Ventia – EastLink Tunnel

Ventilation Stack Air Quality Monitoring Validated Data Report

01 October 2022 to 31 December 2022

Ref: DR.2022Q4.ETL
Issue Date: 27 January 2023
Report prepared by: Tim Allfrey

NATA Accredited Laboratory Number 19660

Accredited for compliance with ISO/IEC17025 – Testing

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian / national standards.

Norditech Pty Ltd
Unit 2/87 Station Road
Seven Hills NSW 2147

1300 572 822

info@norditech.com.au
norditech.com.au

Document Control

Revision	Date	Details	Prepared By	Approved By
0	27/01/2023		TA	BN

Prepared by

Tim Allfrey
27 January 2023

Approved by

Bruno Nourdine
27 January 2023

Distribution

Format	Recipient	Details
PDF	George Vasiliadis	GVasiliadis@connecteast.com.au
PDF	Nick Huntington	NHuntington@connecteast.com.au

Table of Contents

Figures

Tables

1 Executive Summary

EastLink is a 39 km motorway running between Nunawading and Frankston, linking the Eastern, Monash Frankston and Peninsula Link freeways. Two 1.6 km tunnels pass under the Mullum Mullum Valley, with a ventilation stack at the end of each tunnel as an exit point for tunnel ventilation.

Two ventilation stacks provide ventilation for the tunnel, one at the western end of the tunnel at Discharge Point 1 (DP1), and one at the eastern end of the tunnel at Discharge Point 2 (DP2).

This report presents the monthly validated stack data for October 2022 to December 2022 to Ventia Pty Ltd for the EastLink Tunnel.

1.1 Compliance to limits

The Environment Protection Authority (Victoria) designates limits to which pollutant mass rates being discharged from the ventilation stacks must meet. (Environmental Licence No. 2043).

Instances of the ventilation stack pollutants exceeding the EPA Limits goals during the reporting period are presented in Table 1, Table 2 and Table 3 and below. Maximum mass rates are provided for comparison to the limits.

There were nil exceedances of the prescribed limits during the reporting period.

EastLink Ventiliation Stack Air Quality Limit Exceedances October 2022								
Location	Parameter	Time Period	Licence Limit	Units	Maximum Mass Rate	Number of exceedances	Value of exceedance	Date and Time of exceedance
Western Ventilation Stack (Discharge Point 1)	NO_2	1 hour	3.98	kg/h	0.35	-	-	-
	CO	1 hour	112	kg/h	3.98	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.22	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.71	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO_2	1 hour	3.98	kg/h	0.61	-	-	-
	CO	1 hour	112	kg/h	8.15	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.16	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.61	-	-	-

Table 1: October 2022 Exceedances of EPA Limits

EastLink Ventiliation Stack Air Quality Limit Exceedances November 2022								
Location	Parameter	Time Period	Licence Limit	Units	Maximum Mass Rate	Number of exceedances	Value of exceedance	Date and Time of exceedance
Western Ventilation Stack (Discharge Point 1)	NO_2	1 hour	3.98	kg/h	0.36	-	-	-
	CO	1 hour	112	kg/h	4.06	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.18	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.56	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO_2	1 hour	3.98	kg/h	0.66	-	-	-
	CO	1 hour	112	kg/h	8.21	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.18	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.40	-	-	-

Table 2: November 2022 Exceedances of EPA Limits

EastLink Ventiliation Stack Air Quality Limit Exceedances December 2022								
Location	Parameter	Time Period	Licence Limit	Units	Maximum Mass Rate	Number of exceedances	Value of exceedance	Date and Time of exceedance
Western Ventilation Stack (Discharge Point 1)	NO_2	1 hour	3.98	kg/h	0.38	-	-	-
	CO	1 hour	112	kg/h	4.56	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.20	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.31	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO_2	1 hour	3.98	kg/h	0.70	-	-	-
	CO	1 hour	112	kg/h	7.92	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.17	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.35	-	-	-

Table 3: December 2022 Exceedances of EPA Limits

1.2 Summary of Results

Summaries of the ventilation stack pollutants for the reporting period are presented in Table 4, Table 5 and Table 6 below. Maximum mass rates are provided for comparison to the limits.

EastLink Ventilation Stack Summary October 2022							
Location	Parameter	1hr Average Maximum	1 hr Average Minimum	Monthly Average	Monthly Total	Number of Exceedances	Data Availability (%)
Western Ventilation Stack	NO (kg/h)	3.73	-0.03	0.69	492.71	N/A	95.4%
	NO_2 (kg/h)	0.35	-0.01	0.07	46.62	0	95.4%
	CO (kg/h)	3.98	-0.03	1.14	806.75	0	95.4%
	$PM_{2.5}$ (kg/h)	0.22	0.00	0.03	24.58	0	99.9%
	PM_{10} (kg/h)	0.71	0.00	0.06	42.78	0	99.6%
Eastern Ventilation Stack	NO (kg/h)	3.22	-0.21	0.76	533.68	N/A	94.5%
	NO_2 (kg/h)	0.61	0.00	0.15	105.13	0	94.5%
	CO (kg/h)	8.15	-0.04	1.89	1342.09	0	95.6%
	$PM_{2.5}$ (kg/h)	0.16	0.00	0.04	26.76	0	99.7%
	PM_{10} (kg/h)	0.61	0.00	0.07	53.03	0	99.2%

Table 4: October 2022 Summary of results

EastLink Ventilation Stack Summary November 2022							
Location	Parameter	1hr Average Maximum	1 hr Average Minimum	Monthly Average	Monthly Total	Number of Exceedances	Data Availability (%)
Western Ventilation Stack	NO (kg/h)	3.78	-0.02	0.75	514.85	N/A	95.6%
	NO_2 (kg/h)	0.36	0.00	0.07	44.82	0	95.6%
	CO (kg/h)	4.06	-0.03	1.10	759.92	0	95.6%
	$PM_{2.5}$ (kg/h)	0.18	0.00	0.04	26.93	0	98.6%
	PM_{10} (kg/h)	0.56	-0.01	0.06	41.68	0	99.4%
Eastern Ventilation Stack	NO (kg/h)	3.20	-0.25	0.86	592.66	N/A	95.7%
	NO_2 (kg/h)	0.66	-0.01	0.16	109.95	0	95.7%
	CO (kg/h)	8.21	-0.04	2.18	1503.58	0	95.6%
	$PM_{2.5}$ (kg/h)	0.18	0.00	0.04	28.91	0	98.6%
	PM_{10} (kg/h)	0.40	-0.01	0.08	55.88	0	99.4%

Table 5: November 2022 Summary of results

EastLink Ventilation Stack Summary December 2022							
Location	Parameter	1hr Average Maximum	1 hr Average Minimum	Monthly Average	Monthly Total	Number of Exceedances	Data Availability (%)
Western Ventilation Stack	NO (kg/h)	3.62	-0.01	0.67	479.78	N/A	95.7%
	NO_2 (kg/h)	0.38	-0.01	0.07	49.13	0	95.7%
	CO (kg/h)	4.56	-0.07	1.25	887.00	0	95.6%
	$PM_{2.5}$ (kg/h)	0.20	0.00	0.03	23.60	0	99.1%
	PM_{10} (kg/h)	0.31	0.00	0.06	41.85	0	99.6%
Eastern Ventilation Stack	NO (kg/h)	3.30	-0.24	0.76	539.18	N/A	95.6%
	NO_2 (kg/h)	0.70	0.00	0.15	109.48	0	95.6%
	CO (kg/h)	7.92	-0.05	2.07	1471.21	0	95.6%
	$PM_{2.5}$ (kg/h)	0.17	0.00	0.04	26.42	0	99.7%
	PM_{10} (kg/h)	0.35	0.00	0.07	51.65	0	99.6%

Table 6: December 2022 Summary of results

2 Compliance Limits

Air quality limits are provided in Condition LI_DA1.13 of the Environment Protection Authority (Victoria) Licence No 2043 for the EastLink Tunnel. The air quality limits for 1 hour mass rates are shown in Table 7 below.

EastLink Ventiliation Stack Air Quality Limits					
Location	Parameter	Time Period	License Limit	Units	Applicable Licence
Western Ventilation Stack (Discharge Point 1)	NO_2	1 hour	3.98	kg/h	EPA Vic Licence No 2043
	CO	1 hour	112	kg/h	
	$PM_{2.5}$	1 hour	2.4	kg/h	
	PM_{10}	1 hour	2.6	kg/h	
Eastern Ventilation Stack (Discharge Point 2)	NO_2	1 hour	3.98	kg/h	EPA Vic Licence No 2043
	CO	1 hour	112	kg/h	
	$PM_{2.5}$	1 hour	2.4	kg/h	
	PM_{10}	1 hour	2.6	kg/h	

Table 7: EPA Compliance Limits

The procedure for reporting of particulate matter results from the TEOMs and assessment of licence compliance is detailed in the EastLink Particulate Matter Protocol (PMP) dated 17/06/2013. The PMP requires validated uncorrected TEOM one hour clock average data to be compared to the following TEOM mass rate compliance limits for both DP1 and DP2.

- $PM_{2.5}$: 2.0 kg/h
- PM_{10}: 2.0 kg/h

2.1 Standards Compliance

Norditech's NATA Accreditation does not cover the following parameters monitored at the EastLink Tunnel ventilation stack air quality monitoring stations

- Measurement of Stack Flow.
- AS/NZS 3580.9.8 refers specifically to the monitoring of PM_{10}.

3 Introduction

Norditech were contracted by Ventia Pty Ltd in August 2021 to provide continuous stack air quality monitoring and reporting services for the EastLink Tunnel. Ventia Pty Ltd are responsible for the operation and maintenance of the motorway.

Norditech is a NATA accredited organisation (Accreditation Number 19660)

Addresses of relevant parties:

Norditech Pty Ltd
2/87 Station Rd
Seven Hills NSW 2147

Ventia Pty Ltd
2 Hillcrest Avenue
Ringwood VIC 3134

This report presents the validated Western and Eastern ventilation stack data for October 2022 to December 2022.

- Describes air quality measurements.
- Reports any readings above the relevant EPA Limits.
- Compares monitoring results.
- Has been quality assured.

4 Explanation of Monitoring

4.1 Methodology

In tunnel air is discharged via two ventilation stacks – one located at the Western end of the tunnel (DP1), and one located at the Eastern end (DP2). For each stack, monitoring as per the requirements of EPA Licence 2043 is undertaken.

Gaseous parameters are sampled by an extractive sampling system. Oxides of nitrogen are measured using chemiluminescence. Carbon monoxide is measured using non-dispersive infra-red absorption.

Particulates PM_{10} and $PM_{2.5}$ are measured using tapered element oscillating microbalances.

Stack gas velocity is measured using an optical flow sensor.

Monthly routine maintenance is undertaken by Norditech. Maintenance is performed as per the relevant Australian Standard or in house method. Maintenance cycles generally involve 1, 3, 6 and 12 monthly scheduled items.

The following instrumentation and methods are used in data collection:

EastLink Ventilation Stack Measurement Methods		
Parameter	Method	Instrument
CO	In house method TP.003	Thermo Scientific 48i
NO, NO_2, NO_x	In house method TP.001	Thermo Scientific 42i
PM_{10}	AS/NZS 3580.9.8	Rupprecht & Patashnick TEOM
	In house method TP.005	
	AS 4323.1	
$PM_{2.5}$	In house method TP.026	Rupprecht & Patashnick TEOM
	AS 4323.1	
Temperature	In house method TP.012	By TEOM
Stack Velocity	USEAP (CFR 40) Part 75	OSI OFS2000

Table 8: Measurement methods and instrumentation

4.2 Ventilation Stacks

The locations of the EastLink Tunnel Western and Eastern ventilation stacks are detailed in Table 9 and Figure 1 below.

EastLink Ventilation Stack Locations		
Discharge Point	Site Name	GPS Coordinates
1	Western Ventilation Stack	-37.801229°, 145.196092°
2	Eastern Ventilation Stack	-37.808885°, 145.212012°

Table 9: EastLink Tunnel ventilation stack GPS Coordinates

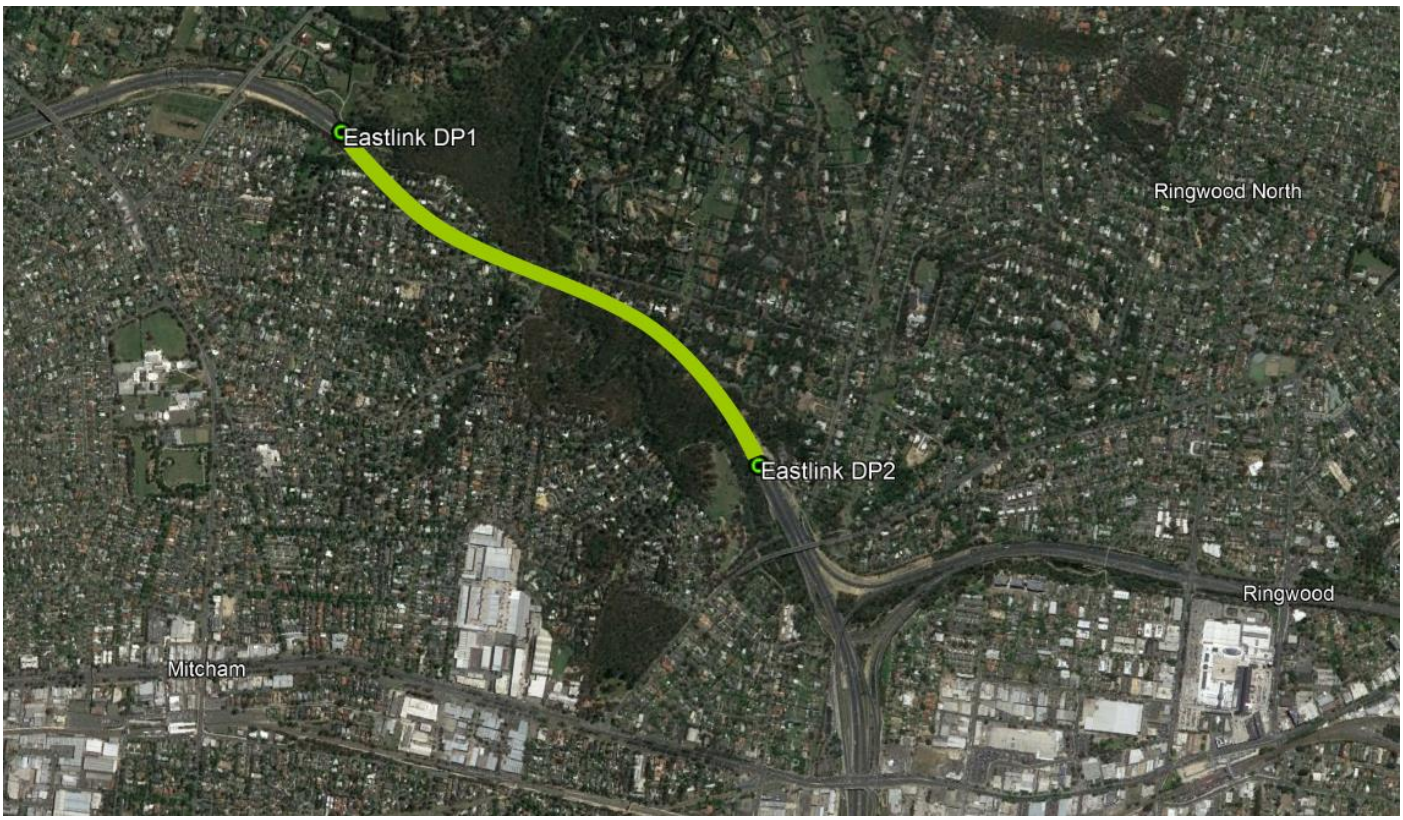

Figure 1: EastLink Tunnel ventilation stack locations

:

4.3 Data Collection

At each Air Quality Monitoring Station, data is logged to an EnviDAS data logger at 1 minute average intervals. Each 1 minute average is calculated from data sampled at 10 second intervals.

