

Tollaust Pty Ltd - Lane Cove Tunnel

CO In Tunnel Air Quality Monitoring Validated Data Report

1 June 2021 to 30 June 2021

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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.

To ensure that carbon monoxide levels within the tunnel are kept within acceptable levels, a network of 28 air quality sensors are installed in strategic locations throughout the tunnel. Data from these sensors are recorded, validated and reported on a monthly basis.

This report presents the monthly validated data for June 2021 to Tollaustr Pty Ltd for the Lane Cove Tunnel.

1.1 Compliance to limits

The Minister's Conditions of Approval (MCoA) designates limits to which air quality inside the tunnel must meet. These limits relate to the maximum concentration of carbon monoxide in the air inside the tunnel.

There were no measured exceedances of the carbon monoxide limits during the reporting period of June 2021

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

2 Introduction

Norditech were contracted by Tollaust Pty Ltd in December 2018 to provide in tunnel data validation and reporting services for Lane Cove Tunnel.

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 in tunnel CO data for June 2021.

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

3 Compliance Limits

Air quality goals provided are provided in Condition 160 and 161 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.

| Parameter | Averaging Period | Goal Limit | Units | Applicable MCoA |
|----------------------|---------------------------|------------|-------|-----------------|
| Carbon Monoxide (CO) | 3 minute rolling average | 200 | ppm | MCoA 161 |
| | 15 minute rolling average | 87 | ppm | MCoA 160 |
| | 30 minute rolling average | 50 | ppm | MCoA 160 |

Table 1: MCoA Compliance Goals

4 Explanation of Monitoring

4.1 Methodology

Carbon monoxide (CO) levels are measured inside the tunnel using a network of 28 separate CO monitors attached to the walls of both eastbound and westbound tunnels. The monitors measure CO using an analytical method known as non-dispersive infra red absorption with gas filter correlation. Basically this involves projecting an infra-red beam across a 3 metre section of the tunnel and measuring the amount of infra-red light absorbed by CO molecules in the path of the beam. The quantity of infrared light absorbed is proportional to the concentration of CO in the path of the beam. The monitors used were specially designed for use in road tunnels where access for routine essential maintenance is restricted by the need to minimise traffic disruption. Similar monitors are widely used in other road tunnels in Australia and worldwide.

This method of analysis is similar to the standard method AM-6 outlined in “NSW EPA 2001, Approved Methods for Sampling and Analysis of Pollutants in New South Wales.” However the method differs from the standard principally by the use of the open beam type instrument as described above in place of a closed analytical cell and sample delivery pump as typically used in ambient air monitoring stations. This deviation from the standard method has been approved by the Department of Planning on the advice of an independent consultant with specialist expertise in the field of air quality monitoring.

The number and locations of the CO monitors has been selected using computer generated modelling to provide a representative profile of CO levels inside the tunnel.

The instruments being used for in tunnel CO monitoring are Codel TunnelCraft III Open Path Infra-red gas cell correlation instruments.

4.2 Monitoring Locations

The 28 CO monitors are located strategically in portal and tunnel wall locations. Specific monitor locations and identifiers are detailed in the table and schematic Figure 1 below.

| Monitoring Location | Equipment Identification |
|---------------------|--------------------------|
| A | AQS101 |
| B | AQS501 |
| C | AQS502 |
| F | AQS503 |
| G | ACO101 |
| H | AQS504 |
| I | AQS505 |
| J | AQS102 |
| M | ACO102 |
| N | ACO501 |
| Q | AQS103 |
| R | AQS506 |
| S | ACO103 |
| T | ACO502 |
| U | AQS104 |
| V | AQS507 |
| W | ACO401 |
| X | ACO104 |
| Y | AQS401 |
| Z | AQS402 |
| AA | AQS105 |
| AB | ACO801 |
| AC | AQS403 |
| AG | AQS106 |
| AH | ACO503 |
| AI | AQS801 |
| AJ | AQS107 |
| AK | AQS508 |

