Tollaust Pty Ltd - Lane Cove Tunnel

Marden St and Sirius Rd Stack Air Quality Monitoring Validated Data Report

1 January 2021 to 31 January 2021

Ref: DR.202101.LCT
Issue Date: 8 February 2021
Report prepared by: Tim Allfrey

NATA Accredited Laboratory Number 19660

Accredited for compliance with ISO/IEC 17025 – Testing

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

WORLD RECOGNISED ACCREDITATION

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

1300 572 822

info@norditech.com.au

www.norditech.com.au

Document Control

Revision	Date	Details	Prepared By	Approved By
0	8/02/2021	Final	TA	BN

Prepared by

Tim Allfrey
8 February 2021

Approved by

Bruno Nourdine
8 February 2021

Distribution

Format	Recipient	Details
PDF	Liam O'Grady	logrady@transurban.com
PDF	Colin Rymer	CRymer@transurban.com
PDF	Kieran Kilcoyne	KKilcoyne@transurban.com
PDF	Bill Castro	BiCastro@transurban.com
PDF	Scott Tinsley	STinsley@transurban.com
PDF	Josh Gorham	JGorham@transurban.com

Table of Contents

1 Executive Summary 5
1.1 Compliance to limits 5
2 Compliance Limits 6
2.1 Standards Compliance 6
3 Introduction 7
4 Explanation of Monitoring 8
4.1 Methodology 8
4.2 Ventilation Stacks 9
4.3 Data Collection 10
4.4 Data Validation 10
4.5 Reporting and Calculations 11
4.5.1 Data Availability 11
4.5.2 Unit Conversions 11
4.5.3 Combined Sirius Road South and Sirius Road North results 12
4.5.4 Accumulative Load 12
5 Calibrations and Maintenance 13
5.1 Units and Uncertainties 13
5.2 Last Calibrations and Maintenance performed 14
5.3 Maintenance Notes 15
5.3.1 Marden St 15
5.3.2 Sirius Rd South 15
5.3.3 Sirius Rd North 15
5.4 Automatic Instrument Calibration Checks 16
6 Results 17
6.1 Data Availability 17
6.2 Exceedances 18
6.3 Tabulated Results 19
6.3.1 Summary of 30 minute Average Data Marden St and Sirius Rd Combined 19
6.3.2 Summary of 30 minute Average Flow, Relative Humidity and Temperature. 20
6.3.3 Accumulative Load (Combined Stacks) 21
6.4 Graphical Representations 22
6.4.1 Monthly Summaries 22
6.4.1.1 Marden St Stack - Monthly CO 22
6.4.1.2 Marden St Stack - Monthly NO_x 23
6.4.1.3 Marden St Stack – Monthly PM_{10} 24
6.4.1.4 Marden St Stack – Monthly VOC 25
6.4.1.5 Sirius Rd Stack - Monthly CO 26
6.4.1.6 Sirius Rd Stack - Monthly NO_x 27
6.4.1.7 Sirius Rd Stack – Monthly PM_{10} 28
6.4.1.8 Sirius Rd Stack – Monthly VOC 29
6.4.2 Accumulative Loads 30
6.4.2.1 Combined Stacks CO Accumulative Load 30
6.4.2.2 Combined Stacks NO_x Accumulative Load 31
6.4.2.3 Combined Stacks PM_{10} Accumulative Load 32
6.4.2.4 Combined Stacks VOC Accumulative Load 33
6.4.3 Three Monthly Trends 34
6.4.3.1 Marden St Stack – Three Monthly CO 34
6.4.3.2 Marden St Stack – Three Monthly NO_2, NO_x 35
6.4.3.3 Marden St Stack – Three Monthly PM_{10} 36
6.4.3.4 Marden St Stack – Three Monthly VOC 37
6.4.3.5 Sirius Rd Stack – Three Monthly CO 38
6.4.3.6 Sirius Rd Stack – Three Monthly NO_2, NO_x 39

6.4.3.7 Sirius Rd Stack – Three Monthly PM_{10} 40
6.4.3.8 Sirius Rd Stack – Three Monthly VOC 41
7 Report Summary 42
Appendix 1 43
Glossary 43
Data Validation Explanations 43

Figures

Figure 1: Lane Cove Tunnel ventilation stack locations 9
Figure 2: Marden St Stack – Monthly CO 22
Figure 3: Marden St Stack – Monthly NO_x 23
Figure 4: Marden St Stack – Monthly PM_{10} 24
Figure 5: Marden St Stack – Monthly VOC 25
Figure 6: Sirius Rd Stack – Monthly CO 26
Figure 7: Sirius Rd Stack – Monthly NO_x 27
Figure 8: Sirius Rd Stack – Monthly PM_{10} 28
Figure 9: Sirius Rd Stack – Monthly VOC 29
Figure 10: Combined Stacks CO Accumulative Load 30
Figure 11: Combined Stacks NO_x Accumulative Load 31
Figure 12: Combined Stacks PM_{10} Accumulative Load 32
Figure 13: Combined Stacks VOC Accumulative Load 33
Figure 14: Marden St Stack – Three Monthly CO 34
Figure 15: Marden St Stack – Three Monthly NO_x 35
Figure 16: Marden St Stack – Three Monthly PM_{10} 36
Figure 17: Marden St Stack – Three Monthly VOC 37
Figure 18: Sirius Rd Stack – Three Monthly CO 38
Figure 19: Sirius Rd Stack – Three Monthly NO_x 39
Figure 20: Sirius Rd Stack – Three Monthly PM_{10} 40
Figure 21: Sirius Rd Stack – Three Monthly VOC 41

Tables

Table 1: Exceedances of MCoA Goals 5
Table 2: MCoA Compliance Goals 6
Table 3: Measurement methods and instrumentation 8
Table 4: Lane Cove Tunnel ventilation stack GPS Coordinates 9
Table 5: Sirius Rd Reporting Condition criteria 12
Table 6: Measurement units and uncertainties 13
Table 7: Instrument details and calibration dates 14
Table 8: Nightly span, zero and CO reference times. 16
Table 9: LCT ventilation stack data availability 17
Table 10: Exceedances of MCoA Goals 18
Table 11: Summary of 30 minute average data Marden St and Sirius Rd combined 19
Table 12: Summary of 30 minute average flow, RH and temperature 20
Table 13: Total Accumulative Load (Combined Stacks) 21

1 Executive Summary

The Lane Cove Tunnel runs for 3.6km between North Ryde and Artarmon, linking the M2 Motorway and the Gore Hill Freeway and forms part of Sydney's motorway network. The tunnel commenced operation in March 2007.

Two stacks provide ventilation for the tunnel, one at the western end of the tunnel (Sirius Road, Lane Cove West), and one at the eastern end of the tunnel (Marden St, Artarmon). The Sirius Road stack comprises two partitions, north and south. Sirius Road results are a combined weighted average to the two partitions.

This report presents the monthly validated stack data for January 2021 to Tollaust Pty Ltd for the Lane Cove Tunnel.

1.1 Compliance to limits

The Minister's Conditions of Approval (MCoA) designates limits to which pollutants being discharged from the ventilation stacks must meet. (MCoA 173).

There were nil exceedances of the prescribed limits during the reporting period, as indicated in Table 1 below.

Lane Cove Tunnel Ventiliation Stack Air Quality Limit Exceedances January 2021							
Location	Parameter	Time Period	Concentration Limit	Units	Number of exceedances	Value of exceedance	Date and Time of exceedance
Marden St (Eastern Stack)	CO	30 minutes	62.5	mg/m^3	0	-	-
	NO_x	30 minutes	25.7	mg/m3	0	-	-
	PM_{10}	30 minutes	1200	µg/m3	0	-	-
	VOC	30 minutes	6.3	mg/m3	0	-	-
Sirius Rd (Western Stack)	CO	30 minutes	62.5	mg/m3	0	-	-
	NO_x	30 minutes	32.8	mg/m3	0	-	-
	PM_{10}	30 minutes	1600	µg/m3	0	-	-
	VOC	30 minutes	6.3	mg/m3	0	-	-
Combined Stacks	CO	Annual	1530	t/annum	0	-	-
	NO_x	Annual	229	t/annum	0	-	-
	PM_{10}	Annual	14	t/annum	0	-	-
	VOC	Annual	153	t/annum	0	-	-

Table 1: Exceedances of MCoA Goals

For further information relating to exceedance reporting please refer to sections Compliance Limits, and Exceedances.

2 Compliance Limits

Air quality goals provided are provided in Condition 173 of the Minister's Conditions of Approval issued by the Director-General for the Lane Cove Tunnel project. The air quality goals are shown in the table below.

Lane Cove Tunnel Ventiliation Stack Air Quality Limits					
Location	Parameter	Time Period	Concentration Limit	Units	Applicable MCoA
Marden St (Eastern Stack)	CO	30 minutes	62.5	mg/m^3	MCoA 173
	NO_x	30 minutes	25.7	mg/m3	MCoA 173
	PM_{10}	30 minutes	1200	µg/m3	MCoA 173
	VOC	30 minutes	6.3	mg/m3	MCoA 173
Sirius Rd (Western Stack)	CO	30 minutes	62.5	mg/m3	MCoA 173
	NO_x	30 minutes	32.8	mg/m3	MCoA 173
	PM_{10}	30 minutes	1600	µg/m3	MCoA 173
	VOC	30 minutes	6.3	mg/m3	MCoA 173
Combined Stacks	CO	Annual	1530	t/annum	MCoA 173
	NO_x	Annual	229	t/annum	MCoA 173
	PM_{10}	Annual	14	t/annum	MCoA 173
	VOC	Annual	153	t/annum	MCoA 173

Table 2: MCoA Compliance Goals

2.1 Standards Compliance

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

- Measurement of Stack Flow.
- Particulate matter PM_{10} and $PM_{2.5}$ sampled by means of an isokinetic sampling system
- AS/NZS 3580.9.8 refers specifically to the monitoring of PM_{10}.

3 Introduction

Norditech were contracted by Tollaust Pty Ltd in December 2018 to provide continuous stack air quality monitoring and reporting services for Lane Cove Tunnel.

Norditech is a NATA accredited organisation (Accreditation Number 19660)

Addresses of relevant parties:

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

Tollaust Pty Ltd
5 Sirius Rd
Lane Cove West NSW 2066

This report presents the validated Marden St and Sirius Rd ventilation stack data for January 2021.

- Describes air quality measurements.
- Reports any readings above the LCT 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 Marden St, Artarmon, and one located at Sirius Rd, Lane Cove West. The Sirius Rd stack comprises of two separate partitions (North and South). For each stack, monitoring as per the requirements of MCoA 172 is undertaken. Each partition of the Sirius Rd stack is monitored by separate air quality monitoring stations.

Gaseous parameters are sampled by an extractive sampling system with automatic purging. Volatile organic compounds are measured using the flame ionization detection principle. 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, via an isokinetic sampling system.

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 data collection:

LCT Ventilation Stack Measurement Methods		
Parameter	Method	Instrument
CO	In house method TP.003	Ecotech Serinus S30
NO, NO_2, NO_x	In house method TP.001	Ecotech Serinus S40
CH_4 ,NMHC, VOC	In house method TP.006	Baseline 9000, ENVEA HC51M
PM_{10}	AS/NZS 3580.9.8	Rupprecht & Patashnick TEOM with Ecotech and Norditech ISS isokinetic sampling system
	In house method TP.005	
	AS 4323.1	
$PM_{2.5}$	In house method TP.026	Rupprecht & Patashnick TEOM with Ecotech and Norditech ISS isokinetic sampling system
	AS 4323.1	
Temperature	In house method TP.012	Vaisala HMT330
Relative Humidity	In house method TP.014	Vaisala HMT330
Flow Rate	TBA	Flowsic100 USD 55SSTI Ultrasonic flow sensor

Table 3: Measurement methods and instrumentation

4.2 Ventilation Stacks

The locations of the Marden St and Sirius Rd ventilation stacks are detailed in the table and figure below.