Data is transferred automatically to Norditech's data collection software via a TCP/IP link over 4G cellular network, at a frequency of not less than 1 hour. Two datasets are maintained by Norditech, one for data validation and reporting purposes, and a non-validated data set for reference purposes.

4.4 Data Validation

Data validation is performed as per Norditech's data validation procedure TP.022. The data validation process identifies any data that is deemed not to be valid. This data is flagged as invalid in the database and is removed from the reported data.

Data may be deemed invalid for several reasons, including but not limited to:

- Instrument fault
- Instrument calibration out of tolerance
- Maintenance activities

For further details and explanations of reasons for invalidating data, please refer to Appendix 1 – Data Validation Explanations.

Initial visual inspection of data is performed by inspection of graphs to identify any anomalies in the data set.

Site visit logs and maintenance and calibration certificates are cross referenced to the data set and any data affected by maintenance activities are flagged.

Instrument drift and calibration tolerances are checked and data flagged in the database as necessary as per NATA compliance requirements.

4.5 Reporting and Calculations

All calculations and averages are calculated from 1 minute average base data and are reported as 'end time'. IE the average data for 01:00 is the data from 00:00 through to 01:00.

All data is reported at Australian Eastern Standard Time.

Validated data for Quarter 4 Month 1 is presented in the Excel workbook named "202210 EastLink Q4M1 Validated data.xlsx"

The workbooks each consist of the following sheets:

- Sheet 1: Cover
- Sheet 2: M1 Data kg1h – Hourly data in kg/h
- Sheet 3: M1 Data g5m – 5 minute data in grams/5m
- Sheet 4: M1 Data mgm3 1h – 1hour data in mg/m^3
- Sheet 5: M1 Data mgm3 5m – 5 minute data in mg/m^3
- Sheet 6: Eastern Validation Data
- Sheet 7: Western Validation Data

Validated data for Quarter 4 Month 2 is presented in the Excel workbook named "202211 EastLink Q4M2 Validated data.xlsx"

The workbooks each consist of the following sheets:

- Sheet 1: Cover
- Sheet 2: M2 Data kg1h – Hourly data in kg/h
- Sheet 3: M2 Data g5m – 5 minute data in grams/5m
- Sheet 4: M2 Data mgm3 1h – 1hour data in mg/m^3
- Sheet 5: M2 Data mgm3 5m – 5 minute data in mg/m^3
- Sheet 6: Eastern Validation Data
- Sheet 7: Western Validation Data

Validated data for Quarter 4 Month 3 is presented in the Excel workbook named "202212 EastLink Q4M3 Validated data.xlsx"

The workbook consists of the following sheets:

- Sheet 1: Cover
- Sheet 2: M3 Data kg1h – Hourly data in kg/h
- Sheet 3: M3 Data g5m – 5 minute data in grams/5m
- Sheet 4: M3 Data mgm3 1h – 1hour data in mg/m^3
- Sheet 5: M3 Data mgm3 5m – 5 minute data in mg/m^3
- Sheet 6: Eastern Validation Data
- Sheet 7: Western Validation Data

4.5.1 Data Availability

Data availability refers to the amount of available data for the reporting period. Data availability is calculated using the following formula:

$$Data\ availability\ \% = \frac{sum\ of\ available\ data\ points}{sum\ of\ possible\ data\ points} * 100$$

Where:

- Sum of available data points is the number of validated 1 hour average data points for the reporting period
- Sum of possible data points is the number of theoretically available 1 hour data points for the reporting period

4.5.2 Unit Conversions

Stack velocity readings are converted to flow rate using the following stack areas:

- Western Stack area 35 m^2
- Eastern Stack area 35 m^2

Pollutant and flow data are reported at actual conditions.

5 Calibrations and Maintenance

5.1 Units and Uncertainties

EastLink Ventilation Stack Instrument Units and Uncertainties				
Parameter	Units	Resolution	Uncertainty	Measurement Range
CO	mg/m3	0.01	± 8.2% of reading at 62.5mg/m3 (k=1.96)	0 to 200
NO	mg/m3	0.01	± 8.1% of reading for range 25.7 – 32.8mg/m3 (k=1.96)	0 to 150
NO_2	mg/m3	0.01	± 8.5% of reading at 25.7mg/m3 (k=1.96)	0 to 150
NO_x	mg/m3	0.01	± 8.1% of reading for range 25.7 – 32.8mg/m3 (k=1.96)	0 to 150
PM_{10}	µg/m3	0.1	±5.0 µg/m3 or 3.6% of reading, whichever is the greater. K factor of 1.96	0 to 5000
$PM_{2.5}$	µg/m3	0.1	±5.0 µg/m3 or 3.6% of reading, whichever is the greater. K factor of 1.96	0 to 5000
Temperature	°C	0.1	±2.0 °C[1]	-25 to 105
Stack Velocity	m/s	1	±0.1 m/s[1]	-40 to +40

[1] Manufacturer's stated accuracy

Table 10: Measurement units and uncertainties

5.2 Last Calibrations and Maintenance performed

Instrumentation maintenance and last calibration dates are provided in Table 11, Table 12 and Table 13 below:

EastLink Ventilation Stack Maintenance and Calibrations October 2022				
Location	Parameter	Date of last scheduled maintenance	Maintenance type	Date of last calibration
Western Ventilation Stack (Discharge Point 1)	CO	19/10/2022	1 Monthly	19/10/2022
	NO, NO2	19/10/2022	1 Monthly	19/10/2022
	PM10	15/09/2022	3 Monthly	15/09/2022
	PM2.5	15/09/2022	3 Monthly	15/09/2022
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
Eastern Ventilation Stack (Discharge Point 2)	CO	14/10/2022	1 Monthly	14/10/2022
	NO, NO2	14/10/2022	1 Monthly	14/10/2022
	PM10	15/09/2022	3 Monthly	15/09/2022
	PM2.5	15/09/2022	3 Monthly	15/09/2022
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022

Table 11: October 2022 Instrument calibration dates

EastLink Ventilation Stack Maintenance and Calibrations November 2022				
Location	Parameter	Date of last scheduled maintenance	Maintenance type	Date of last calibration
Western Ventilation Stack (Discharge Point 1)	CO	18/11/2022	1 Monthly	18/11/2022
	NO, NO2	18/11/2022	1 Monthly	18/11/2022
	PM10	15/09/2022	3 Monthly	15/09/2022
	PM2.5	15/09/2022	3 Monthly	15/09/2022
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
Eastern Ventilation Stack (Discharge Point 2)	CO	18/11/2022	1 Monthly	18/11/2022
	NO, NO2	18/11/2022	1 Monthly	18/11/2022
	PM10	15/09/2022	3 Monthly	15/09/2022
	PM2.5	15/09/2022	3 Monthly	15/09/2022
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022

Table 12: November 2022 Instrument calibration dates

EastLink Ventilation Stack Maintenance and Calibrations December 2022				
Location	Parameter	Date of last scheduled maintenance	Maintenance type	Date of last calibration
Western Ventilation Stack (Discharge Point 1)	CO	7/12/2022	6 Monthly	7/12/2022
	NO, NO2	7/12/2022	6 Monthly	7/12/2022
	PM10	7/12/2022	6 Monthly	7/12/2022
	PM2.5	7/12/2022	6 Monthly	7/12/2022
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022
Eastern Ventilation Stack (Discharge Point 2)	CO	7/12/2022	6 Monthly	7/12/2022
	NO, NO2	7/12/2022	6 Monthly	7/12/2022
	PM10	7/12/2022	6 Monthly	7/12/2022
	PM2.5	7/12/2022	6 Monthly	7/12/2022
	Stack Velocity	31/08/2022	12 Monthly	31/08/2022

Table 13: December 2022 Instrument calibration dates

5.3 Automatic Instrument Calibration Checks

Table 14 below identifies the times at which the daily gaseous parameter automatic span and zero checks are performed.

Further to the span and zero checks, the CO analysers perform nightly background reference cycles.

This data is removed from the dataset, however are not included in the data validation tables.

Nightly span and zero times for NO, NO_2 and CO		
Location	Parameter	Span / Zero cycle time
Western	CO	00:00 - 00:45
	NO, NO2	01:00 - 01:45
Eastern	CO	00:00 - 00:40
	NO, NO2	00:00 - 00:40

Table 14: Nightly span, zero and CO reference times.

6 Results

6.1 October 2022

6.1.1 Data Availability

Data availability for the in ventilation stack parameters are provided in Table 15 below. For further information on data availability please refer to section 6.1.5.

EastLink Ventilation Stack Data Availability October 2022							
Station		NO	NO_2	CO	$PM_{2.5}$	PM_{10}	Stack Velocity
Western	Data Availability	95.4%	95.4%	95.4%	99.9%	99.6%	100.0%
	Collected Periods	710.0	710.0	710.0	743.0	741.0	744.0
	Available Periods	744.0	744.0	744.0	744.0	744.0	744.0
Eastern	Data Availability	94.5%	94.5%	95.6%	99.7%	99.2%	100.0%
	Collected Periods	703.0	703.0	711.0	742.0	738.0	744.0
	Available Periods	744.0	744.0	744.0	744.0	744.0	744.0

Table 15: October 2022 ventilation stack data availability

6.1.2 Exceedances

Instances of the ventilation stack pollutants exceeding the EPA Limits goals during the reporting period are presented in Table 16 below. Maximum mass rates are provided for comparison to the limits.

There were nil exceedances of the prescribed limits during the reporting period.

EastLink Ventiliation Stack Air Quality Limit Exceedances October 2022								
Location	Parameter	Time Period	Licence Limit	Units	Maximum Mass Rate	Number of exceedances	Value of exceedance	Date and Time of exceedance
Western Ventilation Stack (Discharge Point 1)	NO_2	1 hour	3.98	kg/h	0.35	-	-	-
	CO	1 hour	112	kg/h	3.98	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.22	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.71	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO_2	1 hour	3.98	kg/h	0.60	-	-	-
	CO	1 hour	112	kg/h	8.15	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.16	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.61	-	-	-

Table 16: October 2022 Exceedances of EPA Goals

6.1.3 Tabulated Results

6.1.3.1 Statistical Summary of 1 hour Mass Rate Data Western and Eastern Ventilation Stacks

Table 17 presents 1 hour mass rate statistical data for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

EastLink Ventilation Stack Summary October 2022								
Location	Parameter	Maximum	99th Percentile	98th Percentile	95th Percentile	90th Percentile	75th Percentile	50th Percentile
Western Ventilation Stack	NO (kg/h)	3.73	3.25	2.87	2.41	1.73	1.08	0.53
	NO_2 (kg/h)	0.35	0.31	0.27	0.22	0.16	0.10	0.05
	CO (kg/h)	3.98	3.60	3.41	3.08	2.52	1.85	1.36
	$PM_{2.5}$ (kg/h)	0.22	0.15	0.13	0.11	0.09	0.05	0.03
	PM_{10} (kg/h)	0.71	0.26	0.24	0.20	0.15	0.08	0.05
Eastern Ventilation Stack	NO (kg/h)	3.16	2.63	2.46	2.17	1.90	1.50	0.53
	NO_2 (kg/h)	0.60	0.56	0.53	0.43	0.35	0.26	0.13
	CO (kg/h)	8.15	6.11	5.66	4.94	4.17	3.15	2.19
	$PM_{2.5}$ (kg/h)	0.16	0.13	0.12	0.11	0.09	0.07	0.03
	PM_{10} (kg/h)	0.61	0.32	0.27	0.22	0.18	0.13	0.06

Table 17: October 2022 Summary of 1 hour mass rate pollutant data

6.1.4 Graphical Representations

The following charts present 1 hour mass rate data for NO, NO_2, CO, $PM_{2.5}$, PM_{10} and Stack Velocity for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