| | |
|---------------------|--|
| Portal Monitor | |
| Tunnel Wall Monitor | |

Table 2: Location and identification of CO in tunnel monitors

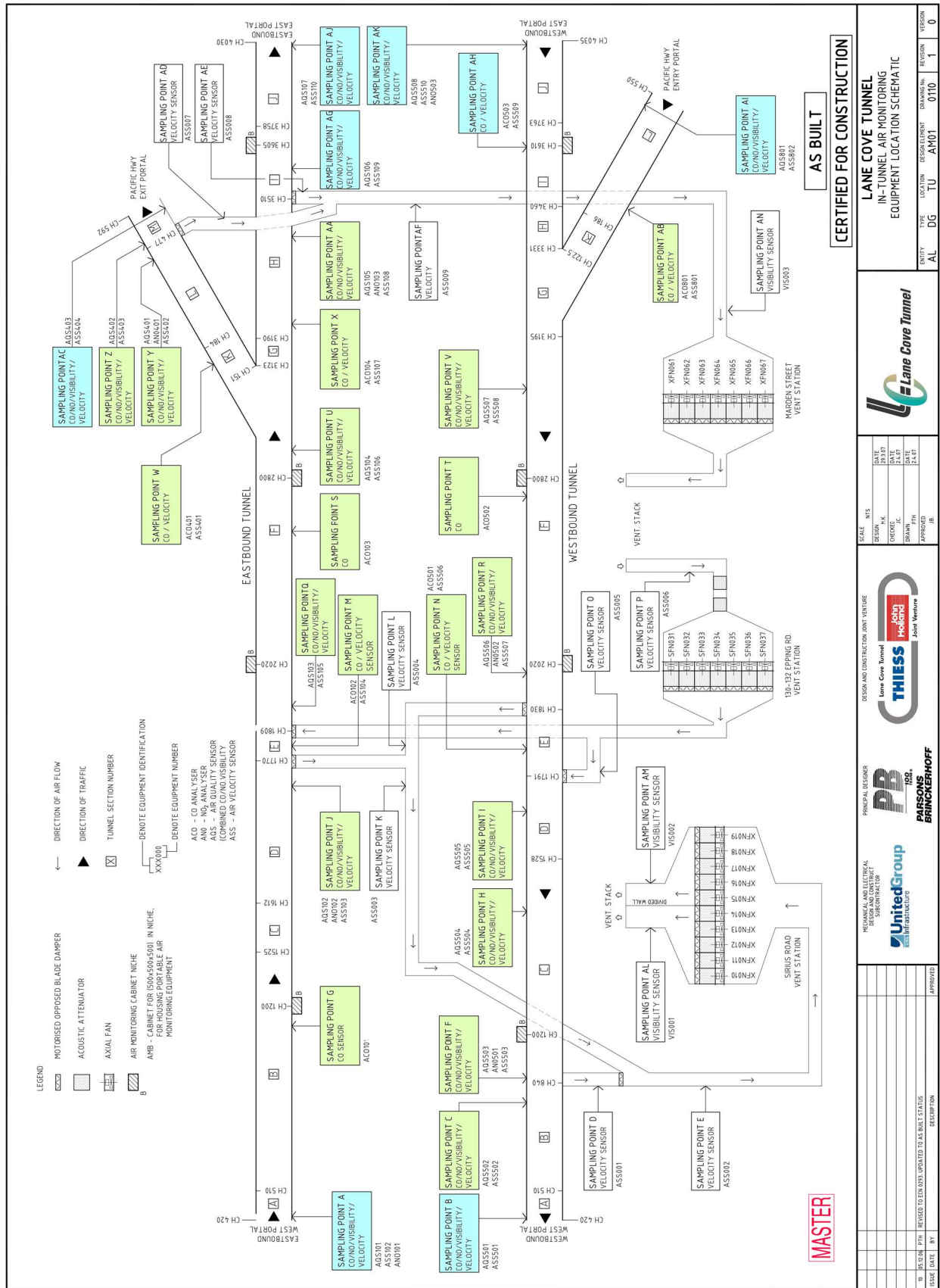


Figure 1: Lane Cove Tunnel CO in tunnel monitor locations

4.3 Data Collection

Data is collected on the Lane Cove Tunnel PMCS, and is provided to Norditech on a weekly basis via email. Data is then imported into a SQL database. Data is logged in 1 minute average periods. All calculations are based on this 1 minute average data.

4.4 Data Validation

Data validation is performed as per Norditech's data validation procedure. 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

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.

4.5 Reporting

This report presents the validated in tunnel CO data for June 2021.

All calculations are based on 1 minute average data and are reported as 'end time'. IE the average data for 01:03 is the data from 01:00 through to 01:03.

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

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

Where:

- Sum of available data points is the number of validated 3 minute rolling average data points for the reporting period
- Sum of possible data points is the number of theoretically available data points for the reporting period

Data is presented in the format of an Excel workbook named "202106 LCT In Tunnel Validated CO data.xlsx".

