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Eastern Creek Data Centre Expansion Project (SSD-21342738)

Air Quality Impact Assessment

Addressee(s):	LCI Consultants
Site Address:	90 Peter Brock Drive, Eastern Creek
Report Reference:	26.1029.FR1V1
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Final Authority

This report must by regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below. A draft report is a working document, is issued without prejudice and is subject to change.

Varun Marwaha **24 October 2025**

NON-TECHNICAL SUMMARY

Northstar Air Quality Pty Ltd has been engaged by LCI Consultants to perform an air quality impact assessment in support of a State Significant Development Application submitted to the NSW Department of Planning, Housing and Infrastructure for the proposed modification to the Eastern Creek Data Centre Expansion Project (SSD-21342738), located at 90 Peter Brock Drive, Eastern Creek NSW.

The proposed modification (MOD2) seeks to include 52 generators in a separate bank to the west of the wider data centre site.

This assessment evaluates potential air quality impacts from the data centre during construction and operation, following NSW Environment Protection Authority guidelines. It assesses these predicted impacts and recommends management and monitoring measures to ensure compliance with air quality standards and protect nearby sensitive locations.

During the construction phase, the potential dust soiling and human health risks are assessed as being manageable through appropriate implementation of the recommended mitigation measures.

During the operations, a dispersion modelling scenario for emergency operations has been assessed due to operations of all 52 generators. A number of additional exceedances of the air quality criteria for a number of pollutants are predicted. With reference to published power supply reliability statistics, the probability of both the interruption to the power supply, and an exceedance of the relevant air quality criteria occurring was calculated through the multiplication of the probability of each event occurring, with values indicating the probability of an additional exceedance of the air quality criteria during a power outage is low.

In accordance with the 'Cumulative Impact Assessment for State Significant Proposals' guidelines, this air quality impact assessment has proportionately addressed relevant cumulative air quality issues based on available information, the regulatory context, and the likely scale and influence of surrounding future developments. Potential cumulative impacts during overlapping construction phases, primarily related to dust emissions and human health risks have been evaluated. These impacts are anticipated to be effectively mitigated through site-specific construction environmental management plans and appropriate controls implemented across each project.

During the operational phase, a potential cumulative scenario was identified in the event of a regional or catastrophic grid outage, where multiple data centres including MOD2 operations, would be required to operate backup generators simultaneously, resulting in a temporary increase in emissions from each data centre. Such emergency events are recognised by the NSW Environment Protection Authority and are subject to regulatory allowances and controls. Routine maintenance testing presents limited potential for cumulative impacts, due to the short duration, staggered timing, and physical separation of facilities, alongside regulatory limits such as the 200-hour annual operating threshold provided under the *Protection of the Environment Operations Act* 1997.

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1. INTRODUCTION

Northstar Air Quality Pty Ltd (Northstar) has been commissioned by LCI Consultants, on behalf of DCI Data Centres (DCI, the Proponent) to perform an air quality impact assessment (AQIA) in support of an expansion (Modification 2) to the Eastern Creek Data Centre Expansion Project (the Project), located at 90 Peter Brock Drive, Eastern Creek NSW (the Project site).

The AQIA is to be submitted to NSW Department of Planning, Housing, and Infrastructure (NSW DPHI) and has been performed in accordance with the NSW Environment Protection Authority (NSW EPA) 'Approved Methods for the Modelling and Assessment of Air Pollutants in NSW' (the Approved Methods) (NSW EPA, 2022).

This AQIA identifies and examines potential air quality (including odour) impacts associated with the construction and operation of the Proposed Modification, aligning with the NSW Planning Secretary's Environmental Assessment Requirements (SEARs), and outlines mitigation and monitoring requirements commensurate with those anticipated impacts to ensure that air quality criteria are achieved at surrounding sensitive receptor locations.

1.1. Background

On 1 September 2023, the then NSW Department of Planning and Environment, as delegate of the Minister for Planning and Public Spaces, approved a State Significant Development (SSD-21342738) application made by the Proponent for the expansion of the Project. Development consent was granted, subject to conditions, for a 32 megawatt (MW) data centre including 27 standby diesel generator units.

A modification application seeking to modify the development consent for the Project (Mod-1) to permit changes to the approved water tank storage arrangements and car parking configuration was made and approved in September 2025.

During detailed design, DCI identified the need to revise the approved design. The Proposed Modification (MOD2) now seeks to increase the data centre capacity to 63 MW with a total of 52 standby diesel generator units, also referred to as SYD02.

It is noted that an Environmental Impact Statement (EIS) (PJEP, 2022) and an associated AQIA (with addendums) were prepared in support of the Project (Todoroski Air Sciences, 2022).

1.2. Purpose of the AQIA

The purpose of this AQIA is to examine and identify whether the Proposed Modification may adversely impact on air quality in the surrounding area either during construction or once operational.

To allow assessment of the level of risk associated with the Proposed Modification in relation to air quality, the AQIA has been performed in accordance with and due reference to (in no order):

- *Protection of the Environment Operations Act* 1997 (POEO Act);
- Protection of the Environment Operations (Clean Air) Regulation 2022 (POEO CAR);
- Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2024); and
- Approved Methods for Modelling and Assessment of Air Pollutants in NSW (NSW EPA, 2022).

Appendix A presents a list of abbreviations, nomenclature and units referenced within this AQIA.

1.3. NSW Planning Secretary Environmental Assessment Requirements

The Proposed Modification is to be assessed as a modification to the existing development consent for SSD-21342738 under Section 4.55 and Section 4.56 of the *Environmental Planning and Assessment Act* 1979 (EP&A Act).

While SSDA projects are typically subject to the NSW Planning Secretary's Environmental Assessment Requirements (SEARs), no SEARs have been issued specifically for MOD2. Consequently, the SEARs for SSD-21342738 (dated 6 July 2021) have been adopted to guide the requirements for MOD2.

Table 1 details the SEARs coverage and indicates where each requirement has been addressed within this AQIA.