6.1.4.1 October 2022 - Monthly 1 hour mass rate NO_2

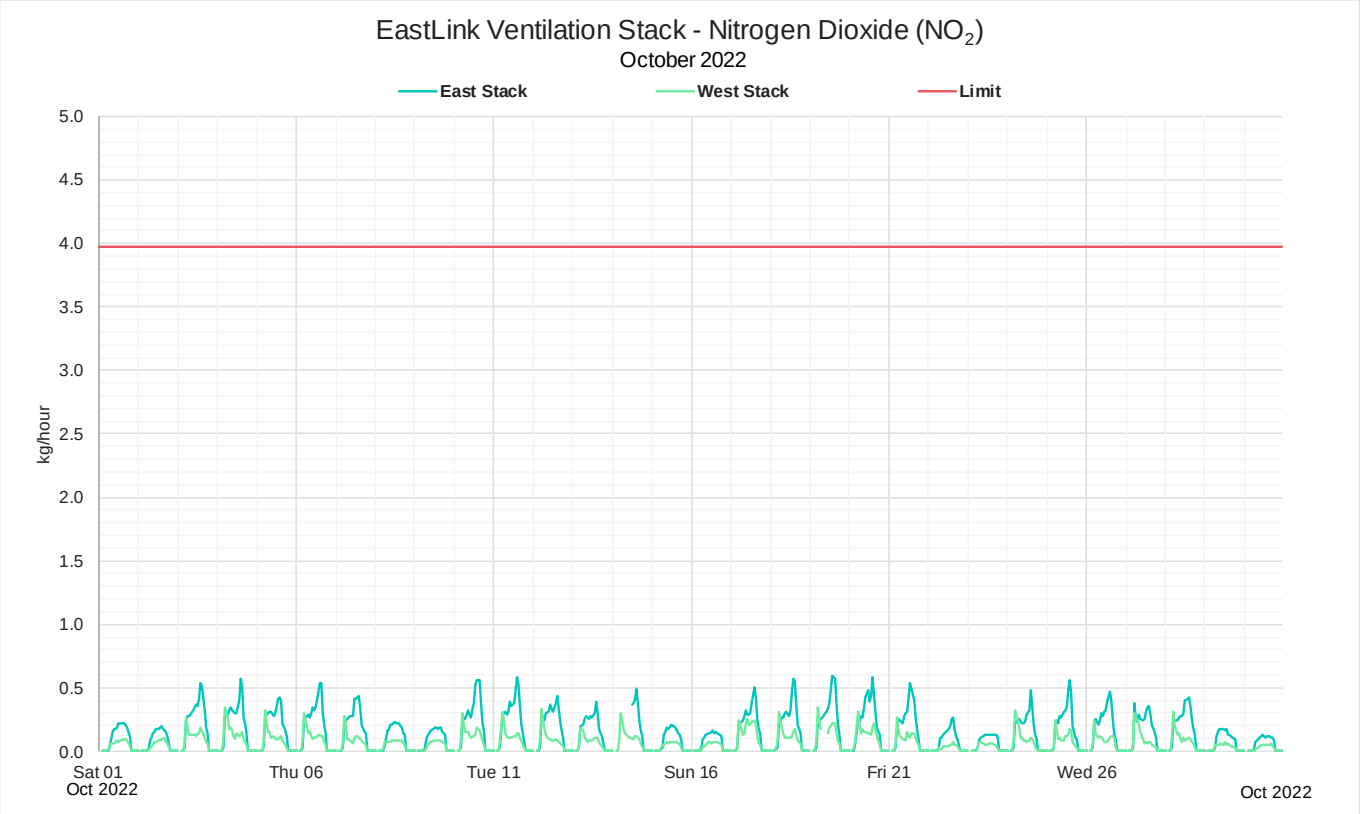

Figure 2: October 2022 Monthly 1 hour mass rate NO_2

6.1.4.2 October 2022 - Monthly 1 hour mass rate NO

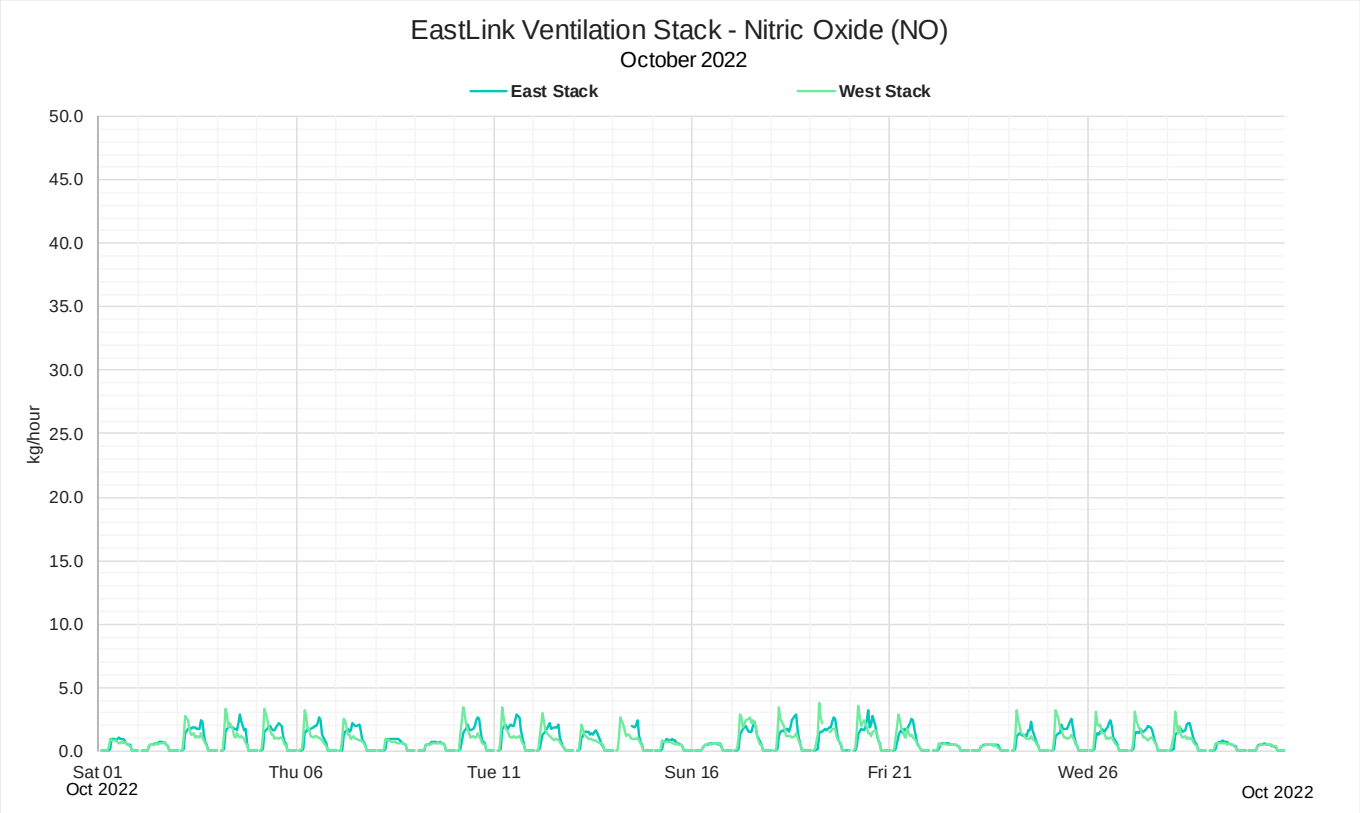

Figure 3: October 2022 Monthly 1 hour mass rate NO

6.1.4.3 October 2022 - Monthly 1 hour mass rate CO

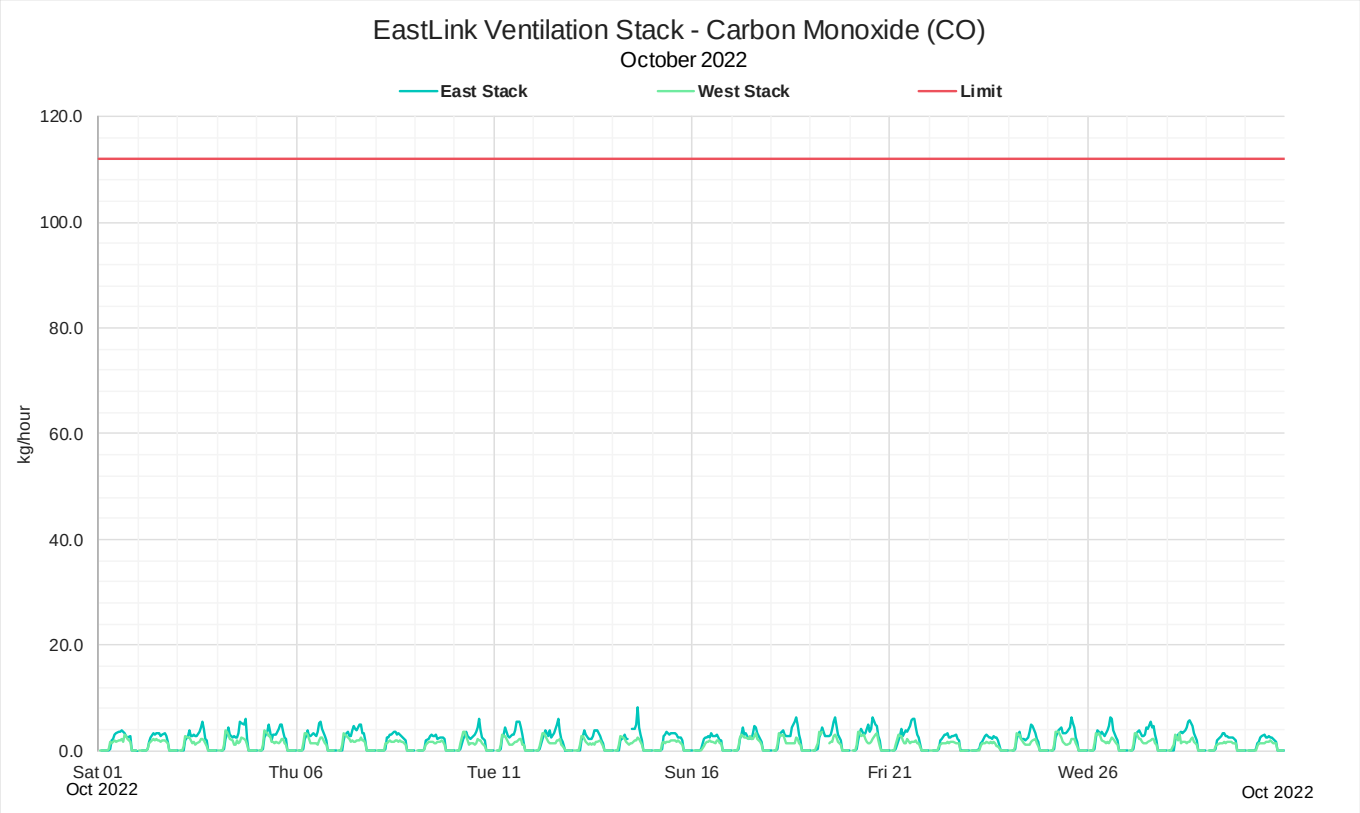

Figure 4: October 2022 Monthly 1 hour mass rate CO

6.1.4.4 October 2022 - Monthly 1 hour mass rate $PM_{2.5}$

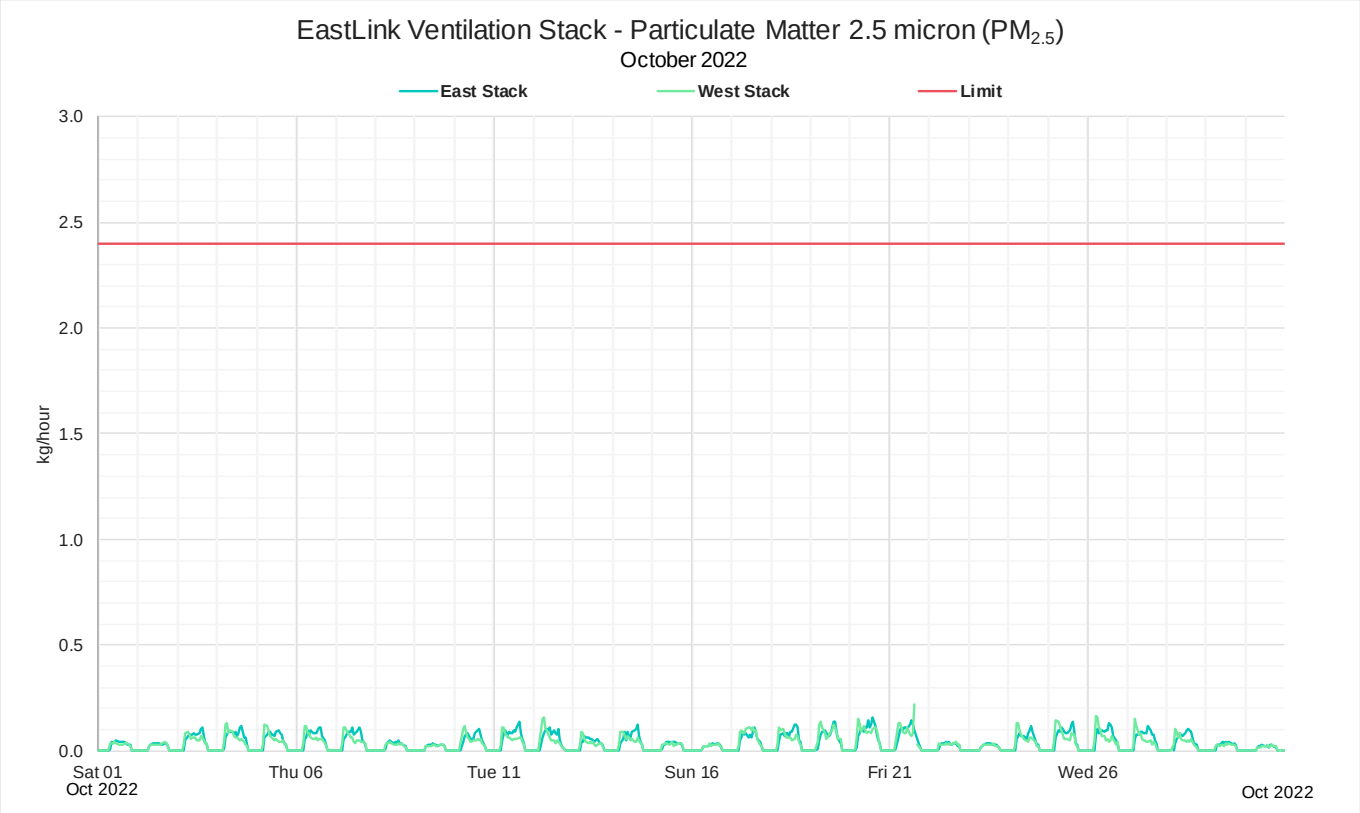

Figure 5: October 2022 Monthly 1 hour mass rate $PM_{2.5}$

6.1.4.5 October 2022 - Monthly 1 hour mass rate PM_{10}

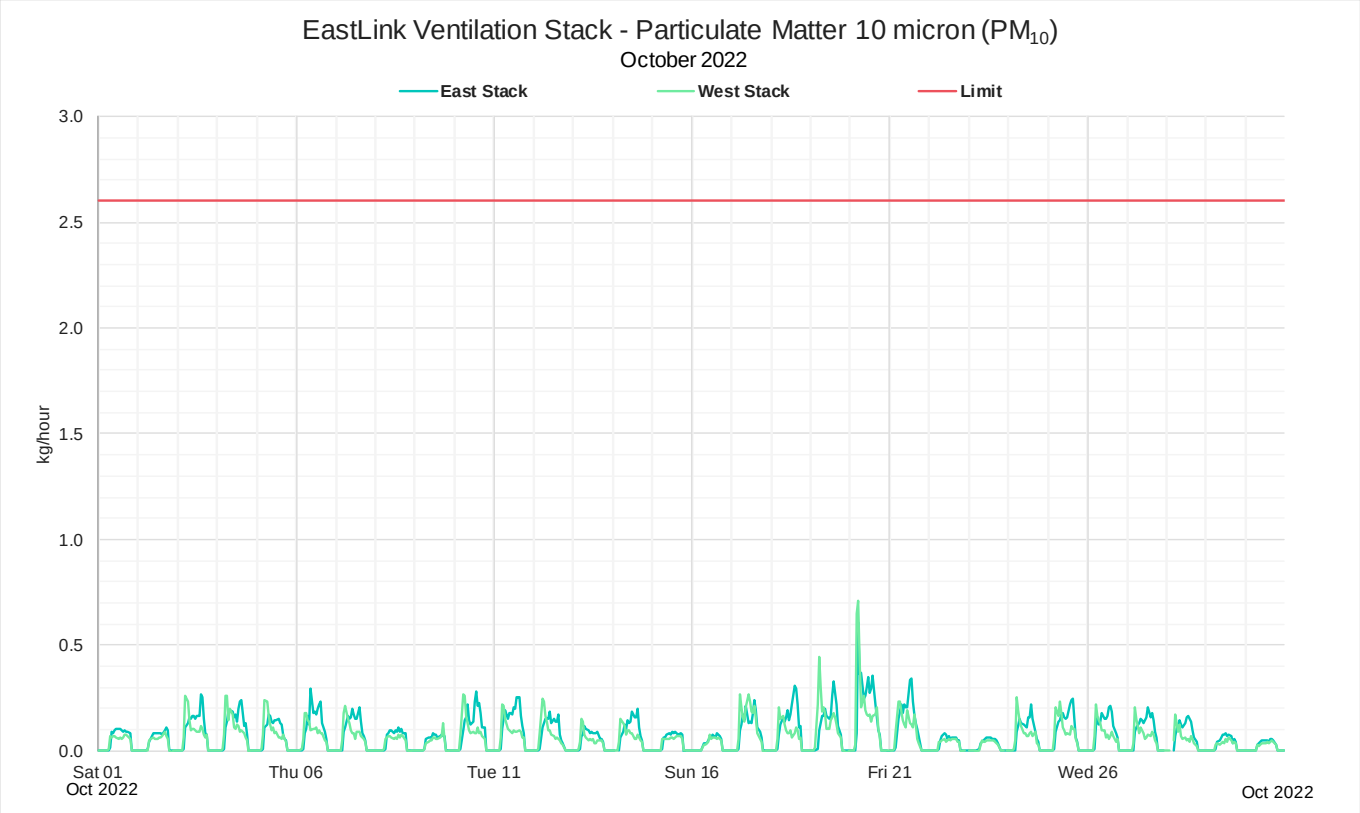

Figure 6: October 2022 Monthly 1 hour mass rate PM_{10}

6.1.4.6 October 2022 - Monthly 1 hour average stack velocity

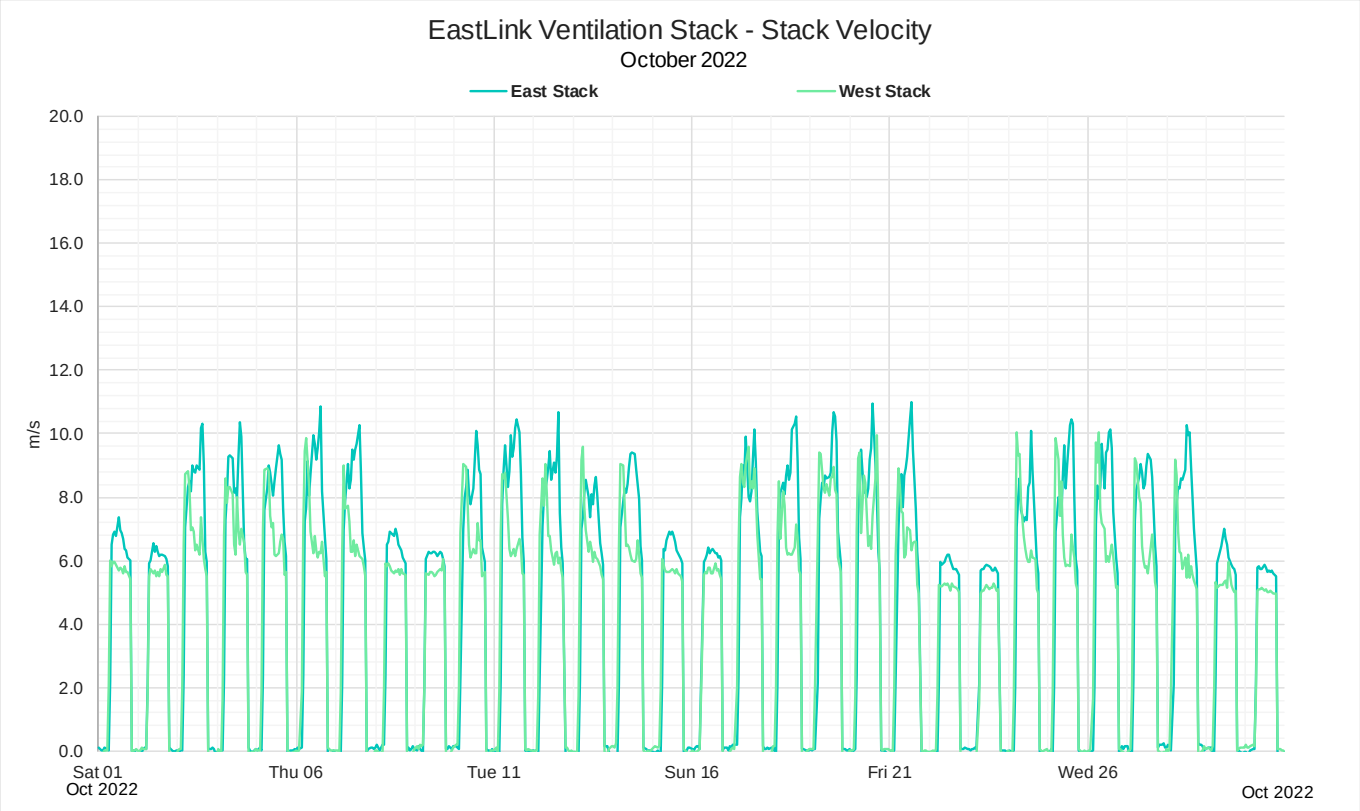

Figure 7: October 2022 Monthly 1 hour average stack velocity

6.1.5 Data Validation Table

Data validation details for the ventilation stack parameters are provided in the Table 18 and Table 19 below.

6.1.5.1 October 2022 - Western Ventilation Stack

Eastlink Tunnel Western Ventilation Stack Data Validation October 2022						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
1/10/2022 00:00	19/10/2022 08:17	CO	Offset applied to data: Offset A: -1.3 Offset B: -1.6	N/A	TA	17/01/2022
1/10/2022 00:00	19/10/2022 08:17	CO	Multiplier applied to data: Multiplier A: 1.0 Multiplier B: 0.933566	N/A	TA	17/01/2022
1/10/2022 00:12	31/10/2022 01:35	PM2.5, PM10	Intermittent not enough samples	N/A	TA	17/01/2022
7/10/2022 03:06	31/10/2022 23:48	PM2.5, PM10	Intermittent unrealistic data - negative	N/A	TA	17/01/2022
19/10/2022 11:05	18/11/2022 07:40	CO	Offset applied to data: Offset A: +0.0 Offset B: -0.5	N/A	TA	17/01/2022
19/10/2022 11:05	18/11/2022 07:40	CO	Multiplier applied to data: Multiplier A: 1.0 Multiplier B: 0.937939	N/A	TA	17/01/2022
19/10/2022 08:18	19/10/2022 11:04	CO, NO, NO2, NOx	Maintenance	2.8	TA	17/01/2022

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 18: October 2022 Western Ventilation Stack data validation

6.1.5.2 October 2022 - Eastern Ventilation Stack

Eastlink Tunnel Eastern Ventilation Stack Data Validation October 2022						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
1/10/2022 00:00	31/10/2022 23:59	CO	Offset applied to data: Offset A: -0.03 Offset B: -0.05	N/A	TA	17/01/2022
1/10/2022 00:00	3/10/2022 01:33	CO	Multiplier applied to data: Multiplier A: 0.935949 Multiplier B: 0.935949	N/A	TA	17/01/2022
7/10/2022 03:01	31/10/2022 23:45	PM2.5, PM10	Intermittent unrealistic data - negative	N/A	TA	17/01/2022
14/10/2022 01:34	14/10/2022 10:33	NO, NO2, NOx	Instrument fault	9.0	TA	17/01/2022
14/10/2022 11:26	18/11/2022 08:54	NO, NO2, NOx	Multiplier applied to data: Multiplier A: 1.0 Multiplier B: 1.102038	N/A	TA	17/01/2022
14/10/2022 10:34	14/10/2022 11:25	CO, NO, NO2, NOx	Maintenance	0.8	TA	17/01/2022
31/10/2022 13:16	31/10/2022 13:17	All parameters	Missing data	0.0	TA	17/01/2022