The workbook consists of the following sheets:

1. Cover
2. Max Single Point 3, 15 and 30m averages
3. Data Validation

5 Instrumentation units and accuracy

Instrumentation details are provided in the table below

| Location ID | Units | Resolution | Uncertainty | Measurement Range |
|-------------|-------|------------|-----------------------------------|-------------------|
| AQS101 | ppm | 0.1 ppm | ± 1.0 ppm or 2% of span value | 0 ppm to 200 ppm |
| AQS501 | | | | |
| AQS502 | | | | |
| AQS503 | | | | |
| ACO101 | | | | |
| AQS504 | | | | |
| AQS505 | | | | |
| AQS102 | | | | |
| ACO102 | | | | |
| ACO501 | | | | |
| AQS103 | | | | |
| AQS506 | | | | |
| ACO103 | | | | |
| ACO502 | | | | |
| AQS104 | | | | |
| AQS507 | | | | |
| ACO401 | | | | |
| ACO104 | | | | |
| AQS401 | | | | |
| AQS402 | | | | |
| AQS105 | | | | |
| ACO801 | | | | |
| AQS403 | | | | |
| AQS106 | | | | |
| ACO503 | | | | |
| AQS801 | | | | |
| AQS107 | | | | |
| AQS508 | | | | |

Table 3: Instrument details and calibration dates

6 Results

6.1 Data Availability

Data availability for the in tunnel CO sensors are provided in the table below. Locations with data availability less than 75% are indicated in red italics. Please refer to the Data Validation Table in the accompanying data file for further details regarding missing or removed data.

Data availability for the reporting period is summarized below:

- ACO102, ACO501, AQS101, AQS106 and AQS801 were flatline for the reporting period.
- ACO103 and AQS403 were missing data for the reporting period.
- ACO402 was operating outside calibration tolerance up to calibration on 9/06/2021
- ACO503 was missing data from 9/06/2021

| Monitoring Location | Equipment Identification | Data Availability (%) |
|---------------------|--------------------------|-----------------------|
| A | AQS101 | 0.0 |
| B | AQS501 | 96.3 |
| C | AQS502 | 96.3 |
| F | AQS503 | 96.0 |
| G | ACO101 | 96.3 |
| H | AQS504 | 96.3 |
| I | AQS505 | 96.3 |
| J | AQS102 | 96.3 |
| M | ACO102 | 0.0 |
| N | ACO501 | 0.0 |
| Q | AQS103 | 94.6 |
| R | AQS506 | 95.7 |
| S | ACO103 | 0.0 |
| T | ACO502 | 96.3 |
| U | AQS104 | 96.3 |
| V | AQS507 | 96.3 |
| W | ACO401 | 96.3 |
| X | ACO104 | 96.3 |
| Y | AQS401 | 96.3 |
| Z | AQS402 | 68.3 |
| AA | AQS105 | 96.3 |
| AB | ACO801 | 96.3 |
| AC | AQS403 | 11.7 |
| AG | AQS106 | 0.0 |
| AH | ACO503 | 25.4 |
| AI | AQS801 | 0.0 |
| AJ | AQS107 | 96.3 |
| AK | AQS508 | 96.1 |

Table 4: In tunnel CO data availability

6.2 Exceedances

If any instances of the in tunnel CO levels exceeded the MCoA goals during the reporting period, they will be presented in the table below

| Parameter | Averaging Period | Goal Limit | Units | Value of exceedance | Date and time of exceedance | Station |
|----------------------|---------------------------|------------|-------|---------------------|-----------------------------|---------|
| Carbon Monoxide (CO) | 3 minute rolling average | 200 | ppm | - | - | - |
| | 15 minute rolling average | 87 | ppm | - | - | - |
| | 30 minute rolling average | 50 | ppm | - | - | - |

Table 5: Exceedances of MCoA Goals

6.3 Graphical Representations

The graphical representations are constructed from 1 minute average data, re-averaged to the 3 minute, 15 minute, and 30 minute rolling averages.