Table 1 NSW Planning SEARs for SSD-21342738 (6 July 2021)

Issue	Description of requirements	Addressed
Air Quality	A quantitative assessment of the potential air quality, dust and odour impacts of the development, during construction and operation, in accordance with relevant Environment Protection Authority guidelines. The assessment must include:	This AQIA
	- scenarios for construction works, operations, and testing of the back-up power system or its considered alternatives and a justified worst-case scenario.	Section 6 Section 7.1
	- assessment of emissions from the back-up power system against the standards of concentration outlined in the Protection of the Environment Operations (Clean Air) Regulation 2010 (including, but not limited to, polycyclic aromatic hydrocarbons (PAHs) and oxides of nitrogen (NO_x) impacts).	Section 7.3
	- assessment of criteria pollutants in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016).	Section 7.1 Section 8.2.1

Issue	Description of requirements	Addressed
	- details of proposed mitigation, management and monitoring measures (including for the back-up power system) required to ensure compliance with section 128 of the Protection of the Environment Operations Act 1997.	Section 8.2.4 Appendix B

Section 9 of the Approved Methods outlines the NSW EPA's requirements for the information to be included in an AQIA. Table 2 summarises each requirement relevant to this type of development proposal and outlines where this information can be located in the AQIA.

Table 2 NSW EPA Approved Methods – impact assessment reporting requirements

Assessment component	Addressed
9.1 Site Plan	
Layout of the site clearly showing all unit operations	Figure 2
All emissions sources clearly identified	Figure 8
Plant boundary	Figure 2
Sensitive receptors (e.g. nearest residences)	Figure 5
Topography	Figure 6
9.2 Description of the activities carried out on the site	
A detailed discussion of all unit operations carried out on the site, including all possible operational variability	Section 2.2
A detailed list of all process inputs and outputs	Section 2.2 Section 2.3
Plans, process flow diagrams and descriptions that clearly identify and explain all pollution control equipment and techniques for all processes on the premises	Figure 2 - Figure 4 Section 2.2
A description of all aspects of the air emission control system, with particular regard to any fugitive emission capture systems (e.g. hooding, ducting), treatment systems (e.g. scrubbers, bag filters) and discharge systems (e.g. stacks)	Section 2.2 Section 2.3
The operational parameters of all emission sources, including all operational variability, i.e. location, release type (stack, volume or area) and release parameters (e.g. stack height, stack diameter, exhaust velocity, temperature, emission concentration and rate)	Table 10 Section 5.2.3
9.3 Emissions Inventory	
A detailed discussion of the methodology used to calculate the expected pollutant emission rates for each source	Section 5.2.3
Detailed calculation of pollutant emission rates for each source	Table 10, Table 12
Tables showing all release parameters of stack and fugitive sources (e.g. temperature, exit velocity, stack dimensions, and emission concentrations and rates)…	Table 10, Table 12
…and all pollutant emission concentrations with a comparison of the emission concentrations against the relevant requirements of the Regulation	Table 3, Table 11 Table 22
9.4 Meteorological data	
A detailed discussion of the prevailing dispersion meteorology at the proposed site. The report should typically include wind rose diagrams, an analysis of wind speed, wind	Section 4.3 Appendix C

Assessment component	Addressed
direction, stability class, ambient temperature and mixing height; and joint frequency distributions of wind speed and wind direction as a function of stability class	
Demonstration that the site-representative data adequately describes the expected meteorological patterns at the site under investigation (e.g. wind speed, wind direction, ambient temperature, atmospheric stability class, inversion conditions and katabatic drift)	Appendix C
A description of the techniques used to prepare the meteorological data into a format for use in the dispersion modelling	Section 4.3 Section 5.2.1.2 Appendix C
A quality assurance and quality control analysis of the meteorological data used in the dispersion modelling. Provide and discuss any relevant results of this analysis	Appendix C
9.5 Background air quality data	
A detailed discussion of the methodology used to calculate the background concentrations for each pollutant	Section 4.4 Appendix D
Tables summarising the ambient monitoring data	Table 7 Appendix D
9.6 Dispersion modelling	
A detailed discussion and justification of all parameters used in the dispersion modelling and the manner in which topography, building wake effects and other site-specific peculiarities that may affect plume dispersion have been treated	Section 5.2.1
A detailed discussion of the methodology used to account for any atmospheric pollutant formation and chemistry	Section 5.2.7
A detailed discussion of air quality impacts for all relevant pollutants, based on predicted ground-level concentrations at the plant boundary and beyond, and at all sensitive receptors	Section 7.1 - Section 7.2 Section 8.2
Ground-level concentrations, hazard index and risk isopleths (contours) and tables summarising the predicted concentrations of all relevant pollutants at sensitive receptors	Section 7.1 – 7.3 Figure 9 - Figure 11

2. THE PROPOSED MODIFICATION

The following provides a description of the context, location and scale of the Proposed Modification, and a description of the processes and development activities at the Project site. It also identifies the potential for emissions to air associated with the Proposed Modification.

2.1. Environmental Setting

The Project site is located in the Blacktown Local Government Area (LGA) and is approximately 40 kilometres (km) west of the Sydney Central Business District (CBD), 20 km west of the Parramatta CBD, and 10 km north-east of the future Western Sydney International Airport.

The Project site is legally described as Lot 34 of Deposited Plan (DP) 1131779, Lot 32 and Lot 33 of DP 1140168 and Lot 25 of DP 1122038. The existing Project site has a total area of approximately 3.5 hectares (ha) while the expanded site has a total area of 4.1 ha.

