Attachment A14

Air Quality Assessment

Air Quality Assessment

150 Day Street, Sydney

Mecone Group Pty Ltd

Level 12, 179 Elizabeth Street
Sydney NSW 2000

Prepared by:

SLR Consulting Australia

SLR Project No.: 610.032206.00001

21 March 2025

Revision: 2.0

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
2.0	21 March 2025	Kate Barker	A Naghizadeh	A Naghizadeh
1.0	31 January 2025	Kate Barker	A Naghizadeh	A Naghizadeh

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Mecone Group Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Table of Contents

Tables

Figures

Appendices

1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) was commissioned by Mecone Group Pty Ltd (the Client) to prepare an Air Quality Assessment (AQA) for the proposed development at 150 Day Street, Sydney, NSW (the Project). The location of the Project site, as well as nearby air quality monitoring and meteorological monitoring sites, is shown in **Figure 1**.

The aim of this report is to address air quality requirements of the Sydney Local Environmental Plan 2012 (the LEP) and the Sydney Development Control Plan 2012 (the DCP) in relation to development near the Cross City Tunnel ventilation stack (CCT Stack).

This AQA report has been prepared with reference to the New South Wales Environment Protection Authority (EPA) document The Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA 2022).

Figure 1 Project Location

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Sub Base Platypus
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Project Number:	610.032206
Location:	Sydney, NSW
Source:	Nearmap
Projection:	GDA2020/MGA Zone 56
Date:	08/01/2025

N W E S

Mecone Pty Ltd

150 Day Street, Sydney
Air Quality Impact Assessment

Site Location

2.0 Project Overview

The planning proposal for the existing Park Royal Hotel at 150 Day Street, Sydney (**the Project site**), involves an ambitious upgrade and expansion of the existing hotel. This project aims to enhance the existing hotel offering while introducing a new, distinct hotel experience above the current structure, enabling the coexistence of the existing Park Royal and a new Pan Pacific Hotel on the same site. Strategically positioned at the edge of the City of Sydney, the development reinforces the city's entry into Darling Harbour by maintaining and emphasising the city wall characteristic of this prominent location.

The project is defined by 3 key principles – maximising adaptive reuse (setting a benchmark for future developments in Sydney), energising the Sydney visitor economy, and significantly enhancing the greening of both the public realm and the skyline, in alignment with the City of Sydney's sustainability goals. Achieving this vision involves expanding the existing core to support the new hotel above, employing a 'strip to structure' approach from ground to Level 02 to facilitate amenity upgrades, lightly refurbishing existing hotel rooms, and comprehensively upgrading all building services. This initiative aims to establish a contemporary hotel destination while setting a new standard for sustainable urban redevelopment.

To achieve the intended outcomes, this planning proposal seeks to amend the *Sydney Local Environmental Plan 2012* by inserting a new site-specific clause for the subject site under Part 6 Division 5 Site specific provisions to:

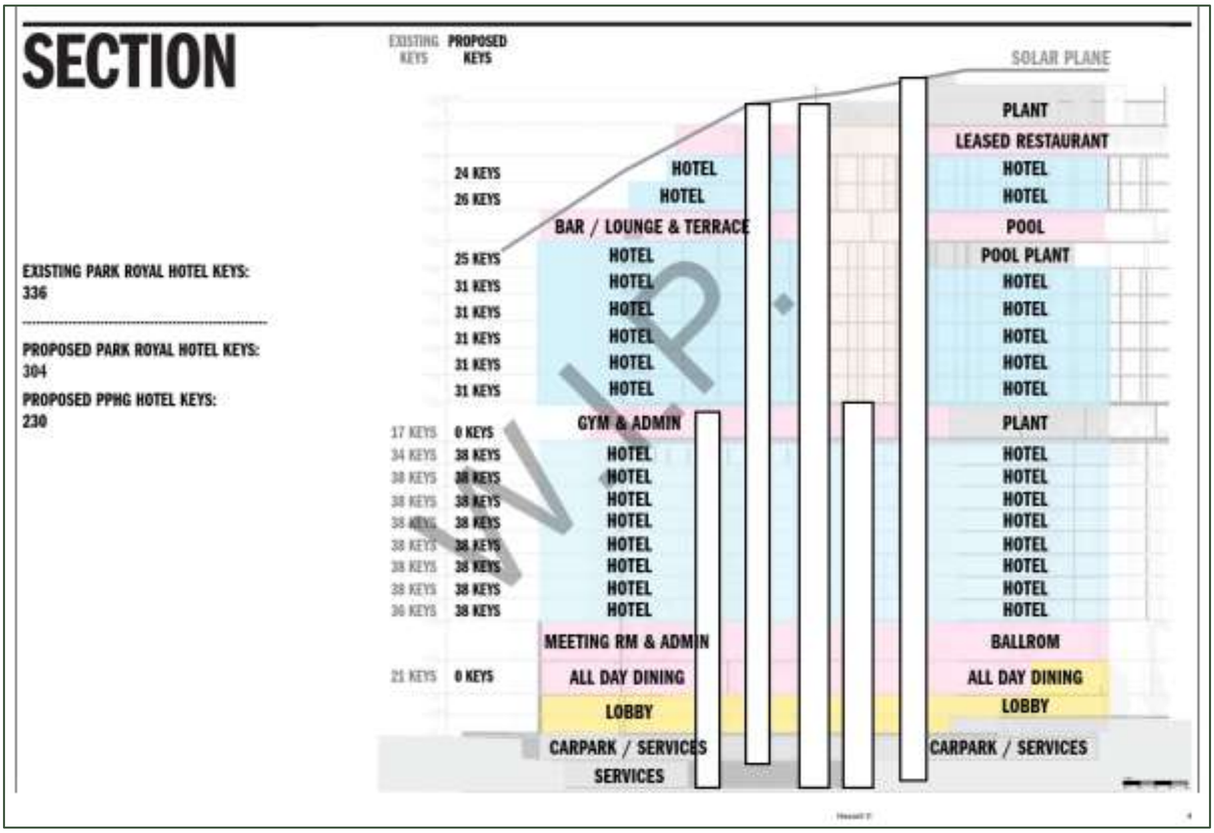
- Allow a maximum building height of 85 metres,
- Permit a maximum floor space ratio of 13.5:1 for hotel and associated land uses,
- Restrict use to employment/hotel use and not residential accommodation or serviced apartments.

The Planning Proposal is supported by a site-specific Development Control Plan (DCP) and reference design scheme, prepared by Hassell. Key elements of the site specific DCP and reference design include:

- Renovation of existing 2 level basement and existing 11 storey hotel, with the addition of a new 11 storey hotel above (including a transfer floor between the two structures), and a rooftop plant floor resulting:
    - Two hotel brand offerings – Park Royal Hotel (3.5 star) and Pan Pacific Hotel (5 star)
    - 490-540 hotel keys with gross floor area of ~30,000m2
    - Upgrade existing infrastructure and services (including new lift core),
    - New and upgraded hotel facilities (including lobby, dining areas, meeting rooms, ball room, gymnasium, bar and restaurants, and pool).
    - Removal existing Porte Cochere and exit ramp resulting in single vehicle entry/exit ramp from Day Street to be used by valet only.
- Ground floor public domain, public art and landscaping design, and
- Significant greening and landscaping of western facade.

Figure 2 illustrates a cross section of the Project Building.

Figure 2 Proposed Building Cross Section[1]



[1] Source: Hassell December 2024

3.0 Planning Instruments

3.1 Sydney Local Environmental Plan 2012

Clause 7.24 of the LEP, states the following in reference to developments near the CCT Stack:

> *"(1) This clause applies to land identified on the Locality and Site Identification Map as "Land Affected by Cross City Tunnel Ventilation Stack".*
>
> *(2) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:*
>
> > *(a) the proposed development will not adversely affect the dispersal of emissions from the Cross City Tunnel ventilation stack, and*
> >
> > *(b) persons using the proposed development will not be unduly affected by those emissions."*

The Project building is located within the area identified as 'land affected by the CCT Stack'.

3.2 Sydney Development Control Plan 2012

Section 3.13.2 of the DCP states the following in reference to development near the CCT Stack:

> *"3.13.2 Air quality for development near the Cross City Tunnel*
>
> *Objective*
>
> *(a) Ensure potential air quality impacts from the Cross City Tunnel plume of emissions are considered in the assessment of a development.*
>
> *Definitions*
>
> *Sensitive receptor means a location where people are likely to work or reside and may include a dwelling, school, hospital, office or public recreational area. An air quality impact assessment should also consider the location of known or likely future sensitive receptors.*
>
> *Provisions*
>
> *(1) These following provisions apply to development that:*
>
> > *(a) has a building height relative to distance from the Cross City Tunnel ventilation stack as nominated in Table 3.6 Development near the Cross City Tunnel ventilation stack;*
> >
> > *(b) may, in the opinion of the consent authority, have an adverse impact on air quality of any sensitive receptor, including neighbouring buildings and/or any area open to air due to the developments potential to disperse the plume of emissions from the Cross City Tunnel ventilation stack; or*
> >
> > *(c) may be adversely impacted in terms of the effect of the emissions from the Cross City Tunnel ventilation stack on occupants of the development.*
>
> *(2) The consent authority is to consider:*
>
> > (a) the impact of the development on the occupants of other existing and future development and people using a place open to

the public due to the potential of the development to disperse the plume of emissions from the Cross City Tunnel ventilation stack;

(b) the likely impact of emissions from the Cross City Tunnel ventilation stack on occupants of the proposed development;

(c) whether the concentration of emissions at any sensitive receptor exceeds the Air Quality Goal of 246 µg/m^3 of NO_2 due to emissions from the Cross City Tunnel;

(d) an Air Quality Impact Assessment Report which:

(i) has been prepared by a suitably qualified person in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, published by the Department of Environment and Climate Change in 2005 and any relevant Council guideline or the Air Quality Assessment Process – Cross City Tunnel: Protocol to Address Provisions of Condition of Approval 247 (Roads and Traffic Authority 11 February 2008); and

(ii) identifies the predicted concentration of Nitrous Oxide at all sensitive receptors; and

(iii) includes an assessment of the matters outlined in sub -clauses (a) through to (c).

Table 3.7: Development near the Cross City Tunnel Ventilation Stack

Distance of development from Cross City Tunnel ventilation stack in metres	Height of proposed development above ground level Proposed building height in metres
0 – 50	greater than 25
50 – 100	greater than 30
100 – 150	greater than 40
150 – 200	greater than 50
200 – 250	greater than 60
250 – 300	greater than 70
300 – 400	greater than 90
400 – 500	greater than 100

"

The Project Building is located approximately 170 m from the CCT Stack with an approximate height of 81.7 m. This is above the height requirements for the assessment provisions listed in Table 3.7 of the DCP.

While Section 3.13.2 (2c) of the DCP does not specify an averaging period for the specified NO_2 Air Quality Goal, and does not explicitly specify whether the predicted incremental or cumulative concentrations are to be compared against this criteria, in line with the Approved Methods, SLR has adopted a 164 µg/m^3 criterion (rather than the less stringent 246 µg/m^3 outlined in the DCP) for predicted cumulative 1-hour average impacts. Additionally, SLR has assessed cumulative annual average NO_2 concentrations at the Project site against the relevant criterion set out in the Approved Methods (31 µg/m^3).

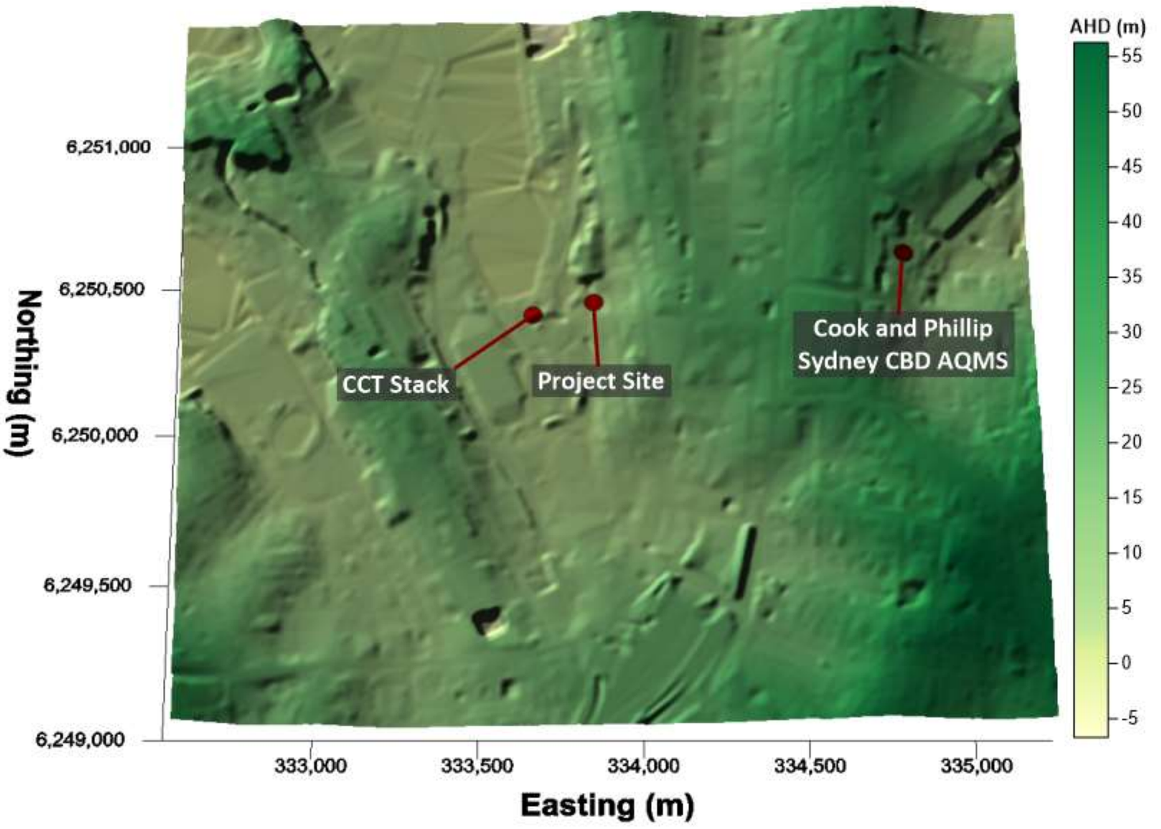
4.0 Project Setting

4.1 Local Topography

Topography is important in air quality studies as local atmospheric dispersion can be influenced by night-time katabatic (downhill) drainage flows from elevated terrain or channelling effects in valleys or gullies.

A three-dimensional representation of the region is given in **Figure 3**. The topography of the area within the illustrated area ranges from an approximate elevation of -5 m to 55 m Australian Height Datum (AHD). The Project site is reasonably flat and there are no significant topographical features between the Project site and the CCT Stack. An expanded view of the topography surrounding the Project site is provided in **Figure 4** which shows the variations in features near the meteorological and air quality monitoring stations referenced in **Section 4.2** and **Section 4.4**.

Figure 3 Topography of Area Surrounding the Project Site



Project Number:	610.032206
Location:	Sydney, NSW
Source:	ICSM Elvis
Projection:	5m - DEM
Date:	08/01/25

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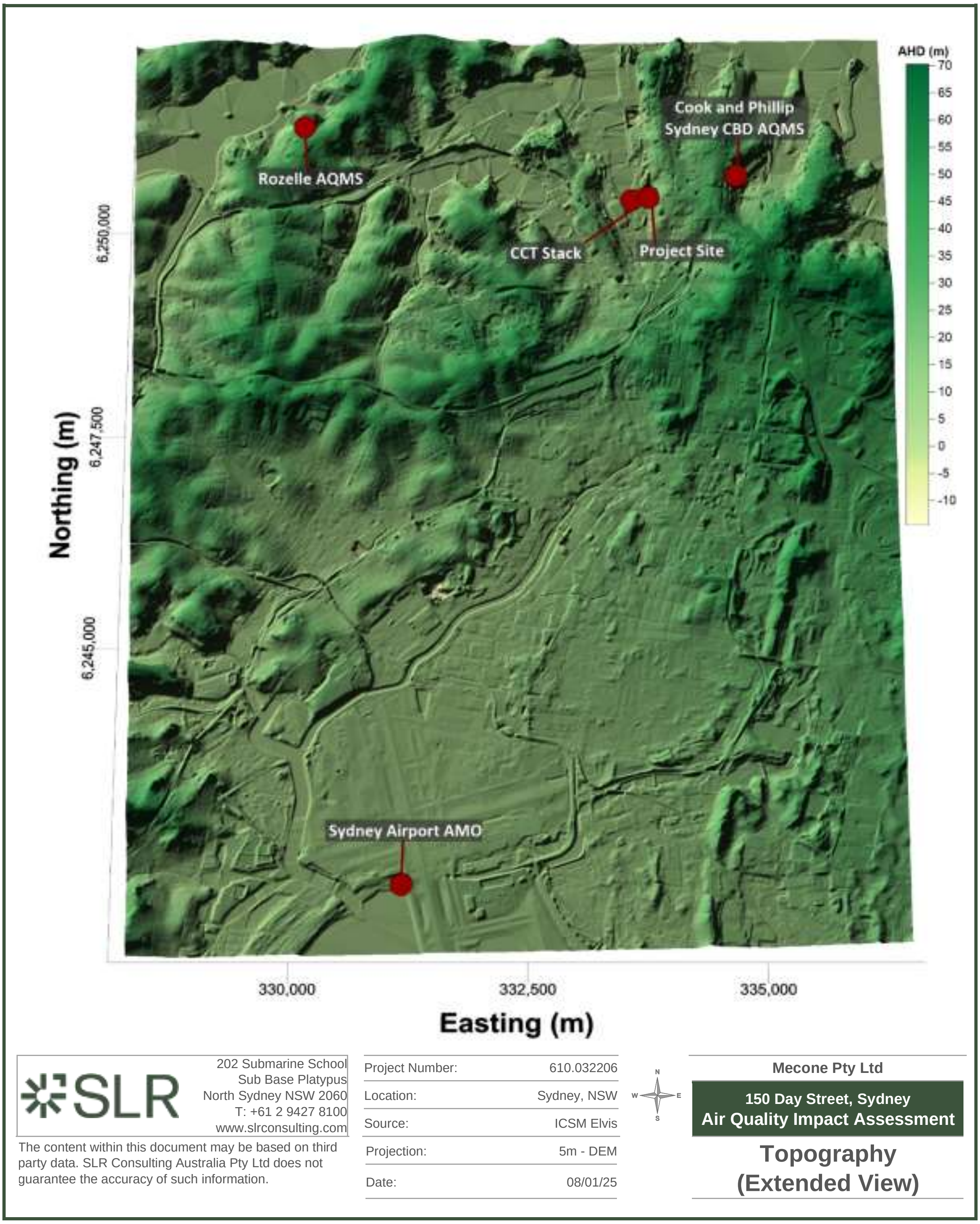
Mecone Pty Ltd
150 Day Street, Sydney
Air Quality Impact Assessment
Topography

