SYDNEY HELICOPTERS

Castlereagh Relocation
Air Quality Impact Assessment

Prepared for:

Colliers International Project Management Pty Ltd
Level 30, 225 George Street
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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Colliers International Project Management 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.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30555-R01-v1.1	21 September 2021	Johan Meline	Jason Shepherd	Johan Meline
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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) was engaged by Sydney Helicopters on behalf of Colliers International Project Management Pty Ltd to undertake an air quality impact assessment of Sydney Helicopters operations at the new facility location at 89 – 151 Old Castlereagh Road, Castlereagh (the Project).

Sydney Helicopters were informed on 21 October 2019 that their current facility site was being acquired by Transport NSW. The NSW Government has advised that they will require possession of the site by mid-2021 and are committed to supporting the relocation of the entire operation to a comparable replacement site.

This report summarises the potential construction and operational air quality impacts associated with the Project and has been prepared to accompany the development application for the relocation of the Sydney Helicopter operations to Castlereagh.

1.1 Approach to Assessment

The operations at the Sydney Helicopter facility at the new facility location are expected to be similar to the old location in Clyde. Considering the relatively small scale of the helipad operations and the siteworks required to establish the new facility a quantitative dispersion modelling assessment of the helicopter operation air emissions and potential air emissions associated with the construction activities impacts are expected to be of limited value especially in relation to identification of air quality control measures to actively manage air quality risk associated with the operations.

SLR has therefore performed a qualitative risk-based assessment of the air emissions from the construction and operations to assess the potential for off-site air quality impacts, so that appropriate mitigation measures can be identified and incorporated into the project design and any relevant environmental management plans.

Based on SLR's experience, provided effective mitigation is adopted, the residual air quality impact will be insignificant for almost all construction activities. The adopted qualitative approach permits mitigation measures appropriate to the level of risk associated with individual activities to be recommended and is therefore deemed to be a more meaningful assessment methodology than quantitative modelling.

1.1.1 Assessment of Impacts from Construction

For the assessment of construction phase impacts, the IAQM *"Guidance on the Assessment of Dust from Demolition and Construction",* developed in the United Kingdom by the Institute of Air Quality Management (IAQM, 2014) has been used to provide a qualitative assessment method (see **Appendix A** for full methodology). The IAQM method uses a four-step process for assessing potential dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.
- **Step 2**: Assess risk of dust effects from activities based on:
  - the scale and nature of the works, which determines the potential dust emission magnitude; and
  - the sensitivity of the area surrounding dust-generating activities.
- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- **Step 4**: Assess significance of remaining activities after management measures have been considered.

As noted in **Section 2.4** there is no sensitive receptor within 350 m from the boundary of the Site, or within 500 m from the Site entrance (by distance of road). Hence no further assessment is required by the IAQM method.

The risks in relation to air quality impacts on sensitive receptors from the site constructions is considered negligible. However, common practices for dust management should be applied.

1.1.2 Assessment of Impacts from Operations

The risk-based operational assessment methodology takes a range of impact descriptors into account, including the following:

- **Nature of Impact**: Does the impact result in an adverse or beneficial environment?
- **Sensitivity**: How sensitive is the receiving environment to the anticipated impacts? This may be applied to the sensitivity of the environment in a regional context or specific receptor locations.
- **Magnitude**: What is the anticipated scale of the impact?

The combination of sensitivity and impact magnitude is used to derive the predicted significance of that change. Given the nature of the operations proposed, it is considered that this approach is appropriate to identify the key activities that have the potential to give rise to off-site air quality impacts, in order that recommended mitigation measures may be identified.

Nature of Impact

Predicted impacts may be described in terms of the overall effect upon the environment:

- **Beneficial**: The predicted impact will cause a beneficial effect on the receiving environment.
- **Neutral**: The predicted impact will cause neither a beneficial nor adverse effect.
- **Adverse**: The predicted impact will cause an adverse effect on the receiving environment.

Receptor Sensitivity

Sensitivity may vary with the anticipated impact or effect. A receptor may be identified as having different sensitivity to different environmental changes, for instance, a high sensitivity to changes in air quality, but low sensitivity to noise impacts. Sensitivity may also be derived from statutory designation which is designed to protect the receptor from such impacts.

Sensitivity terminology may vary depending upon the environmental effect, but generally this may be described in accordance with the following broad categories - *Very high*, *High*, *Medium* and *Low*. **Table 1** outlines the methodology used in this study to define the sensitivity of receptors to air quality impacts.

Table 1 Methodology for Assessing Sensitivity of a Receptor

Sensitivity	Criteria
Very High	Receptors of very high sensitivity to air pollution (e.g. dust or odour) such as: hospitals and clinics, and retirement homes.
High	Receptors of high sensitivity to air pollution, such as: schools, residential areas, food retailers, glasshouses and nurseries.

Sensitivity	Criteria
Medium	Receptors of medium sensitivity to air pollution, such as: farms / horticultural land, offices/recreational areas, painting and furnishing, hi-tech industries and food processing, and outdoor storage (i.e. new cars).
Low	All other air quality sensitive receptors not identified above, such as light and heavy industry.

Magnitude

Magnitude describes the anticipated scale of the anticipated environmental change in terms of how that impact may cause a change to baseline conditions. Magnitude may be described quantitatively or qualitatively. Where an impact is defined by qualitative assessment, suitable justification is provided in the text. Magnitude terminology may be generally described in accordance with the following broad categories - *Substantial*, *Moderate*, *Slight* and *Negligible*. **Table 2** outlines the methodology used in this study to define the magnitude of impacts.

Table 2 Magnitude of Impacts

Magnitude	Description
Substantial	Impact is predicted to cause significant consequences on the receiving environment (may be adverse or beneficial)
Moderate	Impact is predicted to possibly cause statutory objectives/standards to be exceeded (may be adverse)
Slight	Predicted impact may be tolerated.
Negligible	Impact is predicted to cause no significant consequences.

Significance

The risk-based matrix provided below illustrates how the definition of the sensitivity and magnitude are combined to produce impact significance. **Table 3** outlines the methodology used in this study to estimate the significance of impacts.

Table 3 Impact Significance Matrix Magnitude of Impacts

Sensitivity \ Magnitude		[Defined by Table 2]			
		Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
[Defined by Table 1]	Very High Sensitivity	Major Significance	Major/ Intermediate Significance	Intermediate Significance	Neutral Significance
	High Sensitivity	Major/ Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
	Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
	Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

As part of the qualitative risk-based approach adopted for the operational phase air quality assessment, published separation distances have been reviewed to evaluate the potential risk of conflicting land uses. Where separation distance guidelines are published, the separation distances are typically used as a screening tool to identify if a detailed quantitative assessment is required. As such, guideline separation distances are typically based on quantitative modelling studies, history of complaints, air quality monitoring data and EPA experience and are considered to be conservative in nature.

As there are no separation guidelines issued by NSW EPA, guidelines set by other regulatory agencies in Australia were considered.

2 Project Description and Settings

2.1 Construction Activities and Helipad Operations

The extent of the construction activities required for the development is minor since the existing buildings at the site will be utilised. Only minor construction works are proposed including minor modifications to the existing warehouse, some refurbishment of the existing hardstand and removal of two sheds.

Sydney Helicopters operations are expected to continue unchanged from current intensity following the relocation. A summary of the proposed facility operations include:

- Hours of operation between 06:00 to 22:00 with the majority of the flying occurring between 07:30 to 18:00.
- A maximum of 25 flights per day.
- Flight paths as agreed to the west and east avoiding the regatta centre and the Richmond Military airspace to the north of the site.
- Fuel storage of Jet A1 in a double skin bulk full tank in accordance with Australian Standards.
- Estimated annual fuel consumption for the operations is 250,000 L.

2.2 Site Location and Layout

The location of the Project, just south of the Penrith Lakes, and the site layout, are presented below in **Figure 1** and **Figure 2**, respectively.