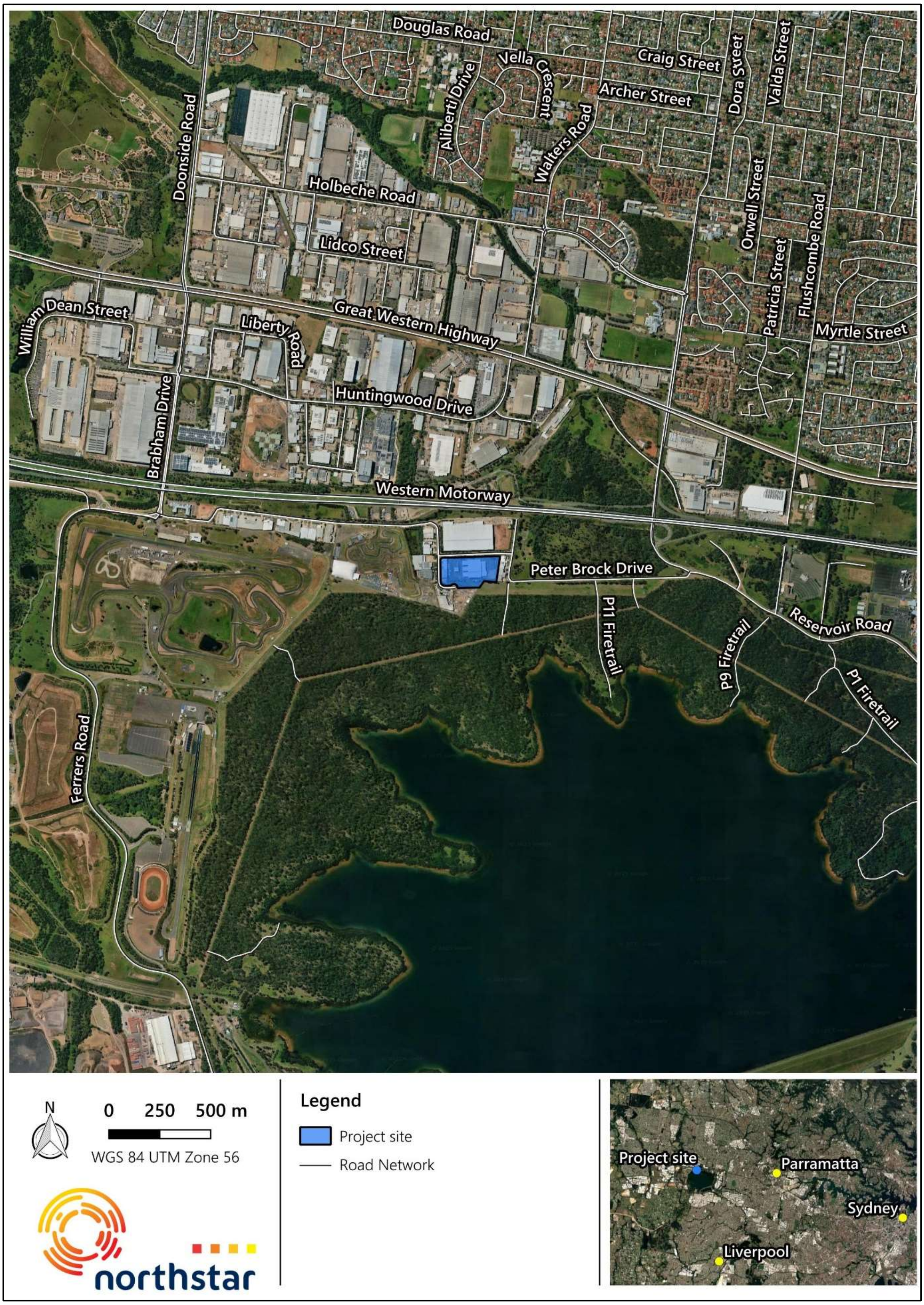
The Project site and majority of adjacent land is zoned as IN1 General Industrial according to the State Environmental Planning Policy (Industry and Employment) 2021. Land use currently consists of existing light industrial uses, with Lot 32 and 33 of DP 1140168 occupied by warehousing and distribution facilities.

The Project site is surrounded by a variety of industrial land use activities and significant transport and utilities infrastructure. Immediate surrounding development includes:

- North: Peter Brock Drive and existing industrial development within the Raceway Precinct, beyond which is the M4 Motorway and industrial areas of Huntingwood and the Great Western Highway.
- East: Existing industrial development within the Raceway Precinct, beyond which is Peter Brock Drive and Auto Place, and open space regulated under the State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (Western Parkland City SEPP).
- South: existing industrial development within the Raceway Precinct, and Prospect Nature Reserve to the south and south east. A 132 kilovolt (kV) electricity transmission line is located immediately to the south of (and partly within) the Project site.
- West: Raceway Place and existing industrial development within the Raceway Precinct, beyond which is the Sydney Motorsport Park and Karting Raceway.

A map showing the location of the Project site is provided in Figure 1. A full description of the sensitivity and uses of the surrounding land, and the identification of discrete receptor locations used in the AQIA, is provided in Section 4.2.

Figure 1 Project site location



Source: Northstar

2.2. Proposed Modification Overview

The Proposed Modification to SSD-2134278 involves the construction, fit out and operation of a multistorey 63 MW data centre building adjacent to the existing Eastern Creek Data Centre, thereby expanding the approved development.

The existing facility comprises three data storage halls supported by two level Uninterruptible Power Supply (UPS) rooms, alongside associated office, storage, workshop and amenities areas, principally in the eastern area of the building. Standby emergency power is currently provided by six diesel generators (four rated at 2.2 MW and two rated at 2 MW). These are fuelled from two underground diesel fuel tanks with 70 000 litres (L) capacity which are installed adjacent to the building. The existing data centre covers a total building area of approximately 10 145 square metres (m^2) and a gross floor area (GFA) of 7 070 m^2.

The Project site is approved to operate 24 hours a day, seven days a week.