6.3.1 Monthly CO maximum 3 minute rolling averages

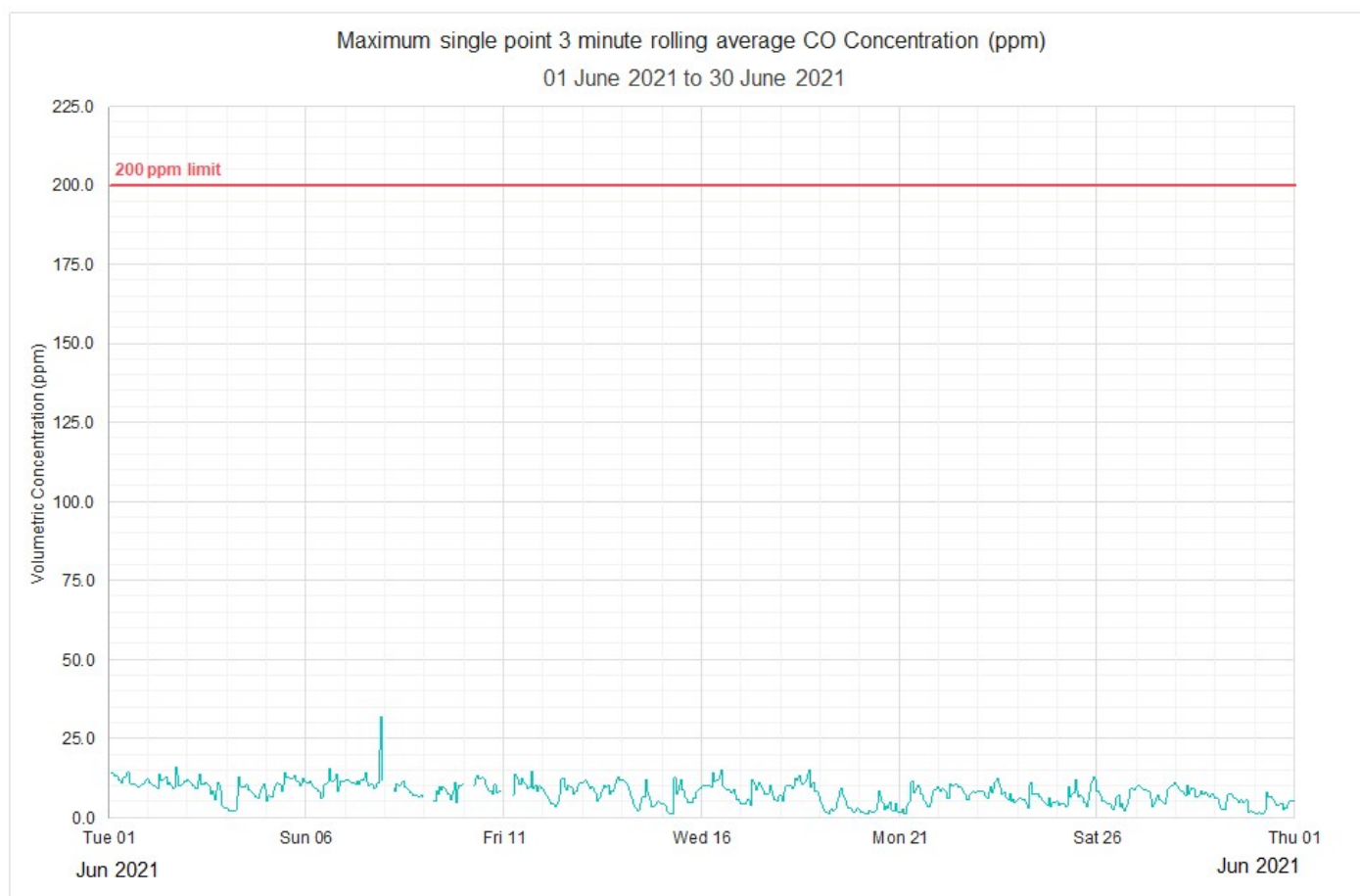


Figure 2: Monthly CO maximum hourly 3 minute rolling averages

6.3.2 Monthly CO maximum 15 minute rolling averages

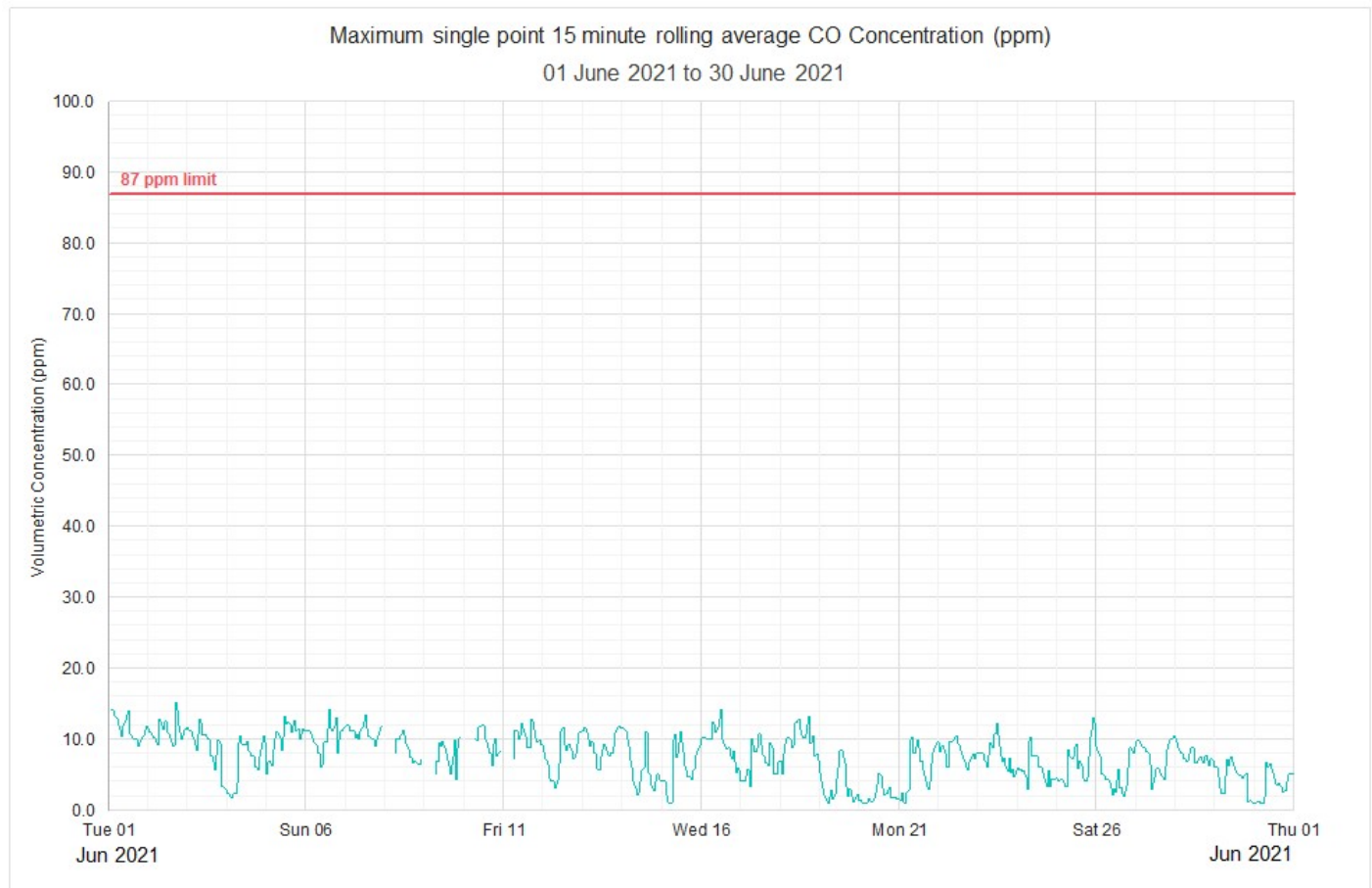