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 19: October 2022 Eastern Ventilation Stack data validation

6.2 November 2022

6.2.1 Data Availability

Data availability for the in ventilation stack parameters are provided in Table 20 below. For further information on data availability please refer to section 6.1.5.

EastLink Ventilation Stack Data Availability November 2022							
Station		NO	NO_2	CO	$PM_{2.5}$	PM_{10}	Stack Velocity
Western	Data Availability	95.6%	95.6%	95.6%	98.6%	99.4%	100.0%
	Collected Periods	688	688	688	710	716	720
	Available Periods	720	720	720	720	720	720
Eastern	Data Availability	95.7%	95.7%	95.7%	99.0%	99.2%	100.0%
	Collected Periods	689	689	689	713	714	720
	Available Periods	720	720	720	720	720	720

Table 20: November 2022 ventilation stack data availability

6.2.2 Exceedances

Instances of the ventilation stack pollutants exceeding the EPA Limits goals during the reporting period are presented in Table 21 below. Maximum mass rates are provided for comparison to the limits.

There were nil exceedances of the prescribed limits during the reporting period.

EastLink Ventiliation Stack Air Quality Limit Exceedances November 2022								
Location	Parameter	Time Period	Licence Limit	Units	Maximum Mass Rate	Number of exceedances	Value of exceedance	Date and Time of exceedance
Western Ventilation Stack (Discharge Point 1)	NO_2	1 hour	3.98	kg/h	0.36	-	-	-
	CO	1 hour	112	kg/h	4.06	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.18	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.56	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO_2	1 hour	3.98	kg/h	0.66	-	-	-
	CO	1 hour	112	kg/h	8.21	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.18	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.40	-	-	-

Table 21: November 2022 Exceedances of EPA Goals

6.2.3 Tabulated Results

6.2.3.1 Statistical Summary of 1 hour Mass Rate Data Western and Eastern Ventilation Stacks

Table 22 presents 1 hour mass rate statistical data for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

EastLink Ventilation Stack Summary November 2022								
Location	Parameter	Maximum	99th Percentile	98th Percentile	95th Percentile	90th Percentile	75th Percentile	50th Percentile
Western Ventilation Stack	NO (kg/h)	3.78	3.48	3.17	2.48	1.89	1.20	0.54
	NO_2 (kg/h)	0.36	0.32	0.28	0.21	0.16	0.10	0.05
	CO (kg/h)	4.06	3.61	3.36	3.01	2.56	1.73	1.21
	$PM_{2.5}$ (kg/h)	0.18	0.16	0.15	0.13	0.10	0.06	0.03
	PM_{10} (kg/h)	0.56	0.28	0.25	0.20	0.15	0.09	0.05
Eastern Ventilation Stack	NO (kg/h)	3.20	2.93	2.85	2.55	2.11	1.69	0.56
	NO_2 (kg/h)	0.66	0.59	0.56	0.47	0.39	0.28	0.13
	CO (kg/h)	8.21	7.29	6.91	5.89	4.66	3.63	2.49
	$PM_{2.5}$ (kg/h)	0.18	0.14	0.14	0.12	0.11	0.08	0.03
	PM_{10} (kg/h)	0.40	0.32	0.29	0.25	0.21	0.14	0.06

Table 22: November 2022 Summary of 1 hour mass rate pollutant data

6.2.4 Graphical Representations

The following charts present 1 hour mass rate data for NO, NO_2, CO, $PM_{2.5}$, PM_{10} and Stack Velocity for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