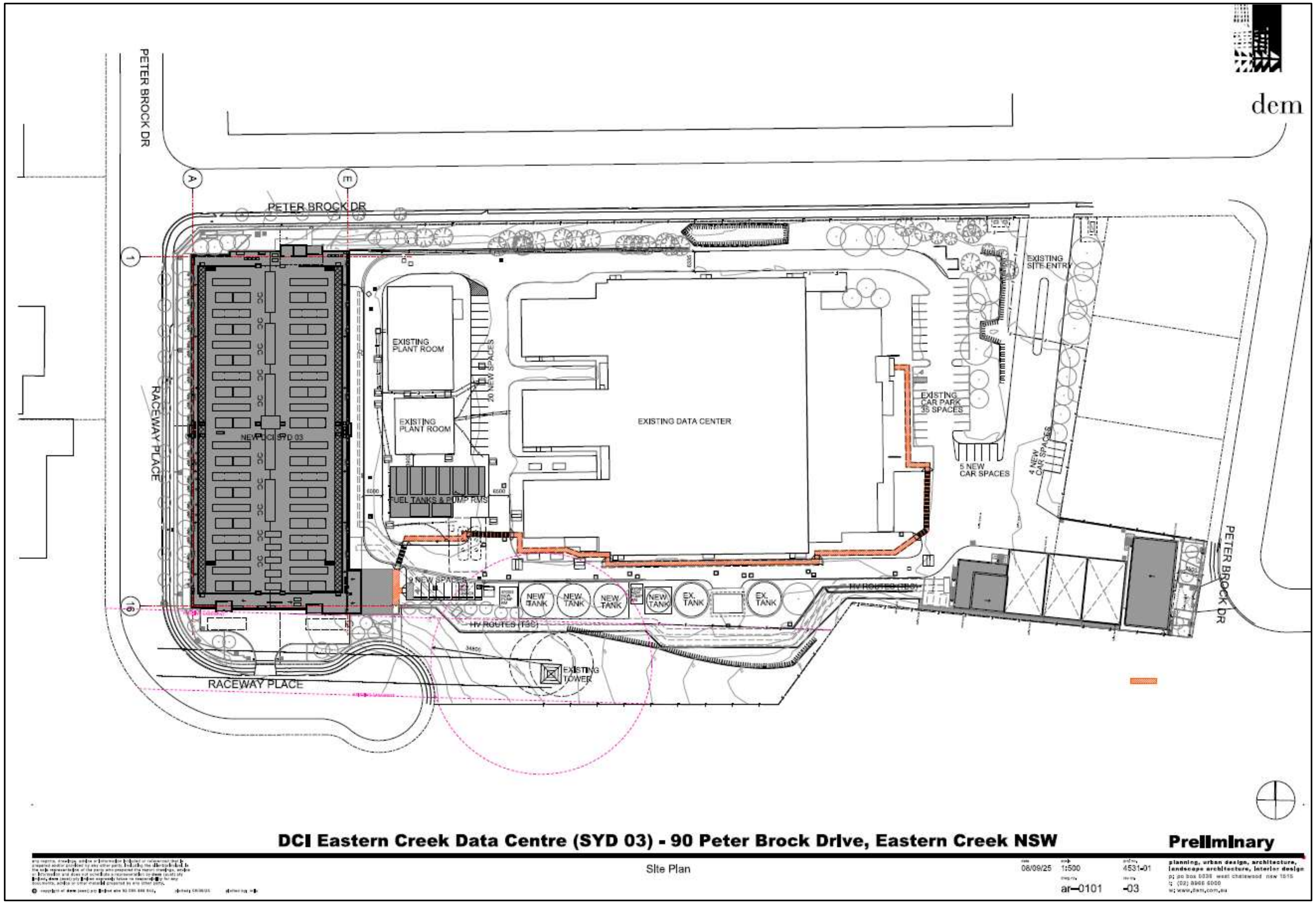
The Proposed Modification involves a new building containing 10 data halls (6 air cooled and 4 liquid cooled) across three levels, with associated office, storage, workshop and amenities. Standby emergency power would be supplied by a total of 52 diesel generators; each rated at 1.8 MW.

The Proposed Modification includes the following key components:

- Site preparation and bulk earthworks;
- Two low levels of plant, office, storage areas and three levels of data halls, with a maximum height of 35.7 m and a total (GFA) of approximately 10 865 m^2;
- Ancillary office spaces and amenities;
- Carparking, loading docks, access roadways and landscaping; and
- Zone Substation Support Works.

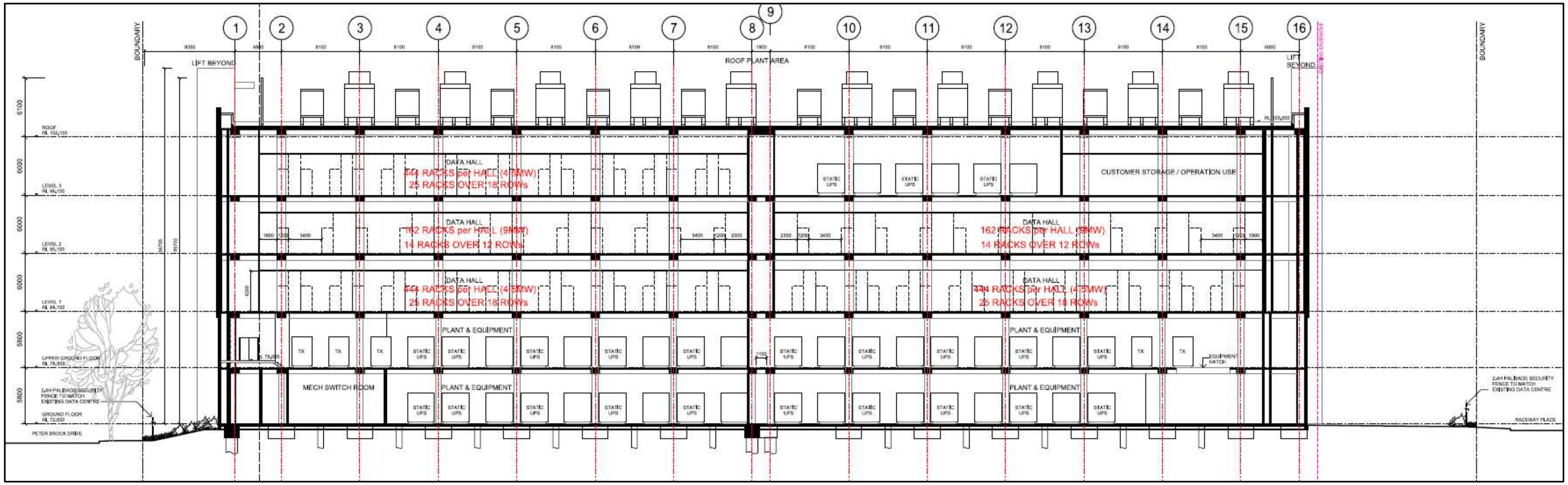
Figure 2 to Figure 4 illustrate the Proposed Modification layout, indicating the size, massing, and height of the buildings, along with the locations of standby diesel generators.