Figure 4 Topography of Area Surrounding the Project Site



4.2 Climate and Meteorology

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station recording long term wind speed and wind direction data is the Sydney Airport Aeronautical Meteorological Observer (Sydney Airport AMO)

(Station ID 66037), located approximately 8.5 kilometres (km) south-southwest of the Project. It is likely that there will be variability between meteorological wind conditions (specifically wind speed and direction) at the Project site and the Sydney Airport AMO due to the variations in the terrain and land cover surrounding each location. To account for this, site specific meteorological modelling had been performed (**Section 5.1**). The observational data from the Sydney Airport AMO is detailed below to describe the general conditions for the region. Sydney Airport AMO has data available for the following parameters:

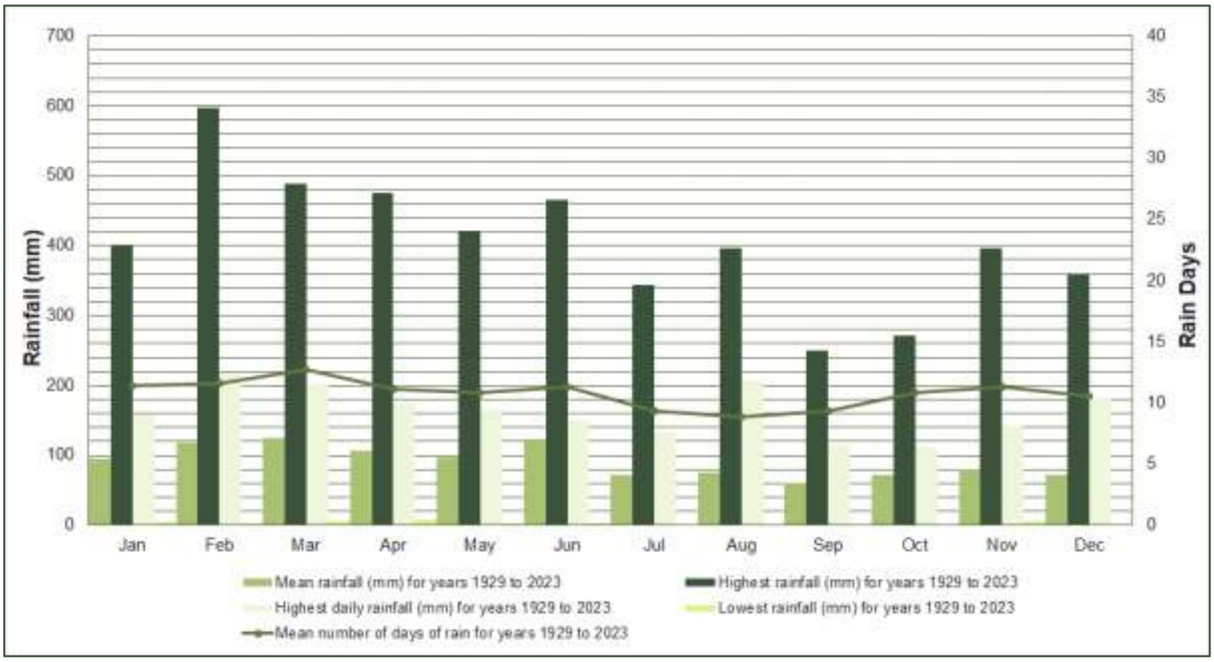
- Temperature (°C)
- Rainfall (mm)
- Relative humidity (%)
- Wind speed (m/s) and wind direction (degrees).

A review of the long-term data collected by this station is provided in the following sections.

4.2.1 Rainfall

Rainfall statistics for Sydney Airport AMO for the years 1929 to 2023 are summarised in **Figure 5**. The mean annual rainfall is 1,093 millimetres (mm). The average monthly rainfall is highest in summer with the highest average monthly rainfall of 124.7 mm/month in February and an average of 13 rain days. The lowest average rainfall is 59.8 mm/month in September, with an average of 9 days of rain. The highest monthly rainfall recorded over the time period examined was 596.9 mm recorded in February 1956. The maximum daily rainfall of 216.2 mm was recorded on 3rd February 1990.

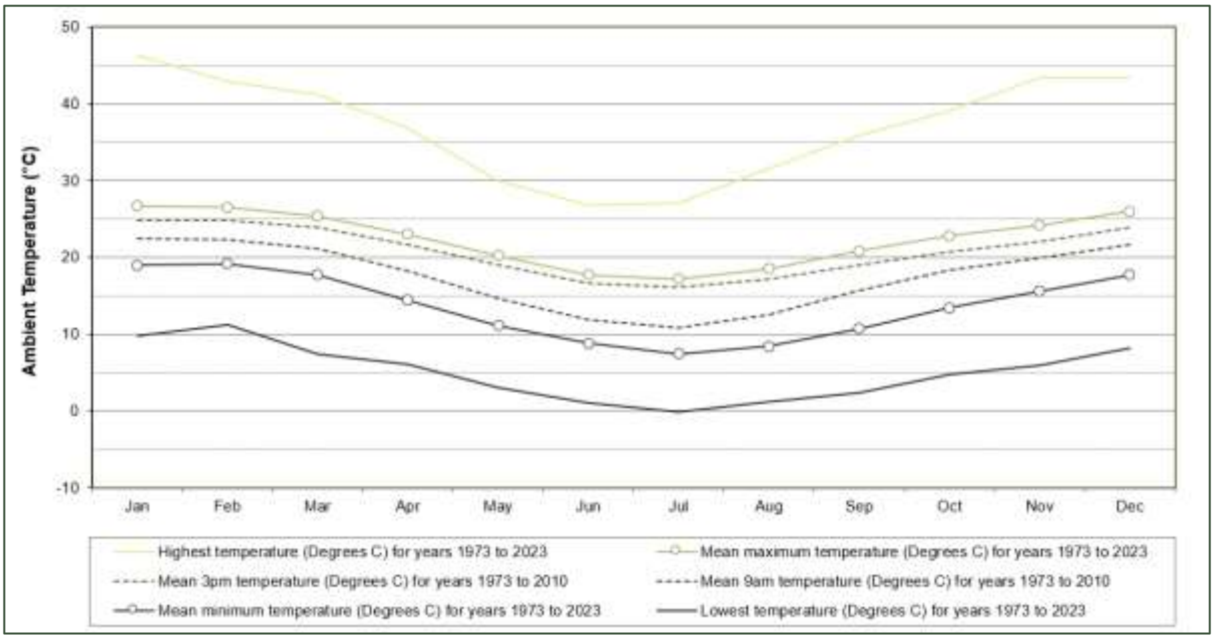
Figure 5 Monthly Rainfall Data for Sydney Airport AWS (1929 – 2023)



4.2.2 Temperature

Long-term temperature statistics for the Sydney Airport AMO are summarised in **Figure 6**. Mean maximum temperatures range from 17.2°C in winter to 26.7°C in summer, while mean minimum temperatures range from 7.4°C in winter to around 19°C in summer. Maximum temperatures above 45°C and minimum temperatures below 10°C have been recorded.

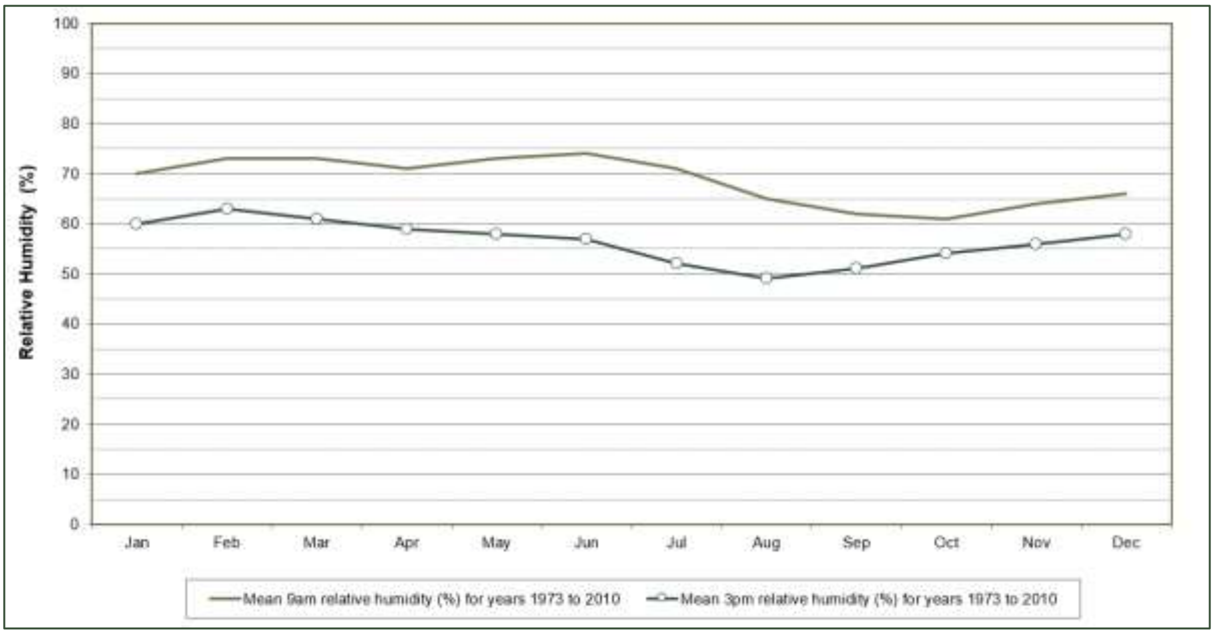
Figure 6 Long Term Temperature Data for Sydney Airport AMO



4.2.3 Relative Humidity

Long-term humidity statistics (9 am and 3 pm monthly averages) for the Sydney Airport AMO are summarised in **Figure 7**. Morning humidity levels range from an average of around 61% in mid-spring to around 74% in winter. Afternoon humidity levels are lower, at around 63% in late summer and dropping to a low of 49% in late winter.

Figure 7 Long Term Humidity Data for Sydney Airport AMO



4.2.4 Wind

Local wind speed and direction influence the dispersion of air pollutants. Wind speed determines both the distance of downwind transport and the rate of dilution as a result of 'plume' stretching. Wind direction, and the variability in wind direction, determines the general path pollutants will follow and the extent of crosswind spreading. Surface roughness (characterised by features such as the topography of the land and the presence of buildings, structures and trees) will also influence dispersion.

Annual and seasonal wind roses for the past five years, 2019 to 2023, compiled from data recorded by the Sydney Airport AMO are presented in **Figure 8**. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from North). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day. There are times when the wind is calm (defined as being from zero to 0.5 metres/second), and the percentage of the time that winds are calm are shown as a note on the wind rose. **Table 1** outlines the wind scale used to describe the wind speed.

Table 1 Wind Scale Descriptions

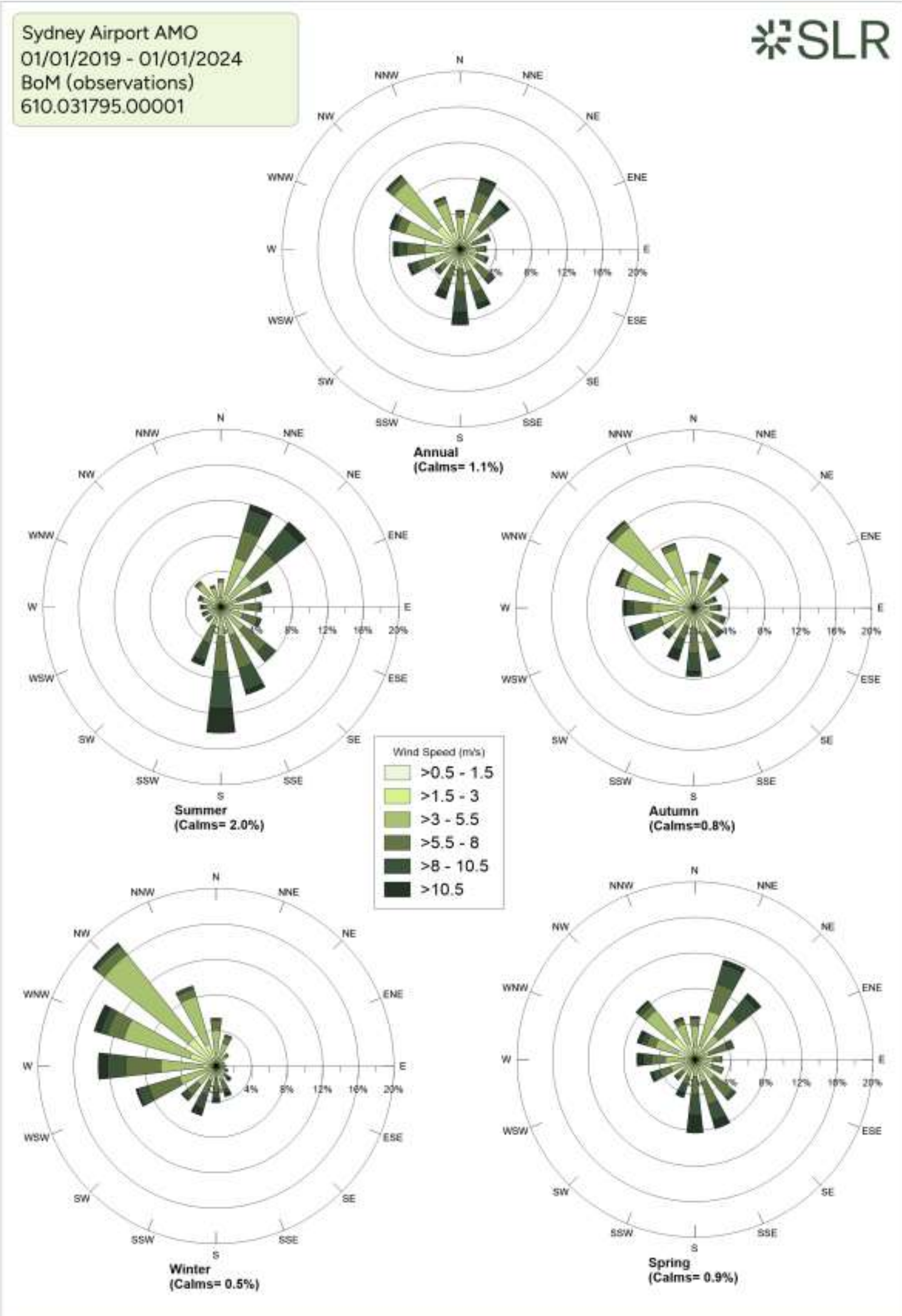
Description	km/h	m/s	Description on land
Calm	0-1.8	0-0.5	Smoke rises vertically
Light air	1.8-5.5	0.5-1.5	Smoke drift indicates wind direction
Light breeze	5.4-10.8	1.5-3	Wind felt on face, leaves rustle, light flags extended, ordinary vanes moved by wind
Gentle breeze	10.8-19.8	3-5.5	Leaves and small twigs in constant motion; light flags extended.
Moderate winds	19.8-28.8	5.5-8.0	Raises dust and loose paper, small branches are moved
Fresh winds	28.8-37.8	8.0-10.5	Small trees in leaf begin to sway, crested wavelets form on inland waters
Strong winds	>37.8	>10.5	Large branches in motion, whistling heard in telephone wires; umbrellas used with difficulty

The annual wind rose indicates the winds in the area blow from all directions with a higher frequency of winds from the northwest, south, and north-northeast. Calm wind conditions were recorded to occur 1.1% of the time throughout the investigated period. The average seasonal wind roses for the year 2018-2023 indicate that:

- In summer, winds range generally evenly from light breeze to strong winds are mostly between and blow predominantly from the south to southeast and northeast/north-northeast, with very few winds from other directions. Calms were recorded approximately 2% of the time during the summer months.
- In autumn, winds range from light breeze to strong winds with a higher frequency of gentle breeze winds than summer. Winds blow predominantly from the northwest and other western directions, with low frequency of winds from northern and southern directions and very little winds from the east. Calms were recorded approximately 0.8% of the time during autumn.
- In winter, winds range from light breeze to strong winds with a higher frequency of gentle breeze winds than autumn. Winds blow predominantly from the northwest with a high frequency of winds ranging from north-northwest to west-southwest with very few winds blowing from any other direction. Calms were recorded approximately 0.5% of the time during the winter months.
- In spring, winds range generally evenly from light breeze to strong winds are mostly between and blow predominantly from the north-northeast and northeast, south/south-southeast and northwest to west-southwest, with very few winds from other directions. Calms were recorded approximately 0.9% of the time during spring.

As identified in **Section 2.0** The Project is located approximately 170 m east of the CCT Stack.. Annual winds from the west quadrant blowing air emissions from the CCT Stack towards the Project Building occur less than 25% of the time.

Figure 8 Average Annual and Seasonal Wind Roses (Sydney Airport AMO - 2019-2023)



4.3 Surrounding Land Use

Under the LEP, the Project site and all the land immediately surrounding the Project site is zoned SP5 (Metropolitan Centre). The Western Distributer is located to the north of the Project site followed by the Cross City Tunnel exit, then commercial offices. To the east of the Project site is Sands Street followed by commercial offices with ground floor retail premises. To the south of the Project site is Bathurst Street followed by more commercial offices with ground floor retail premises. To the west is Day Street, followed by IMAX Sydney, W Sydney hotel, the Darling Quarter Shopping Mall, followed by the Darling Harbour including many tourist attractions such as celebration spaces, the ICC Sydney, restaurants, and Tumbalong Park Chinese Gardens.

4.4 Background Air Quality

Air quality monitoring is performed by the Climate and Atmospheric Science Branch of the Department of Climate Change, Energy, the Environment, and Water (DCCEEW) at a number of air quality monitoring stations (AQMS) across NSW.

The closest AQMS to the Project site is the Cook and Phillip AQMS, located 900 m to the east. The Cook and Phillip (also called Sydney CBD) AQMS was commissioned in 2019 and is located at the north-western corner of Cook and Phillip Park. The station measures air quality in the Sydney Central Business District at an elevation of 26 m. It is part of the Sydney East air quality monitoring region.

The next closest AQMS to the Project site is the Rozelle AQMS, located 3.8 km to the west-northwest of the Project site. The Rozelle AQMS station was commissioned in 1978 and is located on the grounds of Rozelle Hospital, off Balmain Road, Rozelle. It is situated in a residential area in the Parramatta River valley at an elevation of 22 m. It is also part of the Sydney East air quality monitoring region.