Figure 1 Project Location

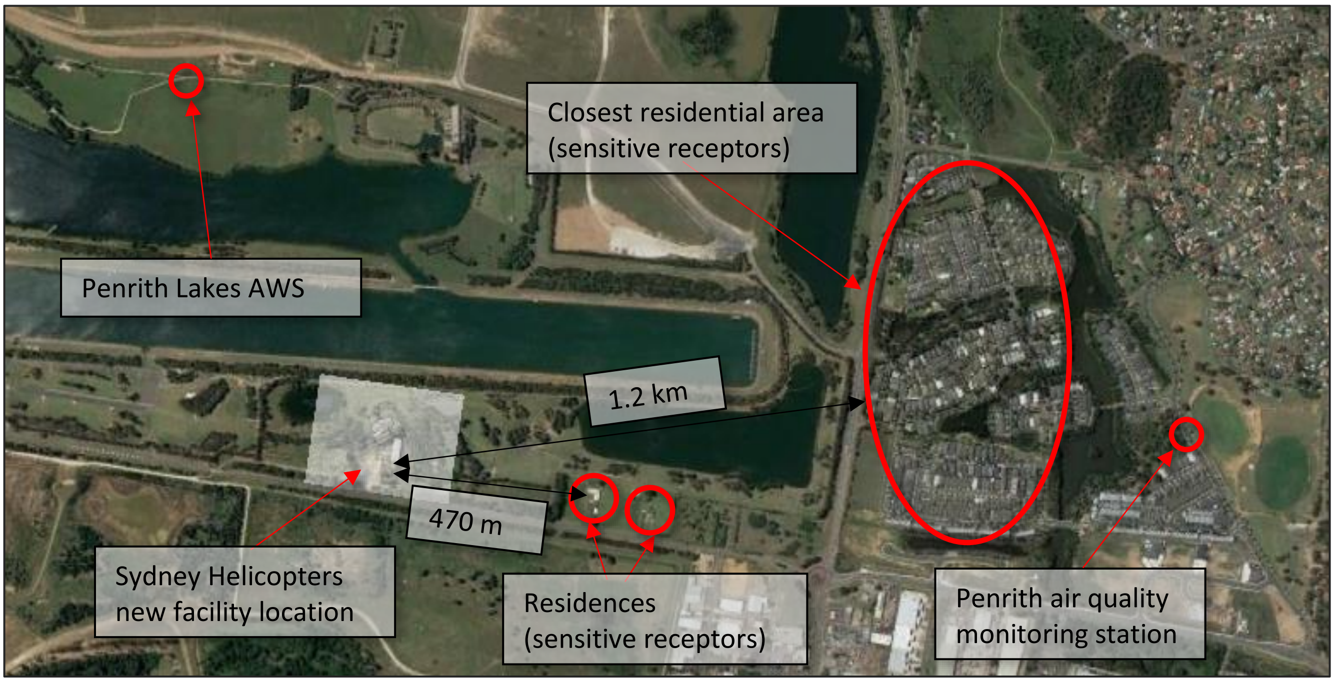
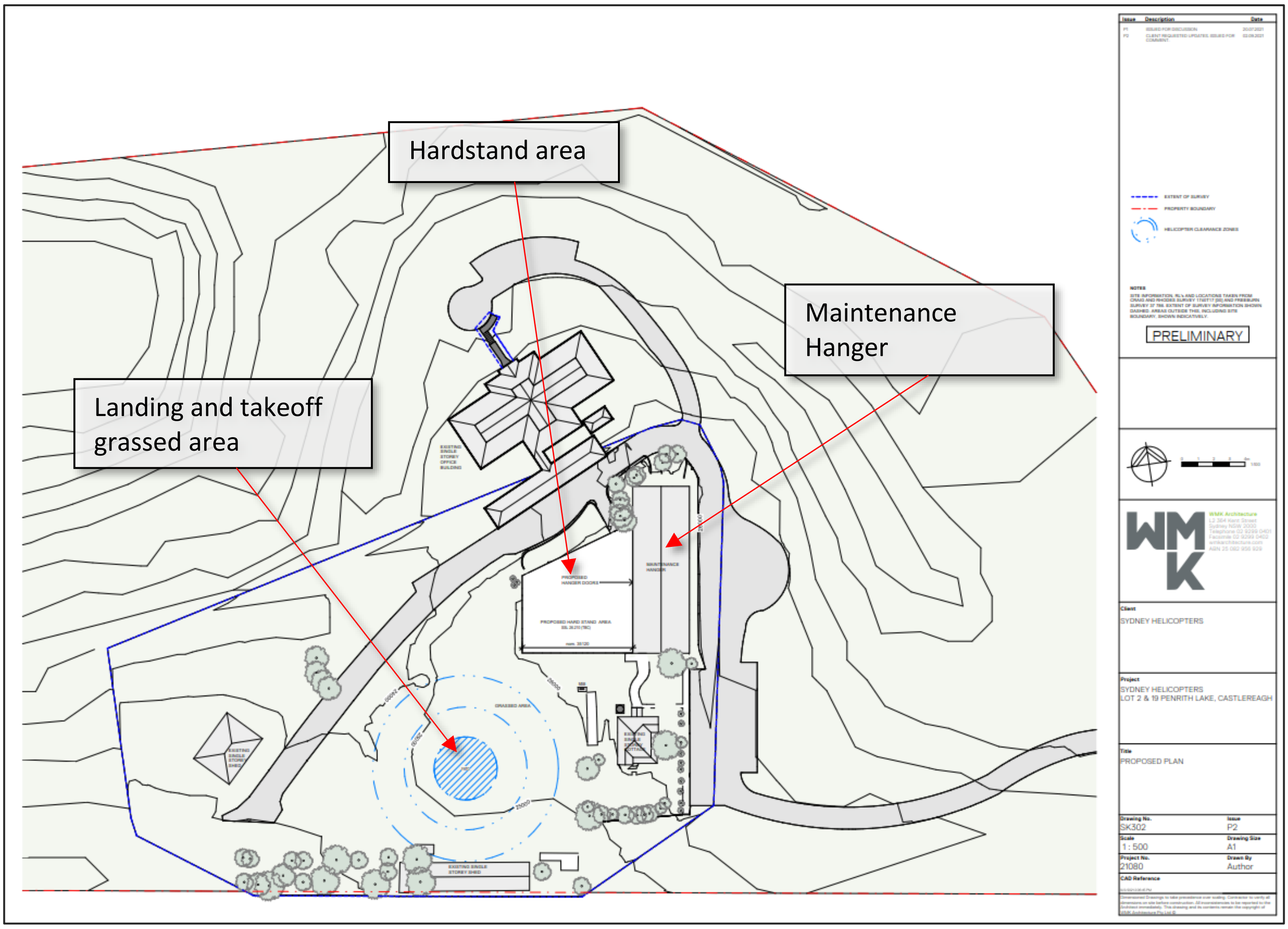


Figure 2 Project Layout



2.3 Project Air Emissions

During operations, air emissions may arise from:

- Emissions of products of combustion from the helicopters during take-off and landing and while idling.
- Emissions of products of combustion from any additional road traffic associated with Sydney Helicopter operations – expected to be low level and therefore not considered further in the assessment.
- Low level of odour emissions associated with the helicopter exhaust emissions, as well as vapours from the handling of fuels – not expected to be noticeable beyond the site boundary or at nearest receptors and therefore not considered further in the assessment.
- Wind-blown dust from unsealed helicopter landing areas will be minimal at the Project site since the landing and take-off area is proposed to be grassed.

Emissions from the helicopter operations have been estimated below based on published emission factors for helicopter engines, presented in the "*Guidance on the Determination of Helicopter Emissions"* from the Federal Office of Civil Aviation in the Swiss Confederation (FOCA, 2015). These emission factors were derived from engine test results and subsequent engine performance modelling for three categories of helicopters including piston engine powered, single and twin turboshaft powered helicopters. As the majority of civil helicopters are single engine or turboshaft powered models, the emission factors for these categories have been used to estimate hourly and daily air pollutant emission rates.

The duration of an LTO cycle for these types of helicopters is reported by (FOCA, 2015) to be:

- Approach (AP) = 5.5 minutes (46% engine power)
- Ground-idle (GI) = 5 minutes (13% engine power)
- Hover and take-off (TO) = 3 minutes (87% engine power)

A summary of the maximum, minimum and average emission factors reported by FOCA (2015) for 34 different models of single engine and turboshaft powered helicopters is provided in **Table 4**.

Table 4 Summary of LTO Emission Factors for Single Engine, Turboshaft Helicopters

	Fuel Consumption (kg/LTO)	NOx (g/LTO)	VOCs (g/LTO)	CO (g/LTO)	PM (g/LTO)
Minimum	16.4	59.9	209.9	261.3	2.3
Maximum	43.4	391.4	445.7	582.0	11.1
Average	**22.9**	**128.3**	**318.1**	**408.7**	**4.2**

Daily and hourly emission rates are presented in **Table 5** below. The daily emissions are calculated based on the maximum expected number of flights per day (25 landing/take-off (LTO) cycles). The hourly emissions are estimated as an hourly average based on the maximum number of flights per day (25 flights) during the hours when most flights occur between 7:30 to 18:00 (10.5 hours).

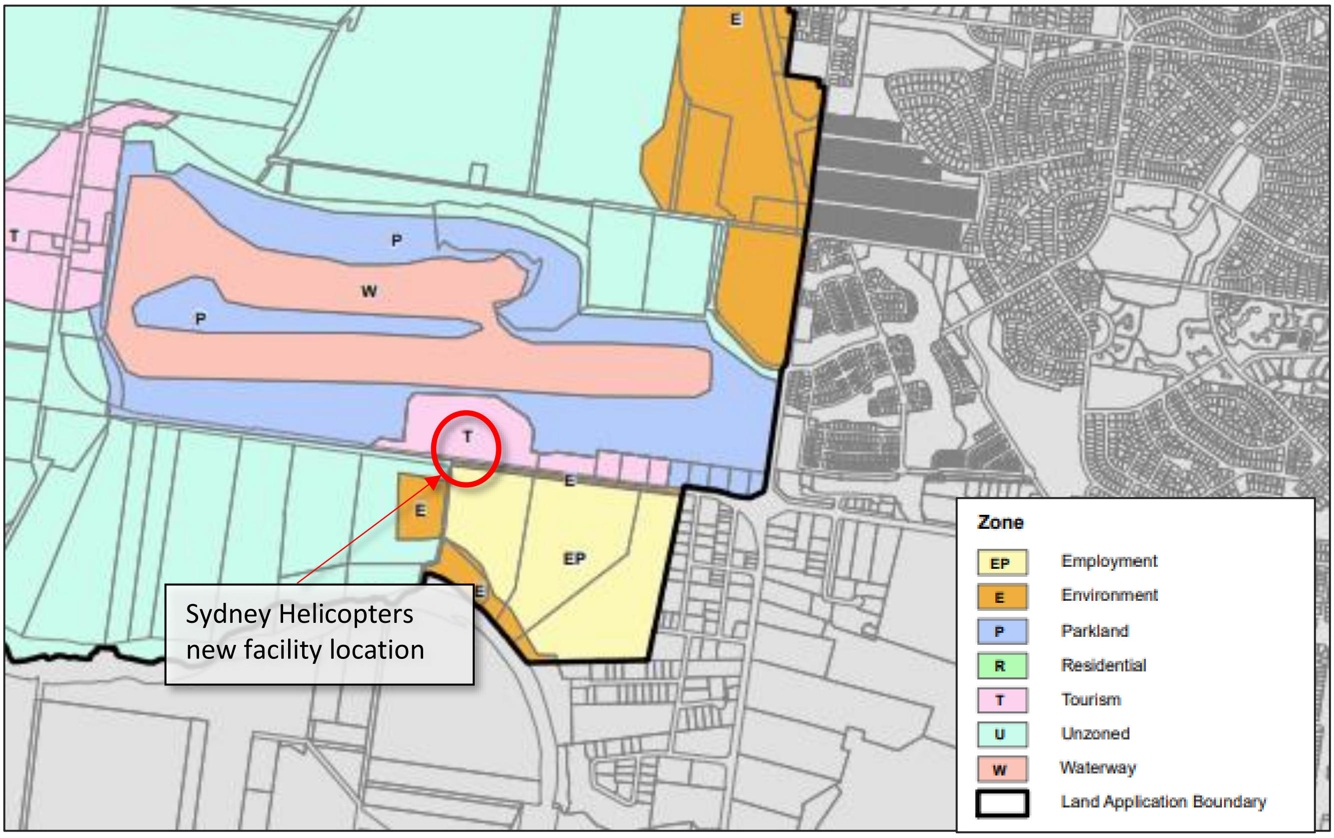
Table 5 Summary of Estimated Emissions from Helicopter Movements