LCT Tunnel Ventilation Stack Locations	
Parameter	GPS Coordinates
Marden St (Eastern Stack)	-33.815025°, 151.179246°
Sirius Rd (Western Stack)	-33.807887°, 151.146074°

Table 4: Lane Cove Tunnel ventilation stack GPS Coordinates

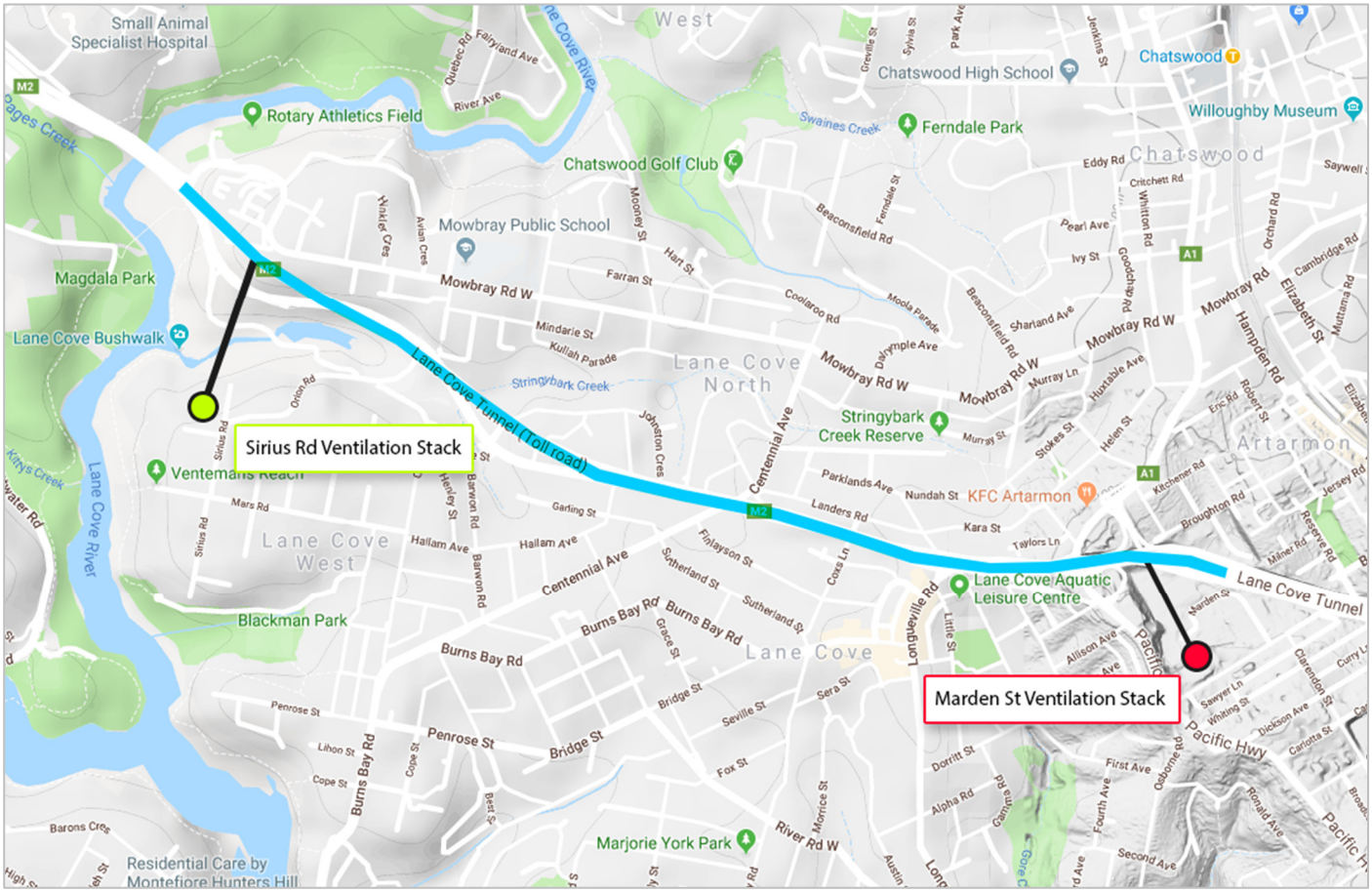

Figure 1: Lane Cove Tunnel ventilation stack locations

:

4.3 Data Collection

At each Air Quality Monitoring Station, data is logged to a WinAQMS data logger at 5 minute average intervals. Each 5 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 ADSL, 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.

Transurban also keeps a non-validated data set on the Airodis data collection PC located at the Lane Cove Tunnel Control Room. This PC is maintained by Norditech.

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 5 minute average base data and are reported as 'end time'. IE the average data for 01:05 is the data from 01:00 through to 01:05.

Validated data for Marden St Stack is presented in the Excel workbook named "202101 LCT Marden St Stack Validated data.xlsx"

The workbook consists of the following sheets:

1. Cover
2. Marden St 5m Avg
3. Marden St Data Validation

Validated data for Sirius Rd Stack is presented in the Excel workbook named "202101 LCT Sirius Rd Stack Validated data.xlsx"

The workbook consists of the following sheets:

1. Cover
2. Sirius Rd Combined 5m Avg
3. Flow Temp RH Individual 5m Avg
4. Sirius Rd South Data Validation
5. Sirius Rd North Data Validation

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 5 minute average data points for the reporting period
- Sum of possible data points is the number of theoretically available data points for the reporting period

4.5.2 Unit Conversions

Total oxides of nitrogen (NO_x) results are expressed as NO_2 equivalents in mg/m^3. VOC results are expressed as methane equivalents in mg/m^3.

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

- Marden Street Stack area 59.8919 m2
- Sirius Road Stack – North Partition area 35.95 m2
- Sirius Road Stack – South Partition area 36.19 m2

Pollutant and flow data are reported at reference conditions: 0°C, 101.325 kPa, dry.

4.5.3 Combined Sirius Road South and Sirius Road North results

Data from the Sirius Road stack are combined results of the north and south partitions. Stack velocity is used to determine whether a partition is active or inactive, and this determines the calculation for the total Sirius Road ventilation stack results.

The table below shows the criteria used to determine how the total Sirius Road ventilation stack data is calculated.

LCT Tunnel Sirius Rd Ventilation Stack Reporting Conditions	
Partitions Active	Calculation
None	Combined result is based on weighted total from both partitions. Weighting is calculated as a function of the ratio of partition flows to total flow
One	Active partition is reported
Both	Combined result is based on weighted total from both partitions. Weighting is calculated as a function of the ratio of partition flows to total flow
Uknown in either partition	No result provided as it can not be determined whether each partition is active or not.

Table 5: Sirius Rd Reporting Condition criteria

4.5.4 Accumulative Load

Accumulative loads are calculated from the monthly measured emission in tonnes for each stack for CO, NO_x, PM_{10} and VOC. The measured emissions are converted to an estimated monthly total emission by taking into account the data capture of each parameter, using the following formula:

$$estimated\ monthly\ total\ emission = \frac{measured\ monthly\ emission}{available\ data\ \%} * 100$$

The estimated monthly total emissions for each parameter for each stack are then added together to give the total emission per parameter per month.

The accumulative load is then calculated as the sum of the previous 12 months estimated total emission for each parameter.

If there is less than 50% data availability for any parameter, then data for the last valid previous month (i.e. above 50% data availability) is substituted.

5 Calibrations and Maintenance

5.1 Units and Uncertainties

LCT 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 123
NO	mg/m3	0.01	± 8.1% of reading for range 25.7 – 32.8mg/m3 (k=1.96)	0 to 31
NO_2	mg/m3	0.01	± 8.5% of reading at 25.7mg/m3 (k=1.96)	0 to 33
NO_x	mg/m3	0.01	± 8.1% of reading for range 25.7 – 32.8mg/m3 (k=1.96)	0 to 33
CH_4	mg/m3	0.01	±12% of reading + 0.3mg/m3 for range 3.5 – 17mg/m3 (k=2.0)	0 to 17
NMHC	mg/m3	0.01	±13% of reading + 0.56mg/m3 for range 3.5 – 20mg/m3 (k=2.0)	0 to 20
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	± 0.6°C, K factor of 2.0	0 to 50
Relative Humidity	%	1	± 6%, K factor of 2.0	1 to 100
Flow Rate	m^3/s	1	±0.1 for velocity measurement[1]	-40 to +40

[1] Manufacturer's stated accuracy

Table 6: Measurement units and uncertainties

5.2 Last Calibrations and Maintenance performed

Instrumentation maintenance and last calibration dates are provided in the table below

LCT Stack Maintenance and Calibrations January 2021				
Location	Parameter	Date of last maintenance	Maintenance type	Date of last calibration
Marden St	CO	4/01/2021	1 Monthly	4/01/2021
	NO, NO2, NOx	4/01/2021	1 Monthly	4/01/2021
	VOC	4/01/2021	1 Monthly	4/01/2021
	PM10	4/11/2020	3 Monthly	4/11/2020
	PM2.5	4/11/2020	3 Monthly	4/11/2020
	Temperature	11/08/2020	12 Monthly	11/08/2020
	Relative Humidity	11/08/2020	12 Monthly	11/08/2020
	Flow Rate	N/A	N/A	15/07/2020
Sirius Rd South	CO	14/01/2021	12 Monthly	14/01/2021
	NO, NO2, NOx	14/01/2021	12 Monthly	14/01/2021
	VOC	14/01/2021	12 Monthly	14/01/2021
	PM10	19/01/2021	12 Monthly	19/01/2021
	PM2.5	19/01/2021	12 Monthly	19/01/2021
	Temperature	14/01/2021	12 Monthly	14/01/2021
	Relative Humidity	14/01/2021	12 Monthly	14/01/2021
	Flow Rate	N/A	N/A	15/07/2020
Sirius Rd North	CO	12/01/2021	1 Monthly	12/01/2021
	NO, NO2, NOx	12/01/2021	1 Monthly	12/01/2021
	VOC	12/01/2021	1 Monthly	12/01/2021
	PM10	10/11/2020	3 Monthly	10/11/2020
	PM2.5	N/A	N/A	12/08/2020
	Temperature	7/09/2020	12 Monthly	7/09/2020
	Relative Humidity	7/09/2020	12 Monthly	7/09/2020
	Flow Rate	N/A	N/A	15/07/2020

Table 7: Instrument details and calibration dates

5.3 Maintenance Notes

The sections below describe the major maintenance undertaken at each of the three monitoring stations during the reporting period. For further details please refer to the corresponding data validation table contained within the relevant accompanying data report file.

5.3.1Marden St

- Scheduled maintenance was undertaken on 4/01/2021

5.3.2 Sirius Rd South

- Scheduled maintenance was undertaken on 14/01/2021 and 19/01/2021

5.3.3 Sirius Rd North

- Scheduled maintenance was undertaken on 12/01/2021

5.4 Automatic Instrument Calibration Checks

The table 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, NO_x, CO, CH_4 and NMHC			
Location	Parameter	Span / Zero cycle time	Background cycle time
Marden St	CO	1:00 - 2:00	23:45 - 23:50
	NO, NO2, NOx	1:00 - 2:00	-
	VOC	1:00 - 2:00	-
Sirius Rd South	CO	1:00 - 2:00	23:45 - 23:50
	NO, NO2, NOx	1:00 - 2:00	-
	VOC	1:00 - 2:00	-
Sirius Rd North	CO	1:00 - 2:00	23:45 - 23:50
	NO, NO2, NOx	1:00 - 2:00	-
	VOC	1:00 - 2:00	-

Table 8: Nightly span, zero and CO reference times.

6 Results

6.1 Data Availability

Data availability for the in ventilation stack parameters are provided in the table below. Locations with data availability less than 90% are indicated in red italics.

- Data availability for all parameters measured in the Lane Cove Tunnel Marden St stack were above 90% for the reporting period with the exception of VOC and $PM_{2.5}$ parameters.
- Data availability for all parameters measured in the Lane Cove Tunnel Sirius Rd stack were below 90% for the reporting period with the exception of Flow.
    - PM2.5 capture was 68.9% due to required scheduled verification activities.

LCT Ventilation Stack Data Capture January 2021								
Station	CO (%)	NO (%)	NO_2 (%)	NO_x (%)	PM_{10} (%)	$PM_{2.5}$ (%)	VOC (%)	Flow (%)
Marden St Stack	95.0	94.6	95.0	95.0	97.2	*86.4*	*81.3*	100.0
Sirius Rd Stack	*87.4*	*85.2*	*85.1*	*85.2*	*88.7*	*68.9*	*86.6*	96.5

Table 9: LCT ventilation stack data availability

6.2 Exceedances

Instances of the ventilation stack pollutants exceeding the MCoA goals during the reporting period are presented in the table below.

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

Lane Cove Tunnel Ventiliation Stack Air Quality Limit Exceedances January 2021							
Location	Parameter	Time Period	Concentration Limit	Units	Number of exceedances	Value of exceedance	Date and Time of exceedance
Marden St (Eastern Stack)	CO	30 minutes	62.5	mg/m^3	0	-	-
	NO_x	30 minutes	25.7	mg/m3	0	-	-
	PM_{10}	30 minutes	1200	µg/m3	0	-	-
	VOC	30 minutes	6.3	mg/m3	0	-	-
Sirius Rd (Western Stack)	CO	30 minutes	62.5	mg/m3	0	-	-
	NO_x	30 minutes	32.8	mg/m3	0	-	-
	PM_{10}	30 minutes	1600	µg/m3	0	-	-
	VOC	30 minutes	6.3	mg/m3	0	-	-
Combined Stacks	CO	Annual	1530	t/annum	0	-	-
	NO_x	Annual	229	t/annum	0	-	-
	PM_{10}	Annual	14	t/annum	0	-	-
	VOC	Annual	153	t/annum	0	-	-

Table 10: Exceedances of MCoA Goals

6.3 Tabulated Results

6.3.1 Summary of 30 minute Average Data Marden St and Sirius Rd Combined

The following table presents 30 minute average minimum, maximum and daily average data for the Marden St Stack, and Sirius Rd combined stack.

30 minute averages are calculated from 5 minute average data. The daily average is calculated from 30 minute average data.