As the Project Building has a number of elevated floors, the upper levels of the Project Building are not anticipated to experience the same ambient pollution concentrations as the lower levels which are in proximity to the CBD roads. It is anticipated that the Cook and Philps AQMS data is representative of ambient concentrations the bottom levels of the Project Building, however use of this data for the upper levels of the Project Building may significantly overrepresent the impacts of road traffic at higher elevations. To appropriately represent the anticipated lower ambient pollution concentrations at the upper levels of the Project Building, Rozelle AQMS data is also presented. The Rozelle AQMS is still within the Sydney East air quality monitoring region and therefore will still be reasonably representative of Sydney East regional ambient concentrations but with fewer major roads in proximity. Levels up to and including the top of Level 11 will use Cook and Phillip AQMS data, and higher levels will use Rozelle AQMS data .

4.4.1 Cook and Phillip AQMS

Cook and Phillip AQMS monitors the following air pollutants:

- Particulate matter less than 10 µm in diameter (PM_{10}).
- Particulate matter less than 2.5 µm in diameter ($PM_{2.5}$).
- Nitrogen dioxide (NO_2).
- Carbon monoxide (CO).
- Sulphur dioxide (SO_2).

Air pollutant data recorded by the Cook and Phillip AQMS were obtained for the calendar years 2019 – 2023. The data are summarised in **Table 2** (red font indicates an exceedance of the relevant criterion followed by the number of exceedances in brackets for averaging periods other than annual), and presented graphically in **Figure 9** to **Figure 13**.

Table 2 shows that exceedances of the 24-hour average PM_{10} criterion were recorded by the Cook and Phillip AQMS in 2019-2020 and 2023, and exceedances of the 24-hour average and $PM_{2.5}$ criteria were recorded in all years except 2022.

A review of the available compliance monitoring reports indicates that the PM_{10} and $PM_{2.5}$ exceedances were primarily due to either:

- exceptional events such as bushfire emergencies, dust storms and hazard reduction burns, (NSW DPIE 2019), or
- non-exceptional events such as local-scale or regional-scale dust emissions, and local woodfire usage (NSW DPIE 2020.

The high number of exceedances recorded in 2019 were due to bushfire smoke that affected Sydney and the surrounding areas for a significant number of days in late 2019 and early 2020 (the 'Black Summer' bushfire event).

The annual average PM_{10} and $PM_{2.5}$ criterion were not exceeded during the five years reviewed.

Exceedances of the 1-hour average NO_2 criterion were recorded in 2019. The annual average NO_2 criterion was not exceeded during the five years reviewed.

Ambient concentrations of the gaseous pollutants CO and SO_2 were all below the relevant criteria for all years investigated.

Three exceedances of the 24-hour average PM_{10} and $PM_{2.5}$ criterion were recorded in 2023. The NEPM compliance report for 2023 has not been published at the time of this assessment, but a review of the available data shows that the exceedances occurred during mid-September, when air quality impacts from large hazard reduction burns were reported across Sydney. [2]

Table 2 Summary of Cook and Phillip AQMS Data (2019 - 2023)

Pollutant	PM_{10}		$PM_{2.5}$		NO_2		CO		SO_2	
Averaging Period	**Maximum 24-hour**	**Annual**	**Maximum 24-hour**	**Annual**	**Maximum 1-hour**	**Annual**	**Maximum 1-hour**	**Maximum 8-hour**	**Maximum 1-hour**	**Annual**
Units	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**mg/m³**	**mg/m³**	**µg/m³**	**µg/m³**
2019	116.8 (13)	7.4	96.5 (19)	3.8	225.5 (2)	24.0	5.5	2.3	51.5	8.6
2020	130.8 (4)	13.6	112.5 (7)	6.8	94.3	26.3	4.4	3.5	54.3	8.6
2021	36.9	11.3	29.5 (1)	5.4	96.4	24.5	3.0	0.9	45.8	8.6
2022	24.5	9.5	14.0	4.1	82.0	23.0	1.0	0.5	37.2	11.4
2023	67.4 (2)	12.9	58.8 (4)	6.3	116.9	25.6	0.0	0.0	0.0	0.0
Criterion	**50**	**25**	**25**	**8**	**164**	**31**	**30**	**10**	**215**	**57**

2 Exceedances of the 24-hour average $PM_{2.5}$ criteria occur on 11th, 12th, 14th September 2023. '*Sydney smoke: air quality among worst in world due to hazard-reduction burns'* | Bushfires | The Guardian.' https://www.theguardian.com/australia-news/2023/sep/14/sydney-air-quality-smoke-haze-today-back-burning-schedule-hazard-reduction-burns, Accessed 4 April 2024.

Figure 9 24-Hour Average PM_{10} Concentrations at Cook and Phillip AQMS (2019 - 2023)

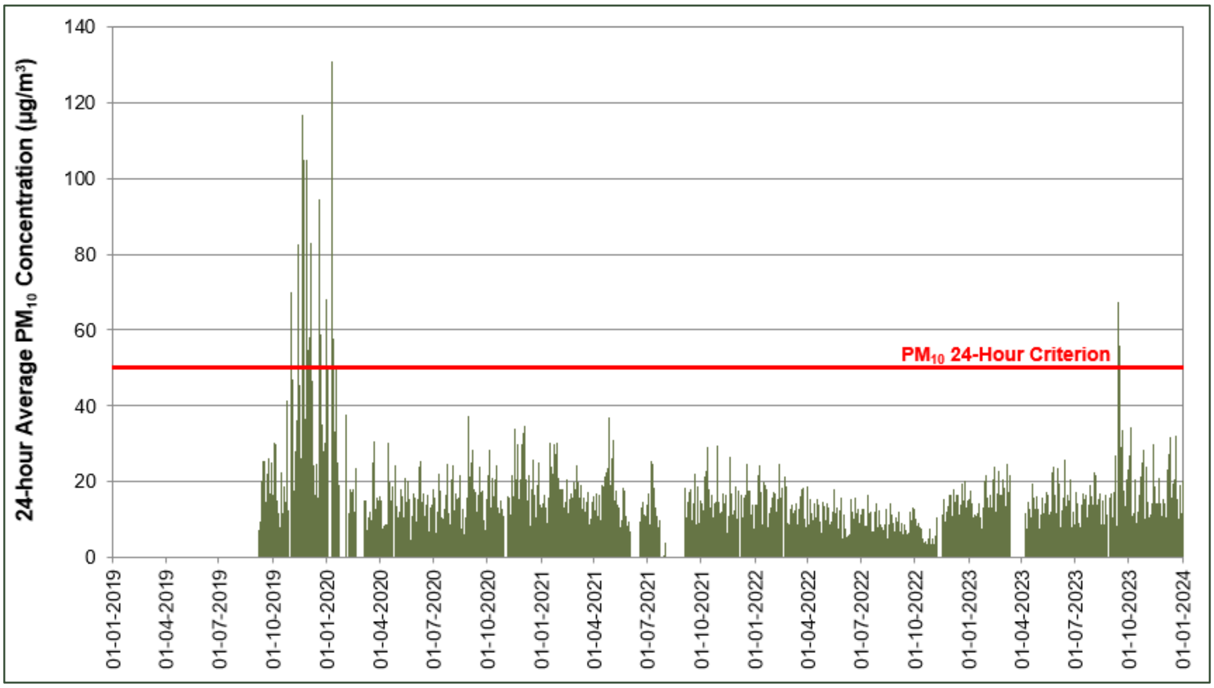


Figure 10 24-Hour Average $PM_{2.5}$ Concentrations at Cook and Phillip AQMS (2019 - 2023)

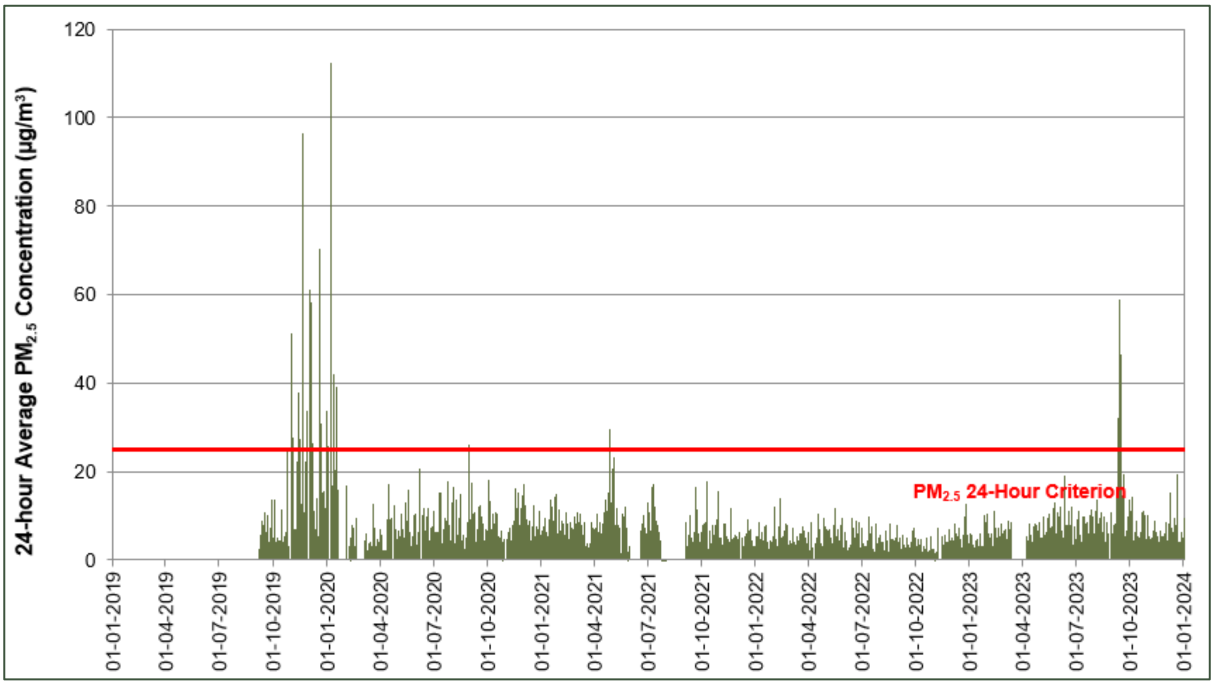


Figure 11 1-Hour Average NO_2 Concentrations at Cook and Phillip AQMS (2019 - 2023)

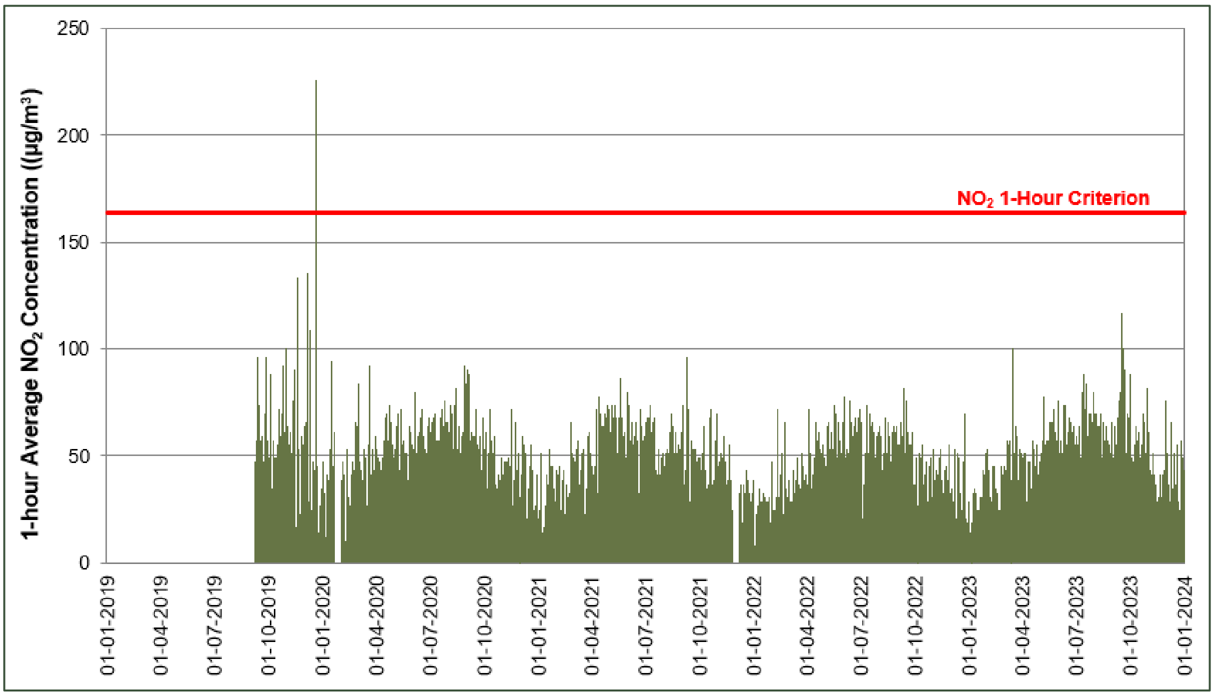


Figure 12 1-Hour Average CO Concentrations at Cook and Phillip AQMS (2019 - 2023)

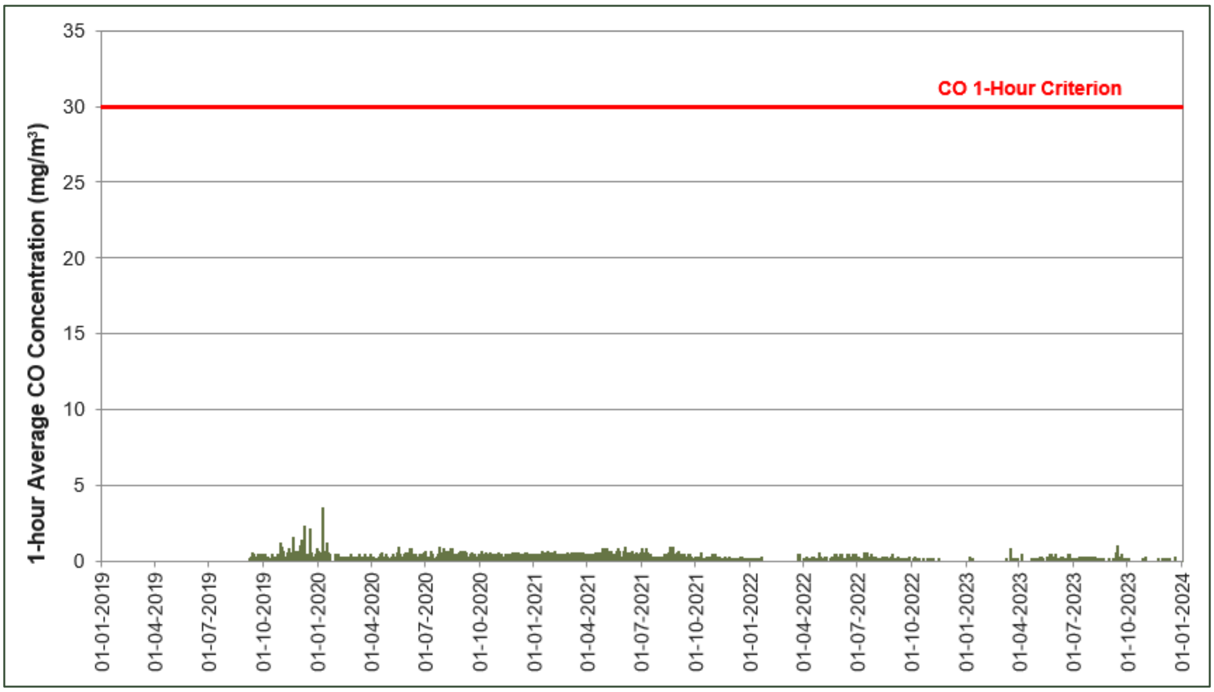
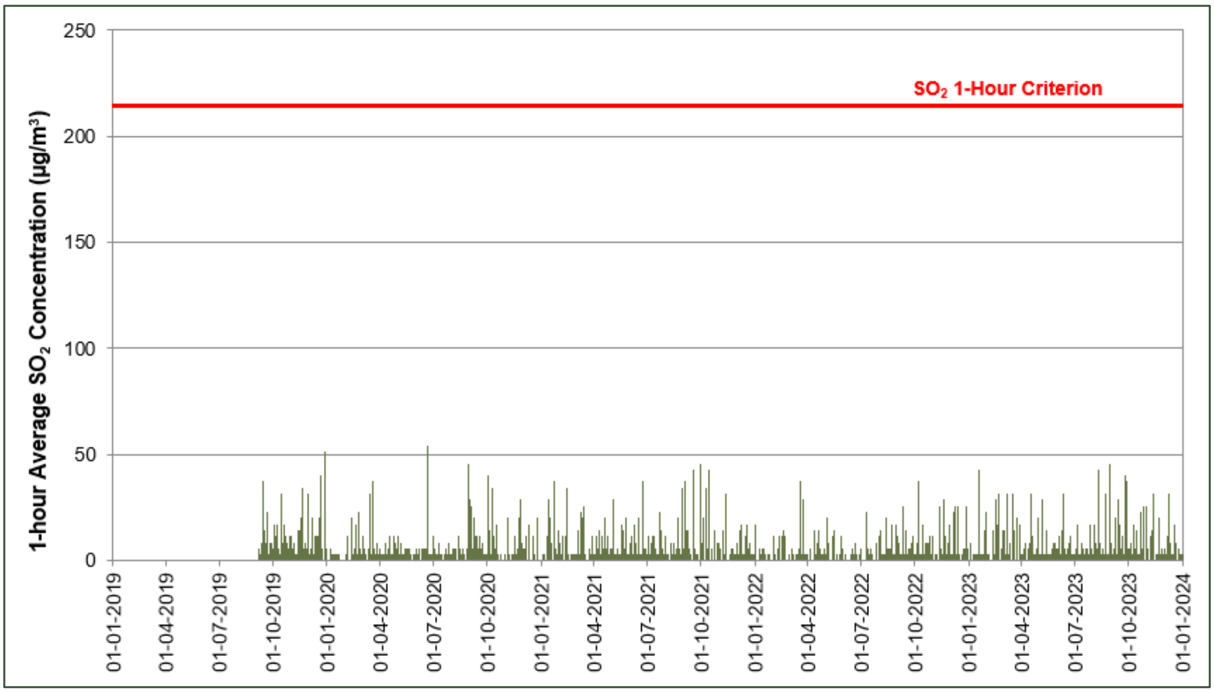


Figure 13 1-Hour Average SO_2 Concentrations at Cook and Phillip AQMS (2019 - 2023)



4.4.2 Rozelle AQMS

Rozelle AQMS monitors the following air pollutants:

- Particulate matter less than 10 µm in diameter (PM_{10}).
- Particulate matter less than 2.5 µm in diameter ($PM_{2.5}$).
- Nitrogen dioxide (NO_2).
- Carbon monoxide (CO).
- Sulphur dioxide (SO_2).

