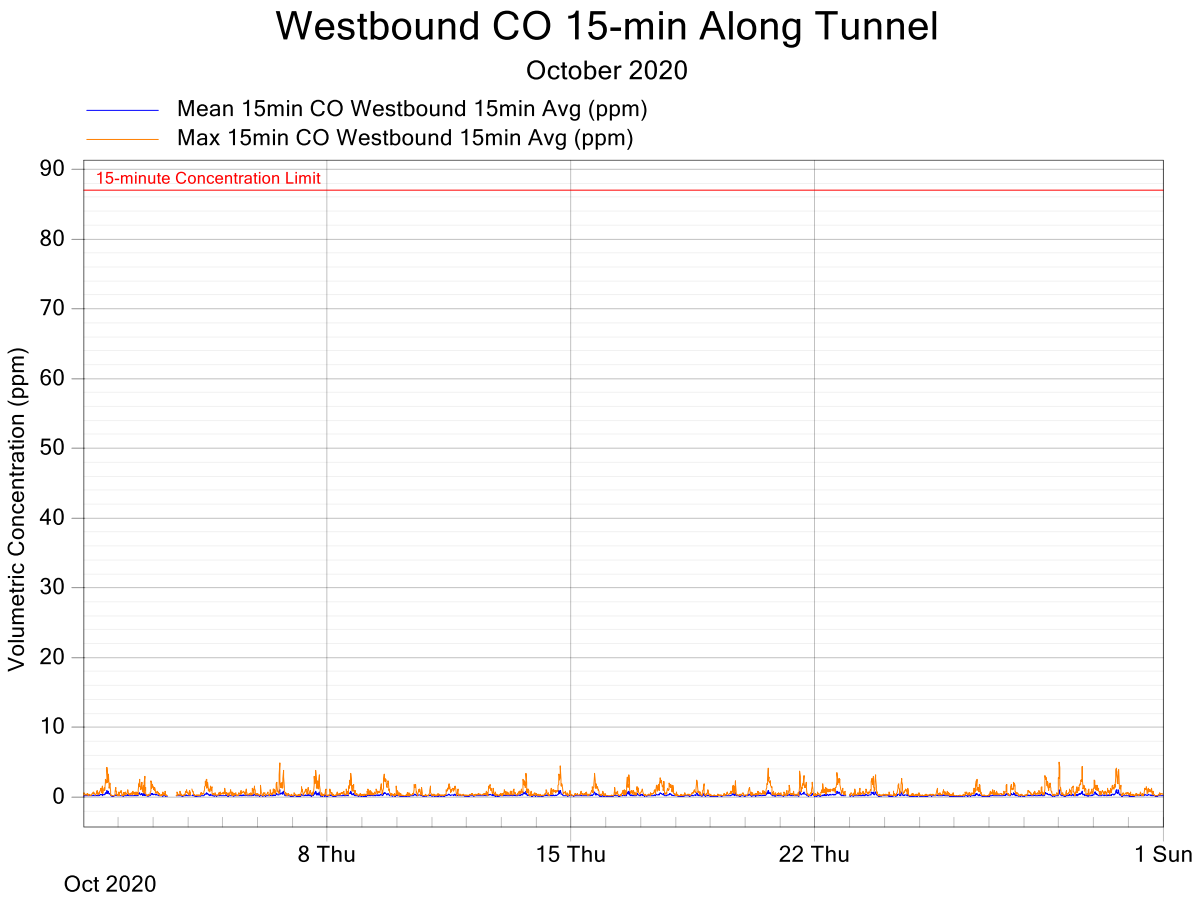

Figure 8: CO 15-minute data for October 2020 - Westbound

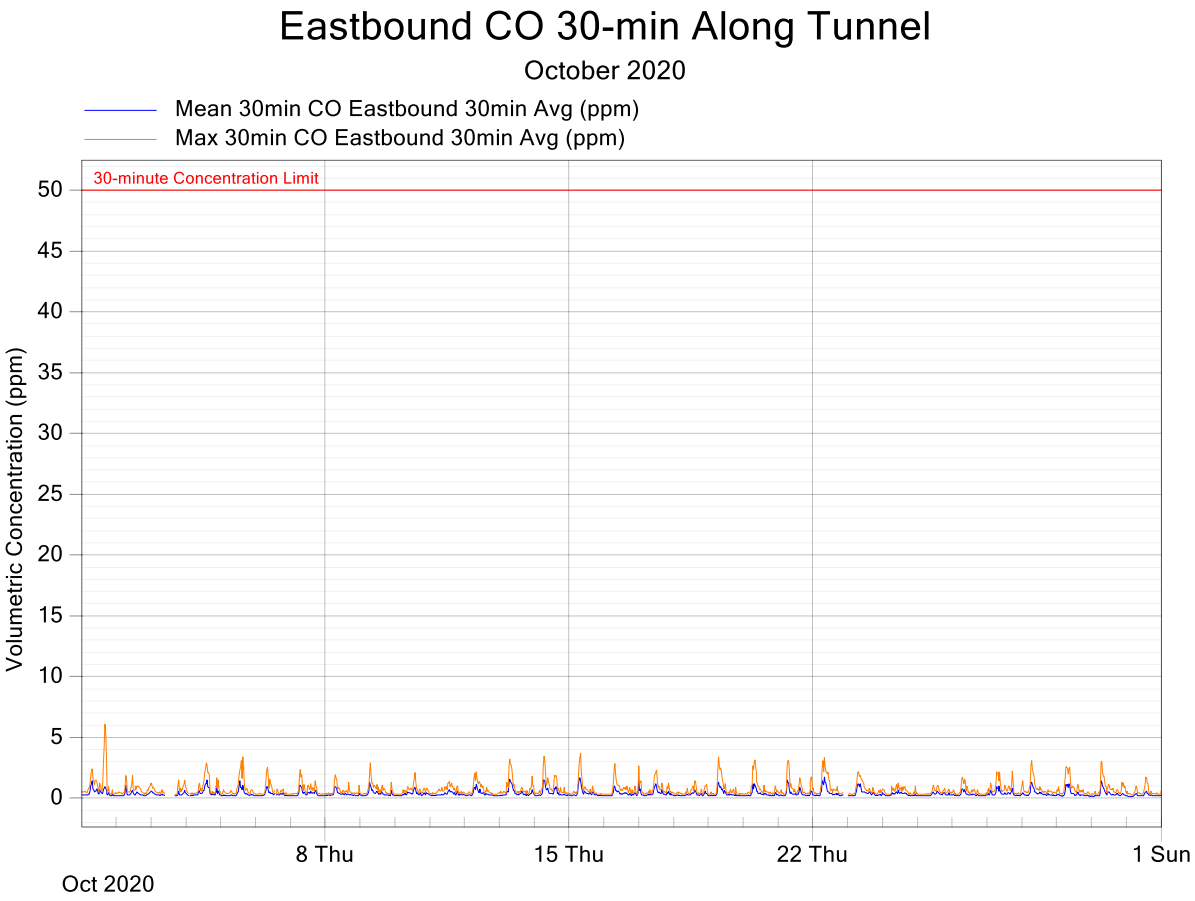

Figure 9: CO 30-minute data for October 2020- Eastbound

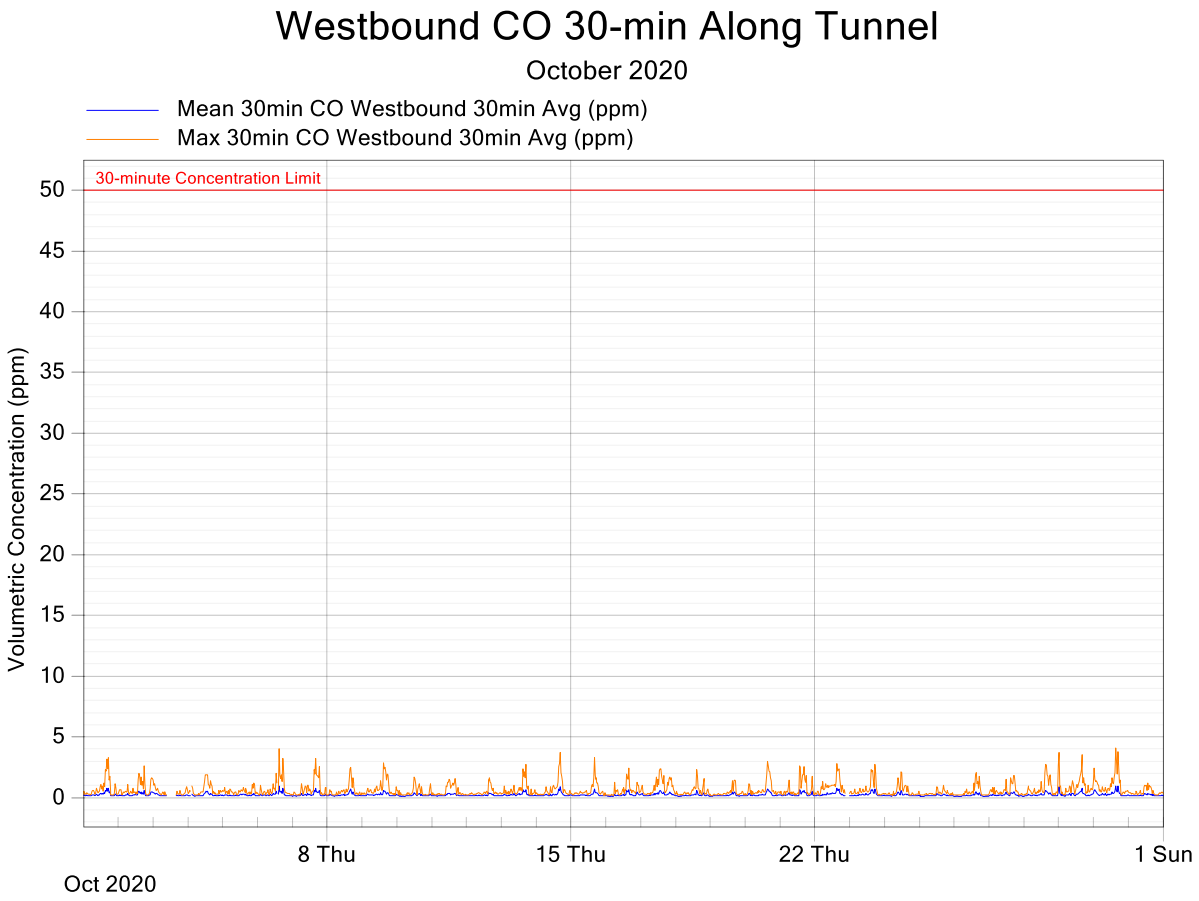

Figure 10: CO 30-minute data for October 2020 - Westbound

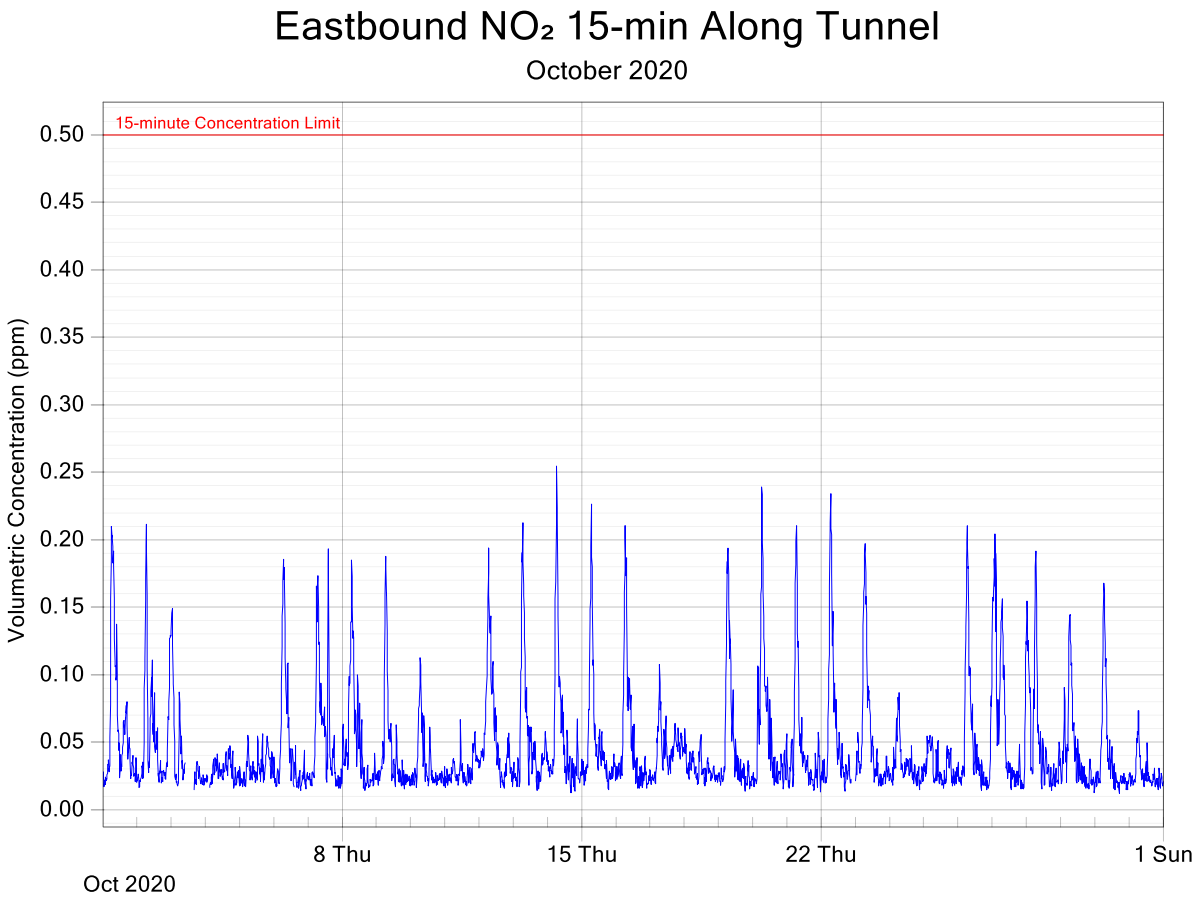

Figure 11: NO_2 15-minute data for October 2020 - Eastbound

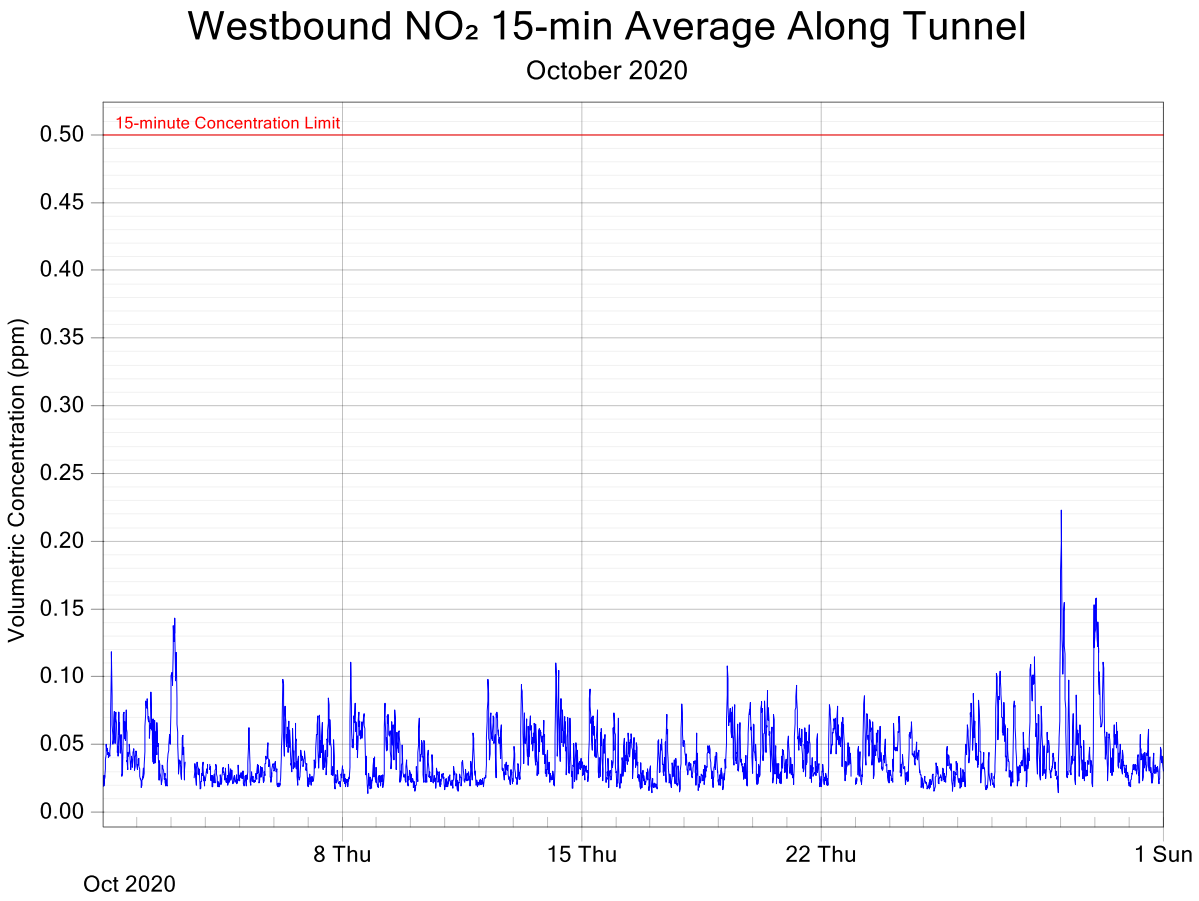