	Units	NOx	VOCs	CO	PM
Hourly emissions	kg/hour	0.31	0.76	0.97	0.01
Daily emissions	kg/day	3.21	7.95	10.2	0.11

2.4 Sensitive Receptors

The details on the zoning for the Project (Tourism) and surrounding area is provided in **Figure 3**.There are two residences to the east of the proposed facility location on Old Castlereagh Road at distances of 470 m and 600 m. These are located in the newly created Tourism zone and it is not clear if these houses will remain as residences and/or sensitive receptors long term. Apart from these, the closest sensitive receptors are located in the residential area approximately 1.2 km to the east as shown in **Figure 1**.

Figure 3 Zoning



Source: State Environmental Planning Policy (Penrith Lakes Scheme) 1989

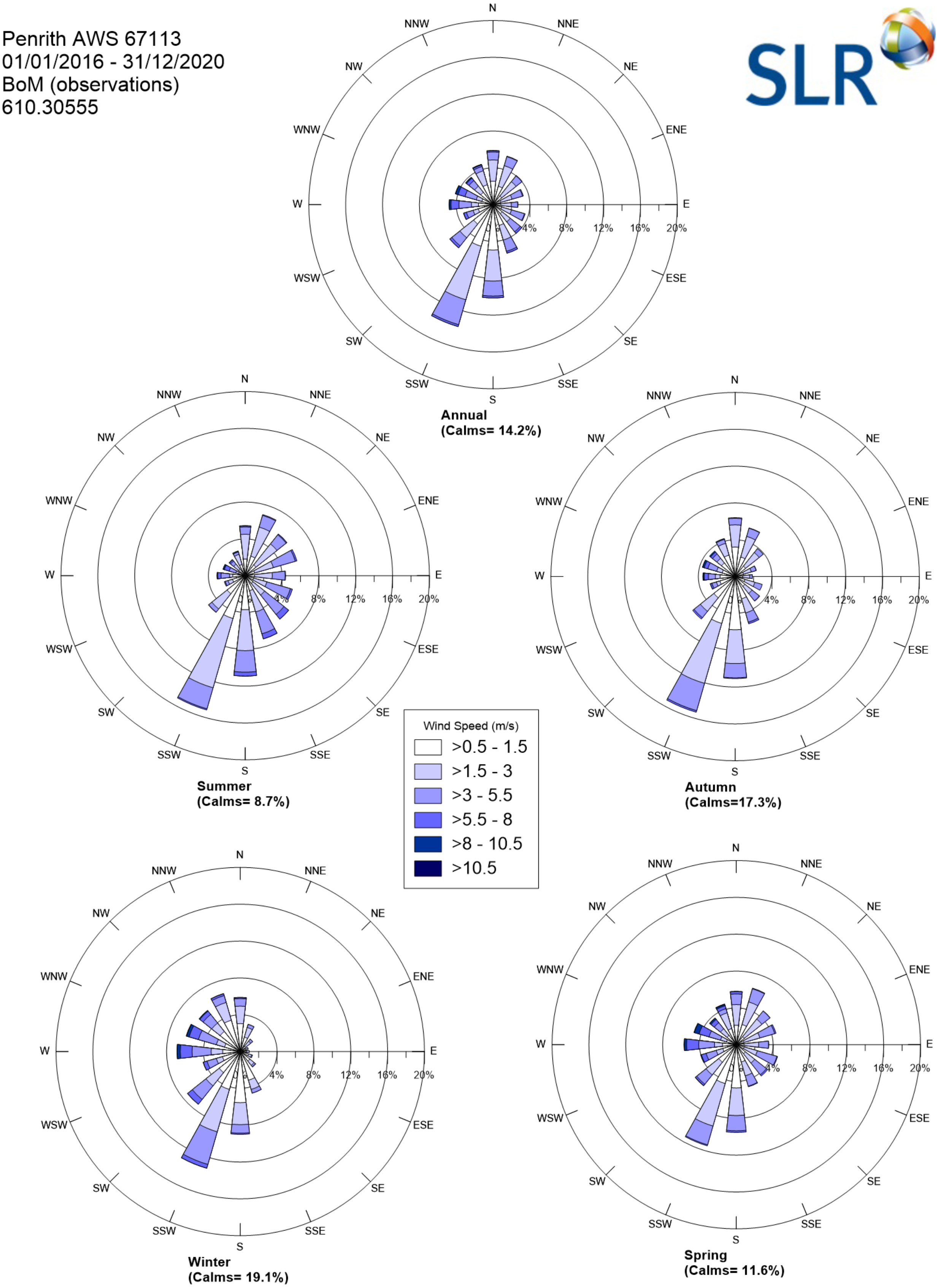
2.5 Local Topography

The land surrounding the Project and the greater Penrith Lakes areas is flat and does not contain any terrain features that may exacerbate air quality impacts from any air emissions in the area.

2.6 Local Meteorology

Wind data from the Bureau of Meteorology Penrith Lakes Automatic Weather Station located less than 1 km to the northwest (as show in **Figure 1**) for the years 2016 to 2020 are presented in **Figure 4** below showing that the prevailing wind directions are south-southwesterly to southerly. With a relatively low frequency of westerly and west-southwesterly winds, there is less potential for exposure of the nearest sensitive receptors to the east of the Project.

Figure 4 Wind roses Penrith Lakes AWS 2016-2020



2.7 Other Local Emission Sources

A review of location of industries reporting to the National Pollution Inventory (NPI, 2021) within a 2 km radius of the proposed facility location shows that a couple of larger scale industries operate in the area. Most significant of these in relation to the type of Project emissions, being fuel combustion related, is the Owens Illinois Sydney glass plant approximately 1.6 km to the west southwest from the proposed facility location.

However, with the Penrith AQMS being located approximately 600 to 800 m north from the glass plant and with south-southwesterly to southerly prevailing winds in the area it is expected that the local air quality and contribution from the glass plant is reasonably captured in the local air quality monitoring data, discussed below.

2.8 Local Ambient Air Quality

Air quality monitoring data for the two closest most relevant ambient air quality monitoring stations (AQMS), Penrith and Richmond, are presented below.

2.8.1 Penrith AQMS

The closet air AQMS in the NSW air quality monitoring network to the Project is the Penrith AQMS approximately 1.9 km to the west at the corner of Laycock Street and Shellbourne Place in Cranebrook. The Penrith AQMS was commissioned in June 2020 and is described as residential/commercial.

Air quality data recorded by the Penrith AQMS were obtained for the period 1 July 2020 – 1 July 2021. The data are summarised in **Table 6** (red font/shading indicates an exceedance of the relevant criterion), and are presented graphically in **Figure 5** to **Figure 9.**

To be consistent with the annual NSW compliance monitoring reports, the data for gaseous pollutants are presented in parts per hundred million (pphm) or parts per million (ppm), rather than µg/m^3 and mg/m^3.

A review of the Penrith AQMS data shows one exceedance of the 24-hour average PM_{10} and two exceedances of the 24-hour average $PM_{2.5}$ criteria.

Ambient concentrations of the gaseous pollutants CO, NO_2, SO_2 were all well below the relevant criteria.