Air pollutant data recorded by the Rozelle AQMS were obtained for the calendar years 2019 – 2023. The data are summarised in **Table 3** (red font indicates an exceedance of the relevant criterion followed by the number of exceedances in brackets for averaging periods other than annual), and presented graphically in **Figure 14** to **Figure 18**.

Table 3 shows that exceedances of the 24-hour average PM_{10} criterion were recorded by the Rozelle AQMS in three years, 2019-2021, and exceedances of the 24-hour average and $PM_{2.5}$ criteria were recorded in all years except 2022.

A review of the available compliance monitoring reports indicates that the PM_{10} and $PM_{2.5}$ exceedances were primarily due to exceptional events such as bushfire emergencies, dust storms and hazard reduction burns (NSW DPIE 2019) (NSW DPIE 2020) (NSW DPE 2021). The high number of exceedances recorded in 2019 were due to the 'Black Summer' bushfire event.

Exceedances of the annual average $PM_{2.5}$ criterion were recorded in 2019. The annual average PM_{10} criterion was not exceeded during the five years reviewed.

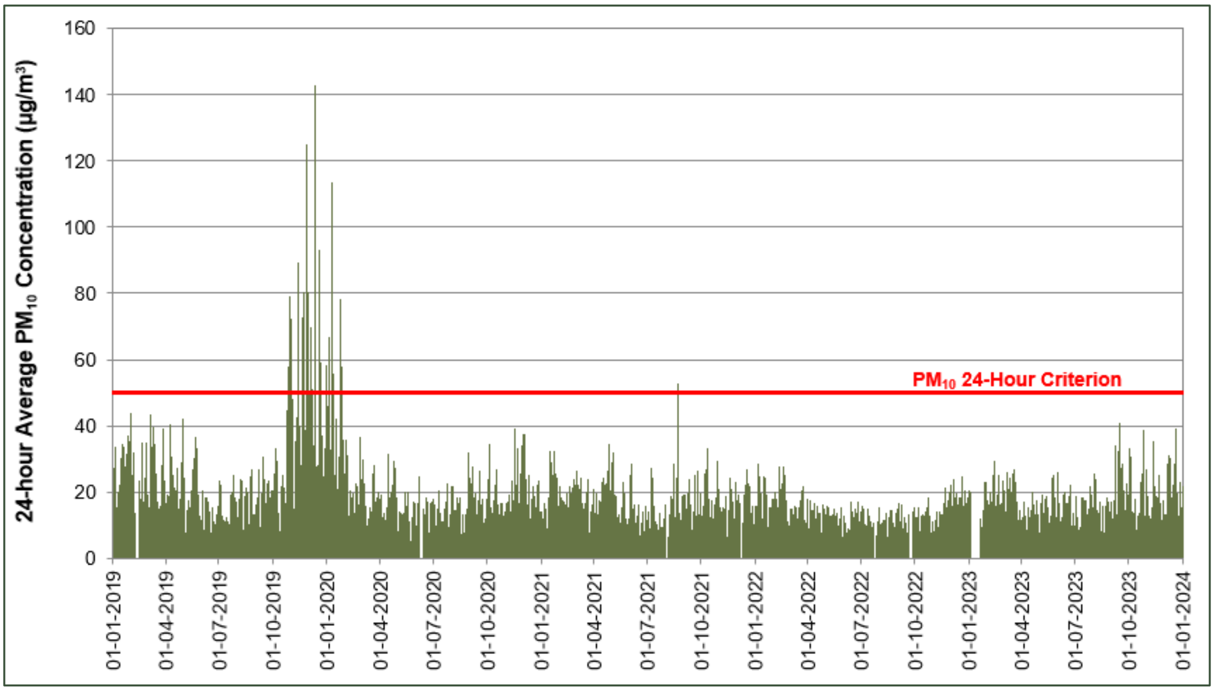
Ambient concentrations of the gaseous pollutants NO_2, CO and SO_2 were all below the relevant criteria for all years investigated.

Three exceedances of the 24-hour average $PM_{2.5}$ criterion were recorded in 2023. The NEPM compliance report for 2023 has not been published at the time of this assessment, but a review of the available data shows that the exceedances occurred during mid-September, when air quality impacts from large hazard reduction burns were reported across Sydney. [3]

Table 3 Summary of Rozelle AQMS Data (2019 - 2023)

Pollutant	PM_{10}		$PM_{2.5}$		NO_2		CO		SO_2	
Averaging Period	**Maximum 24-hour**	**Annual**	**Maximum 24-hour**	**Annual**	**Maximum 1-hour**	**Annual**	**Maximum 1-hour**	**Maximum 8-hour**	**Maximum 1-hour**	**Annual**
Units	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**mg/m³**	**mg/m³**	**µg/m³**	**µg/m³**
2019	142.7 (18)	21.9	101.8 (21)	9.9	184.5 (1)	19.5	6.5	2.8	91.5	14.3
2020	113.5 (7)	17.7	87.3 (8)	7.4	88.2	16.8	4.1	3.3	45.8	8.6
2021	52.6 (1)	15.3	61.7 (3)	6.2	71.8	14.6	1.9	1.6	57.2	11.4
2022	28.5	12.2	12.7	4.5	63.6	11.7	1.9	1.0	82.9	11.4
2023	40.9	14.9	35.4 (3)	6.0	86.1	15.9	1.4	0.9	68.6	8.4
Criterion	**50**	**25**	**25**	**8**	**164**	**31**	**30**	**10**	**286**	**57**

Figure 14 24-Hour Average PM_{10} Concentrations at Rozelle AQMS (2019 - 2023)



3 Exceedances of the 24-hour average $PM_{2.5}$ criteria occur on 11th, 12th, 14th September 2023. '*Sydney smoke: air quality among worst in world due to hazard-reduction burns'* | Bushfires | The Guardian.' https://www.theguardian.com/australia-news/2023/sep/14/sydney-air-quality-smoke-haze-today-back-burning-schedule-hazard-reduction-burns, Accessed 4 April 2024.

Figure 15 24-Hour Average $PM_{2.5}$ Concentrations at Rozelle AQMS (2019 - 2023)

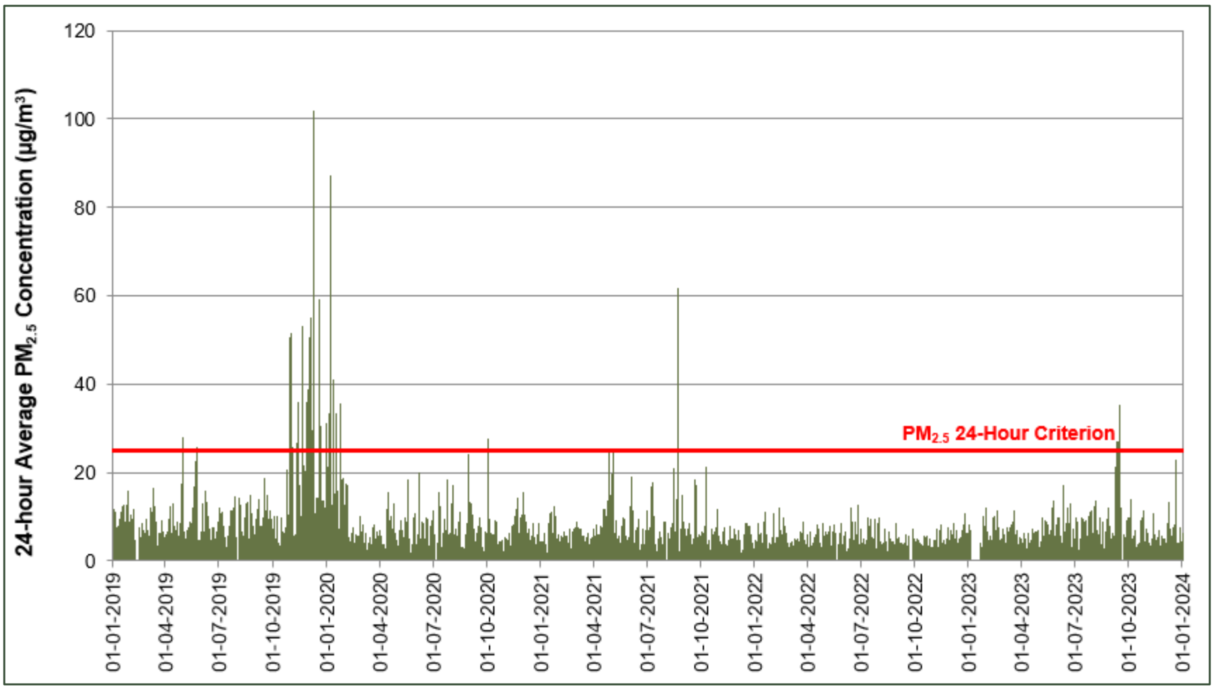


Figure 16 1-Hour Average NO_2 Concentrations at Rozelle AQMS (2019 - 2023)

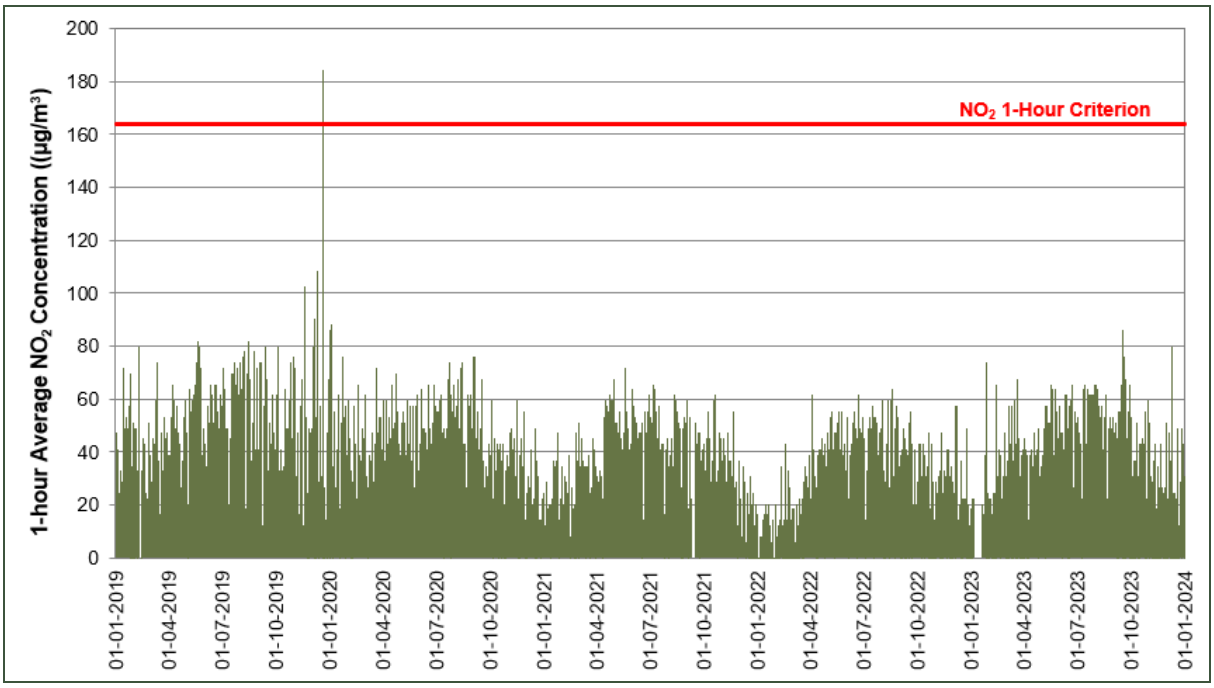


Figure 17 1-Hour Average CO Concentrations at Rozelle AQMS (2019 - 2023)

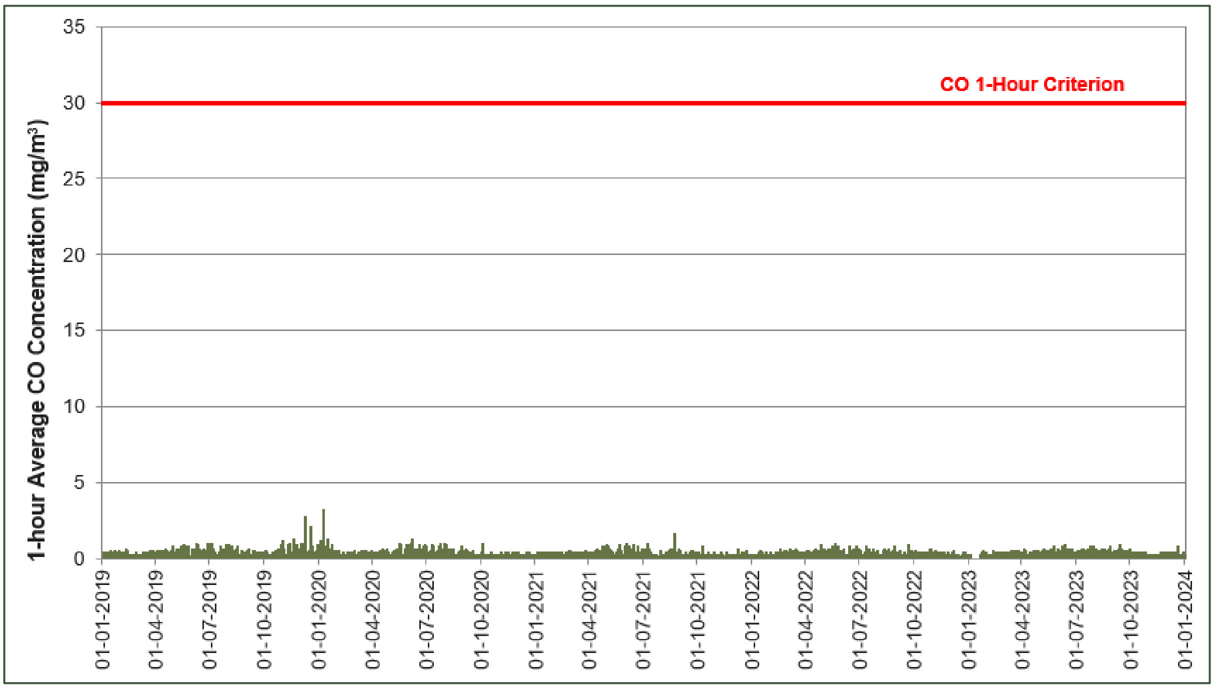
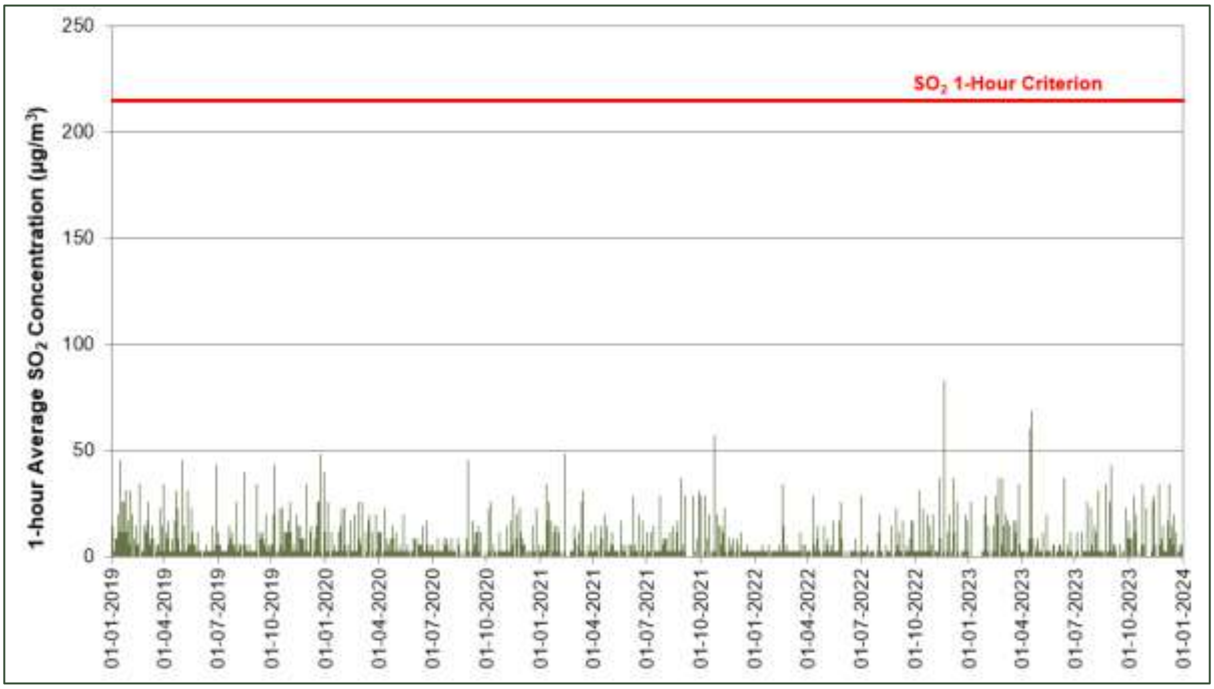


Figure 18 1-Hour Average SO_2 Concentrations at Rozelle AQMS (2019 - 2023)



5.0 Assessment Methodology

Emissions from the CCT Stack were modelled using the GRAMM/GRAL modelling system to predict the incremental impact of these emissions across a modelling domain that covered the CCT Stack and the Project site with sufficient buffer. The modelling was undertaken for two scenarios; namely the existing scenario and the proposed scenario including the Project Building at 150 Day Street. Regional air quality monitoring data available from the DCCEEW ambient monitoring network (see **Section 4.4**) were then used to assess the potential cumulative concentrations of NO_2 that future occupants of the Project site would potentially be exposed to, and to assess compliance against relevant air quality criteria (refer **Section 3.2**). In order to assess the potential change in dispersion of pollutants due to the Project, the incremental NO_X predictions for the two modelling scenarios were compared.

As outlined in **Section 1.0**, the aim of this report is to address Clause 3.13.2 of the DCP. Given the DCP only specifies an Air Quality Goal for NO_2 (refer to **Section 4.4**, atmospheric pollutants emitted from the CCT Stack other than NO_2 have not been assessed for the purpose of this AQA.

5.1 Meteorological Modelling

To provide the meteorological data required by GRAL, information is needed on the prevailing wind regime, mixing depth and atmospheric stability and other parameters such as ambient temperature and relative humidity. In the absence of any site-specific observed meteorological data, a site-representative meteorological dataset was compiled using the CSIRO model TAPM model and the GRAMM meteorological processor.