Figure 3: Monthly CO maximum hourly 15 minute rolling averages

6.3.3 Monthly CO maximum 30 minute rolling averages

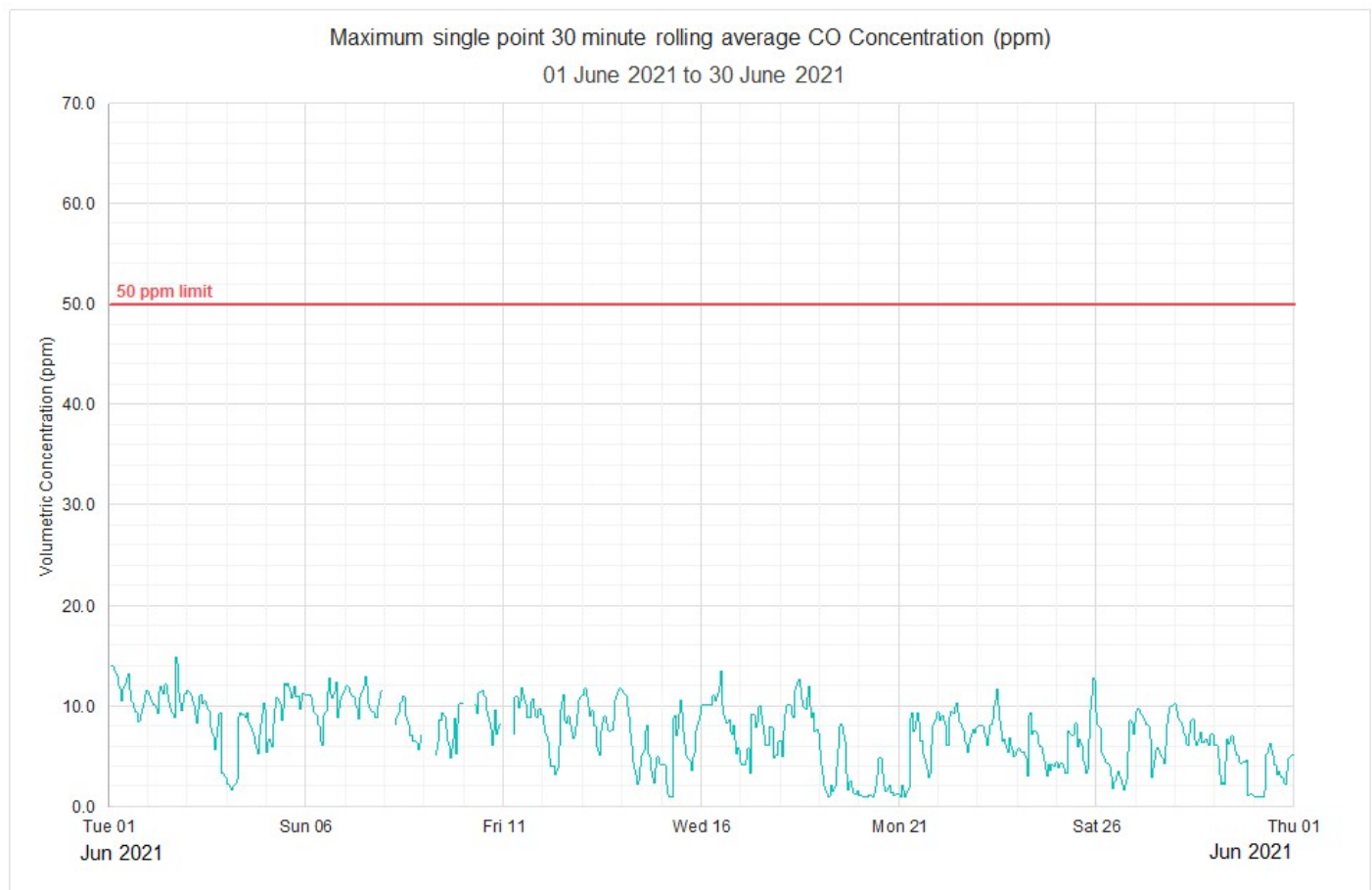


Figure 4: Monthly CO maximum hourly 30 minute rolling averages