LCT Ventilation Stack Summary January 2021								
Parameter	CO (mg/m^3)	NO (mg/m^3)	NO_2 (mg/m^3)	NO_x (mg/m^3)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	VOC (mg/m^3)	Flow (m^3/s)
Marden St (Eastern Stack)								
Minimum 30 minute average	-0.11	0.01	0.02	0.05	-9.4	-9.6	1.19	7
Maximum 30 minute average	7.96	4.36	0.95	7.63	206.4	188.9	2.35	599
Average	2.50	0.97	0.25	1.74	50.3	39.6	1.55	393
Limit	62.5			25.7	1200		6.3	
Sirius Rd (Western Stack)								
Minimum 30 minute average	-0.35	-0.01	0.01	0.00	-8.3	-13.1	1.21	6
Maximum 30 minute average	4.18	1.37	0.31	2.40	130.3	182.0	2.03	380
Average	1.61	0.32	0.10	0.59	30.1	18.5	1.45	342
Limit	62.5			32.8	1600		6.3	

Table 11: Summary of 30 minute average data Marden St and Sirius Rd combined

6.3.2 Summary of 30 minute Average Flow, Relative Humidity and Temperature.

The following table presents 30 minute average minimum, maximum and daily average flow, relative humidity, and temperature data for the Marden St Stack, and Sirius Rd North and South partitions.

30 minute averages are calculated from 5 minute average data. The daily average is calculated from 30 minute average data.

LCT Ventilation Stack Flow, RH, Temp Summary January 2021									
Parameter	Marden St (Eastern Stack)			Sirius Rd - South Partition			Sirius Rd - North Partition		
	Flow (m^3/s)	RH (%)	Temp (°C)	Flow (m^3/s)	RH (%)	Temp (°C)	Flow (m^3/s)	RH (%)	Temp (°C)
Minimum 30 minute average	7	15	21.5	4	12	22.0	2	18	17.5
Maximum 30 minute average	599	84	33.4	363	77	33.2	22	91	36.3
Average	393	55	27.1	333	54	26.5	9	65	23.3

Table 12: Summary of 30 minute average flow, RH and temperature

6.3.3 Accumulative Load (Combined Stacks)

The following table presents annual accumulative total loads for CO, NO_x, PM_{10} and VOC.

Where data availability is less than 50%, data has been substituted with data from the last valid monthly accumulated load for that parameter (i.e. the last month for which greater than 50% of data was available).

LCT Stack Accumulative Load February 2020 to January 2021				
	Carbon Monoxide	Oxides of Nitrogen	PM_{10}	VOC
	Tonnes	Tonnes	Tonnes	Tonnes
Accumulative Load for past 12 months	54.1	37.3	1.3	39.4
Annual Limit (Tonnes)	1530	229	14	153

Table 13: Total Accumulative Load (Combined Stacks)

6.4 Graphical Representations

6.4.1 Monthly Summaries

The following charts present 30 minute average minimum, maximum and daily average data CO, NO_x, PM_{10} and VOC for the Marden St Stack, and Sirius Rd combined stack.

30 minute averages are calculated from 5 minute average data. The daily average is calculated from 30 minute average data.