Figure 2 Proposed modification layout



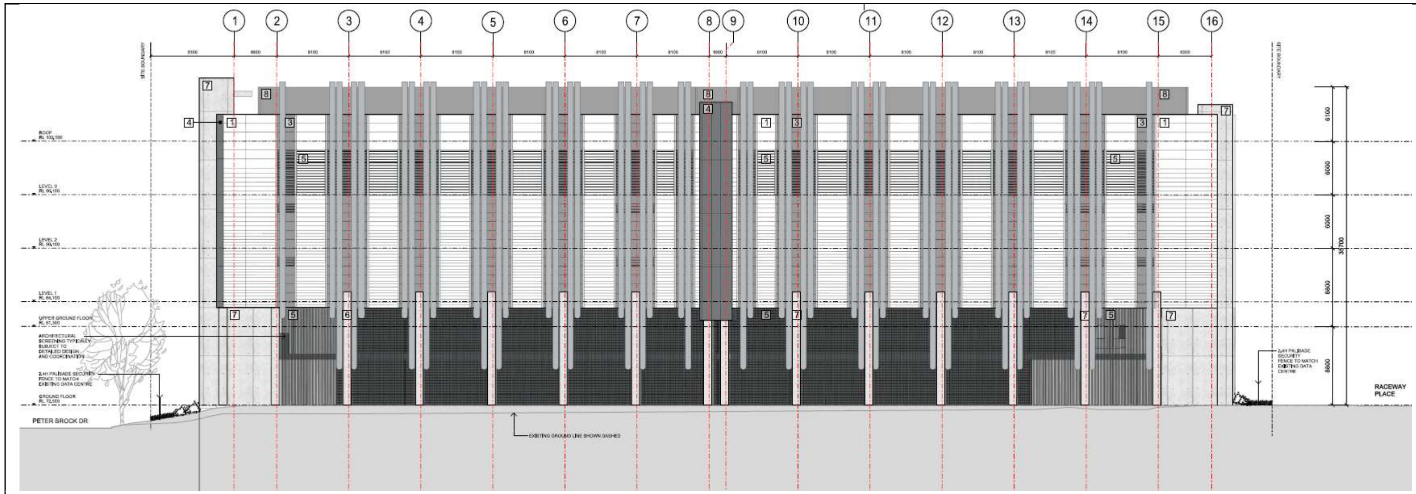
Source: DEM – Project number – 4531-01 – Drawing number – ar-0101-03 dated 8 September 2025

Figure 3 Proposed modification layout – building – sections

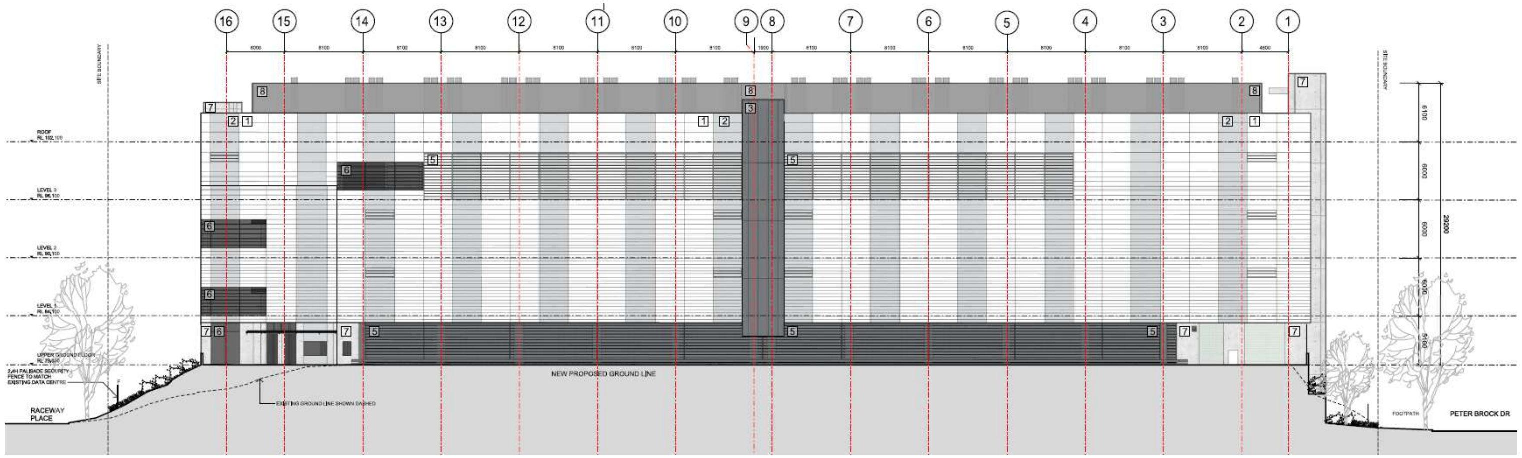


Source: DEM – Project number – 4531-01– Drawing number – ar-2102-01, dated 29 August 2025

Figure 4 Proposed modification layout – east and west elevations



Source: DEM – Project number – 4531-01– Drawing number – ar-2601-02, dated 8 September 2025 - West elevation



Source: DEM – Project number – 4531-01– Drawing number – ar-2602-02, dated 8 September 2025 - East elevation

2.3. Identification of Emissions to Atmosphere

Given the nature of the Proposed Modification, emission to air would be likely to be generated as described in the following sections.

2.3.1. Construction Phase

The Proposed Modification includes a new building facility for the installation of additional data halls and associated infrastructure such as offices, staff amenities, plant and storage rooms, switch and battery rooms, and generator gantry platforms. The construction phase will also involve demolition works, site preparation, earthworks, and landscaping.

An indicative list of plant and equipment that may be used during the construction of the Proposed Modification includes:

- Excavators, front-end loaders (FEL), graders and rollers (smooth drum and vibratory);
- Light and heavy-duty vehicles;
- Drills and pneumatic hand, or power tools; and
- Mobile cranes and elevated working platforms.

The assessment of the potential local air quality risks from construction phase activities is presented in Section 6, while the risk assessment methodology is presented in Appendix B.

2.3.2. Operational Phase

Operational emissions from the Project site on a day-to-day basis would be anticipated to be negligible, with the exception of potential emissions from diesel-fuelled back-up generators during periodic maintenance testing or during a power outage event. Additionally, there is the potential for minor fugitive emissions from the storage of diesel at the Project site.

2.3.2.1. Emissions from Generator Use

The Proposed Modification includes the installation of 52 standby generators to support overall Project operations, providing a power consumption of 63 MW. The generators will be housed within a dedicated four-storey gantry building located on the western side of the Project site.

At the time of assessment, specific generator types have not been finalised. In the absence of confirmed types, a conservative approach has been adopted for this AQIA, assuming the generators to be included for the Proposed Modification will meet or exceed United States Environmental Protection Agency (US EPA) Tier 2 emissions standards[1]. While these standards are US based, they provide a conservative benchmark. Typical Australian non road diesel generators may meet equivalent or more stringent emissions standards such as US EPA Tier 3 or Tier 4, or European Stage III to Stage V. Accordingly, the use of US EPA Tier 2 standards ensures that potential emissions from the operation of the Proposed Modification are not underestimated.