6.2.4.1 November 2022 - Monthly 1 hour mass rate NO_2

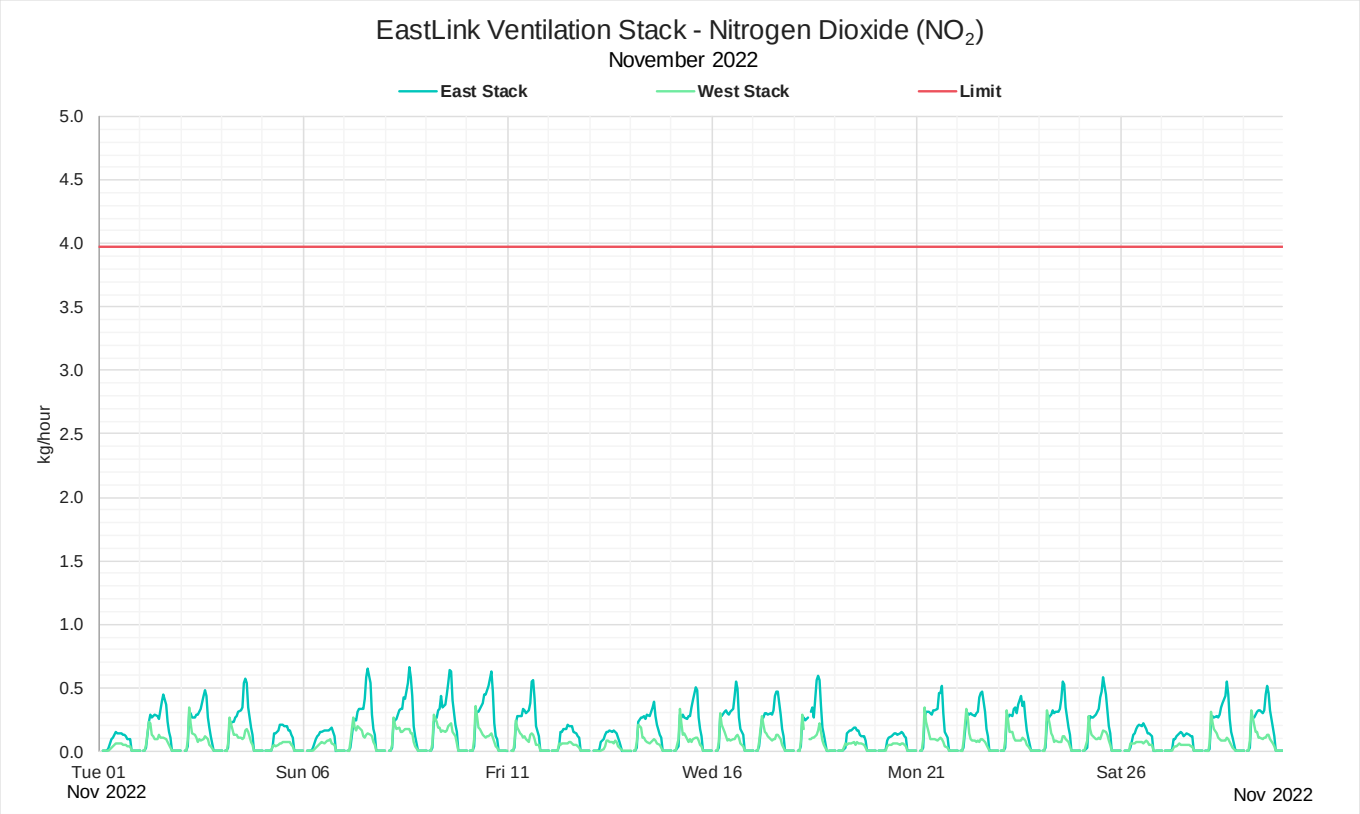

Figure 8: November 2022 Monthly 1 hour mass rate NO_2

6.2.4.2 November 2022 - Monthly 1 hour mass rate NO

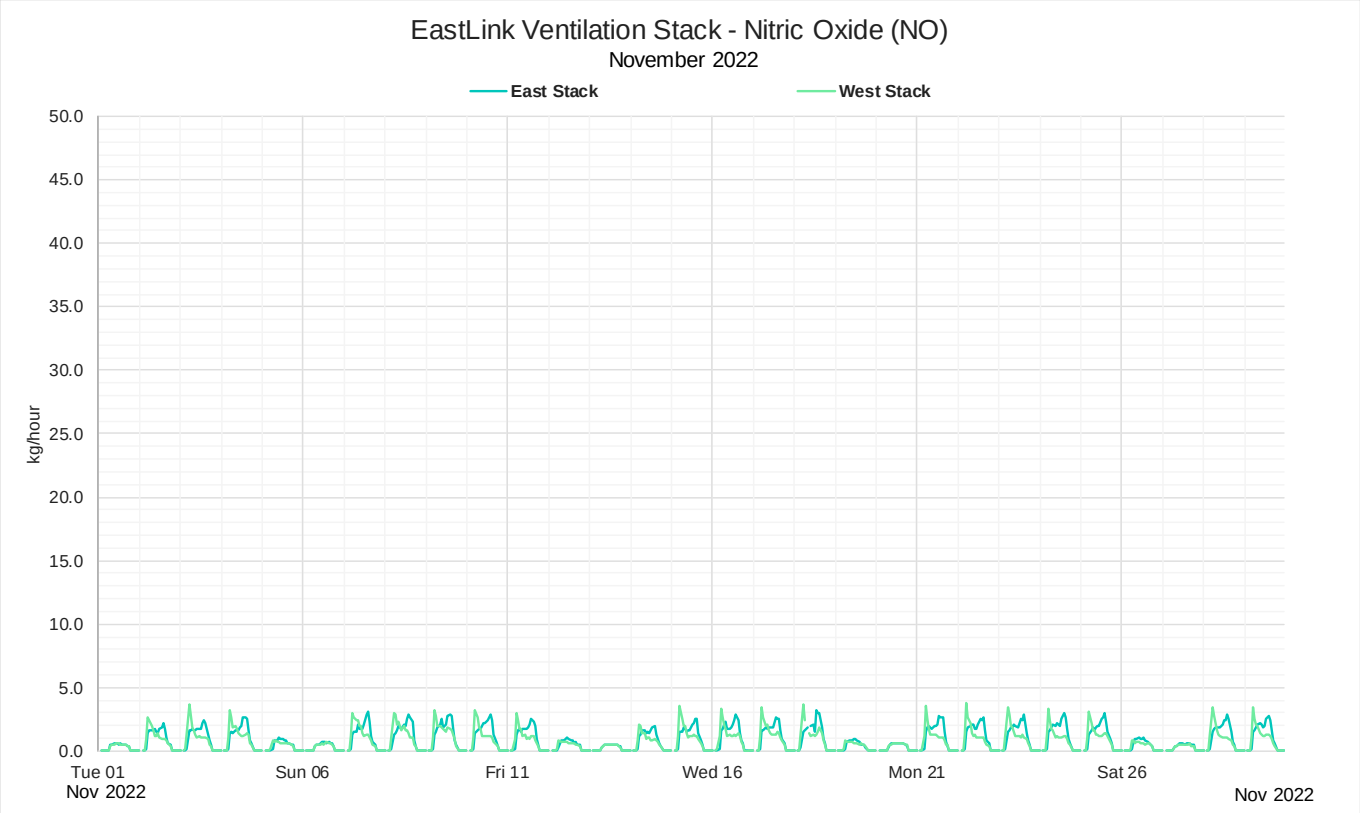

Figure 9: November 2022 Monthly 1 hour mass rate NO

6.2.4.3 November 2022 - Monthly 1 hour mass rate CO

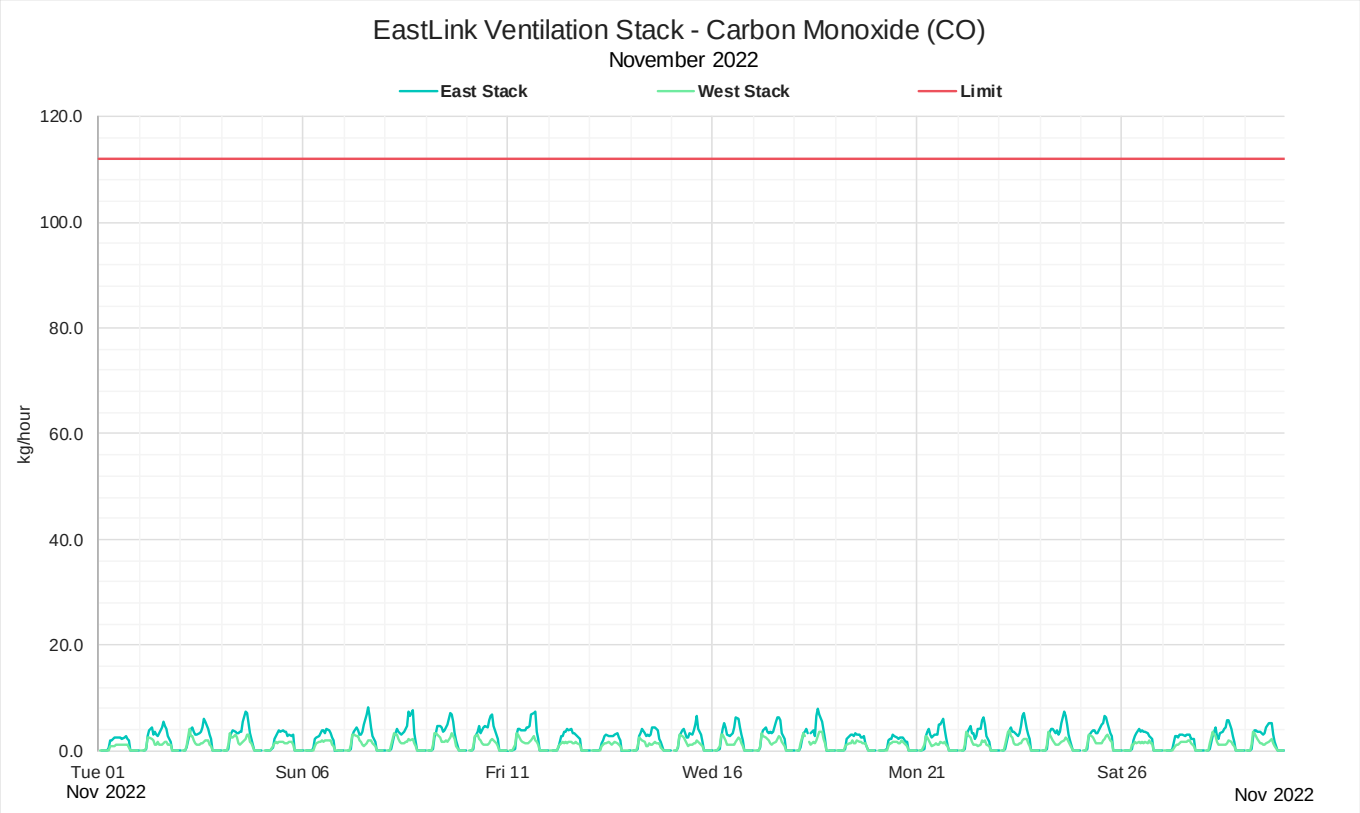

Figure 10: November 2022 Monthly 1 hour mass rate CO

6.2.4.4 November 2022 - Monthly 1 hour mass rate $PM_{2.5}$

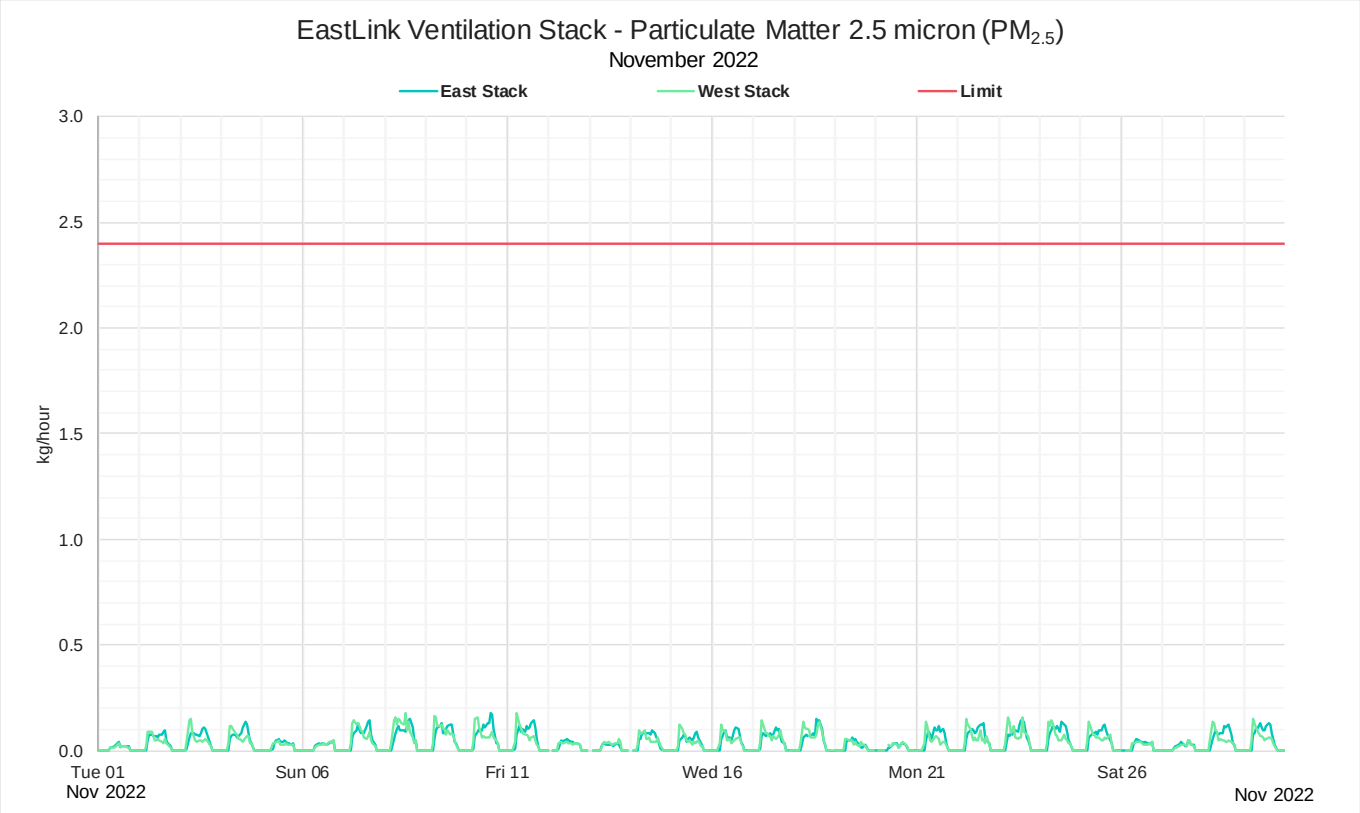

Figure 11: November 2022 Monthly 1 hour mass rate $PM_{2.5}$

6.2.4.5 November 2022 - Monthly 1 hour mass rate PM_{10}

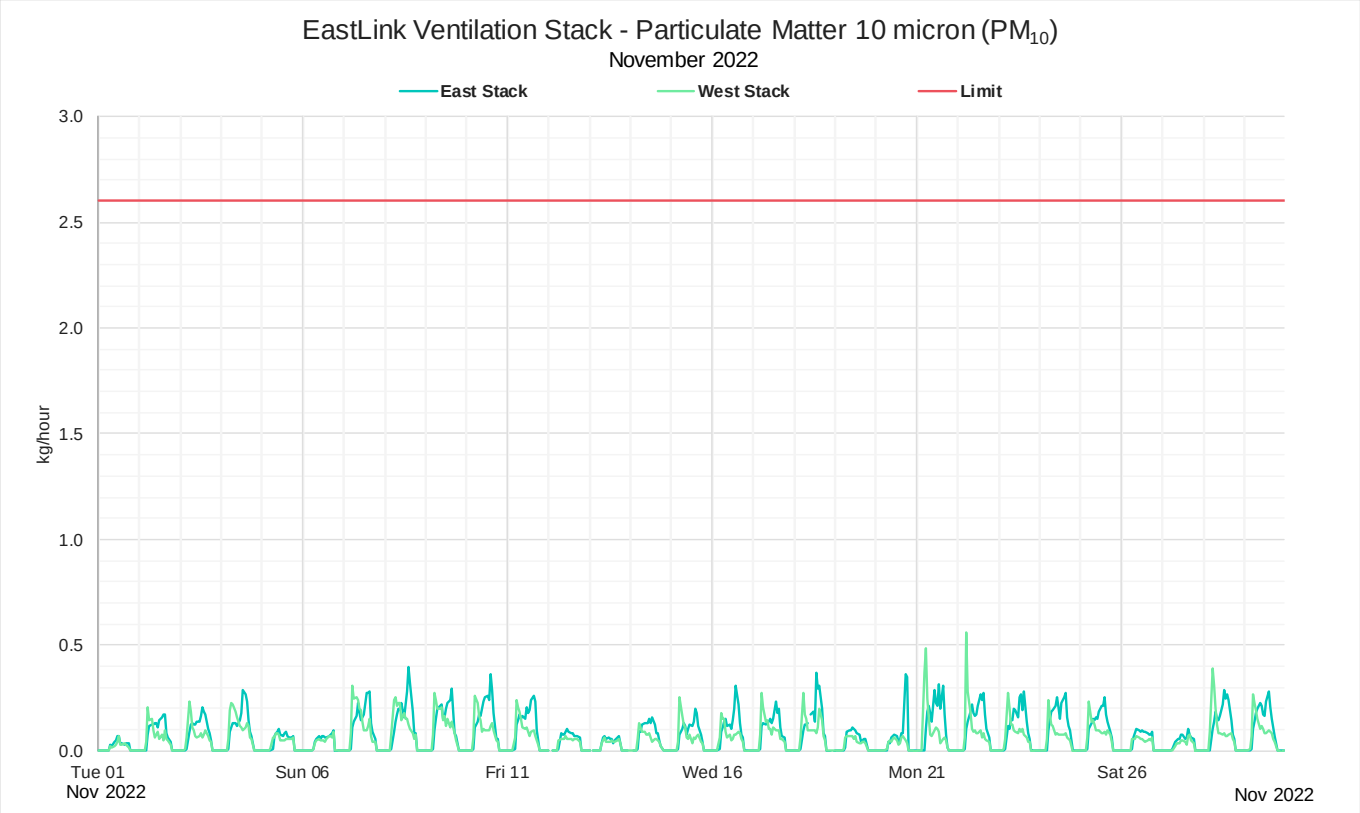

Figure 12: November 2022 Monthly 1 hour mass rate PM_{10}

6.2.4.6 November 2022 - Monthly 1 hour average stack velocity

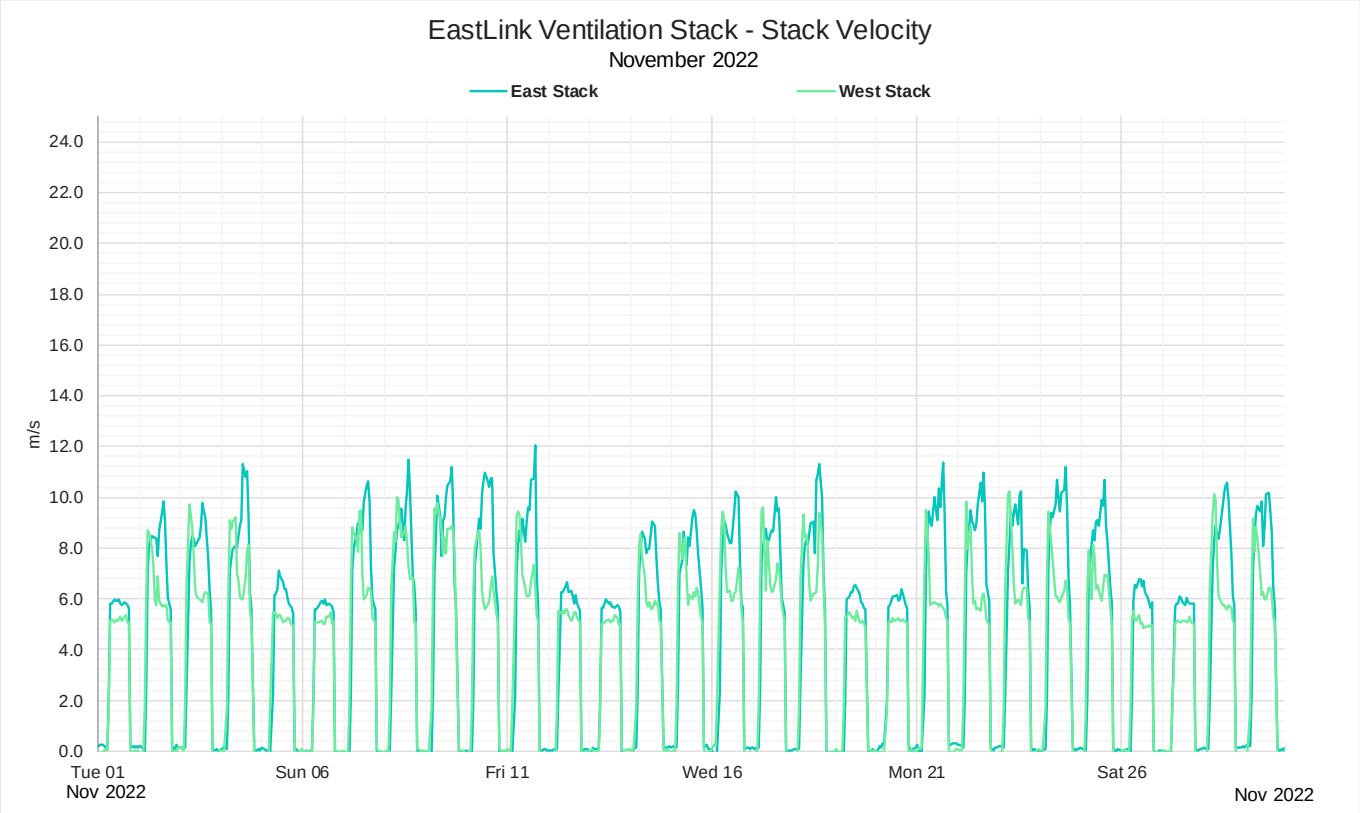

Figure 13: November 2022 Monthly 1 hour average stack velocity

6.2.5 Data Validation Table

Data validation details for the ventilation stack parameters are provided in the Table 23 and Table 24 below.

6.2.5.1 November 2022 - Western Ventilation Stack

Eastlink Tunnel Western Ventilation Stack Data Validation November 2022						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
1/11/2022 00:00	30/11/2022 01:11	PM2.5, PM10	Intermittent not enough samples	N/A	TA	17/01/2022
1/11/2022 02:03	30/11/2022 16:04	PM2.5, PM10	Intermittent unrealistic data - negative	N/A	TA	17/01/2022
19/10/2022 11:05	18/11/2022 07:40	CO	Offset applied to data: Offset A: +0.0 Offset B: -0.5	N/A	TA	17/01/2022
19/10/2022 11:05	18/11/2022 07:40	CO	Multiplier applied to data: Multiplier A: 1.0 Multiplier B: 0.937939	N/A	TA	17/01/2022
18/11/2022 07:41	18/11/2022 08:42	NO, NO2, NOx, CO	Intermittent unrealistic data - negative	N/A	TA	17/01/2022
18/11/2022 08:43	1/01/2023 00:00	CO	Offset applied to data: Offset A: +0.0 Offset B: -0.5	N/A	TA	17/01/2022

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 23: November 2022 Western Ventilation Stack data validation

6.2.5.2 November 2022 - Eastern Ventilation Stack

Eastlink Tunnel Eastern Ventilation Stack Data Validation November 2022						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
14/10/2022 11:26	18/11/2022 08:54	NO, NO2, NOx	Multiplier applied to data: Multiplier A: 1.0 Multiplier B: 1.102038	N/A	TA	17/01/2022
1/11/2022 06:41	30/11/2022 11:38	PM2.5, PM10	Intermittent unrealistic data - negative	N/A	TA	17/01/2022
18/11/2022 08:55	18/11/2022 09:46	NO, NO2, Nox CO, PM2.5, PM10	Maintenance	0.8	TA	17/01/2022

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 24: November 2022 Eastern Ventilation Stack data validation

6.3 December 2022

6.3.1 Data Availability

Data availability for the in ventilation stack parameters are provided in Table 25 below. For further information on data availability please refer to section 6.2.5