6.4.1.1 Marden St Stack - Monthly CO

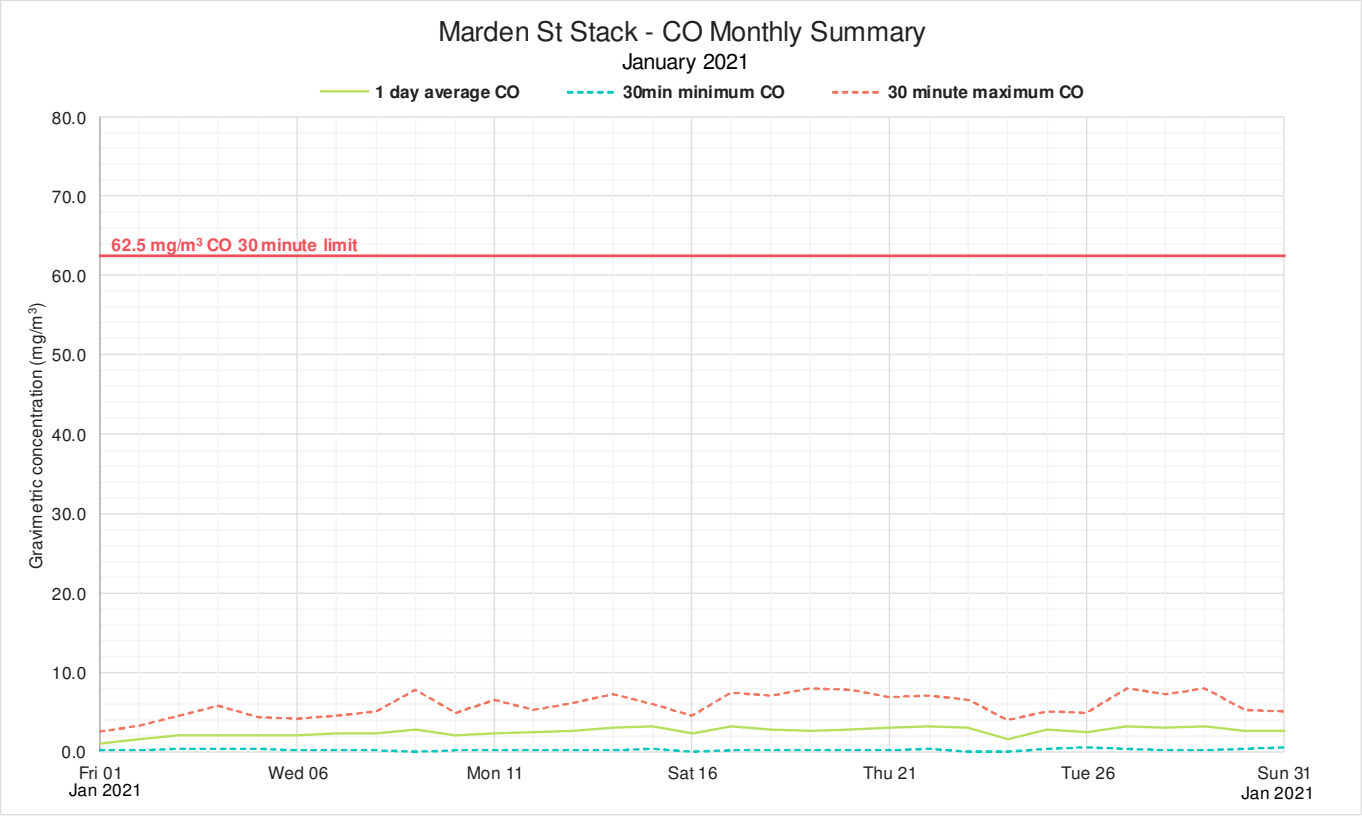

Figure 2: Marden St Stack – Monthly CO

6.4.1.2 Marden St Stack - Monthly NO_x

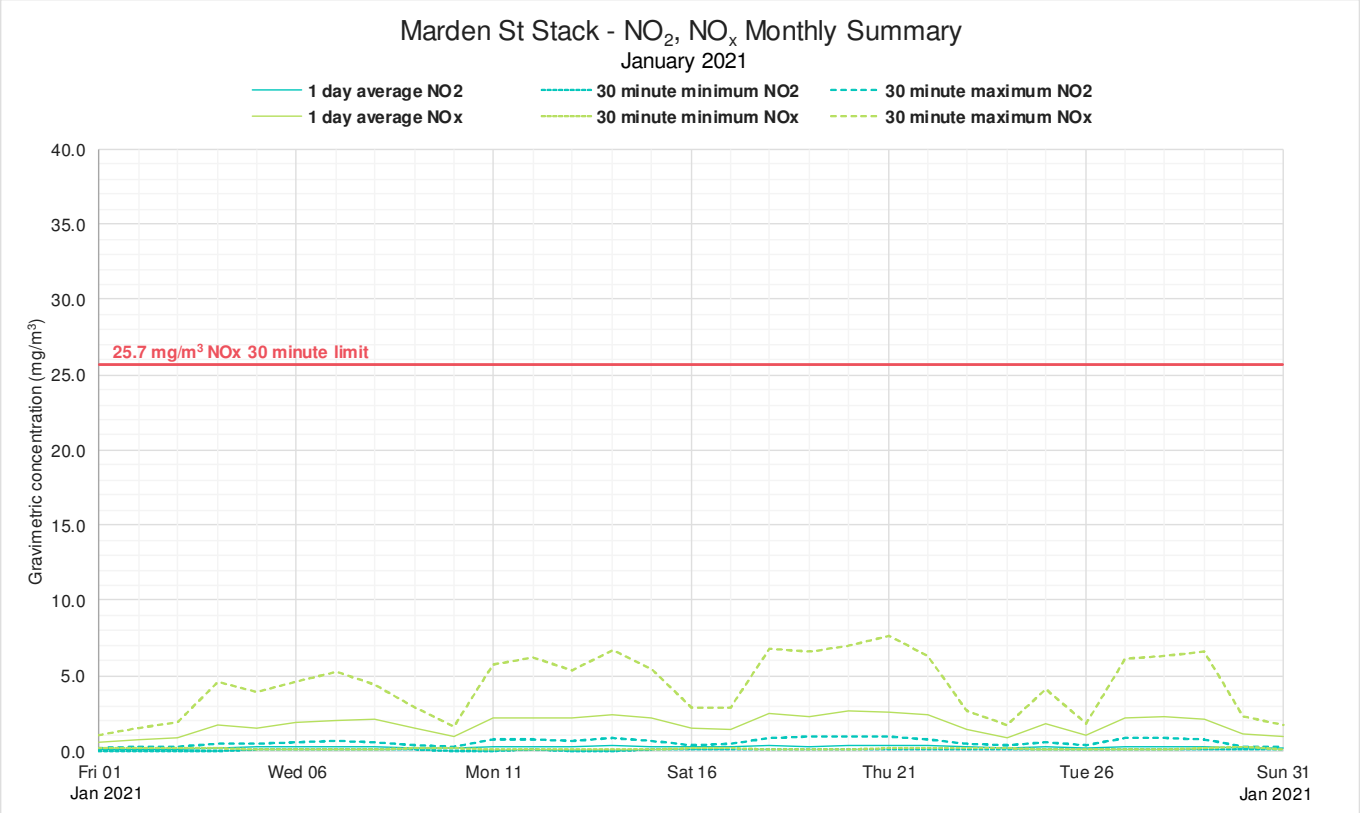

Figure 3: Marden St Stack – Monthly NO_x

6.4.1.3 Marden St Stack – Monthly PM_{10}

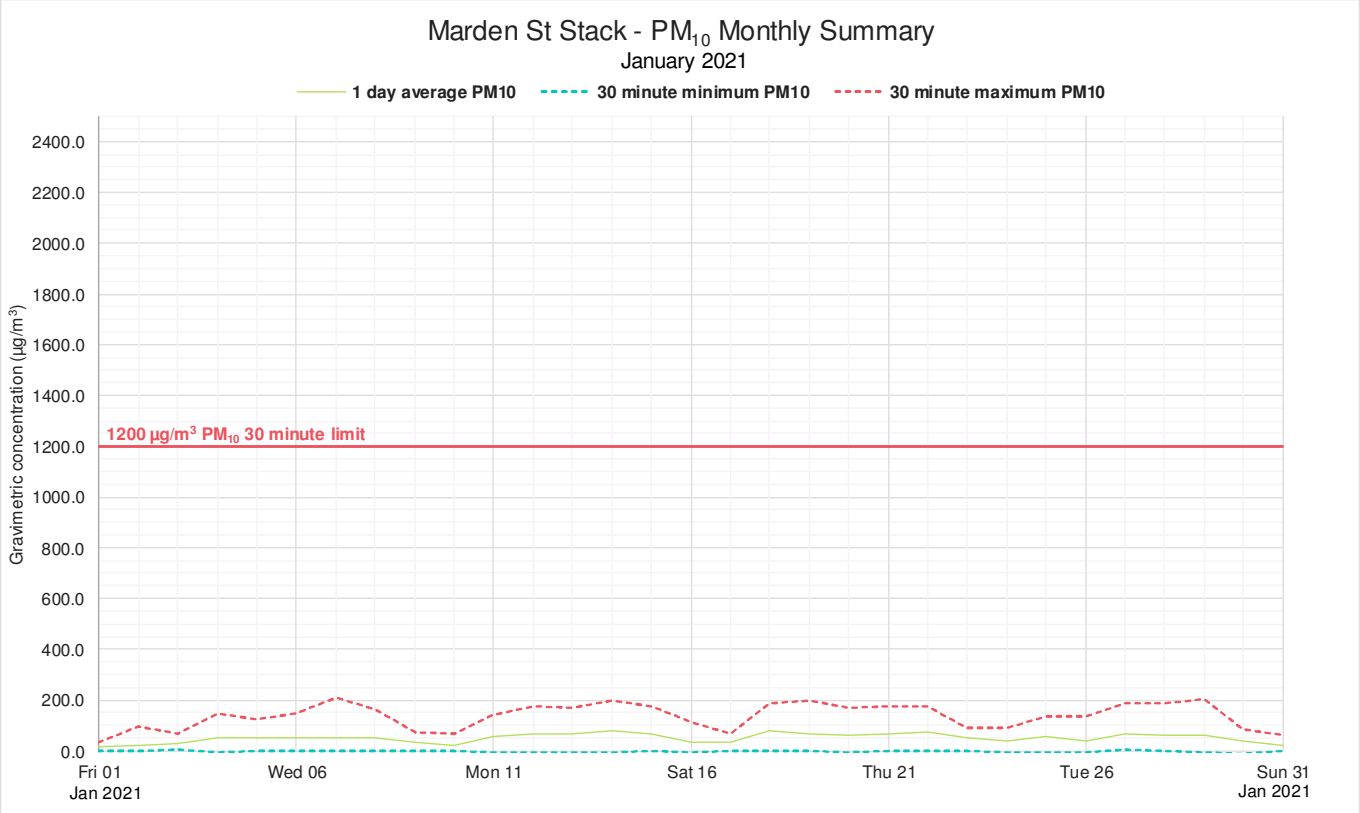

Figure 4: Marden St Stack – Monthly PM_{10}

6.4.1.4 Marden St Stack – Monthly VOC

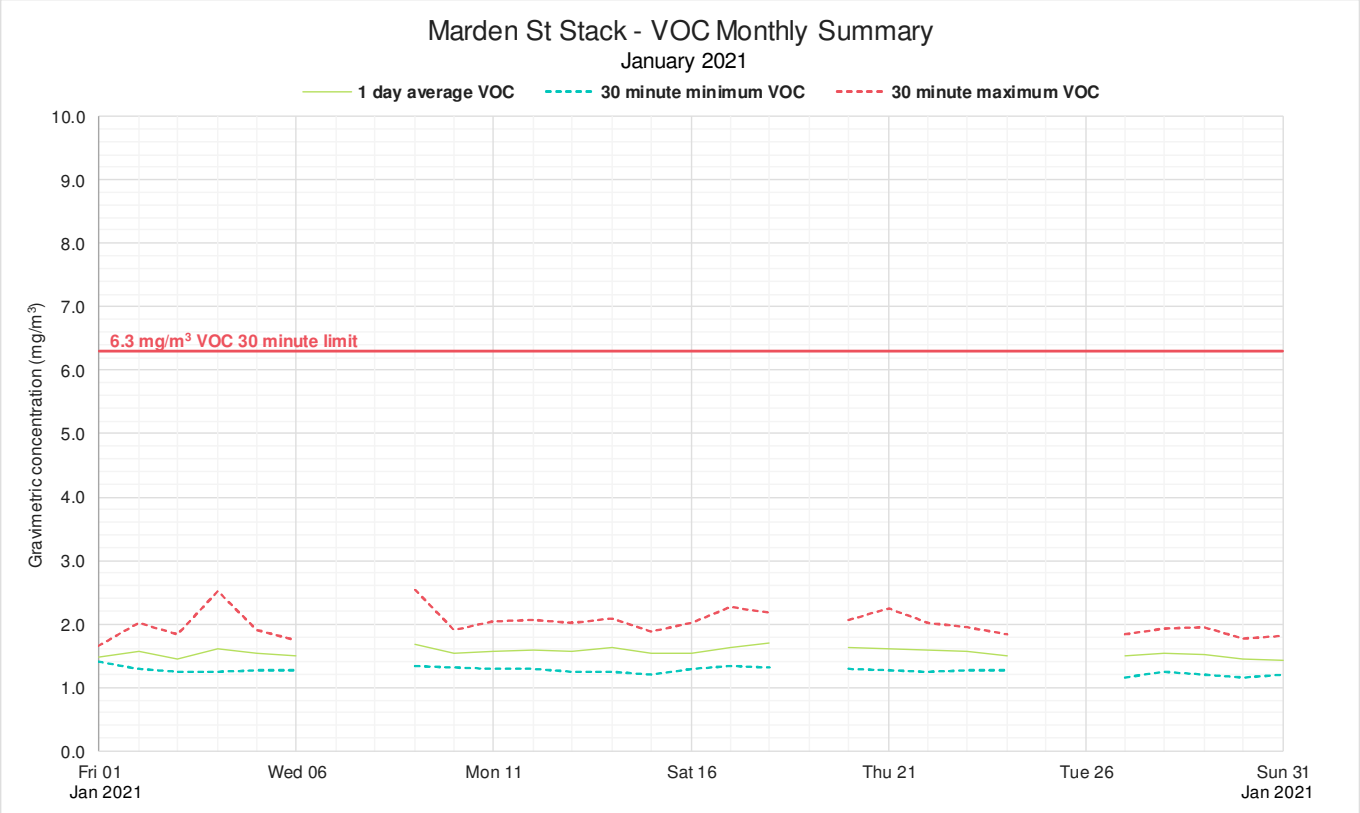

Figure 5: Marden St Stack – Monthly VOC

6.4.1.5 Sirius Rd Stack - Monthly CO

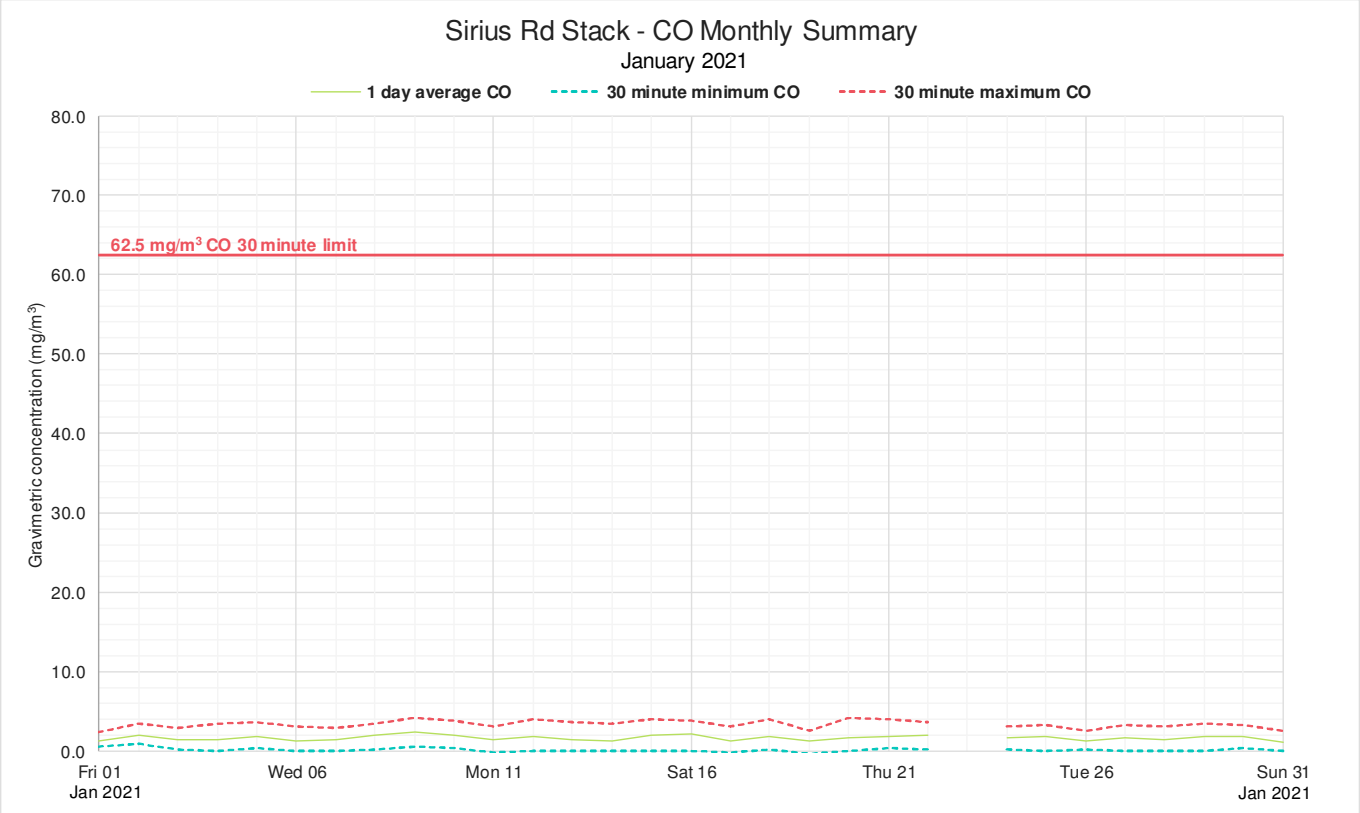