6.3.4 Three Monthly Trend CO maximum 3 minute rolling averages

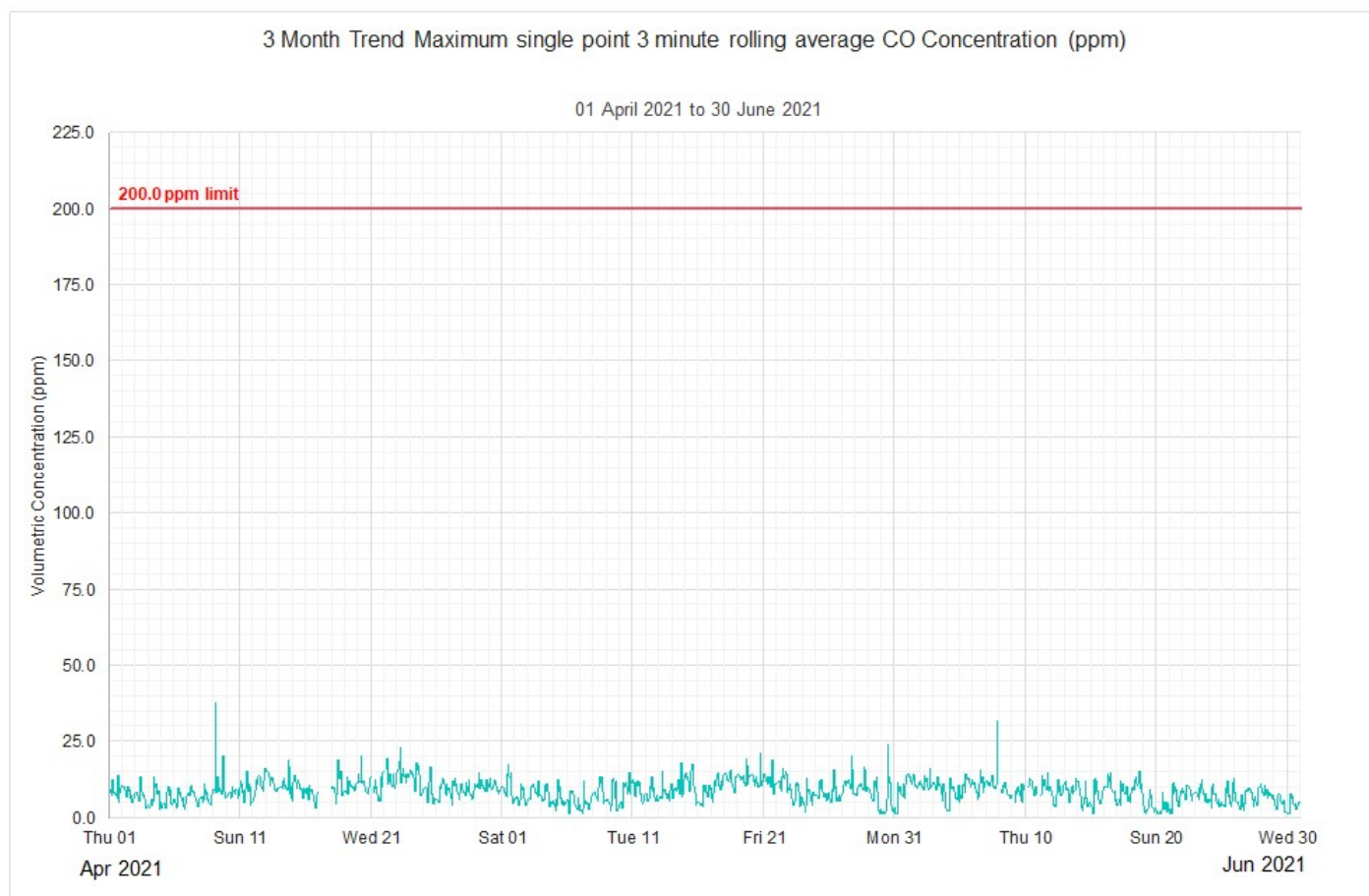


Figure 5: 3 Monthly CO maximum hourly 3 minute rolling averages

6.3.5 Three Monthly Trend CO maximum 15 minute rolling averages

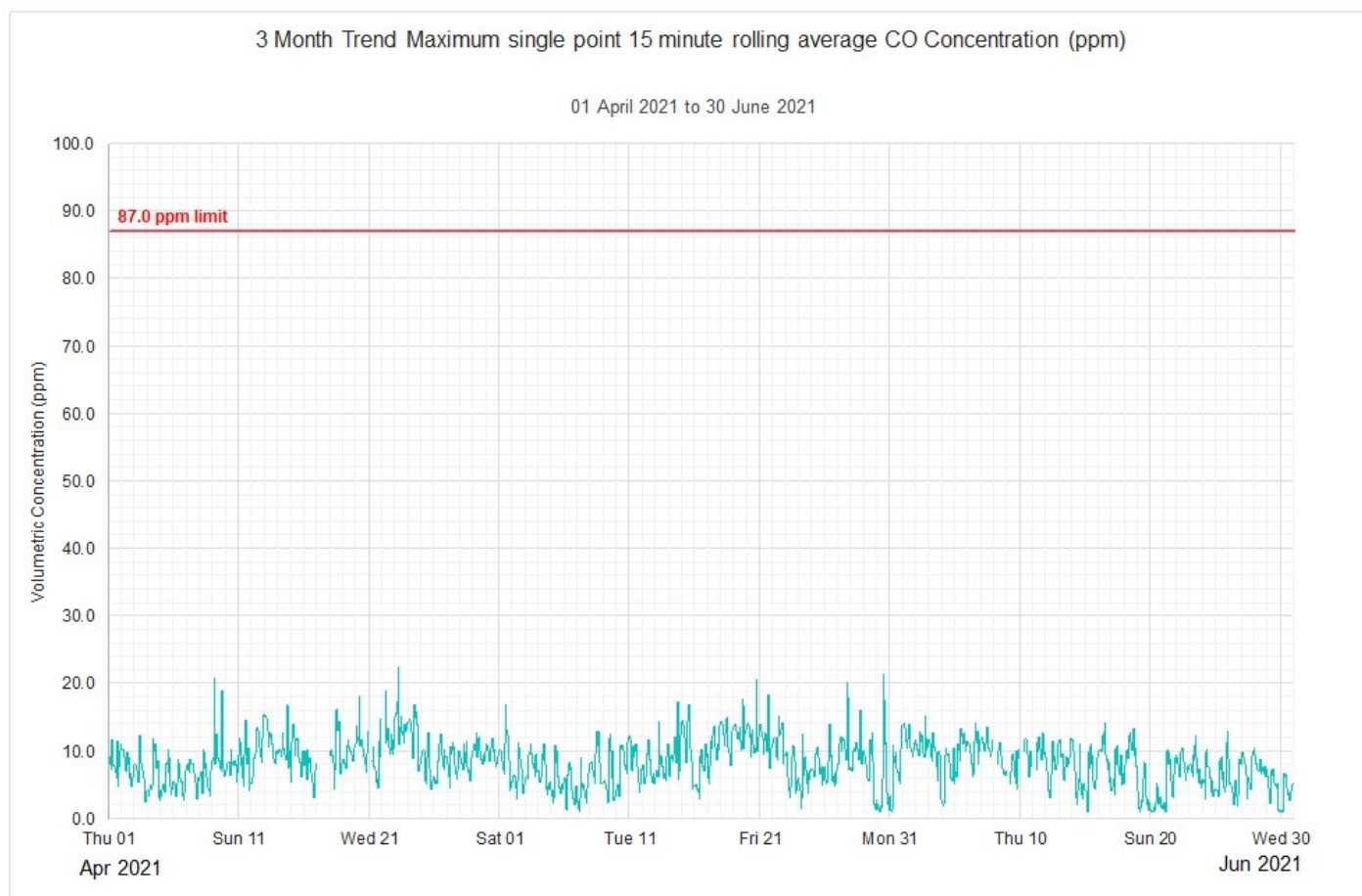