For the Proposed Modification, 42 generators are designated to support the IT load and 10 generators for the mechanical load.

During periods when the back-up generators may be required to provide power during mains power outage events, short-term emissions of combustion related pollutants would be generated. Emissions from diesel-fuelled back-up generators may include various air pollutants, as listed in the National Pollutant Inventory (NPI) Emission Estimation Technique Manual (NPI EETM) for combustion engines (NPI, 2008).

The pollutants of concern from the operation of the back-up generators includes (in no order):

- Particulate matter (PM);
- Oxides of nitrogen (NO_X);
- Carbon monoxide (CO);
- Sulphur dioxide (SO_2);
- Polycyclic aromatic hydrocarbons (PAHs);
- Volatile organic compounds (VOCs), as benzene (C_6H_6), toluene (C_7H_8) and xylene (C_8H_{10}); and
- Formaldehyde (CH_2O).

In addition to the potential operation as a standby energy source during a power outage event, the generators would be required to be run during short-term routine maintenance testing.

The Proponent has outlined the anticipated maintenance testing regime for the generators as follows:

- Monthly testing: Five to six generators tested for a duration of 15 minutes each session.
- Annual load testing: Five to six generators for a duration of one hour.

Routine scheduled testing was noted in the EIS for SSD-21342738 (PJEP, 2022) as:

- Monthly testing: Up to two generators operating at a time on load for up to one hour each.
- Annual testing: Up to six generators operating at a time for up to six hours across five separate tests.

Standby generator maintenance testing activities were considered under the consented development under SSD-21342738 (Todoroski Air Sciences, 2022; Todoroski Air Sciences, 2023). Whilst the Proposed Modification seeks to introduce additional generators to support increased capacity at the Project site, these maintenance

[1] https://dieselnet.com/standards/us/nonroad.php

activities are independent of the total number of generators and are limited in duration, with testing anticipated to occur for less than 200 hours per year (refer Section 3.1.1).

The testing regime described for MOD2 differs slightly from that presented in the original EIS for SSD-21342738 (PJEP, 2022). This appears to reflect revised operational practices or efficiencies at the Project site, and refinements in site management procedures. While the specific basis for the change has not been confirmed, it is considered to represent an optimisation of maintenance requirements, rather than a material change to the nature or intent of the approved activities.

For this AQIA, maintenance testing of the standby generators has not been re-assessed or quantitated It is noted that standby generator maintenance testing activities were previously assessed under SSD-21342738 (Todoroski Air Sciences, 2022; Todoroski Air Sciences, 2023).

2.3.2.2. Emissions from Fuel Storage

The Proposed Modification includes on-site fuel storage, which may generate fugitive air emissions of VOCs during filling and dispensing of fuel, as well as from potential accidental spillages and leaks that may occur.

Existing fuel storage is provided by two underground diesel tanks, each with a capacity of 70 kilolitres (kL), while the consented development under SSD-21342738 allows for a total diesel storage capacity of 685 kL.

With the Proposed Modification, diesel storage capacity will increase from the currently approved total of 825 kL to 860 kL, with six tanks of 120 kL each utilised to meet diesel requirements. This storage capacity equates to approximately 735.9 tonnes (t), which remains below the POEO Act Schedule 1 chemical storage threshold of 2 000 t (refer Section 3.1.2).

Adequate diesel storage containment (such as double-walled tanks and tertiary bunding containment) and automated leak detection measures will be required for inclusion within the Proposed Modification design, in compliance with relevant Australian and New Zealand Standards (AS/NZS), including AS/NZS 1940:2017 (Storage and Handling of Flammable and Combustible Liquids) and AS/NZS 1692:2006 (Steel Tanks for Flammable and Combustible Liquids).

The standby generators are anticipated to use low-sulphur diesel fuel during operations. Spill containment measures are also expected around tank fill connections, pumps, and filters where necessary. Given the low potential for fugitive emissions from fuel storage and the minimal risk of off-site impacts, no further quantification of these emissions has been included in this AQIA.

2.3.3. Odour

Construction phase activities may include the operation of plant and machinery, that may pose an insignificant risk of odour in the event of accidental fuel spillage, which can be effectively managed through the provision of spill kits to promptly manage any spillages.

Operational phase activities will not result in any air emissions, except for the periodic operation of the diesel-fuelled generators for back-up power generation purposes only, as outlined above.

Air emissions of VOCs have been assessed as benzene (C_6H_6) as a principal toxic air pollutant, with anticipated emissions of toluene (C_7H_8) and xylene (C_8H_{10}) assessed and compared against the relevant odour impact assessment criteria.

3. LEGISLATION, REGULATION AND GUIDANCE

The following provides an overview of the legislation and air quality criteria which are applicable to the activities being performed at the Project site.

3.1. Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act* 1997 (POEO Act) sets the statutory framework for managing air quality in NSW, including establishing the licensing scheme for major industrial premises (scheduled activities) and a range of air pollution offences and penalties.

Schedule 1, Part 1 of the POEO Act provides definitions for scheduled activities, and the associated threshold activity rates. For the Proposed Modification, the thresholds associated with electricity generation (clause 17), and chemical storage (clause 9) are most relevant, given the use of standby diesel-fuelled generators as part of the Proposed Modification.