5.1.1 Selection of the Meteorological year

In order to determine a representative meteorological year for use in dispersion modelling, five years of meteorological data (2019-2023) from the closest meteorological monitoring station with detailed hourly data available (Sydney Airport AWS) were analysed against the five-year average meteorological conditions. Specifically, the following parameters were analysed:

- frequency and distribution of the predominant wind directions
- hourly wind speeds observed
- hourly temperature

Based on this analysis, it was concluded that the year 2023 were most representative of the last five years of meteorological conditions experienced at the Project site. A detailed analysis is presented in **Appendix A**.

5.1.2 TAPM

The TAPM prognostic model, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) was used to generate site representative data required for GRAMM modelling as outlined below.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rainwater and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate one full year of hourly meteorological observations at user-defined levels within the atmosphere.

Additionally, TAPM may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to realign the predicted solution towards the observation values. Available observed meteorological data from a number of BoM in the region were incorporated into the TAPM setup. **Table 4** details the parameters used in the TAPM meteorological modelling for this assessment.

Table 4 Meteorological Parameters used for the AQIA – TAPM

Parameter	Value
Modelling Period	1 January 2023 to 31 December 2023
Centre of analysis	332,750mE 6,250,232 mS (UTM Coordinates)
Number of grid points	35 × 35 × 35
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Data assimilation	Canterbury Racecourse AWS (Station # 66194) Sydney Olympic Park AWS (Station # 66212) Sydney Airport AWS (Station # 66037) Terry Hills AWS (Station # 66059) Manly (North Head) AWS (Station # 66197)
Terrain	AUSLIG 9 second DEM

5.1.3 GRAMM

The GRAMM domain was defined so that it covered the CCT Stack and the Project site, with a sufficient buffer zone. Topographical data used in GRAMM were sourced from the Geoscience Australia database that has corrected Shuttle Radar Topography Mission (SRTM) topography data for Australia with a 1 arc second (approximately 30 m) spacing. The land use data for the modelling domain was defined by CORINE land use categories using aerial imagery.

The site-representative predicted meteorological data extracted from the inner domain output from the TAPM model was used as input to the GRAMM model. **Table 5** details the parameters used in the GRAMM model.

Table 5 GRAMM Meteorological Parameters

Parameter	Value
Number of wind speed classes	10
Wind speed classes (m/s)	0-0.5, 0.5-1.0, 1.0-2.0, 2.0-3.0, 3.0-4.0, 4.0-5.0, 5.0-6.0, 6.0-7.0, 7.0-8.0, >8.0
Number of wind direction sectors	36

Parameter	Value
Number of classified weather situations	1063
Horizontal grid resolution (m)	100
Vertical thickness of first layer (m)	10
Number of vertical layers	15
Vertical stretching factor	1.40
Relative top layer height	3,874
Maximum time step (s)	10
Modelling time	3,600
Relaxation velocity	0.10
Relaxation scalars	0.10

5.2 Meteorological Data Used in Model

5.2.1 Wind speed and Direction

A summary of the annual wind behaviour predicted by TAPM, extracted at a location near the Project site is presented as wind roses in **Figure 19**.

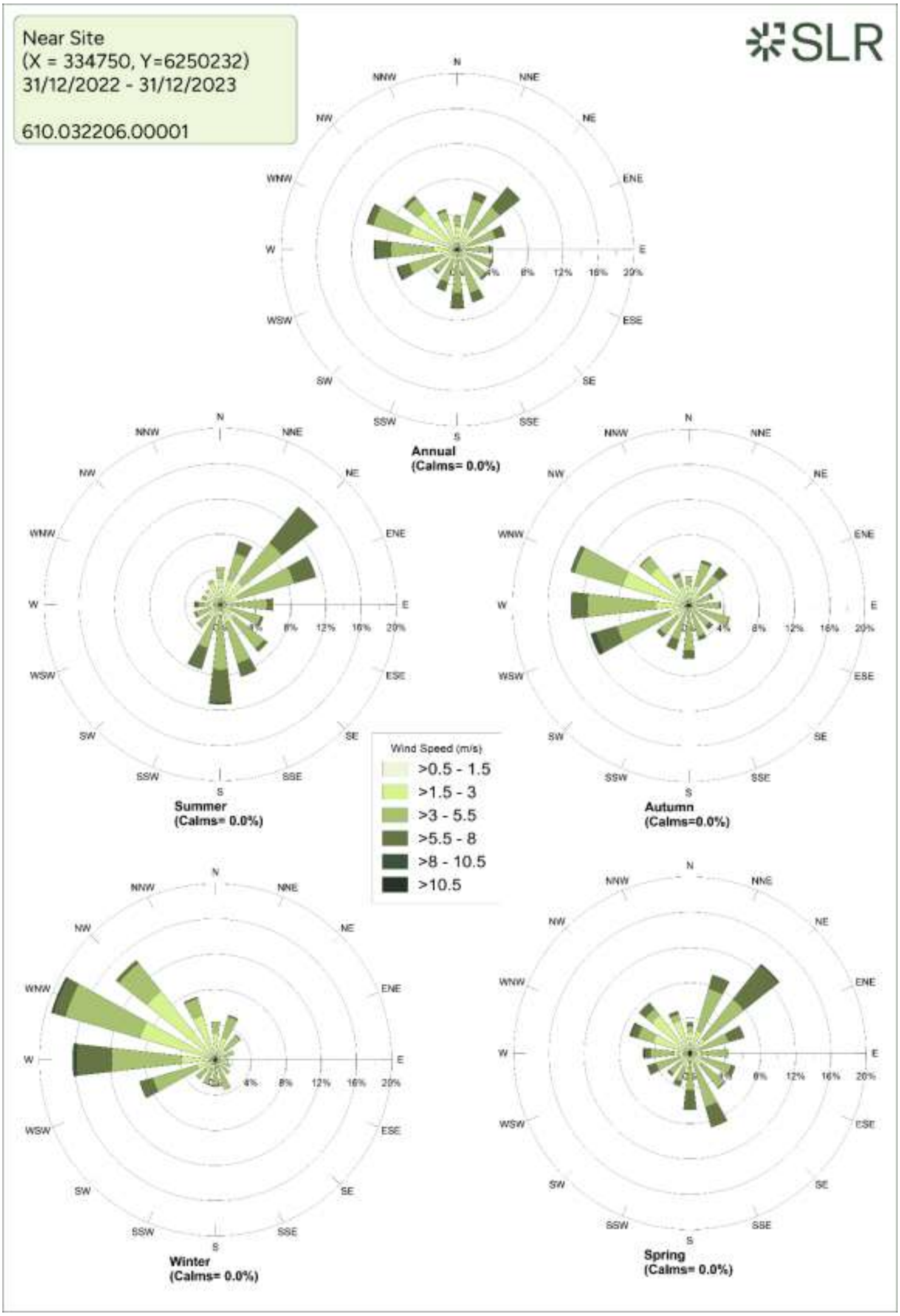
Figure 19 indicates that winds predicted at the Project site are predominantly between 3.5 m/s and 8 m/s. Calm wind conditions were predicted to occur 0% of the time throughout the modelling period.

The seasonal wind roses indicate that:

- In summer, winds are predominantly from the northeast and south, with very low frequency of winds from the west.
- In winter and autumn, winds are predominantly from the west-northwest, with very low frequency of winds from other directions. This trend is more exaggerated in winter.
- In spring, winds are predominantly from the northeast, with low frequency of winds from the southeast and northwest.

It is noted that the wind conditions predicted by the model at other areas within the modelling domain may vary from the wind roses presented in **Figure 19** for one point within the Project site, and within GRAL the dispersion of pollutants from each source within the model will reflect the local conditions.

Figure 19 Predicted Seasonal Wind Roses near Project Site (TAPM predictions, 2023)



5.2.2 Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Gifford-Turner (PGT) assignment scheme identifies six stability classes, A to F, to categorise the degree of atmospheric stability as follows:

- A = Extremely unstable conditions
- B = Moderately unstable conditions
- C = Slightly unstable conditions
- D = Neutral conditions
- E = Slightly stable conditions
- F = Moderately stable conditions

The meteorological conditions defining each PGT stability class are shown in Table 6.

Table 6 Meteorological Conditions Defining PGT Stability Classes

Surface wind speed (m/s)	Daytime insolation			Night-time conditions	
	Strong	Moderate		Strong	Moderate
< 2	A	A - B	< 2	A	A - B
2 - 3	A - B	B	2 - 3	A - B	B
3 - 5	B	B - C	3 - 5	B	B - C
5 - 6	C	C - D	5 - 6	C	C - D
> 6	C	D	> 6	C	D

Source: (NOAA 2018)

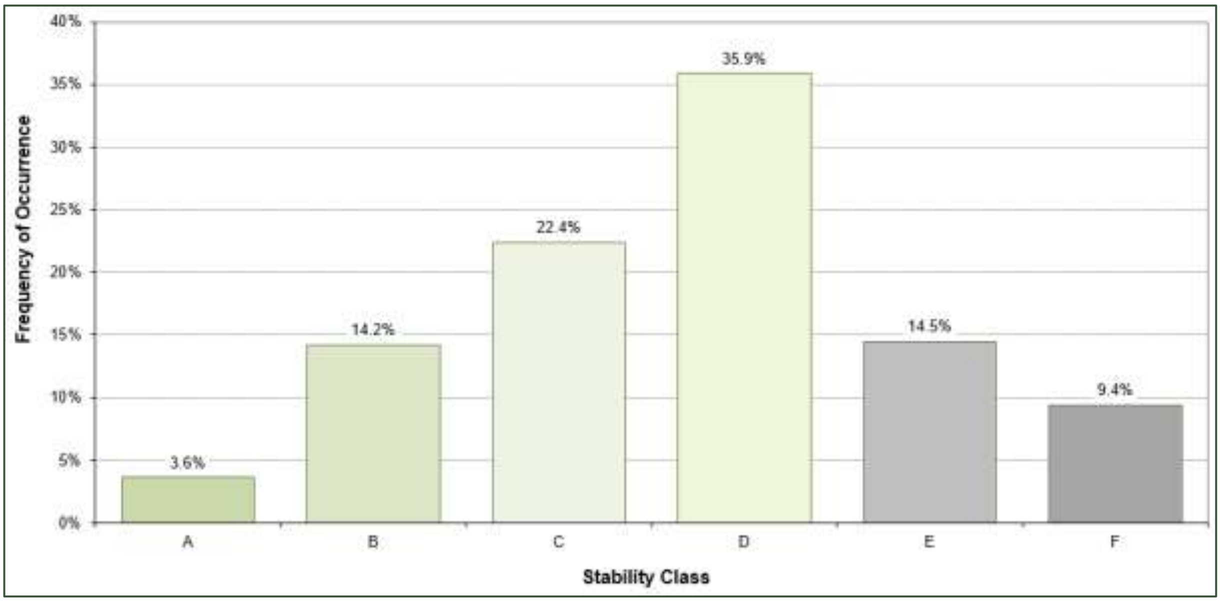
Notes:

1. Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.
2. Night refers to the period from 1 hour before sunset to 1 hour after sunrise.
3. The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

The frequency of each stability class predicted by TAPM during the modelling period, extracted at a location within the Project Site is presented in **Figure 13**.

The results indicate a high frequency of conditions typical to Stability Classes D. Stability Class D is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing.

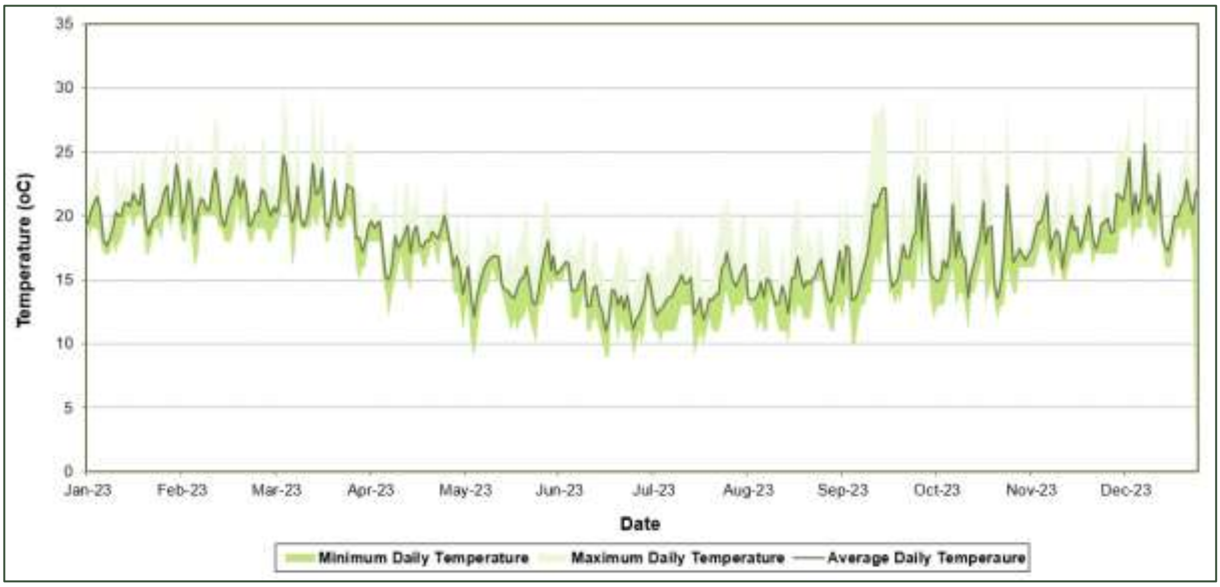
Figure 20 Predicted Stability Class Frequencies at the Project Site (TAPM predictions, 2023)



5.2.3 Temperature

The modelled temperature variations as predicted at the Project Site during the year 2023 are illustrated in **Figure 21**. The maximum temperature (31°C) was predicted on 14 December 2023 and the minimum temperature (9°C) was predicted on 19 July 2023.

Figure 21 Predicted Temperatures at the Project Site (TAPM predictions, 2023)

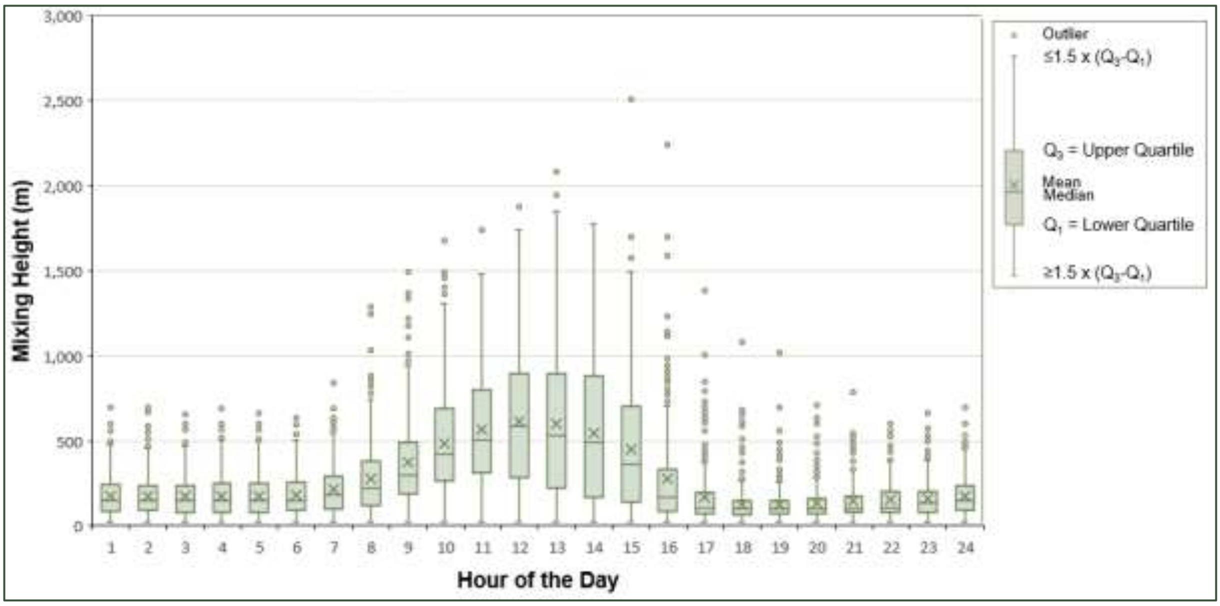


5.2.4 Mixing Heights

Diurnal variations in maximum and average mixing heights predicted by TAPM at the Project site during the 2023 modelling period are illustrated in **Figure 22**.

As would be expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground based temperature inversions and growth of the convective mixing layer.

Figure 22 Predicted Mixing Heights at the Site (CALMET predictions, 2023)



5.3 Dispersion Model

5.3.1 Model Selection

The GRAL modelling system was selected for dispersion modelling of the CCT Stack emissions due to its ability to take account of the localised effects of buildings and obstacles. Like the US-EPA CALPUFF model, GRAL is suitable for regulatory applications, can utilise a full year of meteorological data and has the ability to handle low-wind-speed conditions.

GRAMM/GRAL is a coupled Eulerian (GRAMM, Graz Mesoscale Model wind fields) and Lagrangian (microphysics Graz Lagrangian Model) model, developed by the Graz University of Technology, Austria. It is designed to solve the sources accurately and to compute concentrations with a very high resolution in complex topographic and building configurations.

The Eulerian model GRAMM solves the conservation equations for mass, enthalpy, momentum and humidity. The surface energy balance is calculated in a surface module of GRAMM, where several different land use categories are used to define the surface roughness, the albedo, the emissivity, the soil moisture content, the specific heat capacity of the soil and the heat transfer coefficient.

The Lagrangian model GRAL uses 3D meteorological data generated by GRAMM and computes steady state concentration fields for classified meteorological conditions using 3-7 stability classes, 36 wind direction classes and several wind speed classes to reduce the computational time. Typically, 500-600 bins of meteorological scenarios are required to characterise the dispersion situations that may occur at a given site within a year. Each of the steady-state concentration fields is stored as a separate file. Based on these results, the concentration fields for the annual mean value, maximum daily mean value and maximum value are calculated using a post-processing routine. In this way, the annual average, maximum daily mean, or maximum concentration for defined periods can be computed rapidly. The pseudo time series of concentration field can be obtained by taking the corresponding time series of classified meteorological situations of a certain period and multiplying each concentration field corresponding to certain hours of that period with some emission modulation factors.

5.3.2 Accuracy of Modelling

All atmospheric dispersion models, including GRAL, represent a simplification of the many complex processes involved in the dispersion of pollutants in the atmosphere. To obtain good quality results it is important that the most appropriate model is used and the quality of the input data (meteorological, terrain, source characteristics) is adequate.

The main sources of uncertainty in dispersion models, and their effects, are discussed below.