EastLink Ventilation Stack Data Availability December 2022							
Station		NO	NO_2	CO	$PM_{2.5}$	PM_{10}	Stack Velocity
Western	Data Availability	96%	96%	96%	99%	100%	100%
	Collected Periods	712.0	712.0	711.0	737.0	741.0	744.0
	Available Periods	744.0	744.0	744.0	744.0	744.0	744.0
Eastern	Data Availability	95.6%	95.6%	95.6%	99.7%	99.7%	100.0%
	Collected Periods	711	711	711	742	742	744
	Available Periods	744	744	744	744	744	744

Table 25: December 2022 ventilation stack data availability

6.3.2 Exceedances

Instances of the ventilation stack pollutants exceeding the EPA Limits goals during the reporting period are presented in Table 26 below. Maximum mass rates are provided for comparison to the limits.

There were nil exceedances of the prescribed limits during the reporting period.

EastLink Ventiliation Stack Air Quality Limit Exceedances December 2022								
Location	Parameter	Time Period	Licence Limit	Units	Maximum Mass Rate	Number of exceedances	Value of exceedance	Date and Time of exceedance
Western Ventilation Stack (Discharge Point 1)	NO_2	1 hour	3.98	kg/h	0.38	-	-	-
	CO	1 hour	112	kg/h	4.56	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.20	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.31	-	-	-
Eastern Ventilation Stack (Discharge Point 2)	NO_2	1 hour	3.98	kg/h	0.70	-	-	-
	CO	1 hour	112	kg/h	7.92	-	-	-
	$PM_{2.5}$	1 hour	2.4	kg/h	0.17	-	-	-
	PM_{10}	1 hour	2.6	kg/h	0.35	-	-	-

Table 26: December 2022 Exceedances of EPA Goals

6.3.3 Tabulated Results

6.3.3.1 Statistical Summary of 1 hour mass rate data Western and Eastern Ventilation Stacks

Table 27 presents 1 hour mass rate statistical data for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

EastLink Ventilation Stack Summary December 2022								
Location	Parameter	Maximum	99th Percentile	98th Percentile	95th Percentile	90th Percentile	75th Percentile	50th Percentile
Western Ventilation Stack	NO (kg/h)	3.62	3.42	3.02	2.22	1.77	1.10	0.50
	NO_2 (kg/h)	0.38	0.33	0.30	0.21	0.18	0.11	0.06
	CO (kg/h)	4.56	4.03	3.76	3.37	2.70	1.97	1.46
	$PM_{2.5}$ (kg/h)	0.20	0.15	0.13	0.11	0.08	0.05	0.03
	PM_{10} (kg/h)	0.31	0.25	0.24	0.18	0.15	0.09	0.05
Eastern Ventilation Stack	NO (kg/h)	3.30	3.08	2.97	2.51	2.09	1.30	0.54
	NO_2 (kg/h)	0.70	0.63	0.60	0.48	0.37	0.25	0.14
	CO (kg/h)	7.92	6.77	6.46	5.60	4.50	3.45	2.36
	$PM_{2.5}$ (kg/h)	0.17	0.13	0.13	0.11	0.10	0.06	0.03
	PM_{10} (kg/h)	0.35	0.29	0.28	0.24	0.19	0.11	0.06

Table 27: December 2022 Summary of 1 hour mass rate pollutant data

6.3.4 Graphical Representations

The following charts present 1 hour mass rate data for NO, NO_2, CO, $PM_{2.5}$, PM_{10} and Stack Velocity for the Western and Eastern ventilation stacks.

1 hour mass rates are calculated from 1 minute average data.