Figure 6: Sirius Rd Stack – Monthly CO

6.4.1.6 Sirius Rd Stack - Monthly NO_x

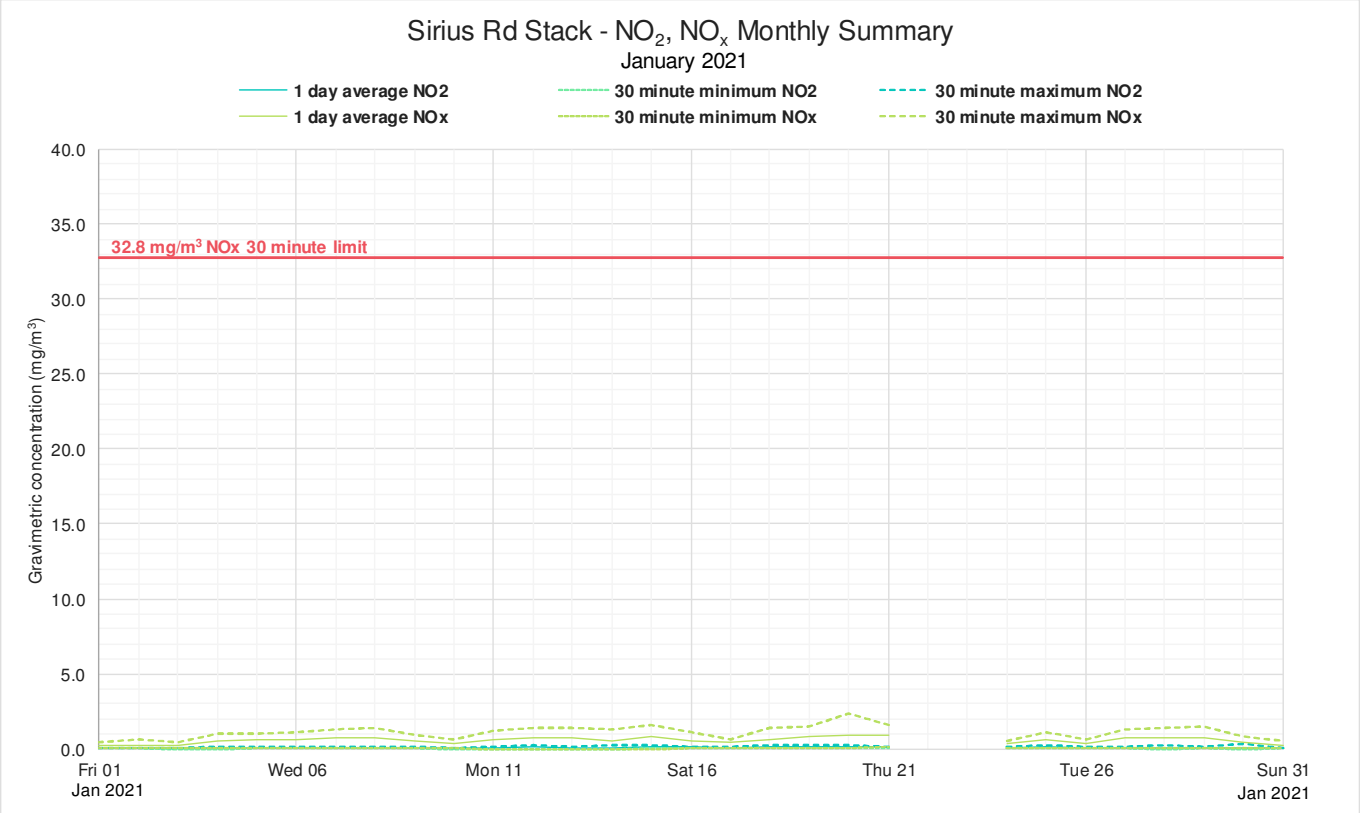

Figure 7: Sirius Rd Stack – Monthly NO_x

6.4.1.7 Sirius Rd Stack – Monthly PM_{10}

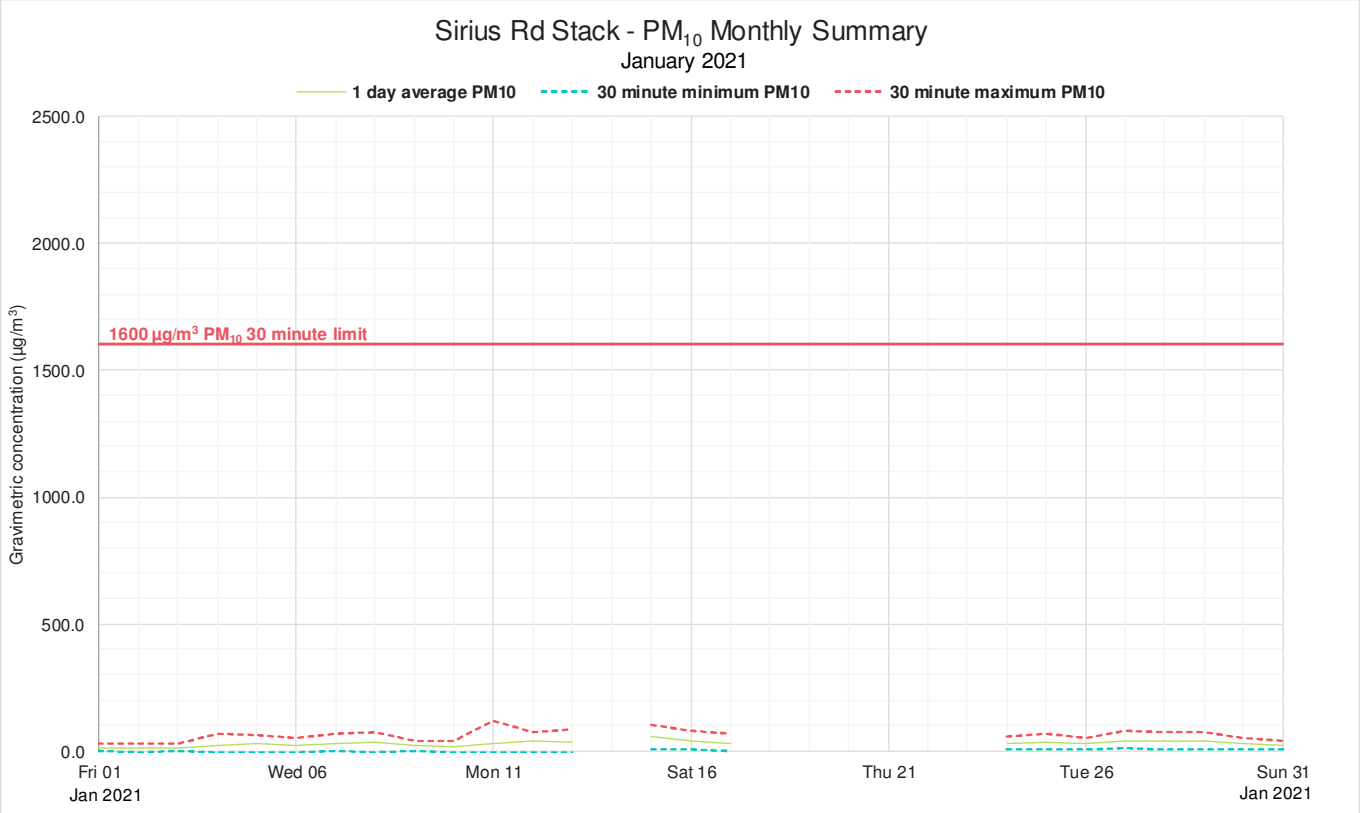

Figure 8: Sirius Rd Stack – Monthly PM_{10}

6.4.1.8 Sirius Rd Stack – Monthly VOC

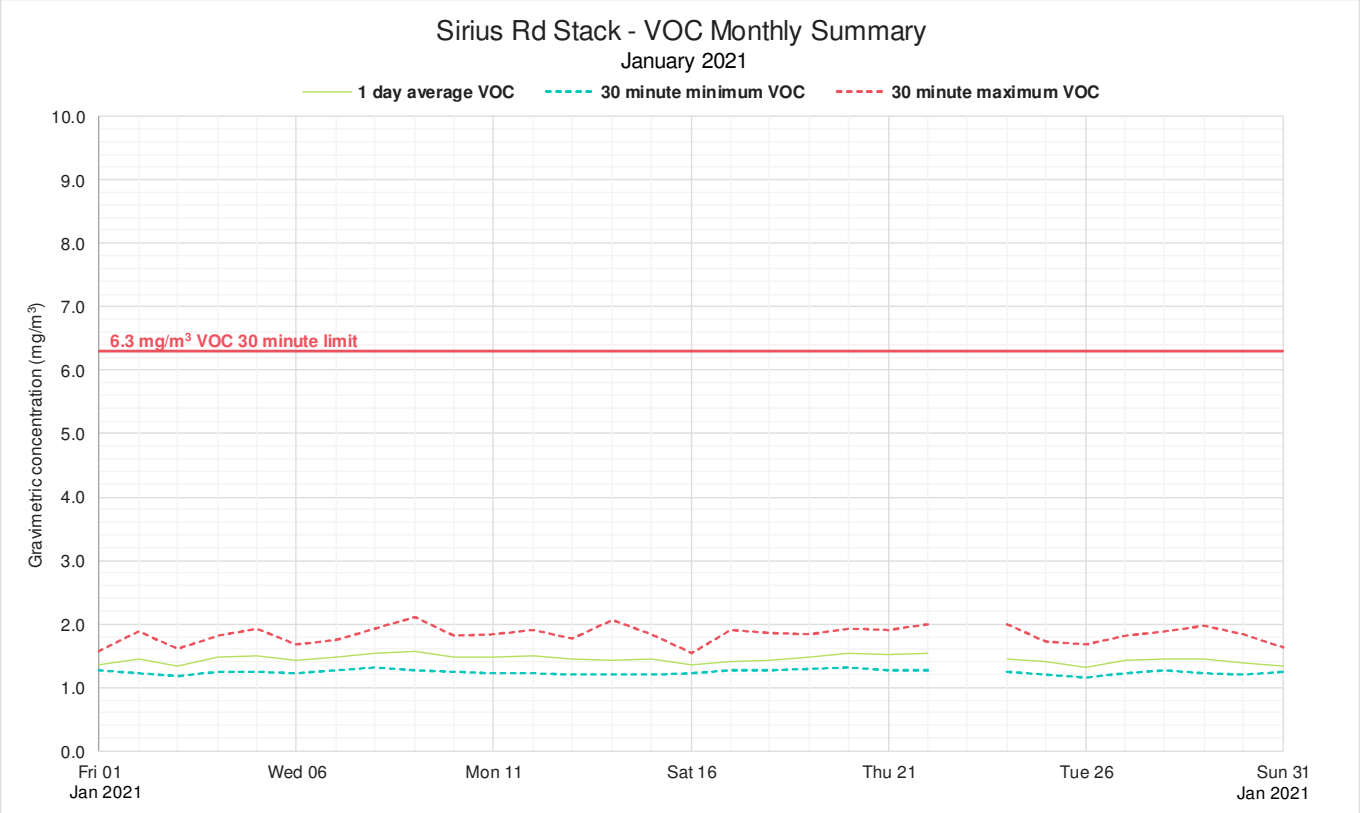

Figure 9: Sirius Rd Stack – Monthly VOC

6.4.2 Accumulative Loads

The following charts present annual accumulative total loads CO, NO_x, PM_{10} and VOC for the Lane Cove Tunnel ventilation stacks.