Table 6 Summary of Penrith AQMS Data (July 2020 – July 2021)

Period	CO	NO_2		SO_2		PM_{10}		$PM_{2.5}$	
	Maximum 1-hour	Maximum 1-hour	Annual	Maximum 1-hour	Annual	Maximum 24-hour	Annual	Maximum 24-hour	Annual
	ppm	pphm	pphm	pphm	pphm	µg/m^3	µg/m^3	µg/m^3	µg/m^3
July 2020 to July 2021	1.1	3.2	0.5	1.0	0.05	73.5	16.5	72.5	7.9
Criterion	**25**	**12**	**3**	**20**	**2**	**50**	**25**	**25**	**8**

Notes:

1 For the period July 20- Jul 21, one (1) exceedance of the 24-hour average PM_{10} and two (2) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

Figure 5 1-Hour Average Ambient CO Concentrations - Penrith AQMS (July 2020 – July 2021)

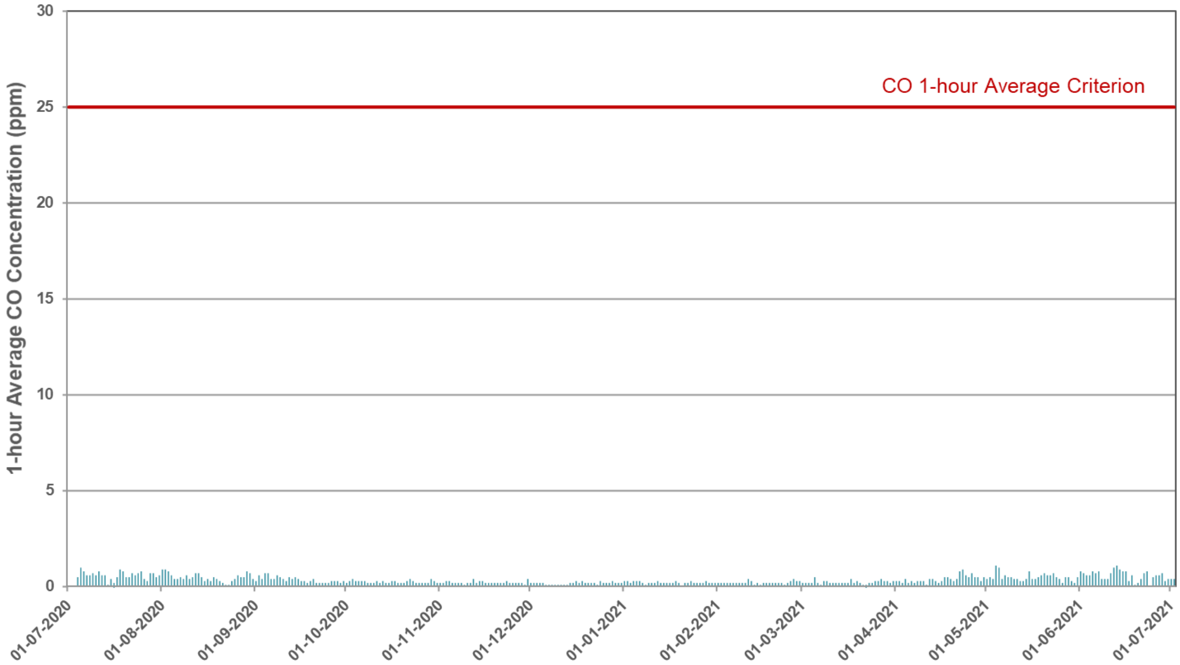


Figure 6 1-Hour Average Ambient NO_2 Concentrations - Penrith AQMS (July 2020 – July 2021)

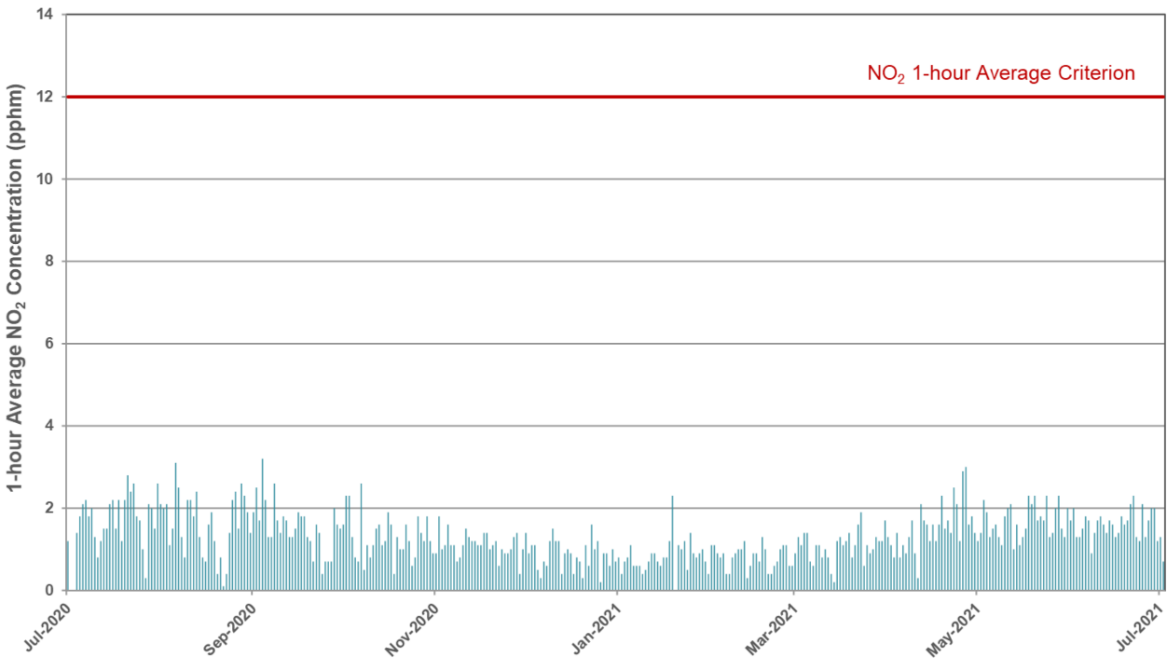


Figure 7 Ambient 1-Hour Average SO_2 Concentrations - Penrith AQMS (July 2020 – July 2021)

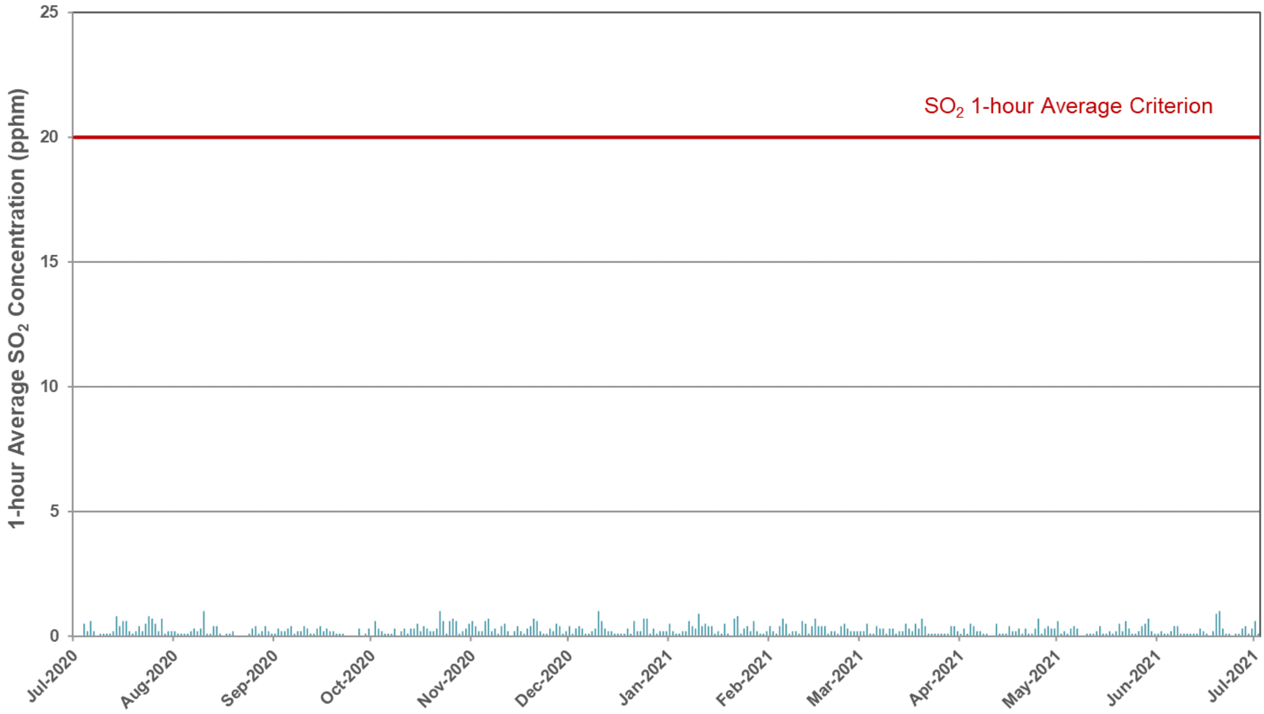


Figure 8 24-Hour Average Ambient PM_{10} Concentrations - Penrith AQMS (July 2020 – July 2021)