- Oversimplification of physics: This can lead to both under-prediction and over-prediction of ground level pollutant concentrations. Uncertainties are greater in Gaussian plume models as they do not include the effects of non-steady-state meteorology (i.e., spatially- and temporally-varying meteorology).
- Uncertainties in emission rates: Ground level concentrations are proportional to the pollutant emission rate. In addition, most modelling studies assume constant worst case emission levels or are based on the results of a small number of stack tests, however operations (and thus emissions) are often quite variable. Accurate measurement of emission rates and source parameters requires continuous monitoring.
- Uncertainties in source parameters: Plume rise is affected by source dimensions, temperature and exit velocity. Inaccuracies in these values will contribute to uncertainties in the predicted height of the plume centreline and thus ground level pollutant concentrations.
- Uncertainties in wind direction and wind speed: Wind direction affects the direction of plume travel, while wind speed affects plume rise and dilution of plume. Uncertainties in these parameters can result in errors in the predicted distance from the source of the plume impact, and magnitude of that impact. In addition, aloft wind directions commonly differ from surface wind directions. The preference to use rugged meteorological instruments to reduce maintenance requirements also means that light winds are often not well characterised.
- Uncertainties in mixing height: If the plume elevation reaches 80% or more of the mixing height, more interaction will occur, and it becomes increasingly important to properly characterise the depth of the mixed layer as well as the strength of the upper air inversion.
- Uncertainties in temperature: Ambient temperature affects plume buoyancy, so inaccuracies in the temperature data can result in potential errors in the predicted distance from the source of the plume impact, and magnitude of that impact.
- Uncertainties in stability estimates: Gaussian plume models use estimates of stability class, and 3D models use explicit vertical profiles of temperature and wind (which are used directly or indirectly to estimate stability class for Gaussian models). In either case, uncertainties in these parameters can cause either under-prediction or over-prediction of ground level concentrations.

The US EPA makes the following statement in its Modelling Guideline (US EPA, 2005) on the relative accuracy of models:

"Models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations; and the models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. For example, errors in highest estimated concentrations of ±10 to 40% are found to be typical, i.e., certainly well within the often quoted factor-of-two accuracy that has long been recognised for these models. However estimates of concentrations that occur at a specific time and site, are poorly correlated with actually observed concentrations and are much less reliable."

To maximise the accuracy of the model predictions, this AQIA utilises the GRAL dispersion model in prognostic mode, enabling the representation of dynamic effects due to local topography such as obstacle-influenced air flows, and accommodating complex topography with a high horizontal resolution. The meteorological dataset was compiled using observations from nearby automatic weather stations and a five-year period of meteorological data was reviewed to ensure that the year selected for use in the modelling is representative of long-term meteorological conditions.

5.3.3 Dispersion Model Configuration

The GRAL model was set up for two scenarios to investigate the dispersion of emissions from the CCT Stack with and without the Project in place. The CCT Stack was represented by an elevated point source. The Project Building, as well as existing buildings and structures that may affect the dispersion of pollutants through channelling and blocking effects, were included in the modelling. Outlines of these buildings are illustrated in **Figure 23** and the heights for all existing buildings were derived using high resolution Light Detection and Ranging (LIDAR) data.

For both scenarios modelled, the GRAL model was set up to predict concentrations across a 1,020 m by 1,030 m domain based on a Cartesian grid of points with an equal spacing of 2 m in the x and y directions. This results in 262,650 grid locations across the domain.

In addition to the grid receptors discussed above, for the modelling scenario with the Project Building in place, a total of 1,045 discrete receptors were distributed across the facade of the Project Building (see **Figure 24**) to predict the incremental impact of emissions from the CCT Stack on pollutant concentrations at various locations at the Project site. The time series of hourly average pollutant concentrations predicted by GRAL for these discrete receptor locations were then added to contemporaneous background time series data for the same period as the meteorological data used in the modelling to allow an assessment of potential cumulative impacts.

Table 7 details the parameters used in GRAL for this assessment.

Table 7 Parameters used in GRAL for the AQA

Parameter	Value
General	
Dispersion time	3,600 seconds
Particles per second	100
Obstacles	Prognostic GRAL
Concentration Grids	
Horizontal concentration grid resolution	2.0 m
Vertical dimension of concentration layers	2.0 m
Number of horizontal slices	7 (1.0 m, 6.0 m, 16 m, 26 m, 36 m, 66 m and 80 m)
Internal flow field grid	
Horizontal grid resolution	2.0 m
Vertical thickness of first layer	2.0 m
Vertical stretching factor	1.01
Number of cells in Z direction	40

Figure 23 Modelled Buildings

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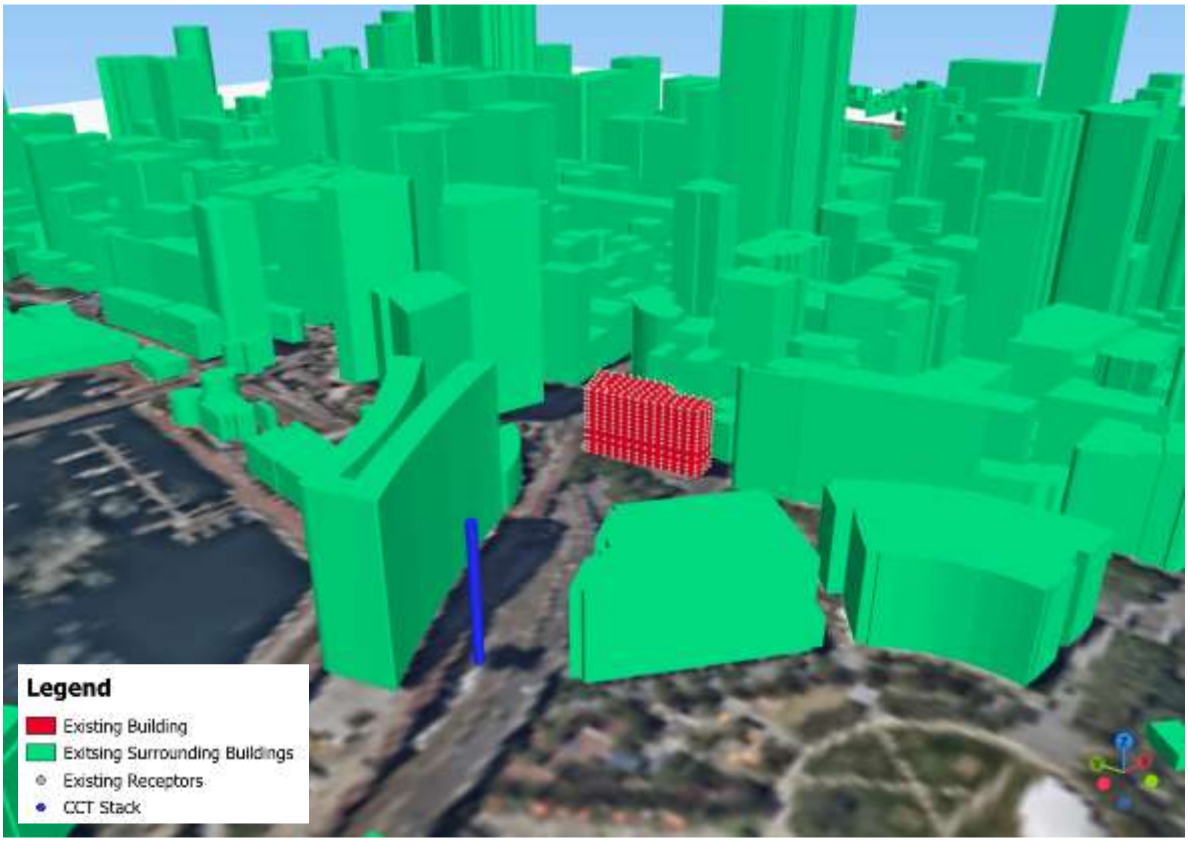
Project Number:	610.032206
Location:	Sydney, NSW
Source:	
Projection:	WGS 84 / UTM zone 56S`
Date:	08/01/2025

Mecone Group Pty Ltd

150 Day Street, Sydney
Air Quality Impact Assessment

Modelled Buildings

Figure 24 Modelled Existing Discrete Receptors



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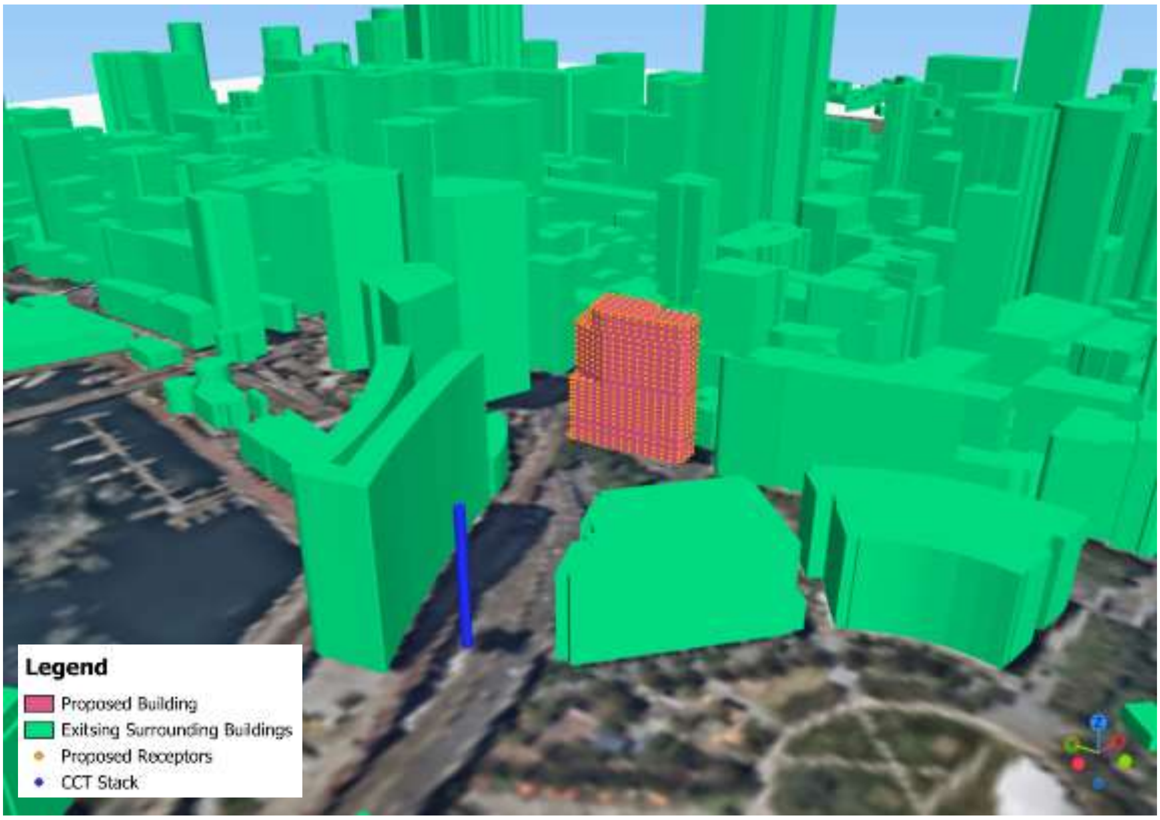
Air Quality Impact Assessment

Discrete Receptors

Figure 25 Modelled Proposed Discrete Receptors



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Projection:	
Date:	08/01/2025

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Air Quality Impact Assessment

Discrete Receptors

Table 8 Modelled Discrete Receptors

Building Level	Height Relative to Ground	Receptor Height	Number of Modelled Existing Receptors	Number of Modelled Proposed Receptors
L00	0	1	40	40
L00 MEZ	2.7	3.7	40	40
L01	5.4	6.4	40	40
L02	9.7	10.7	40	40
L03	14.7	15.7	40	40
L04	17.5	18.5	40	40
L05	20.4	21.4	40	40
L06	23.2	24.2	40	40
L07	26.1	27.1	40	40
L08	28.9	29.9	40	40
L09	31.8	32.8	40	40
L10	34.6	35.6	40	40
L11	37.5	38.5	40	40
L11 Top	37.5	38.5	73	4
L12	42.5	43.5	-	39
L13	45.9	46.9	-	39
L14	49.3	50.3	-	39
L15	52.7	53.7	-	39
L16	56.1	57.1	-	39
L17	59.5	60.5	-	39
L18	62.9	63.9	-	39
L19	66.9	67.9	-	39
L19 Top	66.9	67.9	-	9
L20	70.3	71.3	-	35
L21	73.7	74.7	-	35
L22	77.7	78.7	-	35
Roof	80.7	80.7	-	35
Roof Top	80.7	80.7	-	60

5.3.4 NOx to NO2 conversion

In atmospheric chemistry, NO_X generally refers to the total concentration of nitric oxide (NO) and nitrogen dioxide (NO_2). NO is a colourless and odourless gas that does not significantly affect human health. However, NO emitted from the source oxidises to NO_2 in the presence of ozone (O_3) and sunlight as it travels further from the source. NO_2 can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma.

The rate of oxidation depends on a number of parameters including the ambient O_3 concentration. The following methods can be applied to take account the oxidation of NO to NO_2 in estimating downwind NO_2 concentrations at receptor locations.

Method 1 – 100% Conversion

This method is usually used as a screening level assessment and assumes 100% conversion of NO to NO_2 before the plume arrives at the receptor location. Use of this method can significantly over-predict NO_2 concentrations at nearfield receptors.

Method 2 – Ambient Ozone Limiting Method (OLM)

This method assumes that all the available ozone in the atmosphere will react with NO in the plume until either all the O_3 or all the NO is used up. NO_2 concentrations can be estimated by this method using the following equation:

$[NO_2]\text{total} = \{0.1 \times [NO_X]\text{pred}\} + \text{MIN}\{(0.9) \times [NO_X]\text{pred or } (46/48) \times [O_3]\text{bkgd}\} + [NO_2]\text{bkgd}$

Given the relatively close proximity of the Project site to the CCT Stack, the use of Method 1 (100% conversion) is not appropriate therefore Method 2 has been adopted. This modelling approach is deemed conservative as it assumes that the atmospheric reaction is instantaneous. In reality, the reaction takes place over a number of hours. This provides conservative assessment for near field locations at short transport durations from source.

Method 2 has been adopted using O_3 data from the Cook and Phillips and the Rozelle AQMS. Levels up to and including the top of Level 11 will use Cook and Phillip AQMS data, and higher levels will use Rozelle AQMS data as described in **Section 4.4**.

5.3.5 Source Characteristics and Emission Rates

GRAL requires a range of inputs to describe the emissions to air as a result of the operation of the CCT Stack.

Potential air emissions and relevant stack parameters for the CCT Stack were estimated based available monitoring reports and the emission concentration limits specified in the CCT the Conditions of Approval established by the NSW Government (NSW Department of Planning 2002) and an Environment Protection Licence issued by NSW EPA (NSW EPA 2021). A review of the most recent NO_X emission testing data available on the Linkt website[4] was conducted for this assessment (the operators of the CCT) found that actual emissions from the CCT Stack are on between 0.5% to 15% (on average 5.4%) of the specified concentration limits[5]. The review of the available NO_X emission testing data also shows that, as expected, the emission concentrations are significantly lower during the night time and generally only elevated during the morning and afternoon peaks.

It is understood that the currentl monitoring for the CCT Stack is conducted by Norditech Pty Ltd. It was noted on review of the most recent available data that it is not hard entered into the downloadable files, and that the available files for download are considered “live” excel documents with active links to external spreadsheets owned by Norditech Pty Ltd that are not available online. Therefore SLR does not consider this data source verifiable. In addition, the

[4] https://www.linkt.com.au/sydney/using-toll-roads/about-sydney-toll-roads/cross-city-tunnel/tunnel-air-quality

[5] Average taken from November 2024 data available on the Linkt website..

available Stack Emissions Monitoring Report available for download in PDF format prepared by Norditech Pty Ltd do not provide measurements of data critical to determine emissions, such as stack temperature, or exhaust velocity, although these are reportedly measured.

As such, SLR took the last available data from the Linkt website which include these parameters. This was the NATA accredited monitoring data from 2020 titled “Cross City Tunnel Ventilation Stack Emission Monitoring - Quarter No.2 2019-2020” (SEMA 2020).

Table 9 presents a summary of stack parameters and emission rates for the CCT Stack. Estimation of emission rates based on concentration limits is a very conservative approach.

The modelling conducted for this study, conservatively assumes constant emissions at the specified limits for every hour of the year. It is noted that the use of this approach is likely to significantly overestimate the annual average downwind air pollutant concentrations.

Table 9 Stack Parameters and Emission Rates – Generator

Parameter	Data	Unit	Reference/Base
Temperature	25	°C	Cross City Tunnel Ventilation Stack Emission Monitoring - Quarter No.2 2019-2020 (SEMA 2020)
Stack height	65	m	CCT the Conditions of Approval (NSW Department of Planning 2002)
Exhaust gas velocity	10	m/s	Cross City Tunnel Ventilation Stack Emission Monitoring - Quarter No.2 2019-2020 (SEMA 2020)
Stack Equivalent Duct Diameter	4.6	m	Cross City Tunnel Ventilation Stack Emission Monitoring - Quarter No.2 2019-2020 (SEMA 2020)
NOx emission rate	10	kg/hr	Calculated using the total NOX 1-hr concentration limit of 19 mg/m3 (NSW Department of Planning 2002), exhaust gas velocity of 10 m/s and stack equivalent duct diameter of 4.6 m

6.0 Assessment of Impacts

6.1 Impact of the CCT Stack on the Project

The maximum incremental and cumulative 1-hour and annual average NO_2 concentrations predicted at various elevations along the facade of the proposed Project Building are presented in **Table 10**. These NO_2 concentrations were derived from the NO_X concentrations predicted by the modelling using the Ozone Limiting Method and contemporaneous hourly-varying 1-hour average ozone concentration data from the Cook and Phillips and the Rozelle AQMSs, as described in **Section 4.4**.

Figure 26 illustrates the maximum incremental 1-hour average NO_2 concentrations predicted at various elevations within the modelling domain, while **Figure 27** illustrates the incremental annual average concentrations.

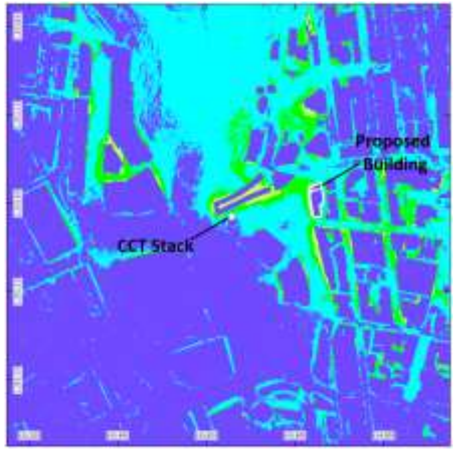
The predicted 1-hour and annual average NO_2 concentrations are in compliance with the relevant criteria at all locations modelled along the building facade.