6.4.2.1 Combined Stacks CO Accumulative Load

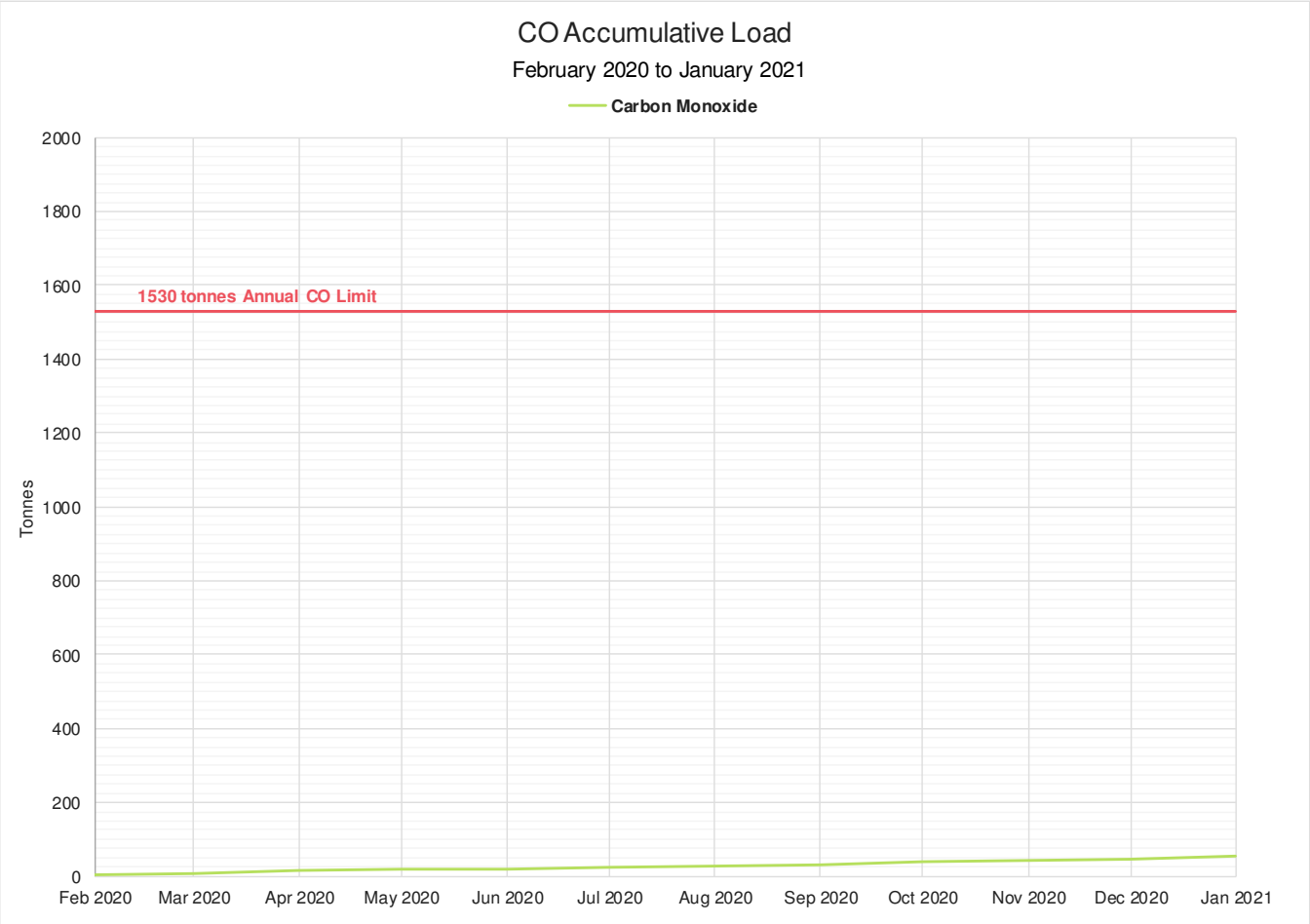

Figure 10: Combined Stacks CO Accumulative Load

6.4.2.2 Combined Stacks NO_x Accumulative Load

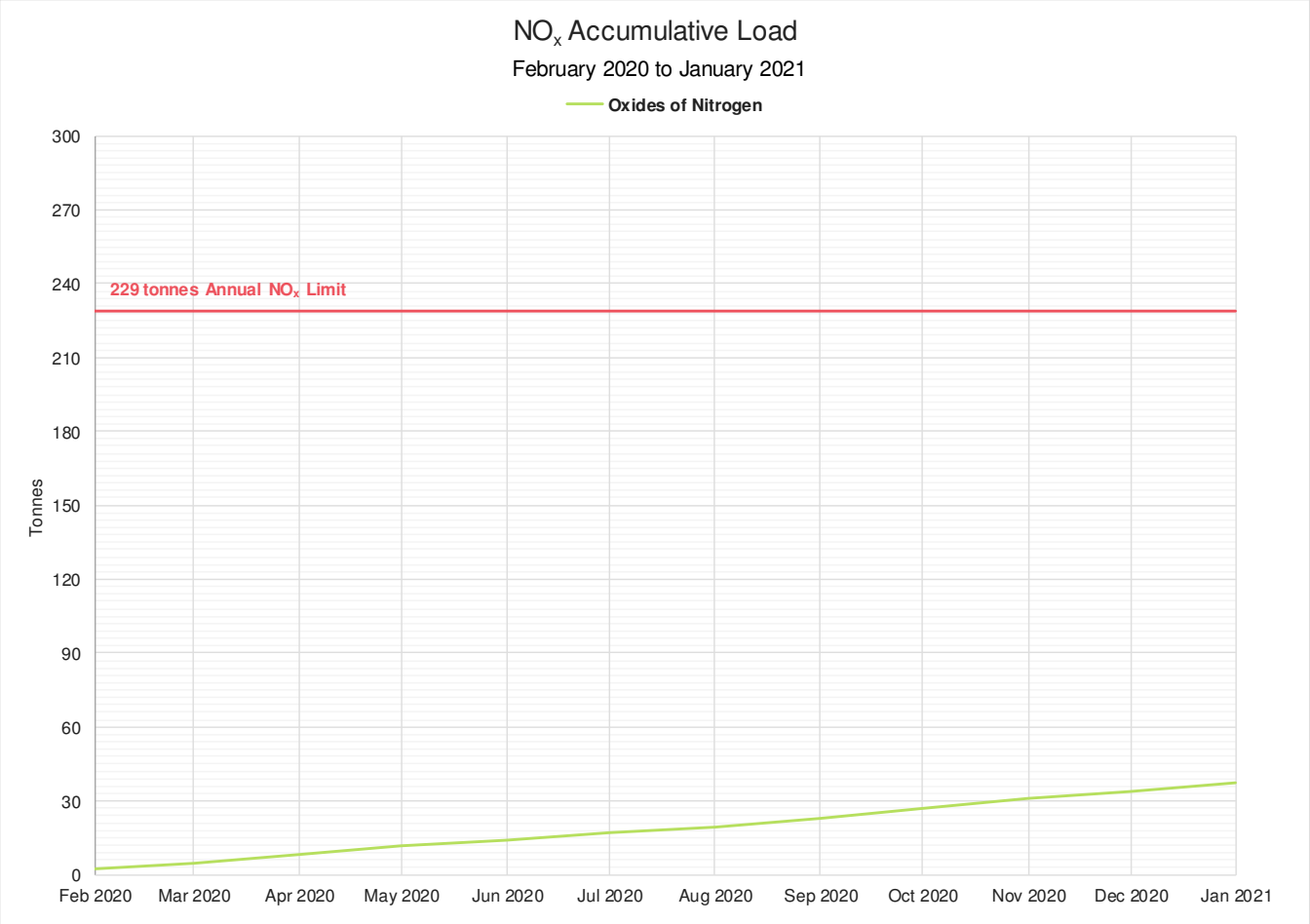

Figure 11: Combined Stacks NO_x Accumulative Load

6.4.2.3 Combined Stacks PM_{10} Accumulative Load

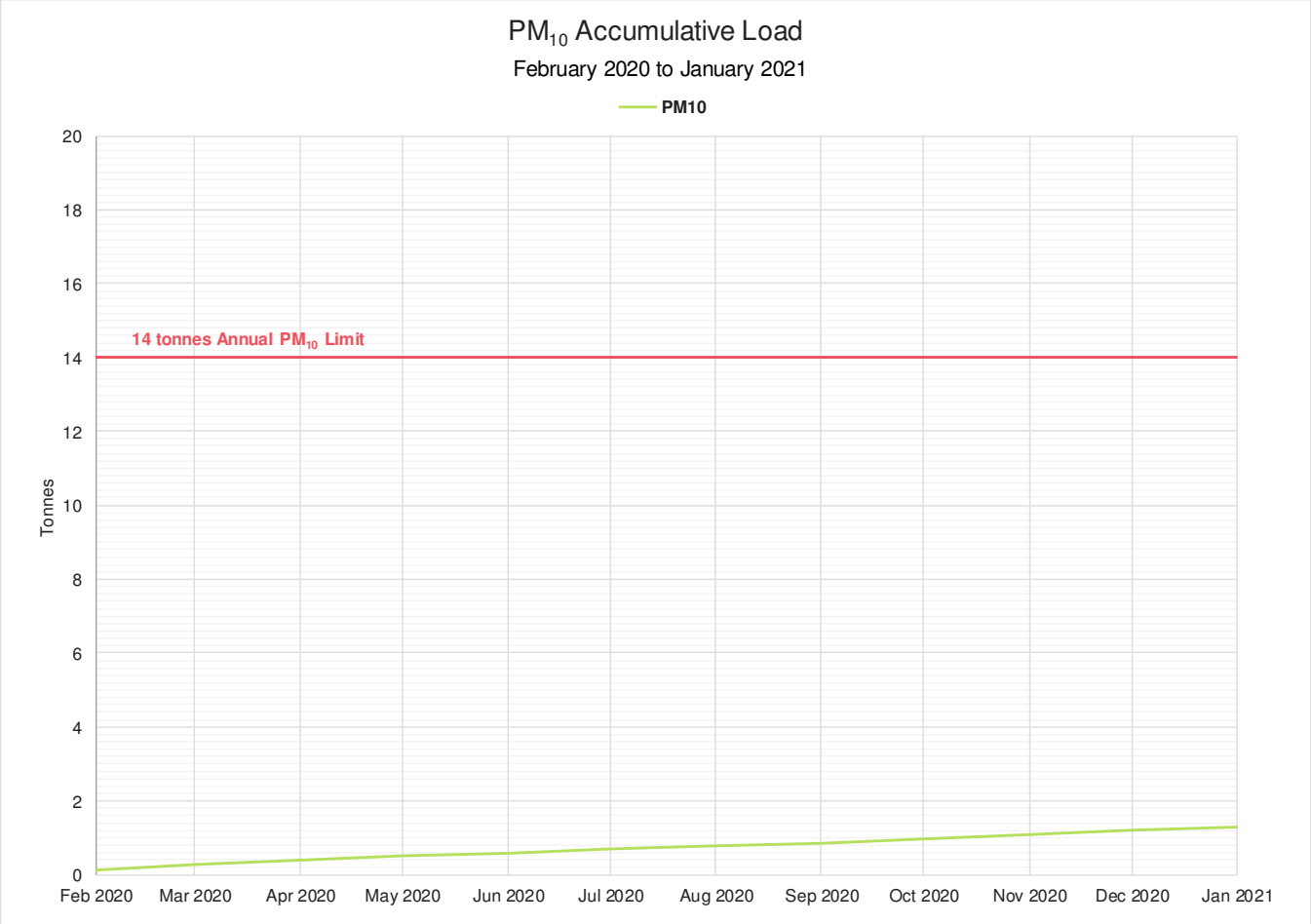

Figure 12: Combined Stacks PM_{10} Accumulative Load

6.4.2.4 Combined Stacks VOC Accumulative Load

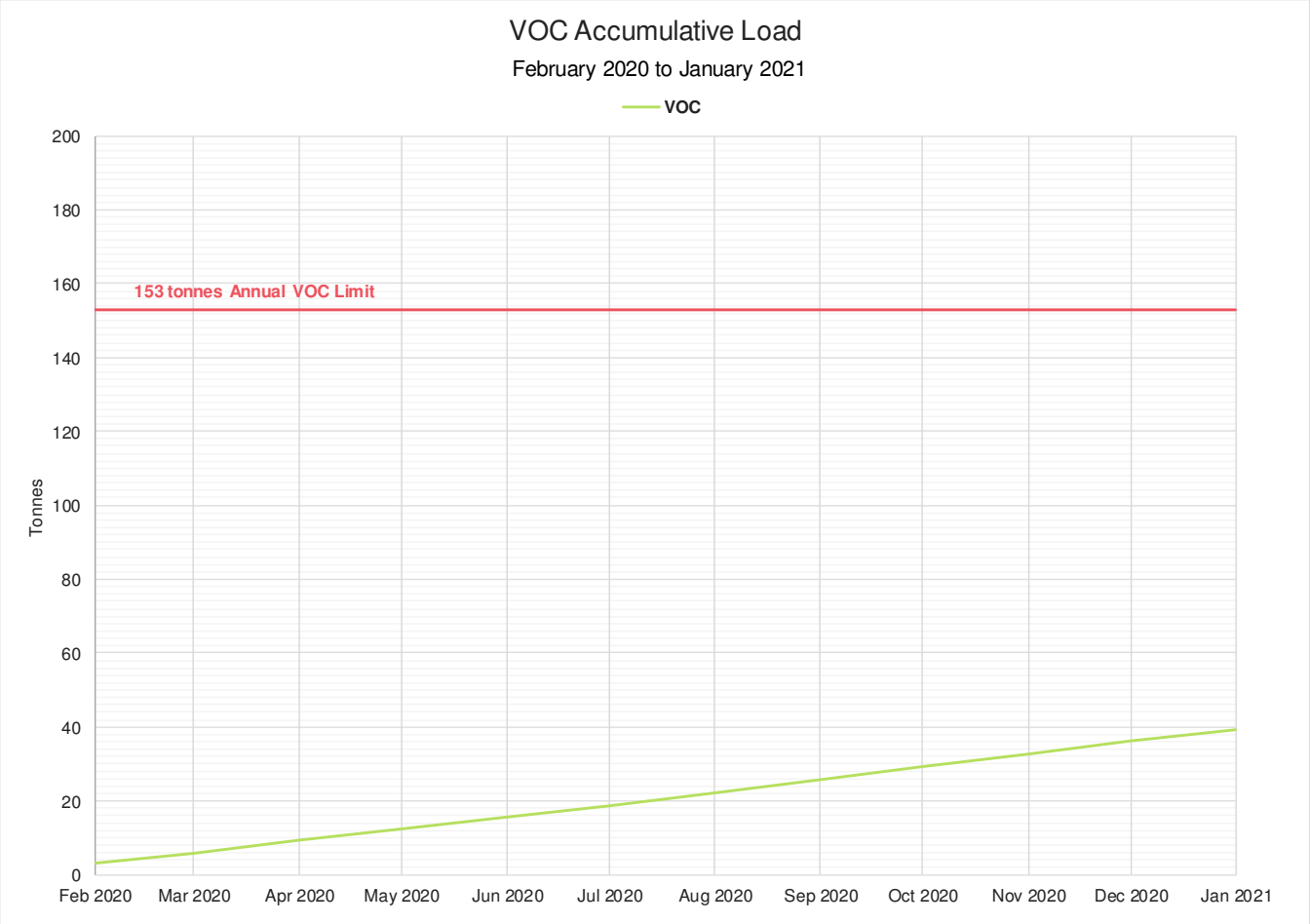

Figure 13: Combined Stacks VOC Accumulative Load

6.4.3 Three Monthly Trends

The following charts present 1 day average CO, NO_x, PM_{10} and VOC for the Marden St Stack, and Sirius Rd combined stack.

The daily average is calculated from 30 minute average data.