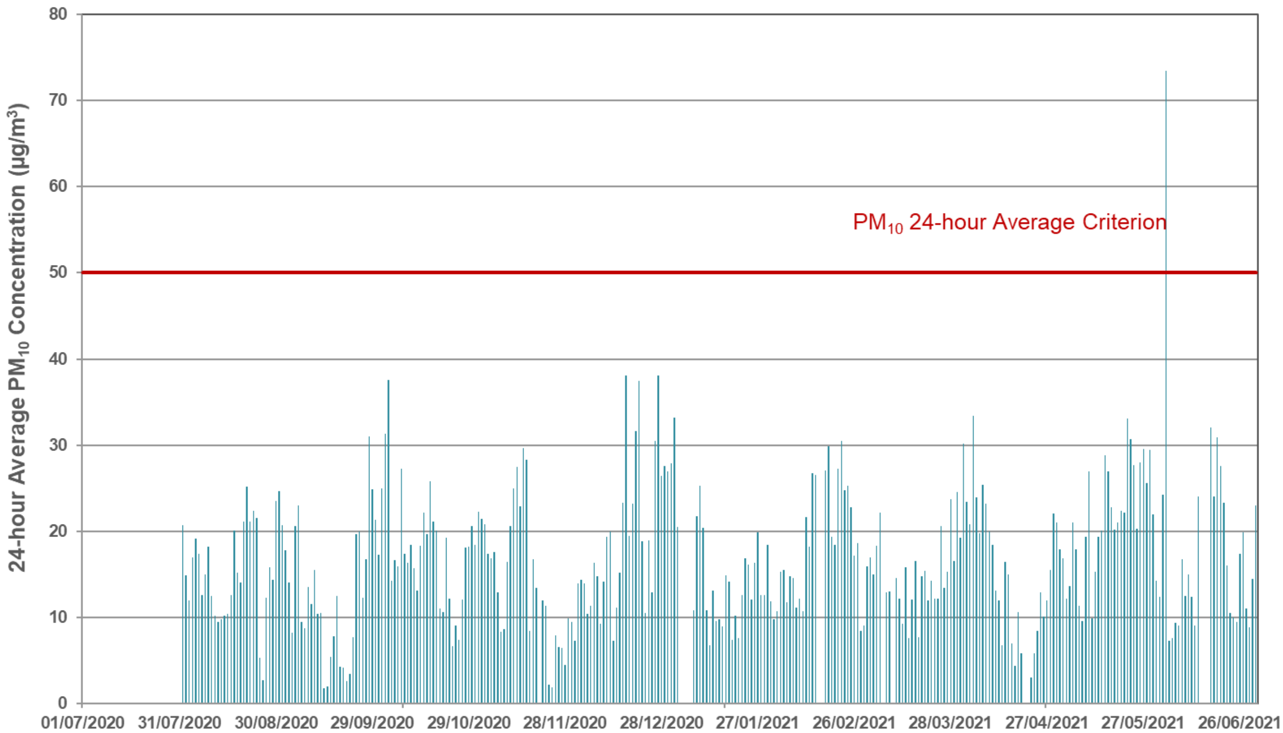
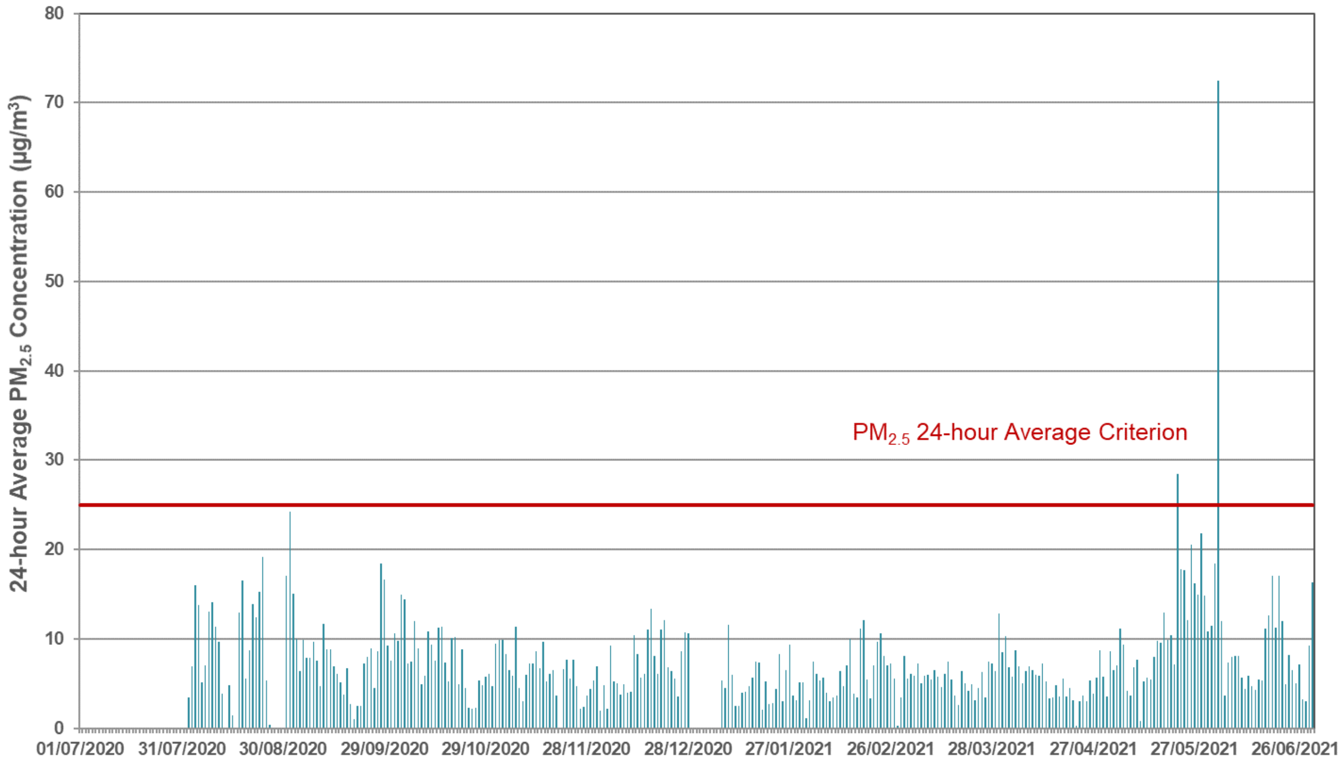


Figure 9 24-Hour Average Ambient $PM_{2.5}$ Concentrations - Penrith AQMS (July 2020 – July 2021)



2.8.2 Richmond AQMS

The next closest AQMS to the Project in the NSW air quality monitoring network is the Richmond AQMS approximately 9 km to the northeast at University of Western Sydney Hawkesbury Campus. The Richmond AQMS was commissioned in May 1992 and is described as residential/semi-rural.

Air quality data recorded by the Richmond AQMS were obtained for the calendar period 2016 to 2020. The data are summarised in **Table 7** (red font/shading indicates an exceedance of the relevant criterion), and are presented graphically in **Figure 10** to **Figure 13**. Again, to be consistent with the annual NSW compliance monitoring reports, the data for gaseous pollutants are presented in parts per hundred million (pphm) or parts per million (ppm), rather than µg/m³ and mg/m³.

A review of the Richmond AQMS data shows that exceedances of the 24-hour average PM_{10} and $PM_{2.5}$ criteria were recorded by the Richmond AQMS in all five years. The high number of exceedances recorded by the Richmond AQMS in late 2019 and early 2020 was due to the bushfire smoke that affected Sydney and the surrounding areas for a number of weeks over this period.

Exceedances of the annual average $PM_{2.5}$ criterion were also recorded by the Richmond AQMS in the years 2018, 2019 and 2020. Ambient $PM_{2.5}$ concentrations often exceed the annual average criteria set out in the Approved Methods across the Sydney Greater Metropolitan Area. The annual average PM_{10} criterion was not exceeded in the data period.

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

Table 7 Summary of Richmond AQMS Data (2016 - 2020)

Period	NO_2		SO_2		PM_{10}		$PM_{2.5}$	
	Maximum 1-hour	Annual	Maximum 1-hour	Annual	Maximum 24-hour	Annual	Maximum 24-hour	Annual
	pphm	pphm	pphm	pphm	µg/m³	µg/m³	µg/m³	µg/m³
2016	3	0.4	2.5	0.03	102.8	16.0	83.4	7.9
2017	2.6	0.5	3.4	0.03	51.5	16.0	34.3	7.0
2018	3	0.5	1.7	0.04	116.3	18.7	123.9	8.1
2019	3	0.5	2.3	0.04	193.4	24.2	141.2	13.1
2020	3.5	0.3	2.6	0.03	237.7	17.0	93	8.4
Criterion	**12**	**3**	**20**	**2**	**50**	**25**	**25**	**8**

Notes:

1 For the 2016, two (2) exceedances of the 24-hour average PM_{10} and six (6) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

2 For the 2017, one (1) exceedance of the 24-hour average PM_{10} and three (3) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

3 For the 2018, eight (8) exceedances of the 24-hour average PM_{10} and four (4) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

4 For the 2019, twenty-eight (28) exceedances of the 24-hour average PM_{10} and thirty-two (32) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

5 For the 2020, nine (9) exceedances of the 24-hour average PM_{10} and nine (9) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

Figure 10 1-Hour Average Ambient NO_2 Concentrations - Richmond AQMS (2016– 2020)