3.1.1. Electricity Generation

Clause 17 of Schedule 1, Part 1 of the POEO Act states:

> *17 Electricity generation*
>
> *(1) This clause applies to the following activities:*
>
> *…*
>
> *metropolitan electricity works (internal combustion engines), meaning the generation of electricity by means of electricity plant:*
>
> *(a) that is based on, or uses, an internal combustion engine, and*
>
> *(b) that is situated in the metropolitan area or in the local government area of Port Stephens, Maitland, Cessnock, Singleton, Wollondilly, or Kiama.*
>
> *(1A) However, this clause does not apply to the generation of electricity by means of electricity plant that is emergency stand-by plant operating for less than 200 hours per year.*
>
> *(2) Each activity referred to in Column 1 of the Table to this clause is declared to be a scheduled activity if it meets the criteria set out in Column 2 of that Table.*

During times of stable external electricity supply, the standby generators would only operate for scheduled maintenance (refer Section 2.3.2). Section 3.9.3 of the EIS produced for SSD-21342738 (PJEP, 2022) described the following testing regime:

> *In the case of a power outage (of more than 3 seconds), the generators would run for a period of at least 15 minutes, or the power outage duration plus 15 minutes.*
>
> *The testing regime would include:*
>
> *Annual Testing – up to 6 generators operating at a time on load for up to 6 hours across 5 separate tests; and*
>
> *Monthly Testing – up to 2 generators operating at a time on load for up to 1 hour each.*
>
> *Monthly testing would occur for up to approximately 168 hours per year[7], while annual testing would occur for up to approximately 30 hours[8]. All testing would be undertaken between the hours of 7am and 6pm, Monday to Saturday.*
>
> *[7] Based on 2 generators being tested at a time, or up to 14 separate tests in total per month, at 1 hour per test*
>
> *[8] Based on 6 generators being tested at a time, or up to 5 separate tests in total per year, at 6 hours each test*

As stated in Section 2.3.2.1, the Proponent has outlined the anticipated maintenance testing regime for the generators which includes monthly testing of five to six generators tested for a duration of 15 minutes each session and an annual load test involving five to six generators for a duration of one hour. This revised regime is likely associated with updated operational practices and site management efficiencies. While the specific rationale for the change has not been confirmed, it is considered an optimisation of maintenance requirements, rather than a material change to the nature or intent of the approved activities.

Whilst the Proposed Modification (MOD2) seeks to increase the number of standby diesel generators from 27 to 52 units, the Project site is not anticipated to exceed the 200 hour limit on electricity generation by emergency standby plant. Accordingly, it is not deemed to constitute a scheduled activity under Schedule 1, Part 1, Clause 17 of the POEO Act and would not require an Environment Protection Licence (EPL) on this basis.

The development consent for SSD-21342738 (dated 1 September 2023) also contains a specific condition (condition A6) limiting the operation of standby generators (including testing) to no more than 200 hours per year. Importantly, this condition clarifies that concurrent testing of multiple generators counts as a single hour toward the threshold. It is anticipated that a condition equivalent to A6 of the extant development consent will be applied to the Proposed Modification.

3.1.2. Chemical Storage

Clause 9 of Schedule 1, Part 1 of the POEO Act states:

9 Chemical storage

(1) This clause applies to the following activities--

"general chemicals storage", meaning the storage or packaging in containers, bulk storage facilities or stockpiles of any chemical substance classified as a dangerous good in the Transport of Dangerous Goods Code , other than the following--

…

"petroleum products storage", meaning the storage or packaging of petroleum or petroleum products in containers, bulk storage facilities or stockpiles.

(2) Each activity referred to in Column 1 of the Table to this clause is declared to be a scheduled activity if it meets the criteria set out in Column 2 of that Table.

Table

Column 1	***Column 2***
Activity	*Criteria*
…	
petroleum products storage	*capacity to store more than 200 tonnes (liquified gases) or 2,000 tonnes (chemicals in any other form)*

As presented above, the Proposed Modification may be considered a scheduled activity under Schedule 1, Part 1, Clause 9 of the POEO Act if the Project site were to have the capacity to store more than 2 000 tonnes (t) of diesel fuel (equivalent to 2 350 kL assuming a fuel density of 850.8 $kg \cdot m^{-3}$).

As outlined in Section 2.2, the Project site has an approved capacity to store up to 825 kL or 701 t of diesel fuel. With the Proposed Modification, diesel storage may increase from the total approved 825 kL, however it is unlikely to be above the POEO diesel storage threshold of 2 000 t.

Therefore, the Project would not be considered scheduled and that an EPL would not be required for this activity.

It is also noted that the development consent for SSD-21342738 (dated 1 September 2023) included a specific condition (condition A6) restricting diesel fuel storage to no more than 2 000 t at any one time.

3.1.3. Equipment Maintenance

Part 5.4 of the POEO Act outlines a number of requirements associated with air pollution. These requirements generally relate to the appropriate maintenance of plant and equipment in an efficient condition and dealing with materials in a manner as to not cause air pollution.

3.2. Protection of the Environment Operations (Clean Air) Regulation

The Protection of the Environment Operations (POEO) (Clean Air) Regulation 2022 (POEO CAR) establishes requirements and concentration standards for air emissions from industrial activities in NSW. It regulates air quality issues related to various sources, including burning activities, motor vehicle fuels, fuel usage and transfer, air impurities from activities and plants, and the storage of volatile organic liquids.

Part 5 of the POEO CAR sets concentration standards for air impurities from activities and plant, with Schedule 2 specifying maximum permissible in-stack emissions limits for both scheduled and non-scheduled premises.

Clause 73, Part 5, Division 6 of the POEO CAR provides an exemption for emergency electricity generation as follows:

> *73 Exemption relating to emergency electricity generation*
>
> *Emergency standby plant is exempt from the air impurities standard for nitrogen dioxide and nitric oxide specified in Schedule 2, Part 2, Division 3 for the plant if –*
>
> *(a) the plant comprises a stationary reciprocating internal combustion engine for generating electricity, and*
>
> *(b) it is used for a total of not more than 200 hours per year.*

As outlined in Section 2.3.2, the generator plant would operate cumulatively for less than 200 hours per year, and the above exemption would therefore apply to the Proposed Modification.

Clause 54 of the POEO CAR also clarifies that standards of concentrations do not apply during start-up and shutdown periods, except where specifically prescribed under Division 4 of the POEO CAR or by EPL condition. Importantly, even where in-stack concentration standards are exempt, operators remain subject to the general duty under section 128(2) of the POEO Act to prevent and minimise air pollution.

Accordingly, while the standby generators may be exempt from relevant NO_X standards of concentration limits (i.e. in-stack emission concentrations), the Proponent is not exempt from meeting ambient air quality criteria for NO_2, which is addressed in Section 3.3.