6.4.3.1 Marden St Stack – Three Monthly CO

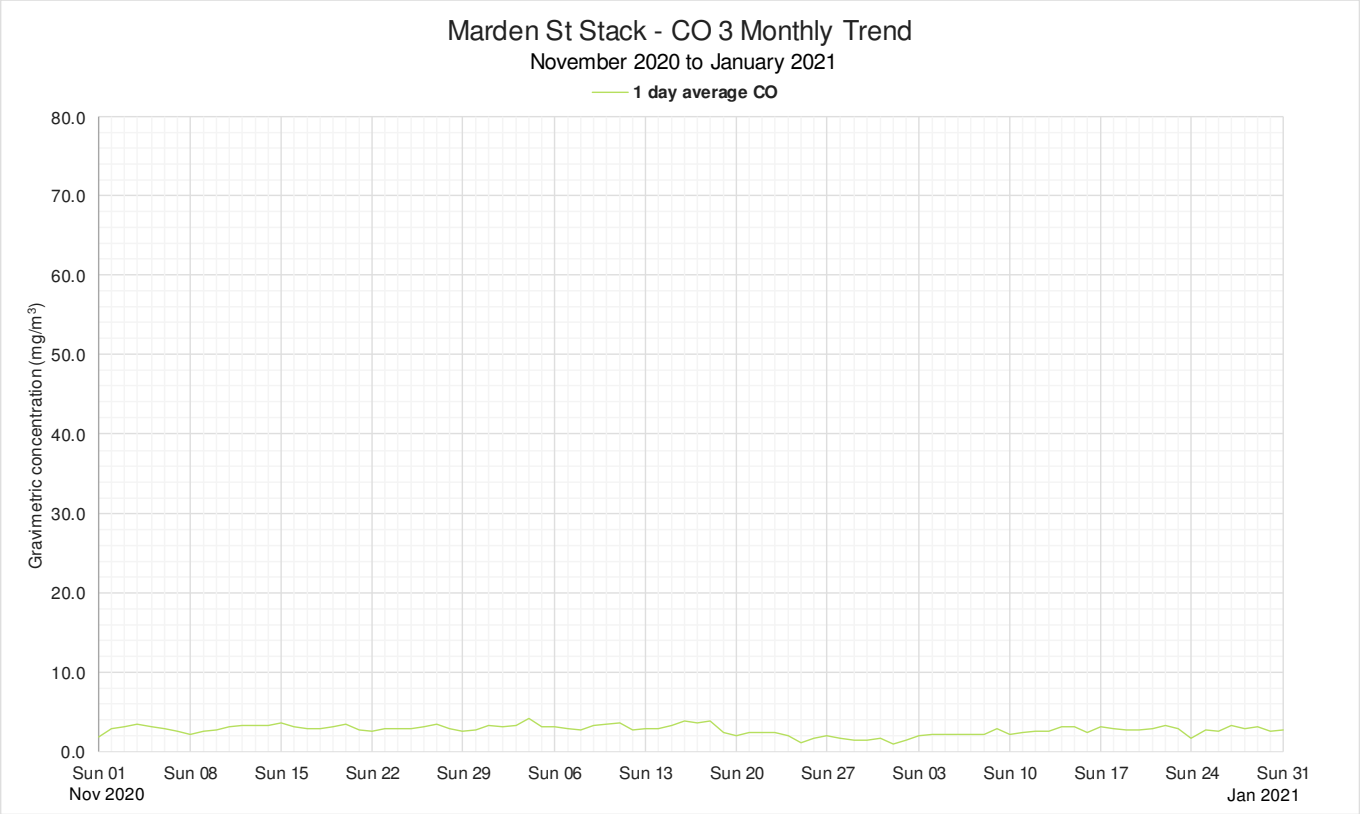

Figure 14: Marden St Stack – Three Monthly CO

6.4.3.2 Marden St Stack – Three Monthly NO_2, NO_x

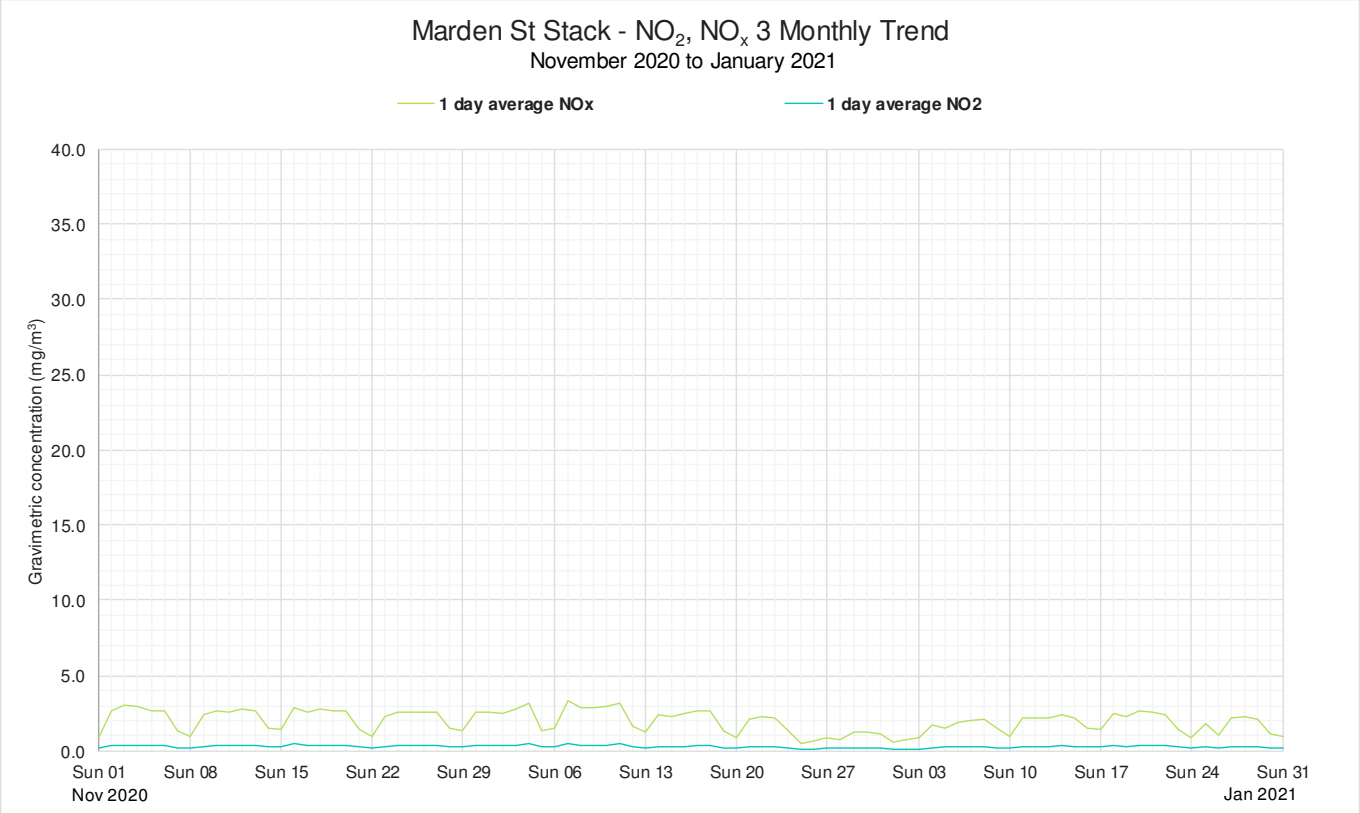

Figure 15: Marden St Stack – Three Monthly NO_x

6.4.3.3 Marden St Stack – Three Monthly PM_{10}

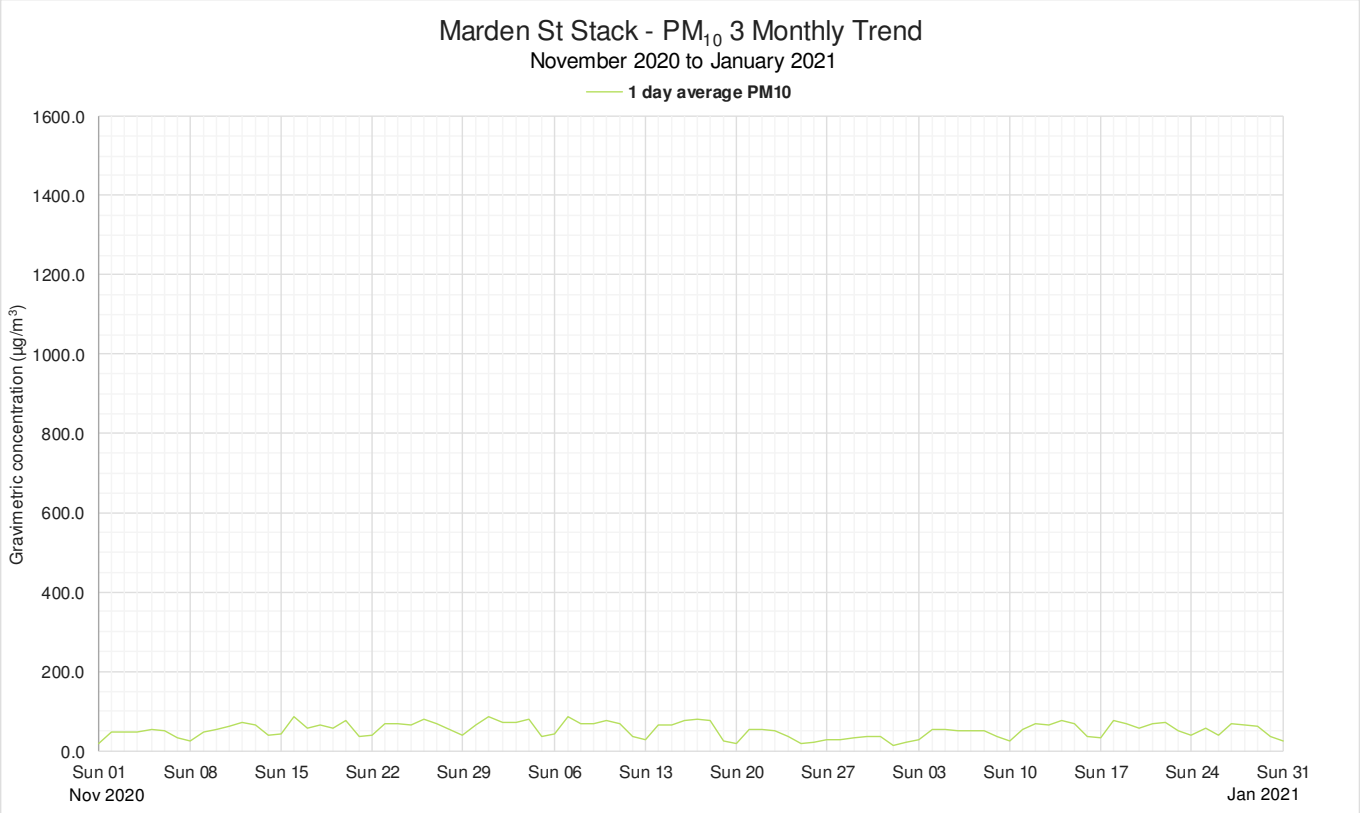

Figure 16: Marden St Stack – Three Monthly PM_{10}

6.4.3.4 Marden St Stack – Three Monthly VOC

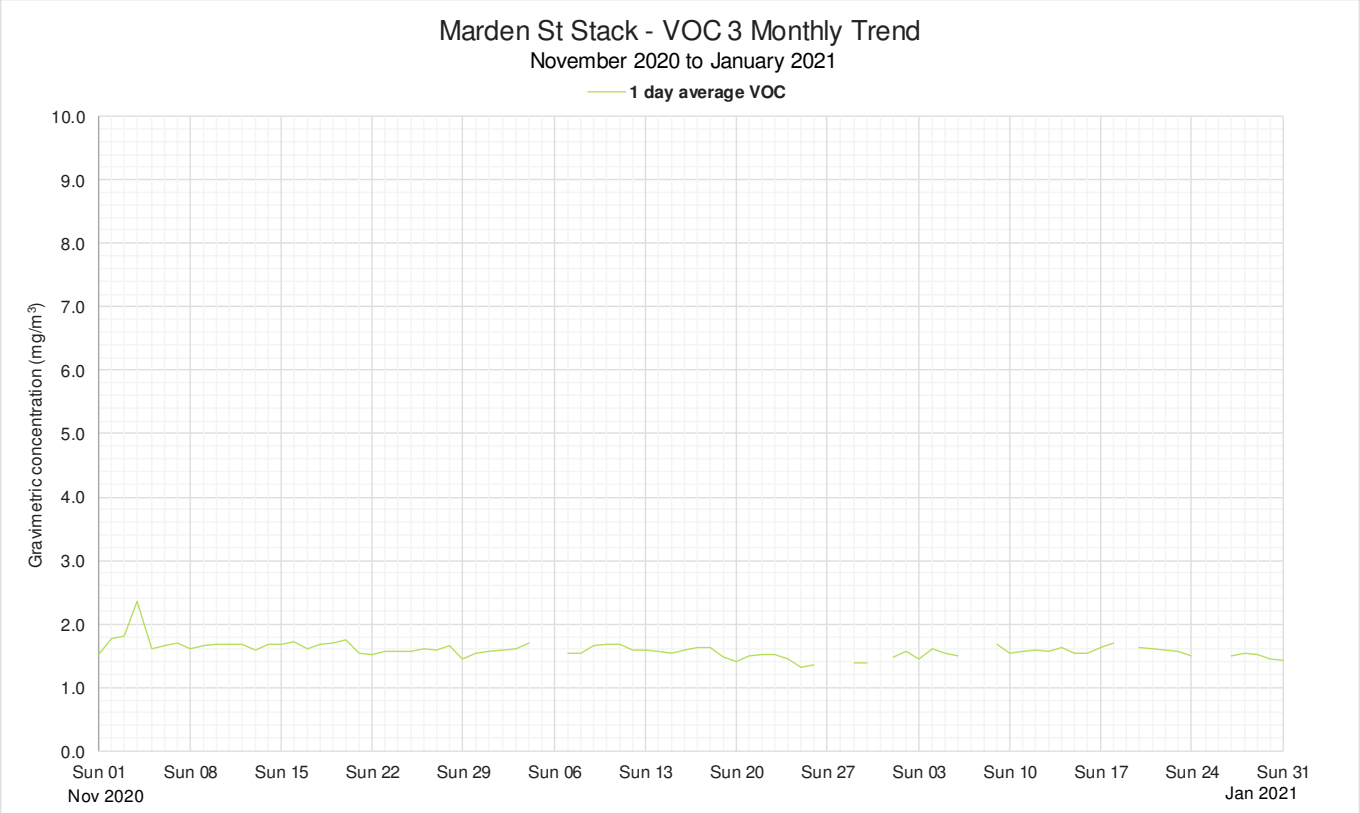

Figure 17: Marden St Stack – Three Monthly VOC

6.4.3.5 Sirius Rd Stack – Three Monthly CO

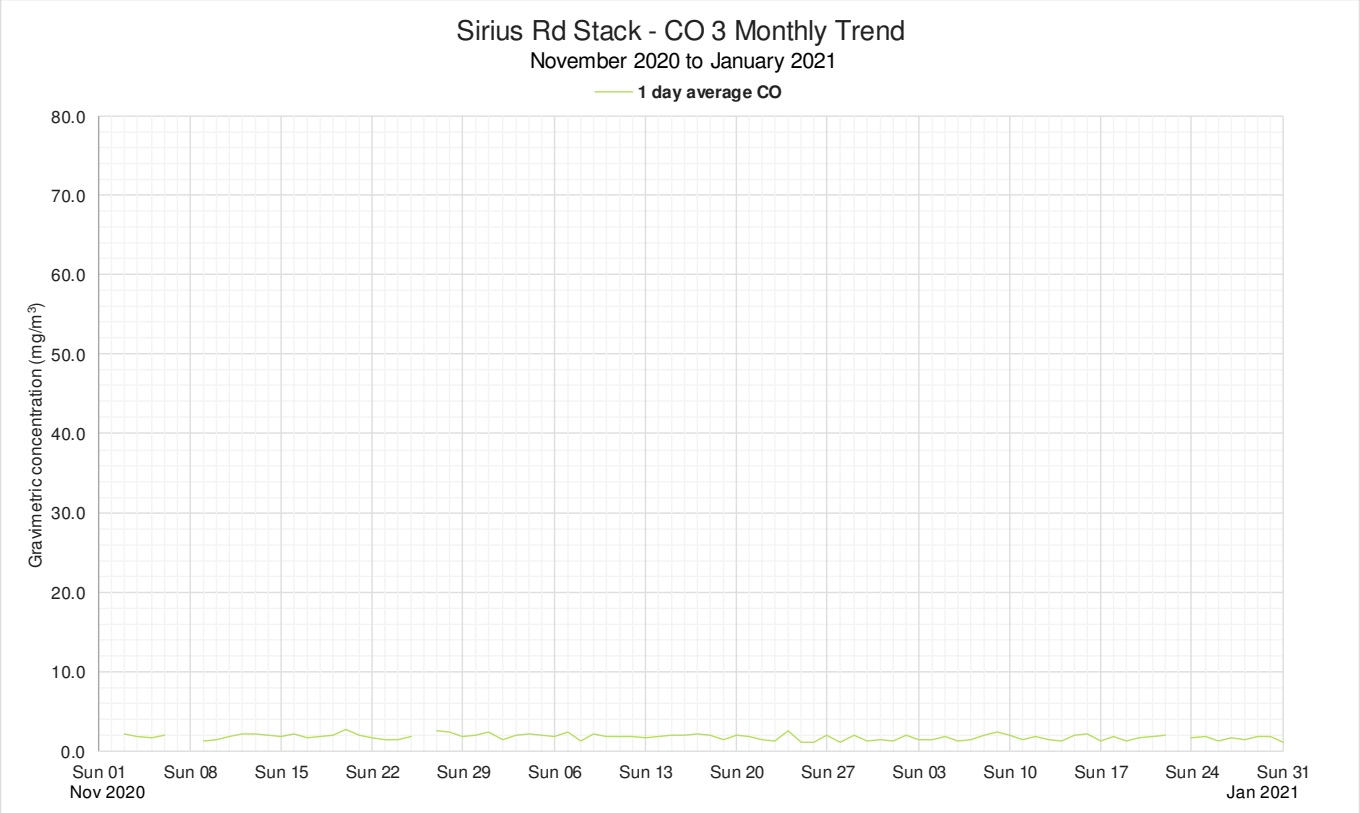

Figure 18: Sirius Rd Stack – Three Monthly CO

6.4.3.6 Sirius Rd Stack – Three Monthly NO_2, NO_x

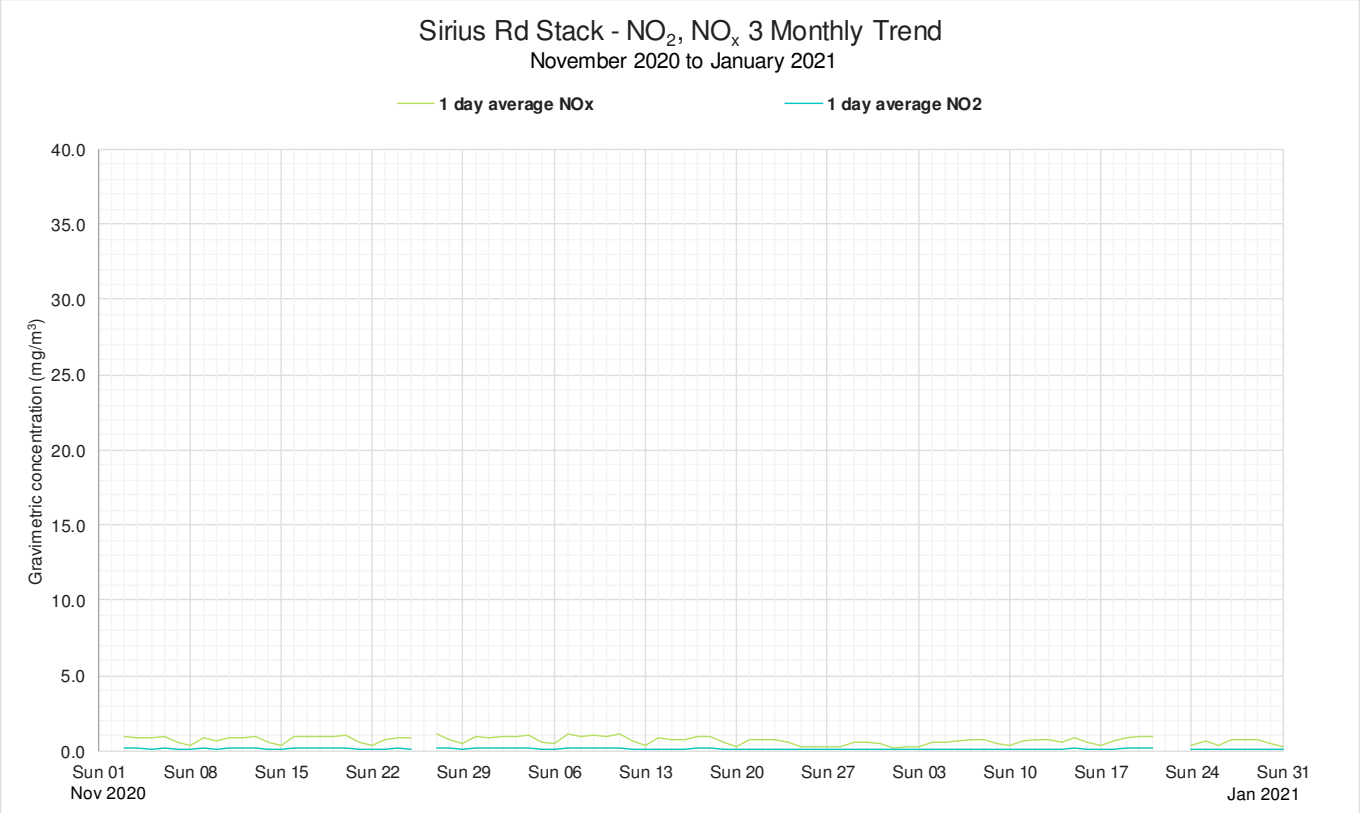

Figure 19: Sirius Rd Stack – Three Monthly NO_x

6.4.3.7 Sirius Rd Stack – Three Monthly PM_{10}

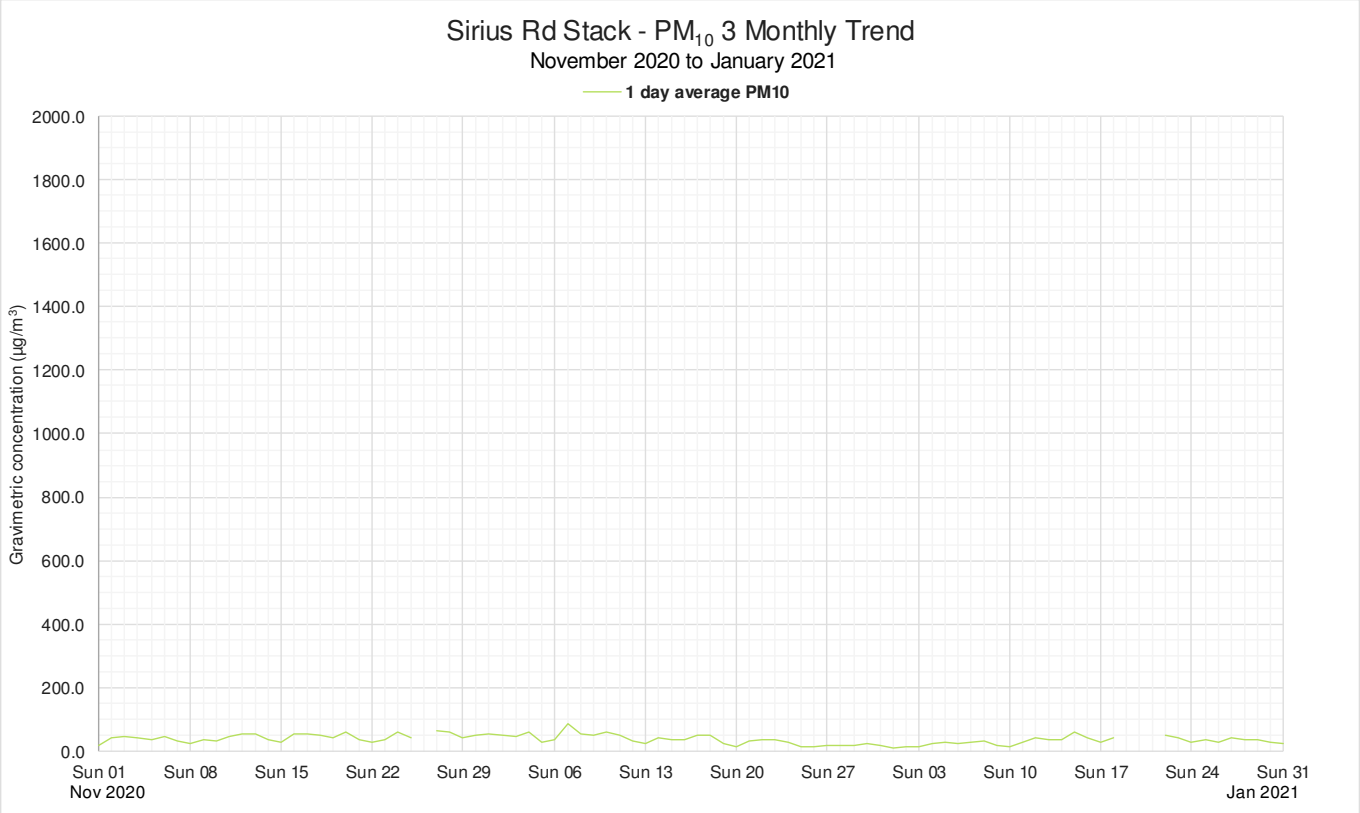

Figure 20: Sirius Rd Stack – Three Monthly PM_{10}

6.4.3.8 Sirius Rd Stack – Three Monthly VOC

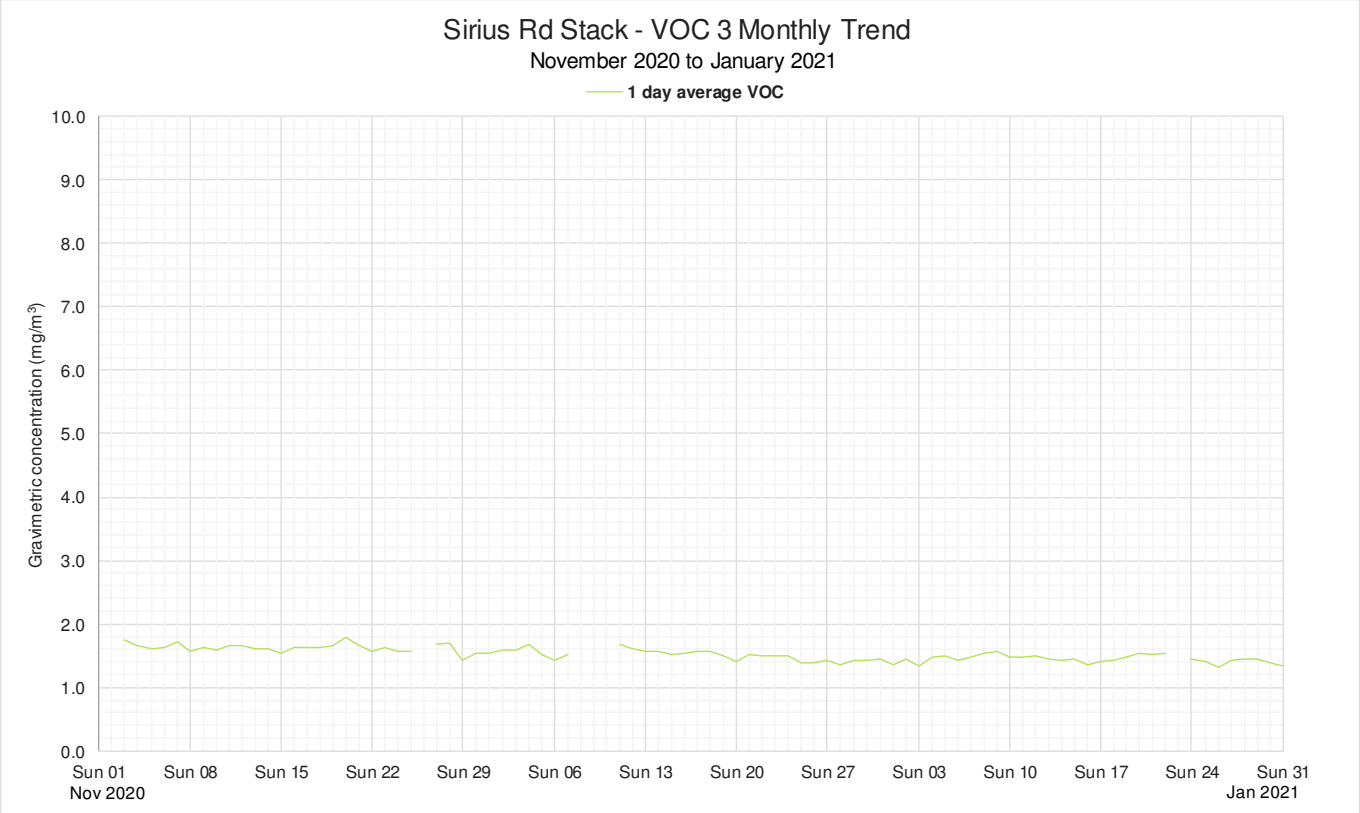

Figure 21: Sirius Rd Stack – Three Monthly VOC

7 Report Summary

- There were nil exceedances of the prescribed limits during the reporting period.
- Data availability for all parameters measured in the Lane Cove Tunnel Marden St stack were above 90% for the reporting period with the exception of VOC and $PM_{2.5}$ parameters.
- Data availability for all parameters measured in the Lane Cove Tunnel Sirius Rd stack were below 90% for the reporting period with the exception of Flow.
    - PM2.5 capture was 68.9% due to required scheduled verification activities.

Appendix 1

Glossary

The following terms and abbreviations are used in this report

°C	Degrees Celsius
µg/m^3	Micrograms per cubic meter at dry, standard temperature and pressure (0°C and 101.3 kPa)
CH_4	Methane
CO	Carbon monoxide
eq.	Equivalents
kPa	kiloPascals
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)
NMHC	Non-methane hydrocarbons
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PM_{10}	Particulate less than 10 microns in equivalent aerodynamic diameter
$PM_{2.5}$	Particulate less than 2.5 microns in equivalent aerodynamic diameter
RH	Relative Humidity
VOC	Volatile organic compounds
$ISS_{2.5}$	Isokinetic Sampling System for $PM_{2.5}$
ISS_{10}	Isokinetic Sampling System for PM_{10}

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.