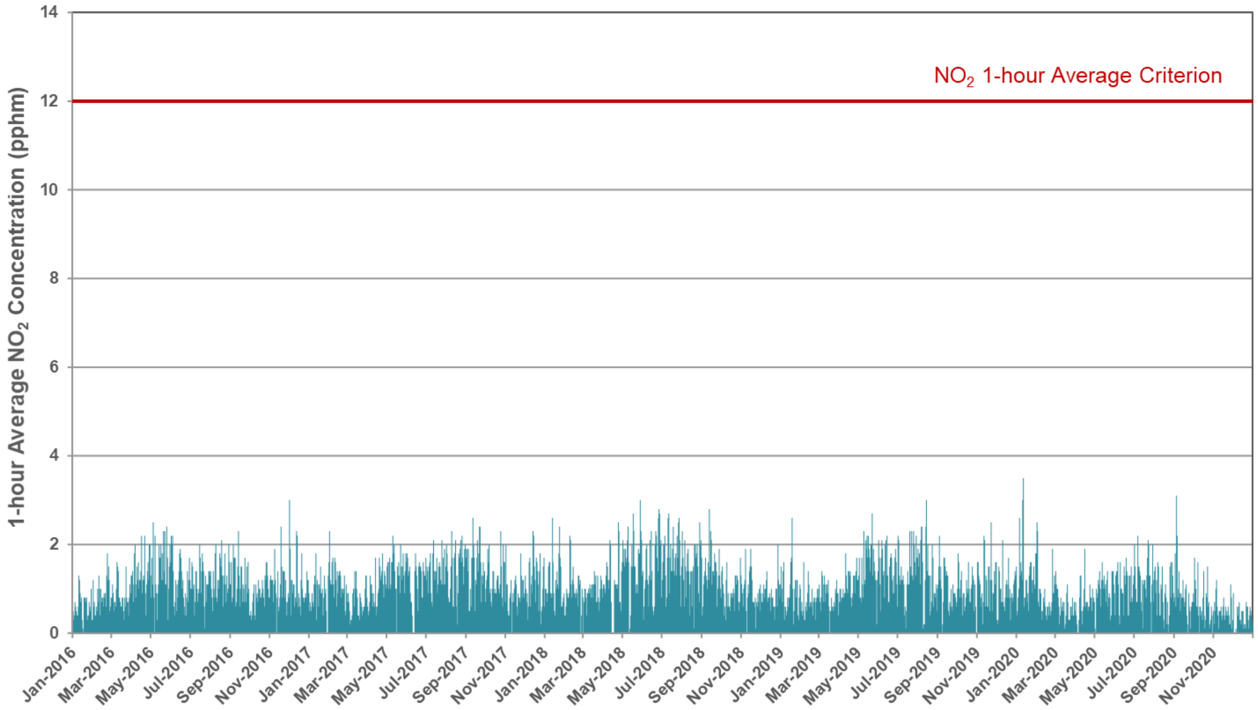


Figure 11 Ambient 1-Hour Average SO_2 Concentrations - Richmond AQMS (2016– 2020)

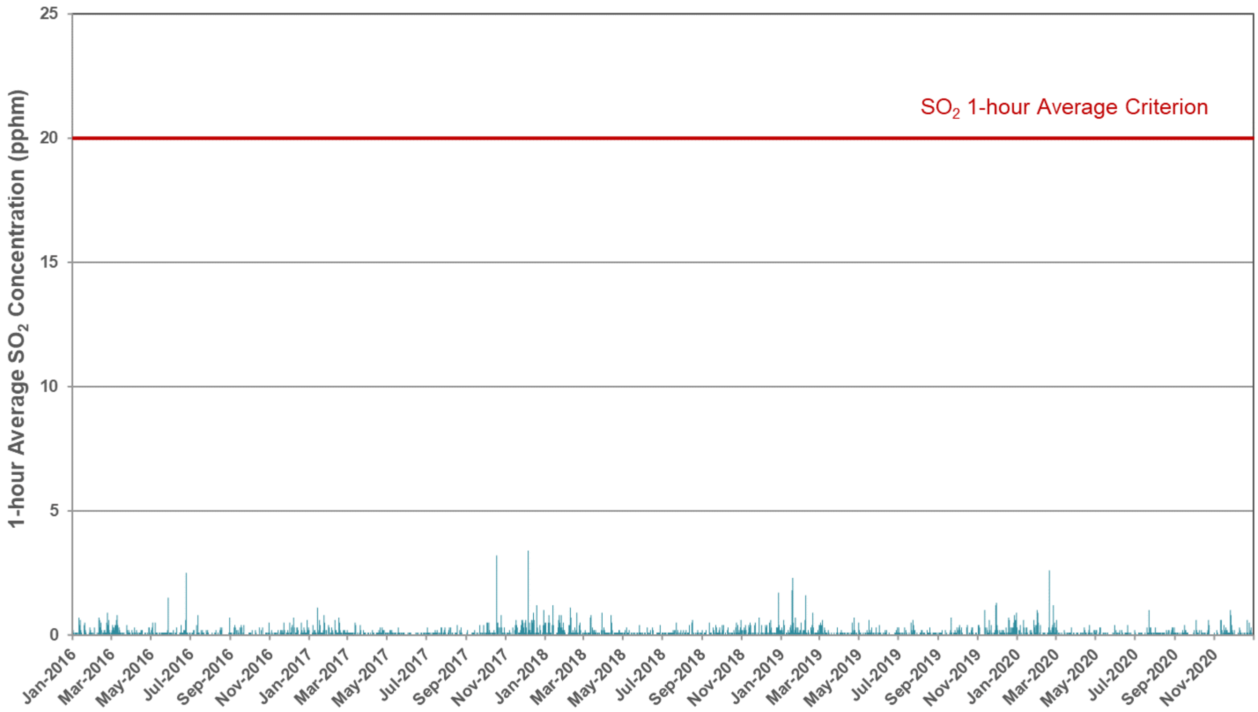


Figure 12 24-Hour Average Ambient PM_{10} Concentrations - Richmond AQMS (2016– 2020)

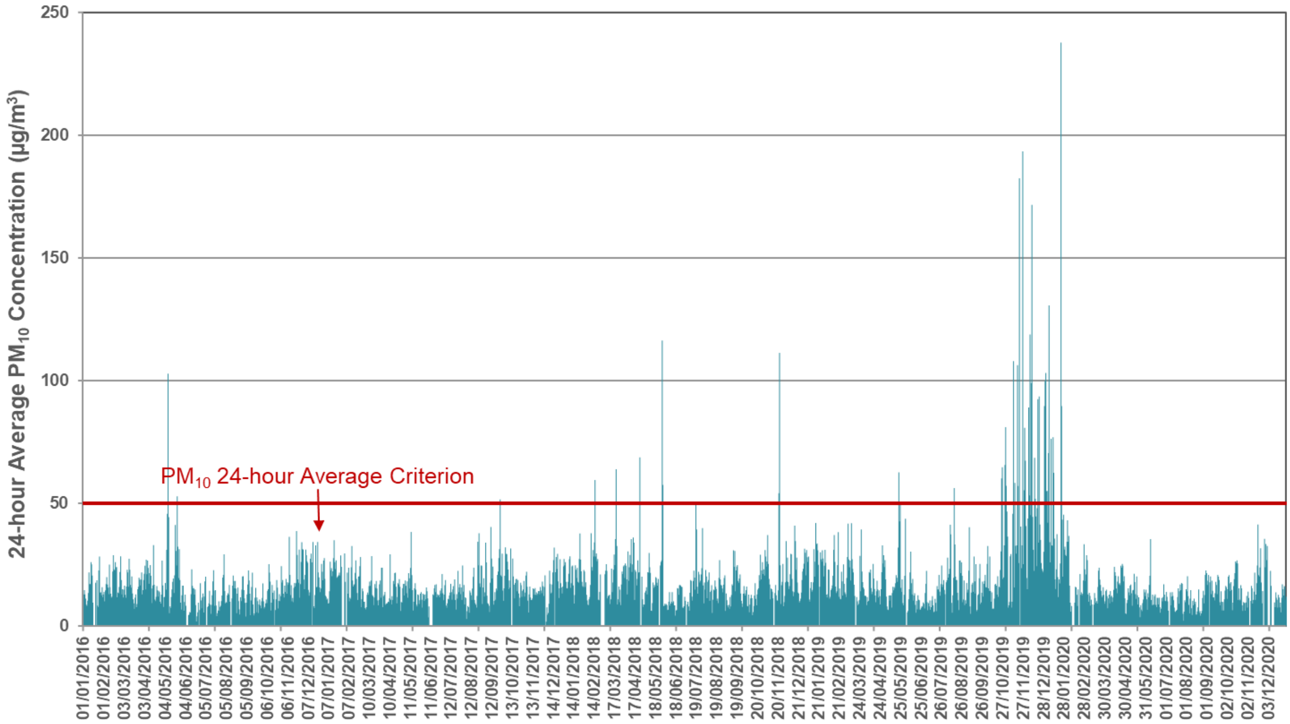
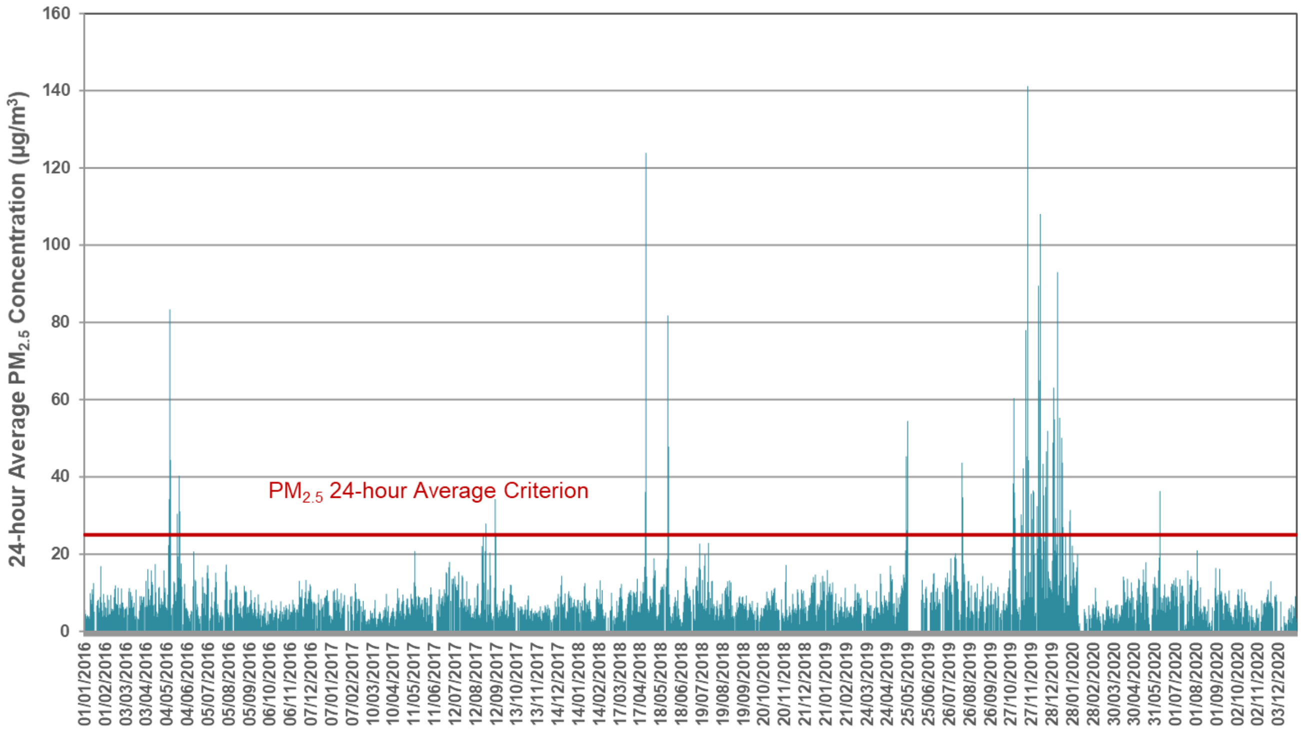