Figure 12: NO_2 15-minute data for October 2020 - Westbound

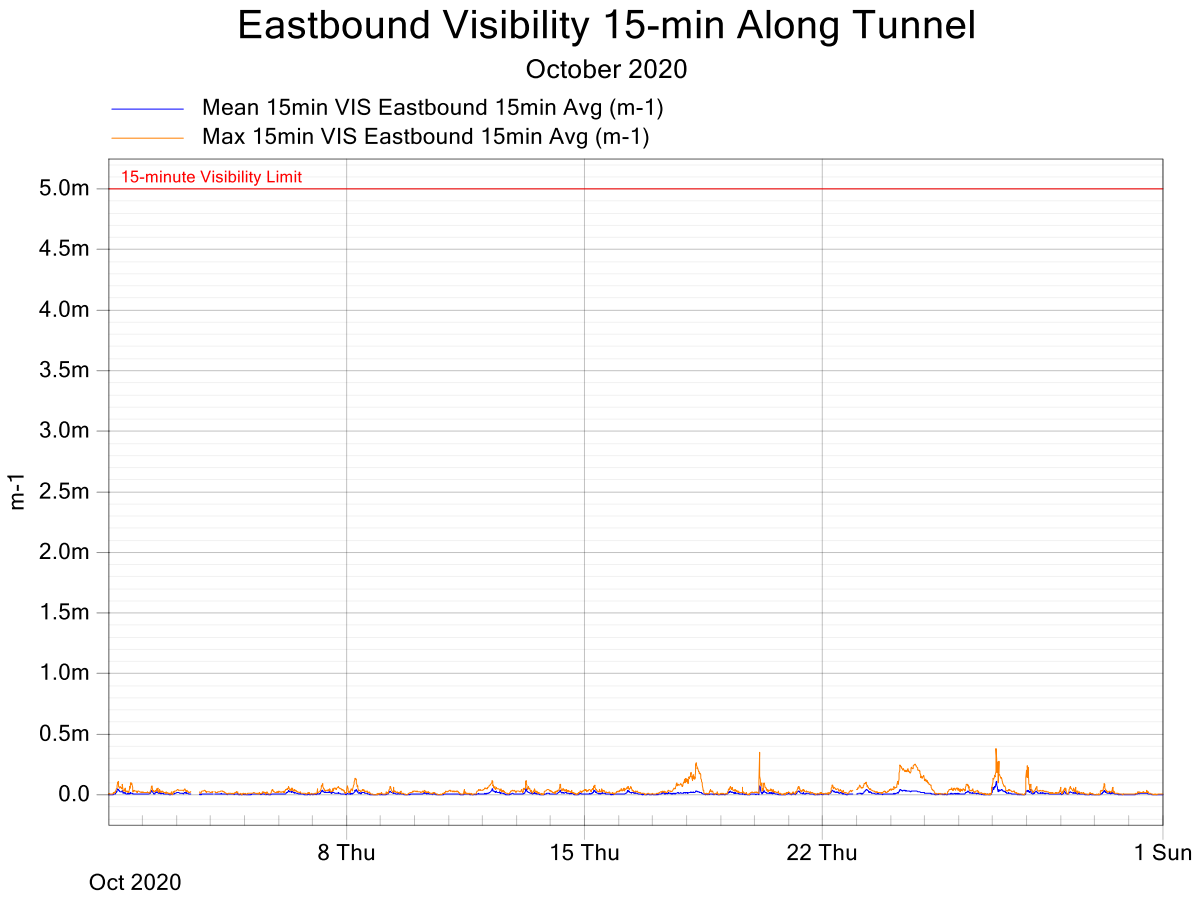

Figure 13: Visibility 15-minute data for October 2020 - Eastbound

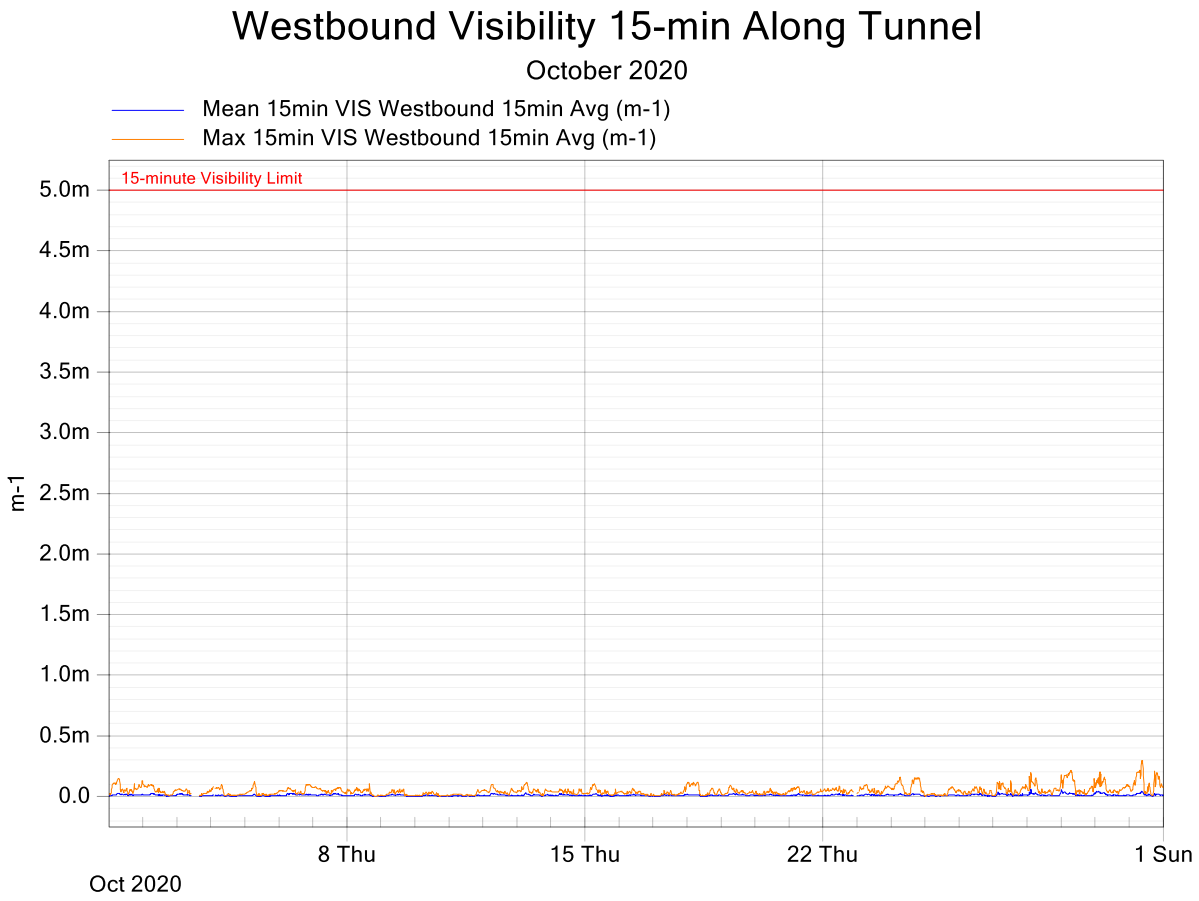

Figure 14: Visibility 15-minute data for October 2020 - Westbound

6.0 Valid Data Exception Tables

Tables 12 and 13 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 12: WestConnex M8 In-Tunnel Eastbound Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