6.3.4.1 December 2022 - Monthly 1 hour mass rate NO_2

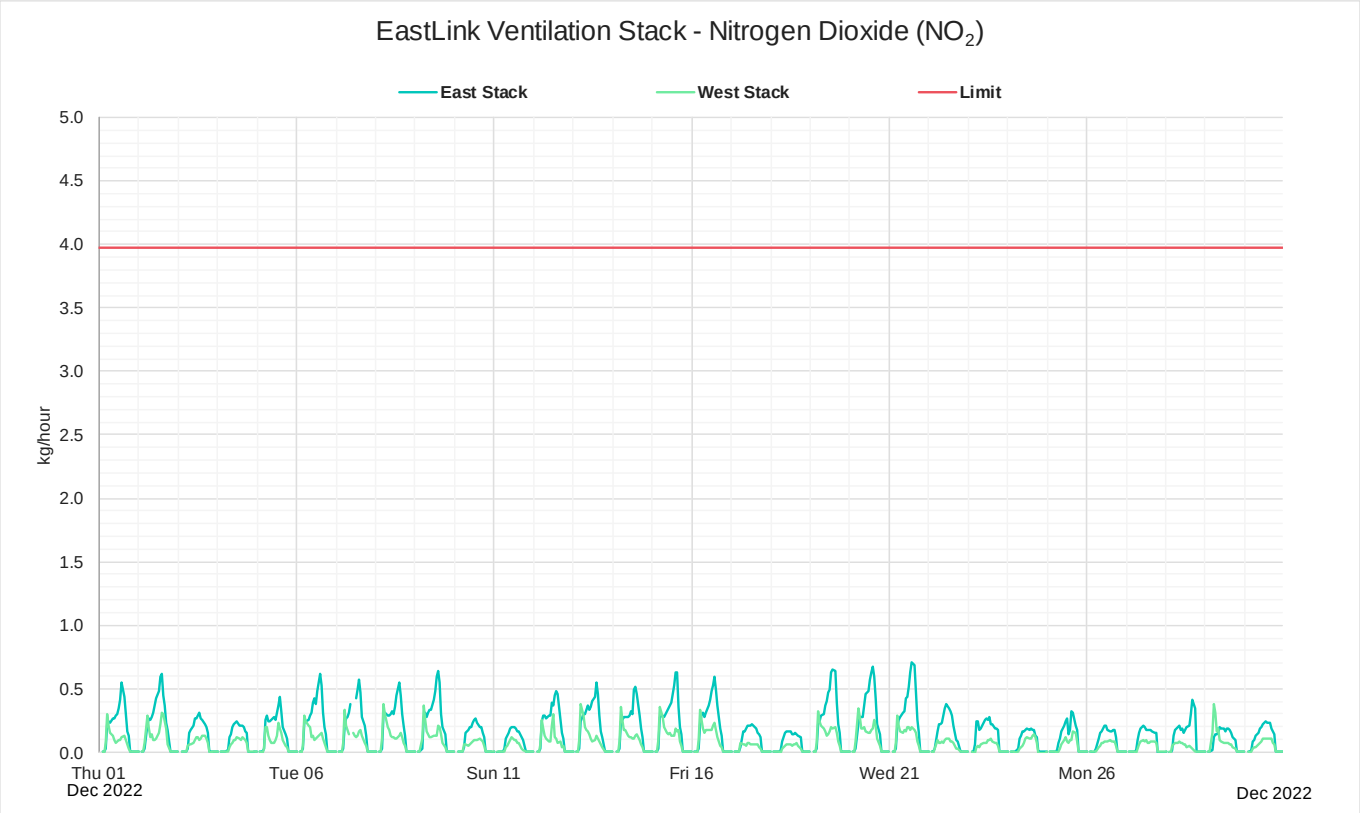

Figure 14: December 2022 Monthly 1 hour mass rate NO_2

6.3.4.2 December 2022 - Monthly 1 hour mass rate NO

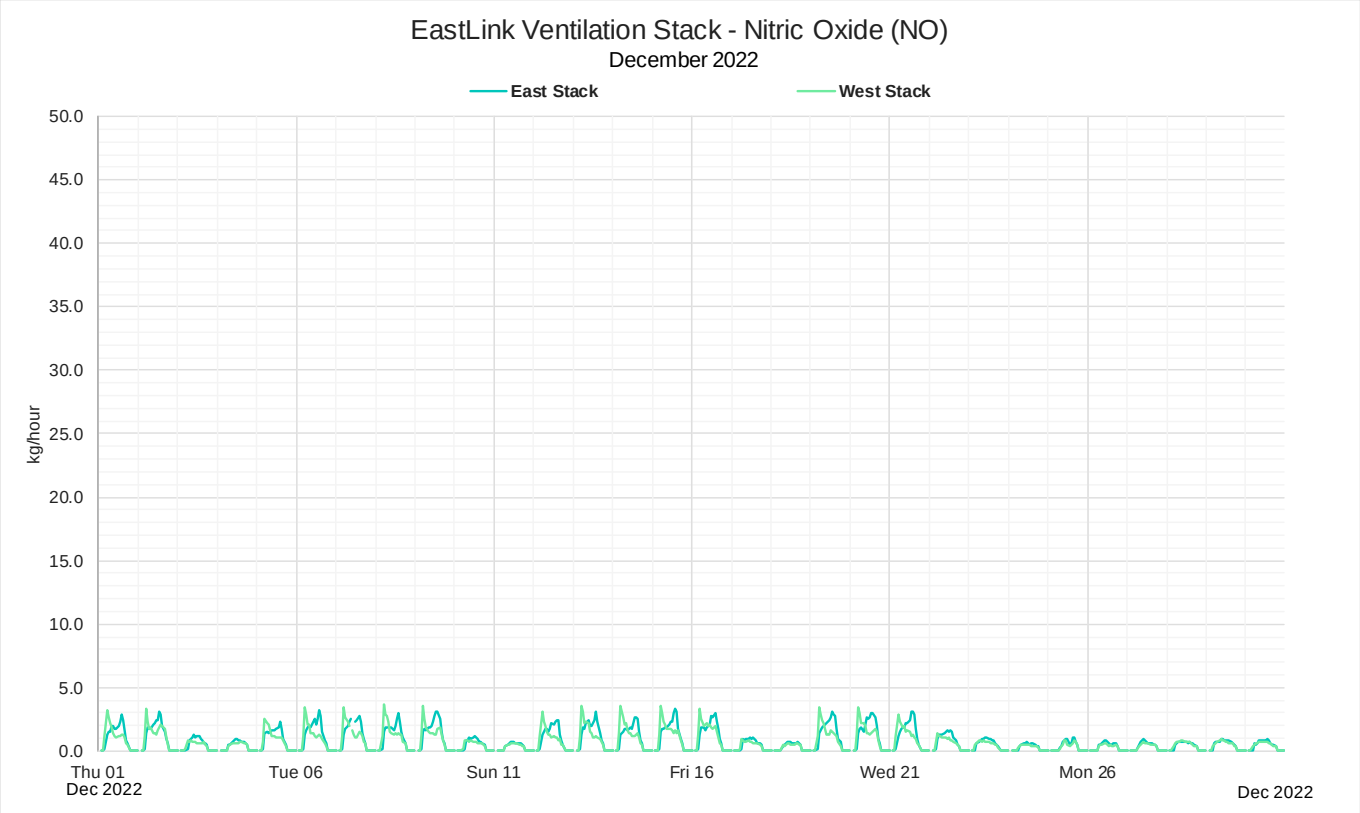

Figure 15: December 2022 Monthly 1 hour mass rate NO

6.3.4.3 December 2022 - Monthly 1 hour mass rate CO

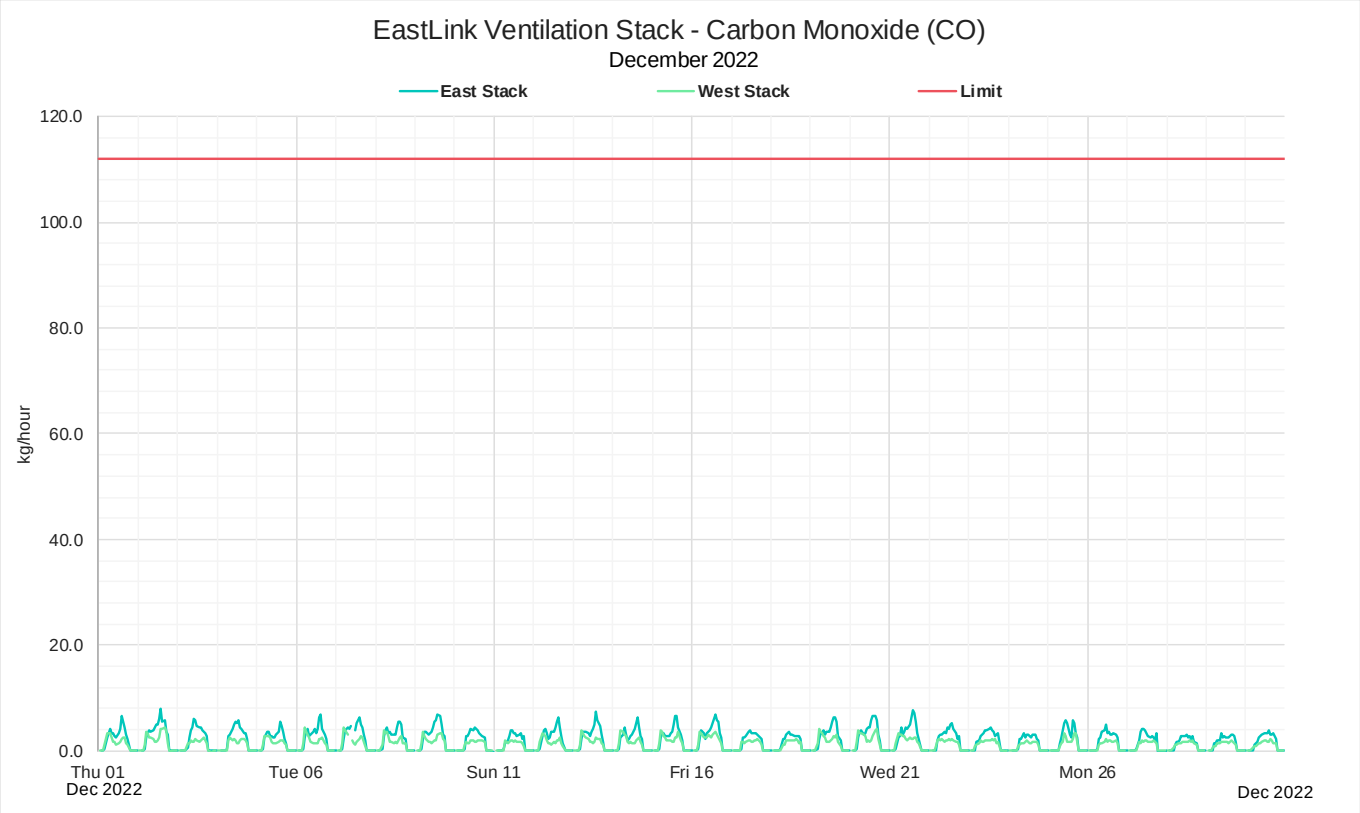

Figure 16: December 2022 Monthly 1 hour mass rate CO

6.3.4.4 December 2022 - Monthly 1 hour mass rate $PM_{2.5}$

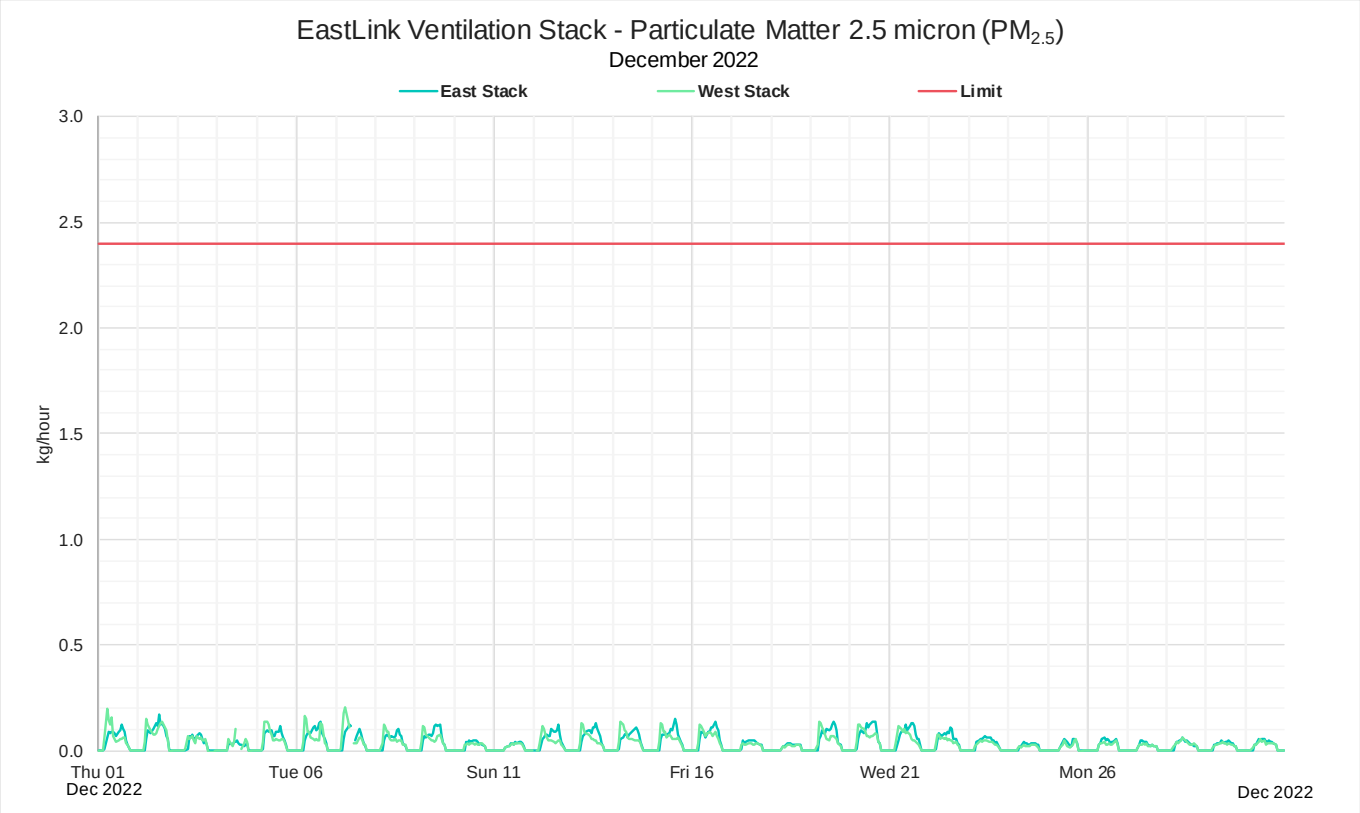

Figure 17: December 2022 Monthly 1 hour mass rate $PM_{2.5}$

6.3.4.5 December 2022 - Monthly 1 hour mass rate PM_{10}

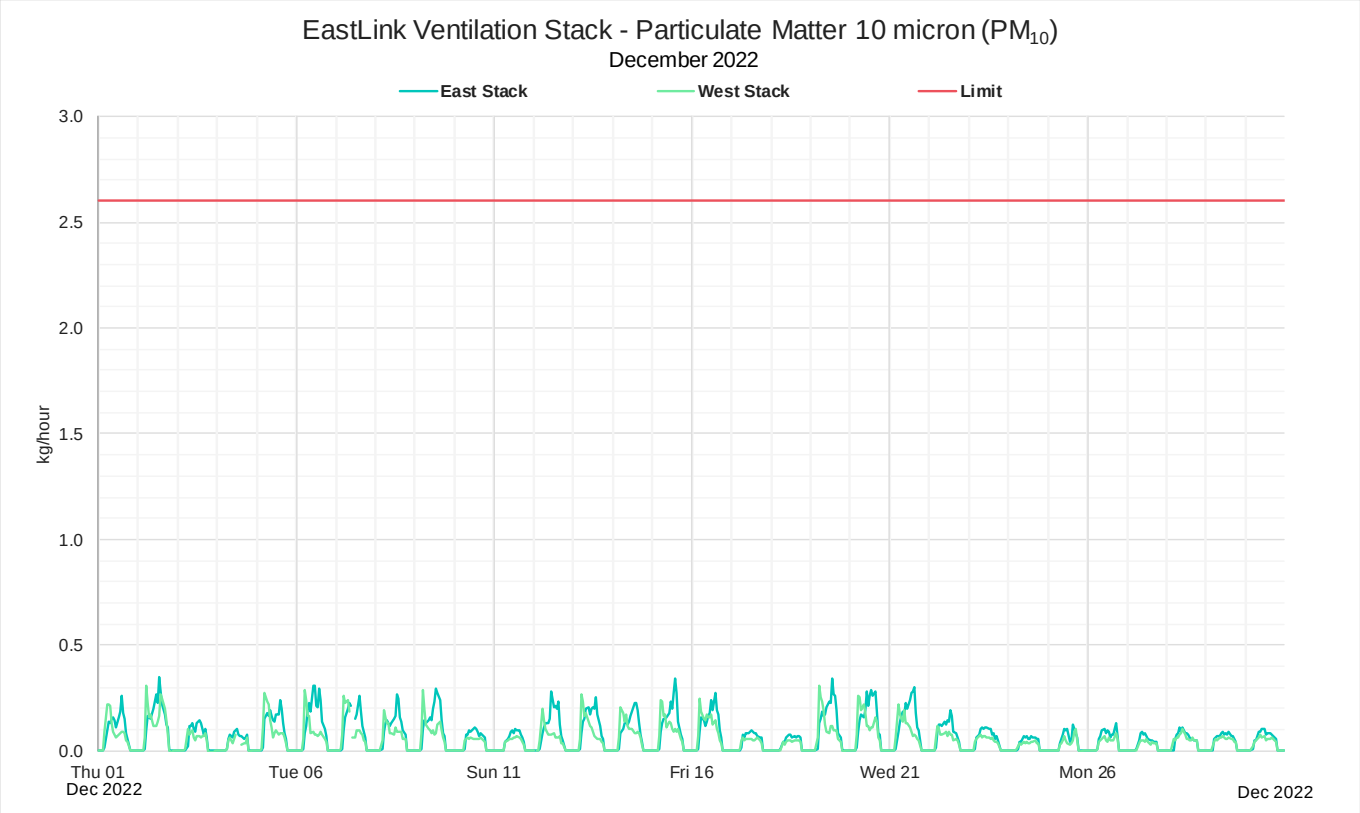

Figure 18: December 2022 Monthly 1 hour mass rate PM_{10}

6.3.4.6 December 2022 - Monthly 1 hour average stack velocity

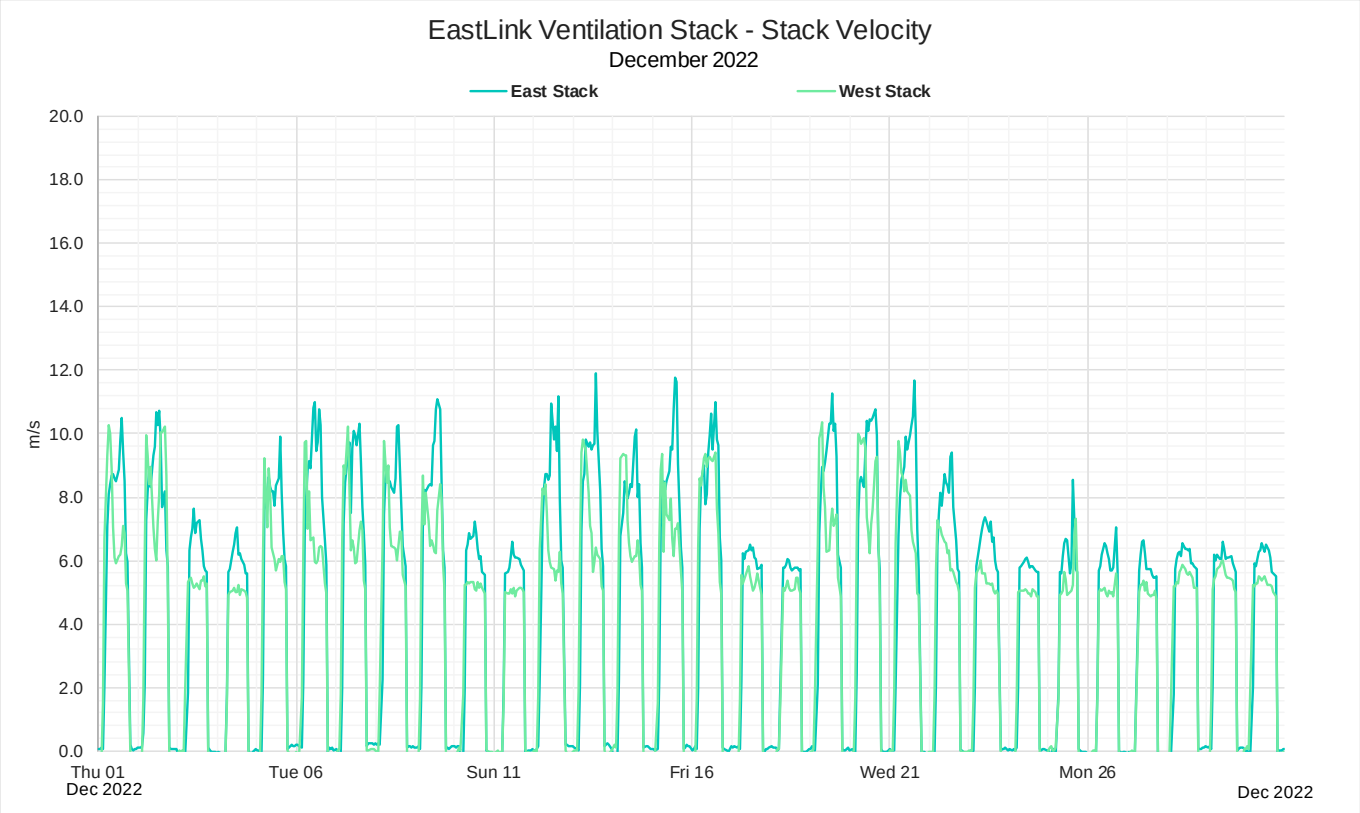

Figure 19: December 2022 Monthly 1 hour average stack velocity

6.3.5 Data Validation Table

Data validation details for the ventilation stack parameters are provided in the Table 28 and Table 29 below.

6.3.5.1 December 2022 - Western Ventilation Stack

Eastlink Tunnel Western Ventilation Stack Data Validation December 2022						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
18/11/2022 08:43	1/01/2023 00:00	CO	Offset applied to data: Offset A: +0.0 Offset B: -0.5	N/A	TA	17/01/2022
1/12/2022 00:04	1/12/2022 00:04	NO, NO2, NOx	Intermittent not enough samples	N/A	TA	17/01/2022
1/12/2022 00:04	31/12/2022 01:39	PM2.5, PM10	Intermittent not enough samples	N/A	TA	17/01/2022
4/12/2022 03:03	28/12/2022 03:48	PM2.5, PM10	Intermittent unrealistic data - negative	N/A	TA	17/01/2022
7/12/2022 08:47	7/12/2022 10:09	NO, NO2, NOx, CO, PM2.5, PM10	Maintenance	1.4	TA	17/01/2022
7/12/2022 10:10	7/12/2022 11:00	PM10	Stabilisation after maintenance	0.8	TA	17/01/2022

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 28: December 2022 Western Ventilation Stack data validation

6.3.5.2 December 2022 - Eastern Ventilation Stack

Eastlink Tunnel Eastern Ventilation Stack Data Validation December 2022						
Start Date	End Date	Parameters	Reason	Hours affected	User Name	Change Date
7/12/2022 10:23	7/12/2022 11:46	NO, NO2, NOx, CO, PM2.5, PM10	Maintenance	1.4	TA	17/01/2022
7/12/2022 11:47	7/12/2022 11:58	PM2.5, PM10	Stabilisation after maintenance	0.2	TA	17/01/2022
9/12/2022 03:08	25/12/2022 03:07	PM2.5, PM10	Intermittent unrealistic data - negative	N/A	TA	17/01/2022

This table details any missing data, data removed due to being deemed invalid, or data that has been adjusted.

Table 29: December 2022 Eastern Ventilation Stack data validation

6.4 Data Availability Year to Date

Data availability statistics for year to date (01 January 2022 to 31 December 2022) are provided in Table 30 below:

EastLink Ventilation Stack Data Availability January 2022 to December 2022						