Figure 13 24-Hour Average Ambient $PM_{2.5}$ Concentrations - Richmond AQMS (2016– 2020)



3 Regulatory Framework

3.1 Secretary's Environmental Assessment Requirements

The Planning Secretary's Environmental Assessment Requirements (SEARs) relating to air quality issues for the project are as follows:

- *A description of potential impacts on the environment and aircraft operations. Sources include dust created by aircraft movements.*
- *An air quality impact assessment in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2016.*

The NSW Environmental Protect Agency has also provided the following guidance for the project:

The EIS for the proposal should include an Air Quality Impact Assessment (AQIA), prepared in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2016. The AQIA at a minimum should include:

- *Sources of all potential air emissions from the site, during construction and operation.*
- *Identification of sensitive receivers potentially impacted by air emissions during construction and operation.*
- *Assessment of potential impacts on identified sensitive receivers.*
- *Details of air quality management and monitoring procedures proposed to minimise any impacts to the environment and human health during construction and operation.*

3.2 Relevant Legislation, Policy and Guidance

The following air quality policy and guidance documents have been referenced within this assessment and have been used to identify the relevant air quality criteria.

3.2.1 Protection of the Environment Operations Act 1997 & Amendment Act 2011

The *Protection of the Environment Operations Act 1997* (and *Amendment Act 2011*) (hereafter the POEO Act) is a key piece of environment protection legislation administered by the NSW EPA which enables the Government to establish instruments for setting environmental standards, goals, protocols and guidelines.

The following sections of the POEO Act are of general relevance to the Project:

- Section 124 and 125 of the POEO Act states that any plant located at a premise should be maintained in an efficient condition and operated in a proper and efficient manner to reduce the potential for air pollution.
- Section 126 of the POEO Act requires that materials (e.g. building and maintenance materials at the development site) are managed in a proper and efficient manner to prevent air pollution (e.g. odour).
- Section 128 of the POEO Act states:

The occupier of a premises must not carry out any activity or operate any plant in or on the premises in such a manner to cause or permit the emission at any point specified in or determined in accordance with the regulation of air impurities in excess of [the standard of concentration and/or the rate] prescribed by the regulations in respect of any such activity or any such plant.

Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.

3.2.2 Protection of the Environment Operations (Clean Air) Regulation 2010

The "*POEO (Clean Air) Regulation 2010*" (the Regulation) is the core regulatory instrument for air quality issues in NSW. In relation to industry, the Regulation sets maximum limits on emissions from activities and plant for a number of substances.

Part 5 of the Regulation deals with emissions of air impurities and sets maximum limits on emissions for a number of substances (including solid particles and visible smoke) from specific activities and plant. The standards of concentrations prescribed by Part 5, Division 3 do not apply to the emission sources identified for this Project (i.e. helicopter exhaust, fugitive emissions from construction activities, vapours from the handling of hydrocarbons products), however such emissions are still subject to the requirements of Section 128 (2) of the POEO Act in relation to the prevention and minimisation of air pollution.

Part 4 of the Regulation sets out requirements to prevent excessive air emissions from motor vehicles and motor vehicle fuels. These requirements will be applicable to vehicles delivering materials, supplies and workers/passengers to the Sydney Helicopters site during the construction and operational phases. These requirements include the need to fit certain spark-ignition or diesel-powered vehicles and equipment with compliant exhaust pipes or anti-pollution devices, and to ensure that the equipment is serviced, maintained or adjusted as required to prevent excessive air emissions.

3.2.3 NSW Environment Protection Authority Air Quality Policy and Guidance

The EPA is the NSW regulatory authority responsible for air quality regulation and associated activities.

The EPA'S published "*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales"* (NSW EPA, 2017) (The Approved Methods) lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria which reflect the environmental outcomes adopted by the EPA. The Approved Methods are referred to in the POEO (Clean Air) Regulation 2002 for assessment of impacts of air pollutants. The air quality criteria set out in the Approved Methods have been reproduced and discussed in **Section 3.3**.

3.2.4 Local Air Quality Toolkit

The Local Government Air Quality Toolkit (AQ Toolkit) has been developed by the EPA to assist local government in their management of air quality issues and provides guidelines for air quality management and for the use of air pollution control techniques. The AQ Toolkit includes an air quality guidance note for construction sites.

3.3 Relevant Air Quality Criteria

Ambient air quality criteria relevant to the key pollutants associated with the Project (as identified in **Section 2.3**) are discussed in the following sections.

The Approved Methods lists the statutory methods that are to be used to model and assess emissions of air pollutants from stationary sources in NSW. The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW and are considered to be appropriate for this Project.

3.3.1 Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms “dust” and “particulates” are often used interchangeably. The term “particulate matter” refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP). The annual goal for TSP recommended by the NSW EPA is 90 micrograms per cubic metre of air ($\mu g/m^3$).

The TSP goal was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

Emissions of particulate matter less than 10 µm and 2.5 µm in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The PM_{10} and $PM_{2.5}$ impact assessment criteria set out in the Approved Methods are as follows:

- PM_{10} - 24-hour maximum of 50 $\mu g/m^3$
- PM_{10} - annual average of 25 $\mu g/m^3$
- $PM_{2.5}$ - 24-hour maximum of 25 $\mu g/m^3$
- $PM_{2.5}$ - annual average of 8 $\mu g/m^3$.

The assessment criteria discussed above are concerned in large part with the health impacts of airborne particulate matter. Nuisance impacts need also to be considered, mainly in relation to deposited dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 grams per square metre per month ($g/m^2/month$).

3.3.2 Gaseous Products of Combustion

Exhaust emissions from construction equipment, Project-related construction and operational-phase road traffic, and from the helicopters using the proposed helipad, will include NO_X, CO, SO_2, particulate matter and VOCs. Potential air quality impacts and assessment criteria for particulate matter are discussed in **Section 3.3.1**, and VOCs are discussed in **Section 3.3.3**. Potential air quality impacts associated with the key gaseous pollutants emitted by fossil fuel combustion are discussed below and the relevant assessment criteria are presented in **Table 8**.

- Oxides of nitrogen (NO_X) is a general term used to describe any mixture of nitrogen oxides formed during combustion. 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, in the presence of oxygen, NO can be oxidised to form NO_2 which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. Long term exposure to NO_2 can lead to lung disease. NO will be converted to NO_2 over time though oxidation with atmospheric ozone after leaving an engine exhaust.
- Carbon monoxide (CO) is an odourless, colourless gas formed from the incomplete burning of fuels in motor vehicles. CO bonds to the haemoglobin in the blood and reduces the oxygen carrying capacity of red blood cells, thus decreasing the oxygen supply to the tissues and organs, in particular the heart and the brain. It can be a common pollutant at the roadside and highest concentrations are found at the kerbside with concentrations decreasing rapidly with increasing distance from the road.
- Sulphur dioxide (SO_2) is a colourless, pungent gas with an irritating smell. When present in sufficiently high concentrations, exposure to SO_2 can lead to impacts on the upper airways in humans (i.e. the noise and throat irritation). SO_2 can also mix with water vapour to form sulphuric acid (acid rain) which can damage vegetation, soil quality and corrode materials. Main sources of SO_2 in the air are industries that process materials containing sulphur (i.e. wood pulping, paper manufacturing, metal refining and smelting, textile bleaching etc.). SO_2 is also present in motor vehicle emissions, however since Australian fuels are relatively low in sulphur, high ambient concentrations are not common.