01/10/20 00:00	29/10/20 01:31	Instrument offline	AQS32502 CO, NO_2, VIS	AH	12/11/20
03/10/20 10:14	23/10/20 01:39	Intermittent data gaps	All parameters	AH	12/11/20
27/10/20 01:20	27/10/20 02:20	Scheduled maintenance	AQS31801 CO, NO_2, VIS	AH	12/11/20
27/10/20 01:39	27/10/20 04:19	Instrument offline due to nearby tunnel works	AQS31503 CO, NO_2, VIS	AH	12/11/20
27/10/20 23:23	28/10/20 00:05	Scheduled maintenance	AQS31701 CO, NO_2, VIS	AH	12/11/20
28/10/20 00:13	28/10/20 00:51	Scheduled maintenance	AQS31604 CO, NO_2, VIS	AH	12/11/20
28/10/20 23:23	01/11/20 00:00	Instrument removed for repair	AQS31603 CO, NO_2, VIS	AH	12/11/20
29/10/20 01:32	29/10/20 01:54	Instrument reinstalled	AQS32502 CO, NO_2, VIS	AH	12/11/20

Table 13: WestConnex M8 In-Tunnel Westbound Valid Data Exception Table

Start Date	End Date	Reason	Change Details	User Name	Change Date
03/10/20 10:14	27/10/20 01:38	Intermittent data gaps	All parameters	AH	12/11/20
08/10/20 17:55	30/10/20 09:45	Intermittent unrealistic data	AQS31103 NO_2	AH	12/11/20
26/10/20 23:36	27/10/20 00:33	Scheduled maintenance	AQS31804 CO, NO_2, VIS	AH	12/11/20

7.0 Report Summary

- Overall percentage availability for Eastbound parameters and Westbound parameters at WestConnex M8 In-tunnel was above 95% during the reporting month
- There were no exceedances of the air quality goals at the WestConnex M8 In-Tunnel Air Quality Network for the reporting month.

----------END OF REPORT----------

Appendix 1 - Definitions & Abbreviations

AQS	Air Quality Sensor
CO	Carbon monoxide
CoA	Conditions of Approval
ERS	Environmental Reporting Services
m^{-1}	Inverse metre
NO_2	Nitrogen dioxide
ppm	Parts per million
SSI	State Significant Infrastructure (see SSI 6788)
VIS	Visibility

Appendix 2 - Explanation of Exception Table

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 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.

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

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.

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

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.