Station	NO	NO_2	CO	$PM_{2.5}$	PM_{10}	Stack Velocity
Western	91.4%	91.4%	91.3%	94.6%	94.1%	95.3%
Eastern	94.3%	94.3%	94.9%	97.9%	98.0%	99.3%

Table 30: EastLink Ventilation Stack year to date data availability

6.5 Annual Performance Statement Bubble Limits

The EPA License 2043 Condition LI_DA1 designates annual emission rate bubble limits for discharge points 1 and 2. Annual emission rates are calculated from 1st July to 30th June each year to coincide with the Annual Performance Statement (APS) reporting period. Ventilation Stack emission rates year to date (01 July 2022 to 31 December 2022) are shown in Table 31 below.

EastLink Ventilation Stack Mass Rate July 2022 to December 2022				
Location	NO2	CO	$PM_{2.5}$	PM_{10}
	Tonnes	Tonnes	Tonnes	Tonnes
Western Ventilation Stack (Discharge Point 1)	0.324	5.031	0.138	0.257
Eastern Ventilation Stack (Discharge Point 2)	0.615	7.838	0.148	0.309
Total	**0.939**	**12.868**	**0.287**	**0.566**
Percentage of Licence limit	**2.7%**	**1.3%**	**1.4%**	**2.5%**
Annual Limit (Tonnes)	35	980	21	23

Table 31: Annual Performance Statement stack emission rates

Figure 20 below presents the ventilation stack emissions of each parameter as a percentage of the Licence limit compared with the percentage of elapse APS Reporting period.

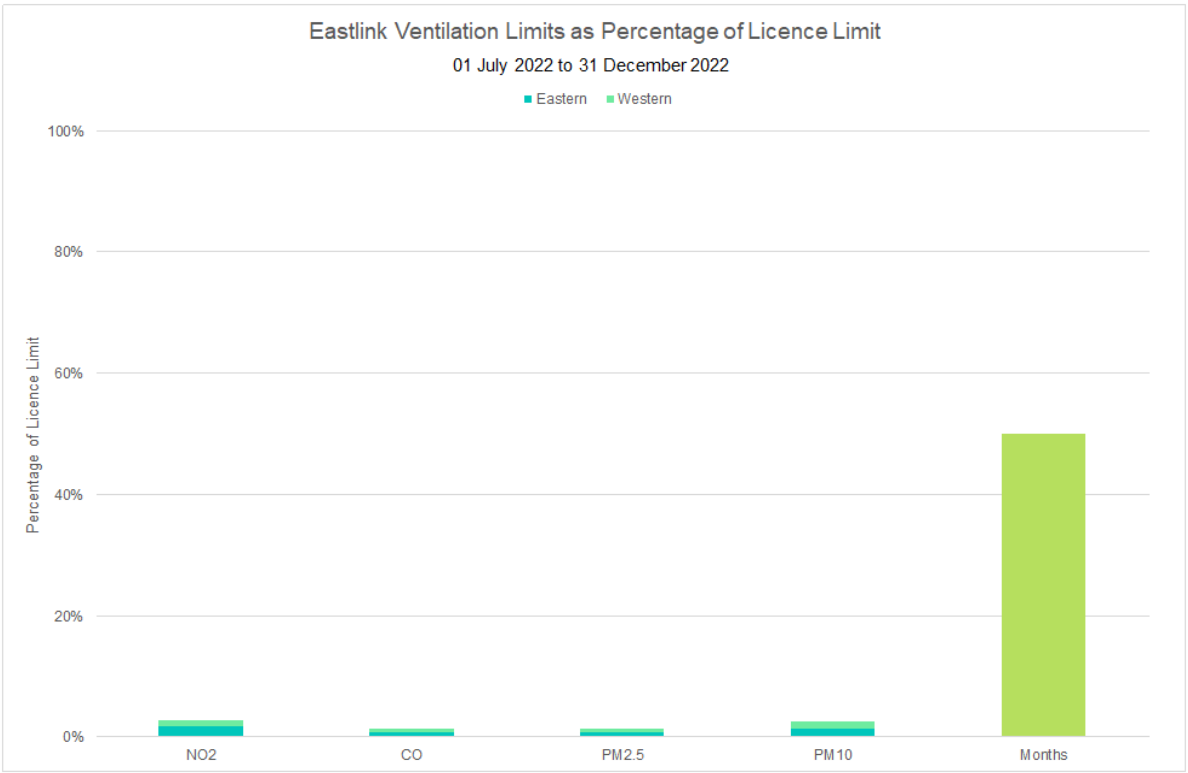

Figure 20: Annual Performance Statement stack emission rates

7 Report Summary

- There were nil exceedances of the prescribed limits during the reporting period.

Appendix 1

Glossary

The following terms and abbreviations are used in this report

CO	Carbon monoxide
DP1	Discharge Point 1
DP2	Discharge Point 2
kg/hour	Kilograms per hour
g/5m	Grams per 5 minutes
m^3/s	Cubic meters per second
mg/m^3	Milligrams per cubic meter at dry, standard temperature and pressure (0°C and 101.3 kPa)
NO	Nitric oxide
NO_2	Nitrogen dioxide
PM_{10}	Particulate less than 10 microns in equivalent aerodynamic diameter
$PM_{2.5}$	Particulate less than 2.5 microns in equivalent aerodynamic diameter

Data Validation Explanations

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

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

Offset or Multiplier 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

Data transmission error refers to a period of time when the instrument could not transmit data. This may be due to a communication fault between the logger and instrument.

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.

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

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

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

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

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

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

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.

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