Table 10 Predicted NO_2 Concentrations

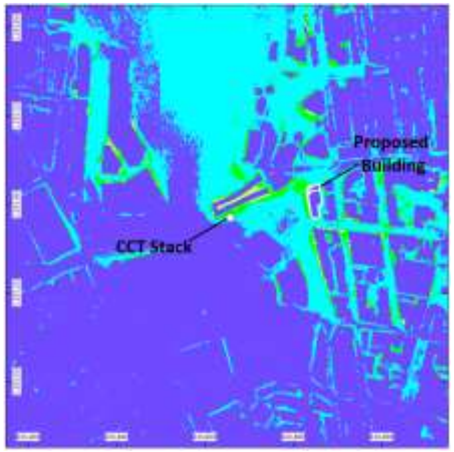
Building Level	Height Relative to Ground	Maximum Incremental Concentrations (µg/m³)		Maximum Cumulative Concentrations (µg/m³)	
		1-Hour Average	Annual Average	1-Hour Average	Annual Average
L00	1	99	3	127	29
L00 MEZ	3.7	106	3	134	29
L01	6.4	99	3	124	29
L02	10.7	89	3	122	29
L03	15.7	83	4	128	30
L04	18.5	81	4	128	30
L05	21.4	78	4	128	30
L06	24.2	77	4	129	30
L07	27.1	77	4	128	30
L08	29.9	75	4	128	30
L09	32.8	74	4	128	30
L10	35.6	74	4	129	30
L11	38.5	70	4	128	30
L11 Top	38.5	28	1	115	27
L12	43.5	90	5	97	21
L13	46.9	92	5	99	21
L14	50.3	89	5	95	21
L15	53.7	92	5	92	21
L16	57.1	81	5	95	21

Building Level	Height Relative to Ground	Maximum Incremental Concentrations (µg/m³)		Maximum Cumulative Concentrations (µg/m³)	
		1-Hour Average	Annual Average	1-Hour Average	Annual Average
L17	60.5	92	4	92	20
L18	63.9	94	4	94	20
L19	67.9	81	7	96	23
L19 Top	67.9	97	8	99	24
L20	71.3	82	4	96	20
L21	74.7	77	4	100	20
L22	78.7	106	8	110	24
Roof	80.7	65	4	88	20
Roof Top	80.7	75	4	95	20
Criteria				164	31

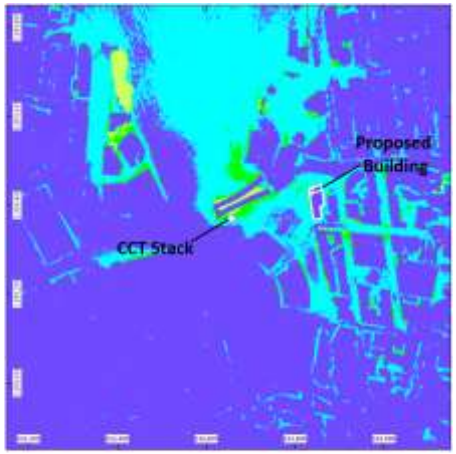
Figure 26 Maximum Predicted Incremental 1-Hour Average NO_X Concentrations



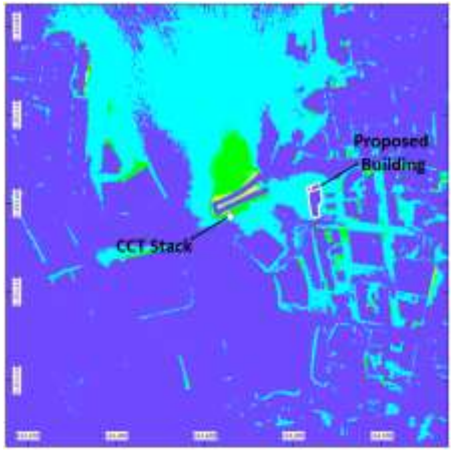
1m elevation



6m elevation

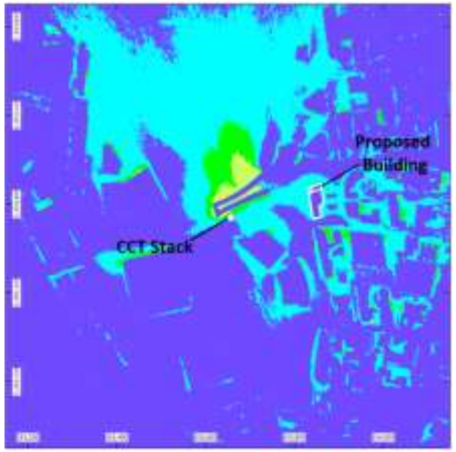


16m elevation

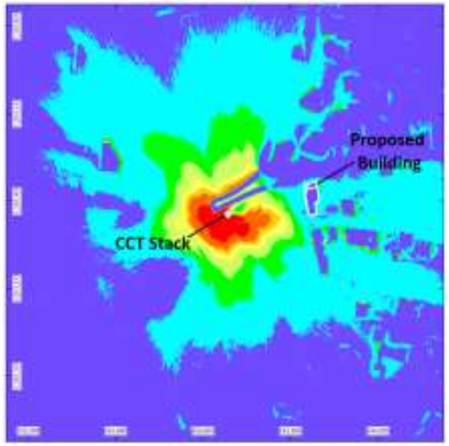


26m elevation

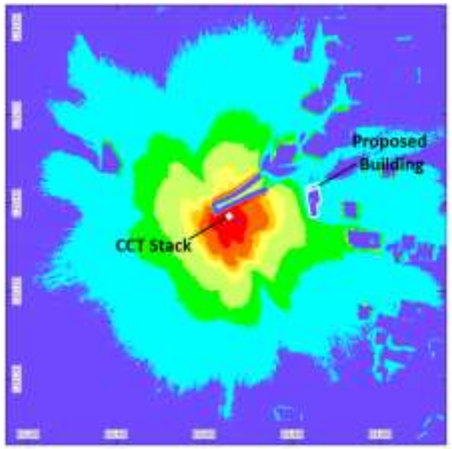
984



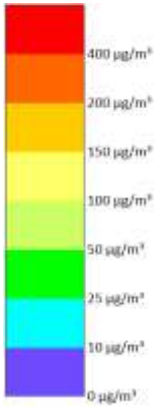
36m elevation



66m elevation



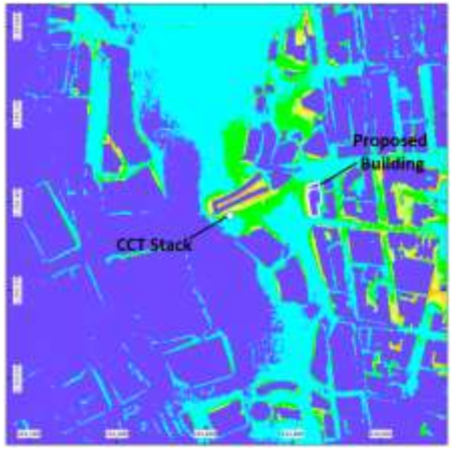
80m elevation



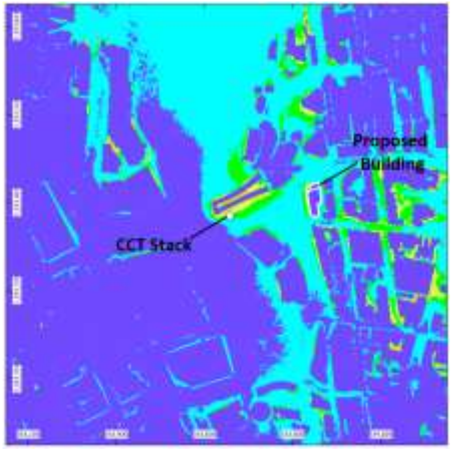
Legend

985

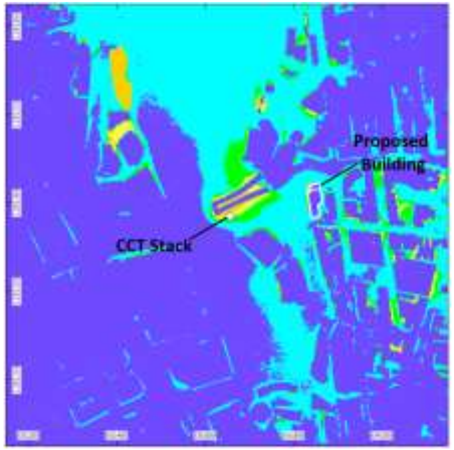
Figure 27 Predicted Incremental Annual Average NO_X Concentrations



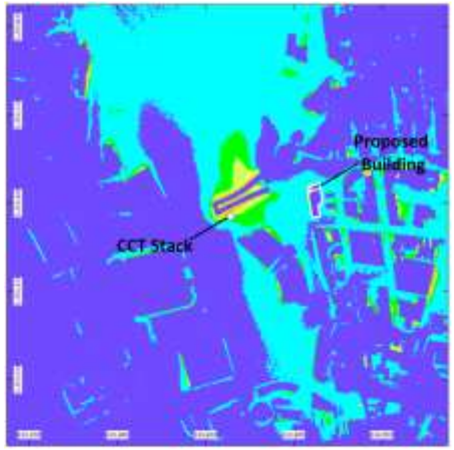
1m elevation



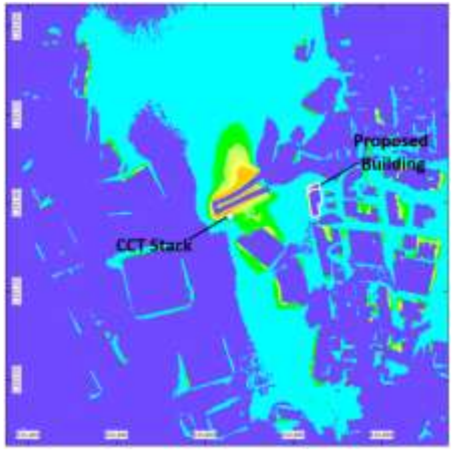
6m elevation



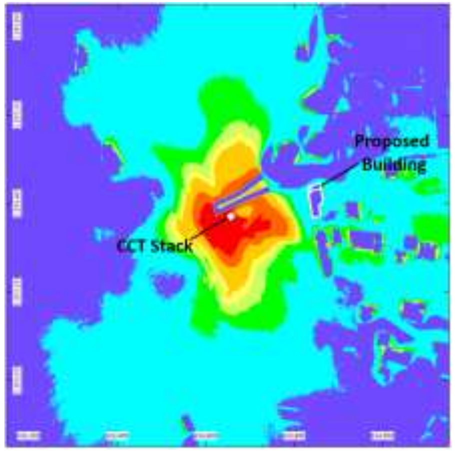
16m elevation



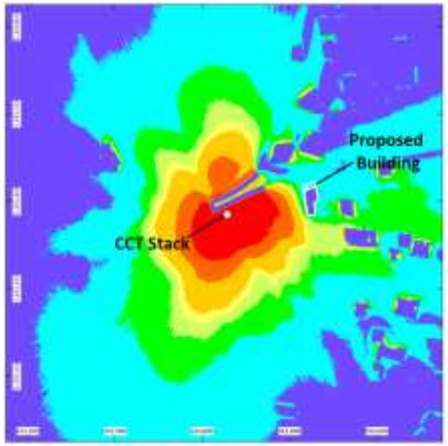
26m elevation



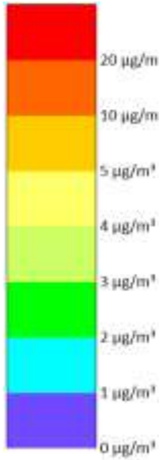
36m elevation



66m elevation



80m elevation



Legend

6.2 Impact of the Project on the CCT Stack Emissions Dispersion

To determine the potential impact the proposed Project Building could have on the dispersion of emissions from the CCT Stack, the changes in incremental NO_X concentrations across the modelling domain were calculated. This was done by deducting the grid receptor (all 262,650 receptors, refer **Section 5.3.3**) concentrations predicted by the model for the proposed scenario (i.e. the scenario with the proposed Project Building in place) from the grid receptor concentrations predicted by the model for the existing scenario. The results were then analysed to assess the range of change across the domain and the georeferenced outputs were plotted to visualise the locations with the most significant change.

Table 11 presents the changes in incremental NO_X concentrations predicted across the modelling domain at various elevations with the Project. It is noted that due to uncertainties associated in modelling and the presence of outliers in the calculated dataset, the 1st percentile (representative of the maximum reduction in NOX concentration predicted across the domain due to the Project), 99th percentile (representative of the maximum increase in NO_X concentration predicted across the domain, and median (median change in NO_X concentrations predicted across the domain) have been presented in **Table 11** instead of the absolute minimum, absolute maximum and average as these metrics are less influenced by any potential outliers. As shown in **Table 11**, changes in 1-hour average and annual average NO_X concentrations for all elevations modelled are relatively insignificant.

Figure 28 and **Figure 29** illustrate the predicted changes in NO_X concentrations predicted across the modelling domain (maximum and minimum rather than 1st percentile and 99th percentile due to post-processing limitations for the number of data points). As illustrated in **Figure 28** and **Figure 29**, the greatest changes in concentrations are predicted at locations very close to the source where the incremental NO_X concentrations are very high (refer to **Figure 26** and **Figure 27**). This means the change in µg/m^3 is actually a small percentage of the predicted impact. SLR estimates that for locations with the highest change in predicted NO_X concentrations, the percentage change in incremental NO_X impact is less than 5%. This is considered to be within the uncertainties associated with dispersion modelling (refer **Section 5.3.2**). Further, as outlined in **Section 5.3.4**, NO gas (which does not significantly affect human health) oxidises to NO_2 (which could significantly affect human health) as it travels further from the source and oxidises. Given the greatest changes in NO_X concentrations are predicted at locations very close to the source, a significant proportion of the predicted NO_X is likely to be NO with a relatively small proportion of NO_2.

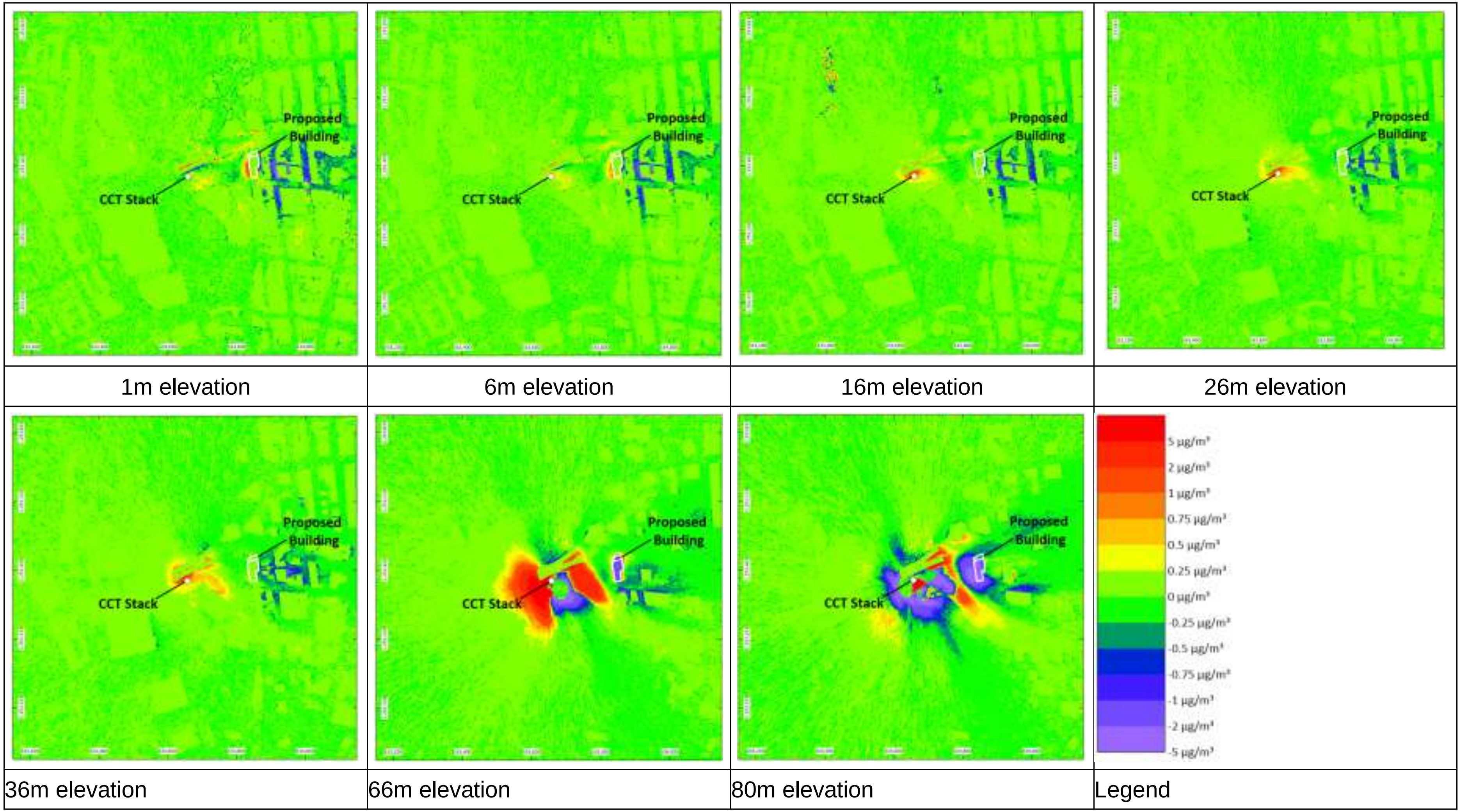
Based on the above, the impact of the proposed Project Building on the dispersion of emissions from the CCT Stack is considered to be negligible.