Figure 6: 3 Monthly CO maximum hourly 15 minute rolling averages

6.3.6 Three Monthly Trend CO maximum 30 minute rolling averages

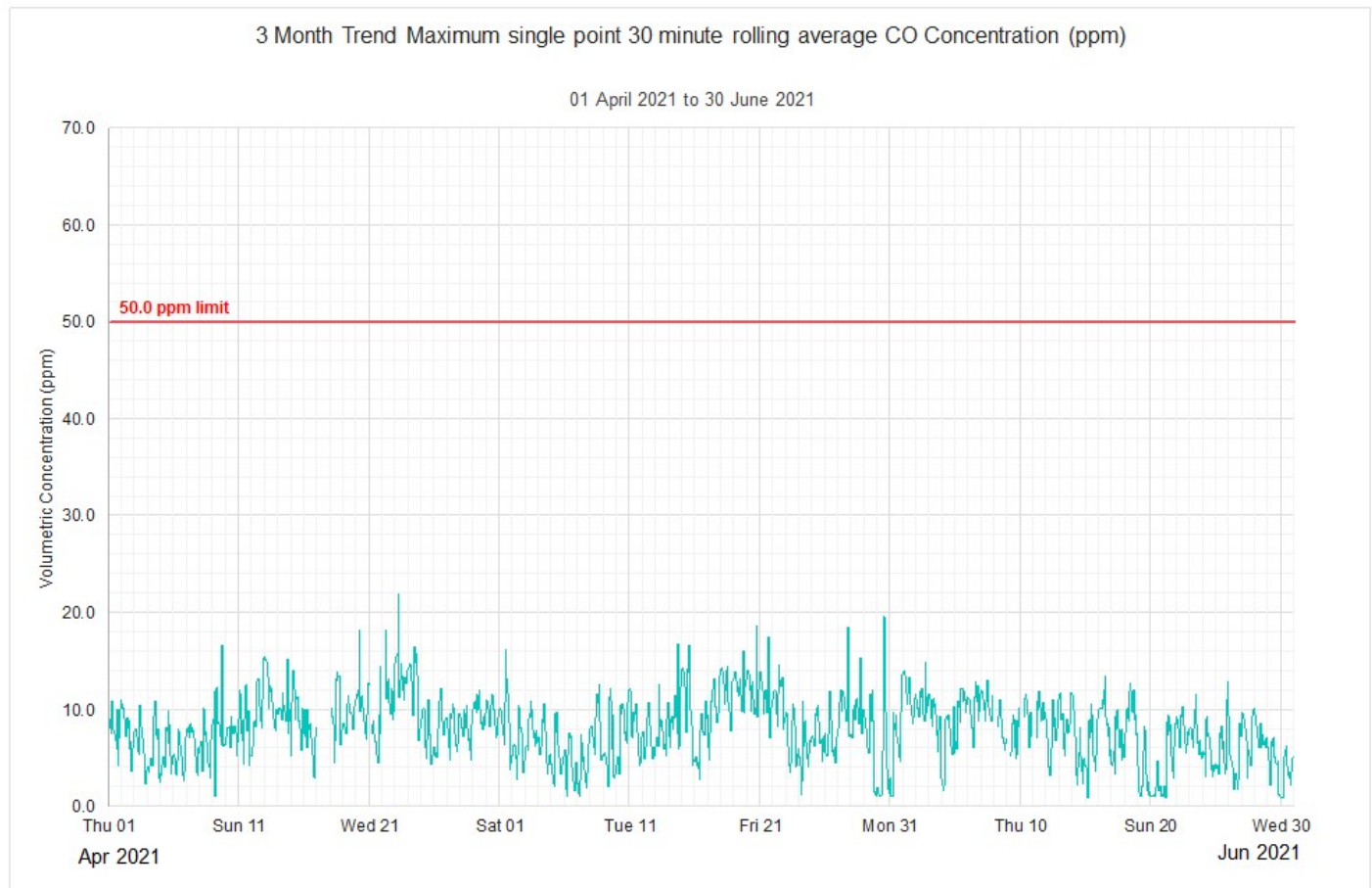


Figure 7: 3 Monthly CO maximum hourly 30 minute rolling averages

7 Glossary

The following terms and abbreviations are used in this report

| | |
|------|----------------------------------|
| CO | Carbon Monoxide |
| LCT | Lane Cove Tunnel |
| MCoA | Ministers Conditions of Approval |
| ppm | parts per million |