Table 8 Impact Assessment Criteria for Gaseous Combustion Products

Pollutant	Averaging Period	Criteria
NO_2	1-hour	12 pphm (246 µg/m^3)
	Annual	3 pphm (62 µg/m^3)
CO	15-min	87 ppm (100 mg/m^3)
	1-hour	25 ppm (100 mg/m^3)
	8-hour	9 ppm (10 mg/m^3)
SO_2	10-min	25 pphm (712 µg/m^3)
	1-hour	20 pphm (570 µg/m^3)
	24-hour	8 pphm (228 µg/m^3)
	Annual	2 pphm (60 µg/m^3)

Note: pphm = parts per hundred million, ppm = parts per million

3.3.3 Volatile Organic Compounds (VOCs)

VOCs are organic compounds (i.e. contain carbon) that have high vapour pressure at normal room-temperature conditions. Their high vapour pressure leads to evaporation from liquid or solid form and emission release to the atmosphere (e.g. evaporative emissions from fuel storage and handling). Impacts due to emissions of VOCs can be health or nuisance (odour) related and depend on the composition of the chemical species present.

VOCs are emitted by a variety of sources, including motor vehicles, chemical and petrochemical processing plants, automobile repair services, painting/printing industries, and rubber/plastics industries. VOCs that are often typical of these sources include benzene, cyclohexane, ethylbenzene, toluene and xylenes. Benzene is a known carcinogen and a key VOC linked with the combustion of motor vehicle fuels. Biogenic (natural) sources of VOC emissions are also significant (e.g. vegetation).

There is no 'VOC' impact assessment criterion, rather these are assessed on an individual basis considering their potential for adverse human health impacts or nuisance impacts due to their odour properties.

3.4 Interstate Recommended Separation Distance Guidelines

A review of separation distance guidelines for the Australian Capital Territory, Victoria, South Australia and Western Australia identified that only the South Australian "*Guideline for Evaluation Distances for Effective Air Quality and Noise Management"* (SA EPA, 2019) included helicopter landing facilities. The guideline lists the recommended evaluation (separation) distance as being for individual assessment, with commentary that the main impact associated with helicopter landing facilities is noise from take-offs and landing. There are no comments in relation to air quality impacts.

4 Impact Assessment

A summary of the conclusions of the investigation components for the assessment are presented in **Table 9**.

Table 9 Summary Table of Potential Air Quality Impact Significance for Assessment

Item	Commentary	Significance for Assessment
Estimated emissions from the helipad operations	The emissions for the operations as estimated in **Section 2.3** are not overall significant. Also, the turbulence created by the helicopter blades will contribute to dispersion of engine exhaust emissions.	Low
Separation distance to nearest sensitive receptors	Helicopter emissions are expected to be well dispersed before reaching nearest off-site sensitive receptors at distances of 470 m to 1.2 km. There are no separation distances listed in interstate separation distance guidelines for helicopter landing facilities. This may be an indication that separation distance requirements in relation air quality are generally insignificant compared to noise requirements.	Low
Local topography	The site is located in relatively open flat terrain with no adverse features potentially impacting on dispersion of emissions from Project.	Low
Prevailing wind direction	Prevailing wind directions are south southwesterly to southerly with a relatively low frequency of easterly to east southeasterly winds with the potential to transport of emissions to the nearest sensitive residential receptors to the east of the Project.	Low
Other nearby emission sources	The review of nearby industrial sources showed that there are some larger industries in the area but that the Penrith AQMS is well positioned to capture contributions from the largest relevant source (the OI Sydney Glass Plant).	Low
Local ambient air quality	The air quality data reviewed for Penrith and Richmond covers both a nearby location for a short-term period and more regional conditions longer term. The ambient air quality data shows conditions as expected and does not highlight any cumulative impact concerns for the Project.	Low

Based on the summary in **Table 9**, showing that all factors considered have a low significance, it is considered highly unlikely that emissions from the Project would have any health-related impacts on existing air quality in the area.

The potential magnitude of impacts due to operations is therefore concluded to be ***negligible***. Correspondingly, the impact significance is concluded to be ***neutral*** (see **Table 10**), which is consistent with low risk.

Table 10 Anticipated Significance of Air Quality Impacts due to Helicopter Movements

Sensitivity		Impact Magnitude [Defined by Table 3]			
		Substantial Magnitude	Moderate Magnitude	Slight Magnitude	Negligible Magnitude
[Defined by Table 2]	**Very High Sensitivity**	Major Significance	Major/ Intermediate Significance	Intermediate Significance	Neutral Significance
	High Sensitivity	Major/ Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
	Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
	Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

5 Conclusions and Recommendations

The qualitative air quality impact assessment for the Project indicates no concerns and suggests low risk to air quality and health.

The construction works for the site development are small scale and should include standard good practice dust controls and management.

6 References

DEC. (2006a). *Technical framework: Assessment and management of odour from stationary sources in NSW, Department of Environment and Conservation NSW, November 2006.*

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APPENDIX A

Construction Dust Impact Assessment Methodology

APPENDIX A - Construction Assessment Methodology

Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located more than 350 m from the boundary of the Site, more than 50 m from the route used by construction vehicles on public roads, and more than 500 m from the Site entrance. This step is noted as having deliberately been chosen to be conservative and will require assessments for most projects.

Step 2a – Assessment of Scale and Nature of the Works

Step 2a of the assessment provides "dust emissions magnitudes" for each of four dust generating activities; demolition, earthworks, construction, and trackout (the movement of site material onto public roads by vehicles). The magnitudes are: *Large*; *Medium*; or *Small*, with suggested definitions for each category. The definitions given in the IAQM guidance for earthworks, construction activities and trackout, which are most relevant to this Development, are as follows:

Demolition *(Any activity involved with the removal of an existing structure [or structures]. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time)*:

- ***Large***: Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
- ***Medium***: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and
- ***Small***: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Earthworks *(Covers the processes of soil-stripping, ground-levelling, excavation and landscaping)*:

- ***Large***: Total site area greater than 10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t.
- ***Medium***: Total site area 2,500 m^2 to 10,000 m^2, moderately dusty soil type (e.g. silt), five to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 m to 8 m in height, total material moved 20,000 t to 100,000 t.
- ***Small***: Total site area less than 2,500 m^2, soil type with large grain size (e.g. sand), less than five heavy earth moving vehicles active at any one time, formation of bunds less than 4 m in height, total material moved less than 20,000 t, earthworks during wetter months.

Construction *(Any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc)*:

- ***Large***: Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting.
- ***Medium***: Total building volume 25,000 m^3 to 100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching.
- ***Small***: Total building volume less than 25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Trackout *(The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network)*:

- ***Large***: More than 50 heavy vehicle movements per day, surface materials with a high potential for dust generation, greater than 100 m of unpaved road length.
- ***Medium***: Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length.
- ***Small***: Less than 10 heavy vehicle movements per day, surface materials with a low potential for dust generation, less than 50 m of unpaved road length.

In order to provide a conservative assessment of potential impacts, it has been assumed that if at least one of the parameters specified in the 'large' definition is satisfied, the works are classified as large, and so on.

Step 2b – Risk Assessment

Assessment of the Sensitivity of the Area

Step 2b of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

- The specific sensitivities that identified sensitive receptors have to dust deposition and human health impacts;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table A-1**. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

Table A-1 IAQM Guidance for Categorising Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
Dust soiling	Users can reasonably expect a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land.	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.
	Examples: Dwellings, museums, medium- and long-term car parks and car showrooms.	*Examples: Parks and places of work.*	*Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*
Health effects	Locations where the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where human exposure is transient.
	Examples: Residential properties, hospitals, schools and residential care homes.	*Examples: Office and shop workers, but will generally not include workers occupationally exposed to PM_{10}.*	*Examples: Public footpaths, playing fields, parks and shopping street.*

According to the IAQM methods, the sensitivity of the identified individual receptors (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors. Additional factors to consider when determining the sensitivity of the area include:

- Any history of dust generating activities in the area;
- The likelihood of concurrent dust generating activity on nearby sites;

- Any pre-existing screening between the source and the receptors;
- Any conclusions drawn from analysing local meteorological data which accurately represent the area and if relevant, the season during which the works will take place;
- Any conclusions drawn from local topography;
- The duration of the potential impact (as a receptor may be willing to accept elevated dust levels for a known short duration, or may become more sensitive or less sensitive (acclimatised) over time for long-term impacts); and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table A-2**. The sensitivity of the area should be derived for each of activity relevant to the project (i.e. construction and earthworks).

Table A-2 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Note: Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. The sensitivity of the area in this case would be high.

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in **Table A-3**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (i.e. an annual average of 25 µg/m^3 for PM_{10}) the IAQM method has been modified slightly.

- This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area*, professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:
- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area, and if relevant the season during which the works will take place;
- any conclusions drawn from local topography;
- duration of the potential impact; and
- any known specific receptor sensitivities which go beyond the classifications given in this document.

Table A-3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Receptor sensitivity	Annual mean PM_{10} conc.	Number of receptors [a,b]	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>25 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	21-25 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	17-21 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<17 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>25 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	21-25 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	17-21 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<17 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Notes: (a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m); noting that only the highest level of area sensitivity from the table needs to be considered.

(b) In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table A-4** (demolition), **Table A-5** (earthworks and construction) and **Table A-6** (trackout) to determine the risk category with no mitigation applied.

Table A-4 Risk Category from Demolition Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk

Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A-5 Risk Category from Earthworks and Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A-6 Risk Category from Trackout Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 3 - Site-Specific Mitigation

Once the risk categories are determined for each of the relevant activities, site-specific management measures can be identified based on whether the site is a low-, medium- or high-risk site.

Step 4 – Residual Impacts

Following Step 3, the residual impact is then determined after management measures have been considered.

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