Table 11 Predicted Changes in 1-hour Average and Annual Average Incremental NO_X Concentrations due to the Project

Elevation	1-Hour Average NO_X Difference (µg/m³)			Annual Average NO_X Difference (µg/m³)		
	1st Percentile	Median	99th Percentile	1st Percentile	Median	99th Percentile
1 m	-8.7	0.00	8.0	-0.51	0.000	0.39
6 m	-5.9	0.00	5.6	-0.38	0.000	0.28
16 m	-5.4	0.00	5.2	-0.34	0.000	0.29
26 m	-4.5	0.00	4.5	-0.31	0.000	0.28
36 m	-4.3	0.00	4.5	-0.32	0.000	0.34
66 m	-9.9	0.04	29	-0.66	0.003	3.0
80 m	-12	0.00	8.6	-2.5	0.000	0.50

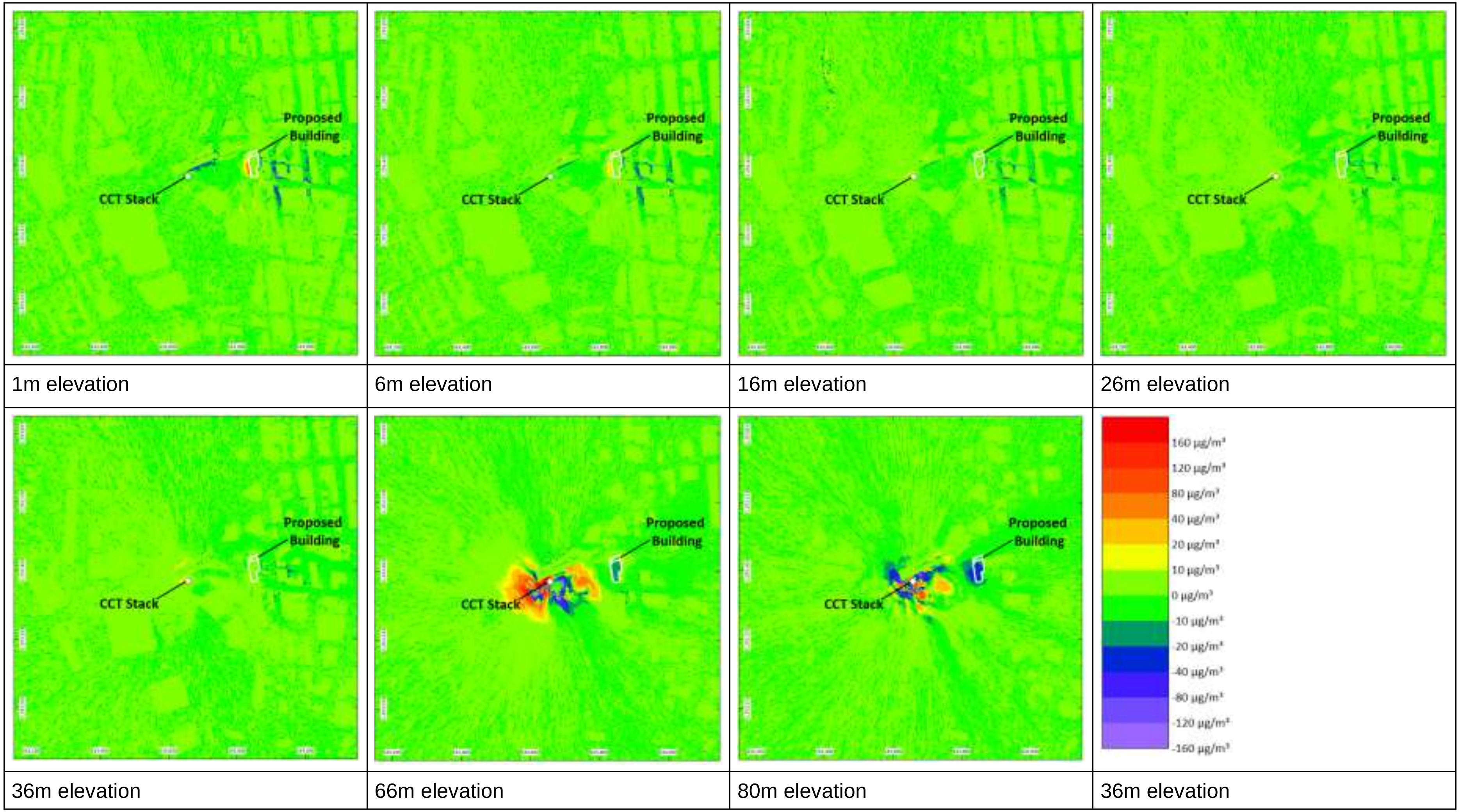
988

Figure 28 Predicted Incremental Annual Average NO_X Concentrations - Difference



686

Figure 29 Predicted Incremental 1 hour Average NOX Concentrations



7.0 Conclusions

The dispersion of NO_X from the CCT Stack was modelled using the GRAMM/GRAL model and a 1-year site-representative meteorological dataset. The modelling was undertaken for two scenarios (ie the existing scenario and a proposed scenario that included the proposed Project Building). The incremental NO_X concentrations predicted by the modelling for the proposed scenario were converted to NO_2 using background O_3 and NO_2 pollutant concentrations measured at the Cook and Phillip and the Rozelle AQMSs. The change in the incremental impacts predicted by the model for the two scenarios was analysed to assess the potential impact of the Project on the dispersion of pollutants for the CCT Stack.

The modelling undertaken for the purpose of this study conservatively assumed that the CCT Stack will constantly emit NO_X at the concentration limit specified by the CCT Conditions of Approval (NSW Department of Planning 2002). In reality, emissions from the CCT Stack are significantly lower (on average 5% of the limit), even during peak traffic conditions.

The results of the modelling showed that the predicted cumulative NO_2 concentrations at all elevations modelled along the proposed building facades are below the relevant air quality criteria. Therefore, people using the Project Building would not be adversely impacted by these emissions.

The comparison of the change in the incremental NO_X impacts predicted by the model for the existing and proposed scenarios showed that the proposed Project Building design would not significantly affect the dispersion of emissions from the CCT Stack.

Given the above, it is concluded that air quality issues do not pose a constraint for the Project.

8.0 References

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9.0 Feedback

At SLR, we are committed to delivering professional quality service to our clients. We are constantly looking for ways to improve the quality of our deliverables and our service to our clients. Client feedback is a valuable tool in helping us prioritise services and resources according to our client needs.

To achieve this, your feedback on the team's performance, deliverables and service are valuable and SLR welcome all feedback via https://www.slrconsulting.com/en/feedback. We recognise the value of your time and we will make a $10 donation to our Charity Partner - Lifeline, for every completed form.

Appendix A Selection of Meteorological Year

Air Quality Assessment

150 Day Street, Sydney

Mecone Group Pty Ltd

SLR Project No.: 610.032206.00001

21 March 2025

Once emitted to atmosphere, emissions will:

- Rise according to the momentum and buoyancy of the emission at the discharge point relative to the prevailing atmospheric conditions
- Be adverted from the source according to the strength and direction of the wind at the height which the plume has risen in the atmosphere
- Be diluted due to mixing with the ambient air, according to the intensity of turbulence
- (Potentially) be chemically transformed and/or depleted by deposition processes.

Dispersion is the combined effect of these processes.

Dispersion modelling is used as a tool to simulate the air quality effects of specific emission sources, given the meteorology typical for a local area together with the expected emissions. Selection of a year when the meteorological data is atypical means that the resultant predictions may not appropriately represent the most likely air quality impacts. Therefore, in dispersion modelling, one of the key considerations is the representative nature of the meteorological data used.

The year of meteorological data used for the dispersion modelling was selected by reviewing the most recent five years of historical surface observations at Sydney Airport AMO (2019 to 2023 inclusive) to determine the year that is most representative of average conditions. Wind direction, wind speed and ambient temperature were compared to averages for the region to determine the most representative year. Data collected from 2019 to 2023 is summarised in **Figure A1** to **Figure A4**. Examination of the data indicates the following:

- **Figure A1** indicates relatively similar wind roses for all years analysed, the years 2021 and 2023 has the highest frequency of winds from the western quadrant, with the year 2020 having the lowest.
- **Figure A2** indicates all years are relatively similar to long term, the year 2023 has the lowest frequency of months with wind speed above the five-average and 2022 has the highest frequency of months with wind speed above the five-average.
- **Figure A3** shows that the year 2020 had the highest frequency of months with calms conditions above the five-year average and 2023 had the lowest frequency of months with calms conditions above the five-year average (with no clams recorded for January).
- **Figure A4** shows that temperatures are relatively similar for all five years analysed.

The years 2019 and 2020 are eliminated for selection purposes due to the high number of bushfires during those years.

The year 2022 also has fewer winds from the northwestern quadrant so may under attribute impacts from the stack.

The year 2021 and 2023 are ultimately considered. Calms frequency in both years are both below to the five-year average which may underpredict impacts in calms conditions. The year 2021 had higher frequency of months with wind speed above the five-average which may increase dispersion.

Therefore, the year 2023 was selected for use in meteorological/dispersion modelling.

Figure A1 Frequency of Winds at Sydney Airport AMO for 2019 to 2023

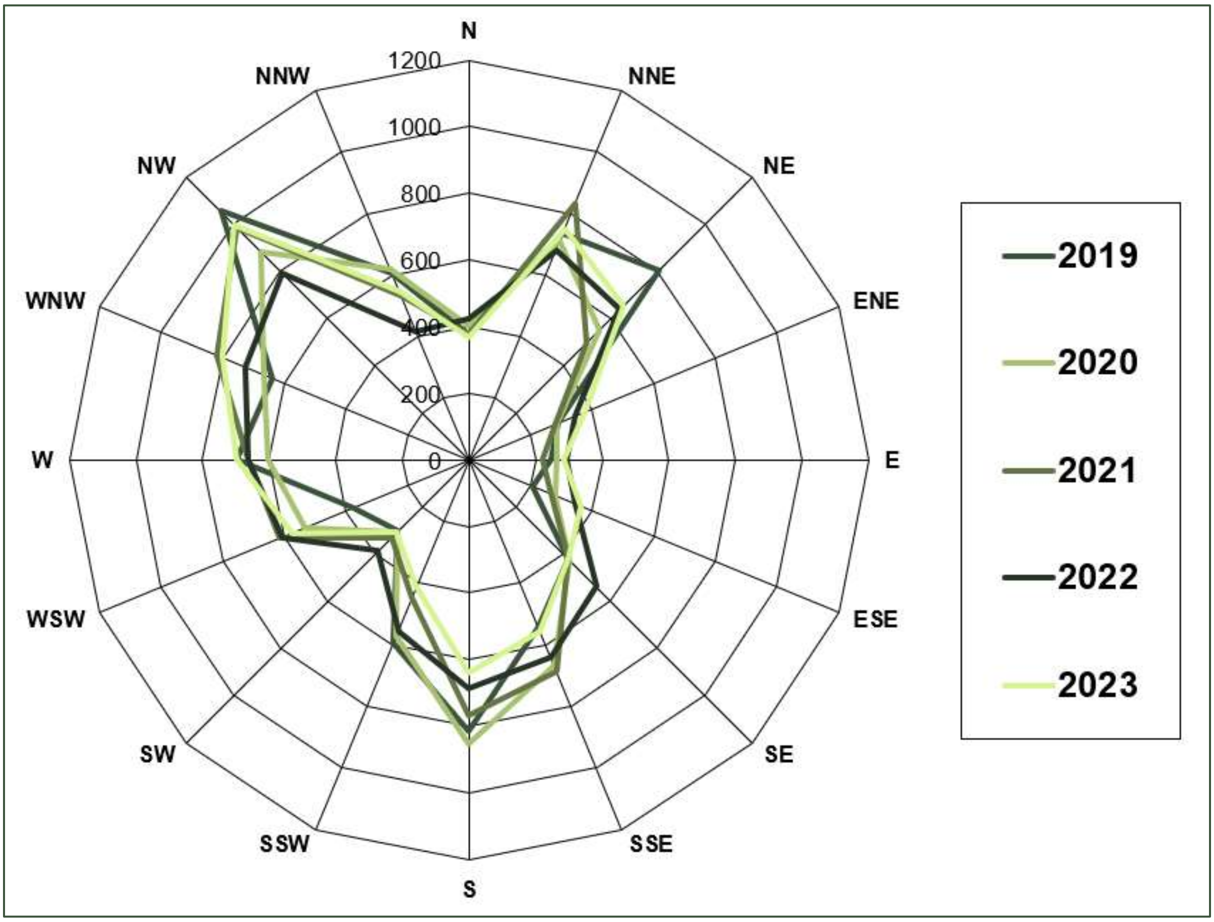


Figure A2 Monthly Average Wind Speed at Sydney Airport AMO for 2019 to 2023

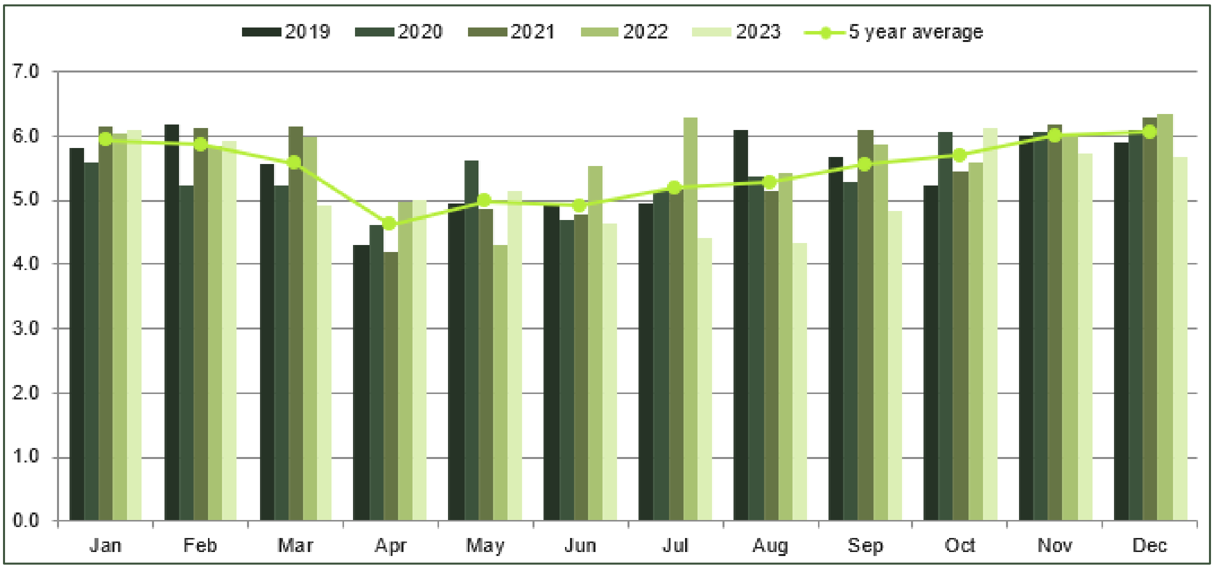


Figure A3 Monthly Calms Frequency at Sydney Airport AMO for 2019 – 2023

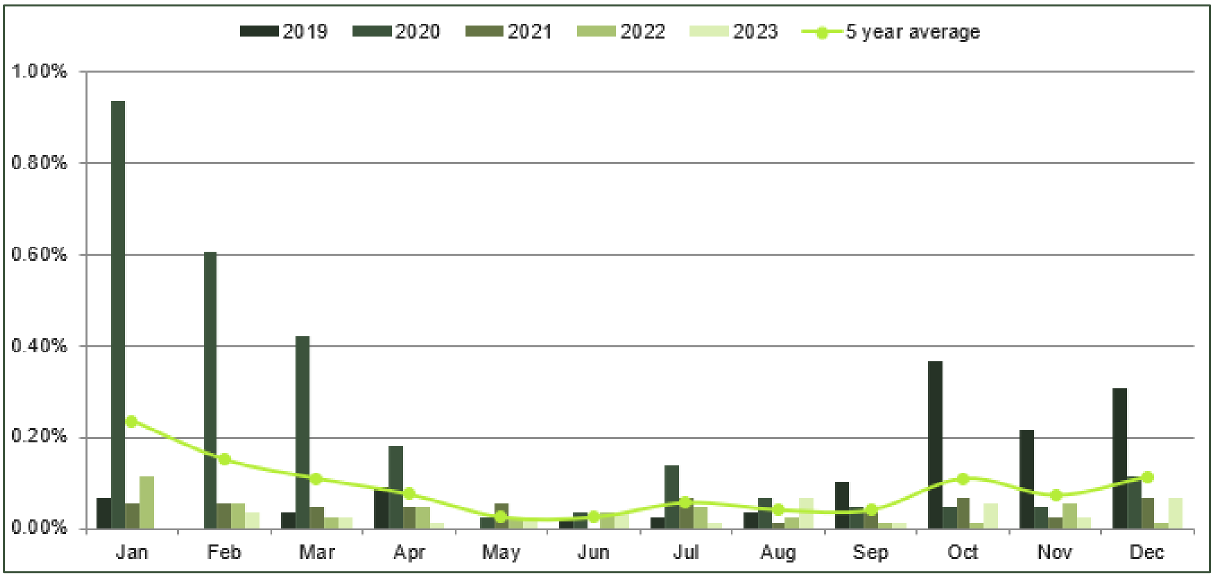
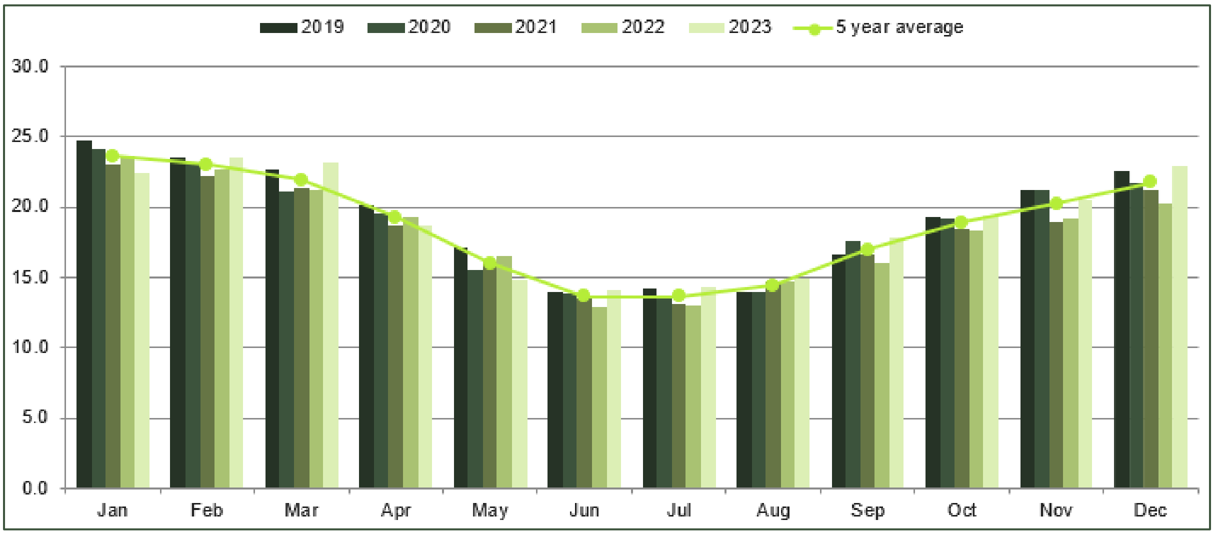


Figure A4 Monthly Average Temperature at Sydney Airport AMO for 2019 – 2023



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