Table 3 POEO CAR standards of concentrations for applicable air impurities

Air impurity	Activity or plant	Concentration	Applicable
Schedule 2, Part 2, Division 2 – Electricity generation (Group 6)			
Solid particles (Total)	An activity or plant using a liquid or solid standard fuel or a non-standard fuel	50 mg·Nm^{-3} (A)	No – Proposed Modification is non-scheduled.
Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	A turbine operating on a fuel other than gas, being a turbine used in connection with an electricity generating system with a capacity of 30 MW or more	90 mg·Nm^{-3} (A)	No – Proposed Modification is not a scheduled activity and would operate for less than 200 hrs·year^{-1}.
Schedule 2, Part 2, Division 3 - Scheduled premises (Group 6)			
Solid particles (Total)	An activity or plant	50 mg·Nm^{-3} (A)	No – Proposed Modification is non-scheduled.
Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	Stationary reciprocating internal combustion engines	450 mg·Nm^{-3} (A)	No – Proposed Modification is not a scheduled activity and would operate for less than 200 hrs·year^{-1}.
Volatile organic compounds (VOCs), as n-propane	A stationary reciprocating internal combustion engine using a liquid fuel	1 140 mg·Nm^{-3} (A) VOCs *or* 5 880 mg·Nm^{-3} (A) CO	No – Proposed Modification is non-scheduled.
Smoke	An activity or plant in connection with which liquid or gaseous fuel is burnt	20 % opacity	No – Proposed Modification is non-scheduled.
Schedule 2, Part 3 – Non-scheduled premises (Group C)			
Solid particles (Total)	An activity or plant	100 mg·Nm^{-3} (B)	Yes
Smoke	An activity or plant in connection with which liquid or gaseous fuel is burnt	20 % opacity	Yes

Notes (A) POEO CAR Sch2, Pt 3, Div 1: dry, 273 K, 101.3 kPa, 7 % O_2

(B) POEO CAR Sch2, Pt 3, Div 2: dry, 273 K, 101.3 kPa, 7 % O_2

Part 4 Clause 20 of the POEO CAR requires that motor vehicles do not emit excessive air impurities which may be visible for a continuous period of more than 10-seconds when determined in accordance with the relevant standard.

All vehicles, plant, and equipment to be used either at the Project site or to transport materials to and from the Project site would be maintained regularly and in accordance with manufacturers' requirements, where these vehicles are under the operational control of the Proponent.

3.3. NSW Approved Methods

State air quality guidelines are prescribed by NSW EPA in the Approved Methods, which has been consulted during the preparation of this AQIA (refer Section 1.3, Table 2).

The Approved Methods lists the statutory methods that are to be used to assess emissions of criteria air pollutants in NSW. Section 7.1 and Section 7.2 of the Approved Methods clearly outlines the impact assessment criteria for those key pollutants of interest and both individual and principal toxic air pollutants. Principal toxic air pollutants are defined in the Approved Methods on the basis that they are carcinogenic, mutagenic, highly persistent, and/or highly toxic in the environment.

The criteria listed in the Approved Methods are derived from a range of sources (including National Health and Medical Research Council [NHMRC], National Environment Protection Council [NEPC], and World Health Organisation [WHO]).

The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW. The standards adopted to protect members of the community from health impacts in NSW for relevant individual air pollutants are presented in Table 4.

To assess the potential impact of emissions of total volatile organic compounds (TVOC), which is a complex mixture of hydrocarbons, the 1-hour impact assessment criterion for benzene (C_6H_6) of 0.029 mg·m^{-3} (29 µg·m^{-3}) as outlined in table 12 of the Approved Methods has been adopted.

Benzene (C_6H_6) is one of the primary components of TVOC emissions resulting from diesel combustion engines and compliance with the benzene (C_6H_6) criterion (refer Table 4) would generally result in compliance with all VOC components from a health-perspective. Additionally, formaldehyde (CH_2O) is assessed as a discrete VOC.

VOC emissions have additionally been assessed against the 1-hour odour impact assessment criteria for toluene (C_7H_8) of 0.36 mg·m^{-3} (360 µg·m^{-3}) and xylene (C_8H_{10}) of 0.19 mg·m^{-3} (190 µg m^{-3}) to address the potential for odour impacts. Table 5 provides a summary of impact assessment criteria for principal toxic, and both individual odorous and toxic pollutants that are referenced within this AQIA, as outlined in Section 7.2 of the Approved Methods.

Table 4 NSW EPA impact assessment criteria

Pollutant	Averaging period	Criterion ($\mu g \cdot m^{-3}$)[(a)]	Notes
Sulphur dioxide (SO_2)	1 hour	215	Numerically equivalent to the AAQ NEPM [(b)] standards and goals
	24 hours	57	
Nitrogen dioxide (NO_2)	1 hour	164	
	Annual	31	
Particulates (as PM_{10})	24 hours	50	
	1 year	25	
Particulates (as $PM_{2.5}$)	24 hours	25	
	1 year	8	
Particulates (as TSP)	1 year	90	
Pollutant	**Averaging period**	**Criterion ($mg \cdot m^{-3}$) [(c)]**	**Notes**
Carbon monoxide (CO)	15 minutes	100	Numerically equivalent to the AAQ NEPM [(b)] standards and goals
	1 hour	30	
	8 hours	10	

Notes: (a): micrograms per cubic metre of air

(b): National Environment Protection (Ambient Air Quality) Measure

(c): milligrams per cubic metre of air

Table 5 NSW EPA impact assessment criteria for principal and individual toxic pollutants

Pollutant	Averaging period [(a)]	Criterion	
		$mg \cdot m^{-3}$ [(b)]	$\mu g \cdot m^{-3}$[(c)]
Polycyclic Aromatic Hydrocarbon (PAH) as benzo(a)pyrene	1 hour	0.0004	0.4
Benzene (C_6H_6)	1 hour	0.029	29
Toluene (C_7H_8)	1 hour	0.36	360
Xylene (C_8H_{10})	1 hour	0.19	190
Formaldehyde (CH_2O)	1 hour	0.02	20

Notes: (a): milligrams per cubic metre of air

(b): micrograms per cubic metre of air

(c): assessed as 99.9th percentile as per Approved Methods

As required under section 7.2.2 of the Approved Methods, the criteria identified in Table 5 are assessed at any location at or beyond the Project site boundary.

3.4. State Environmental Planning Policy

The Project site is located within the Raceway Precinct within the Western Sydney Employment Area (WSEA). Development within the WSEA was previously governed by the State Environmental Planning Policy (Western Sydney Employment Area) 2009 (SEPP WSEA), which aimed to create employment, by providing development in the form of major warehousing distribution, freight transport, industrial and manufacturing facilities.

In March 2022, the SEPP WSEA and its provisions have been consolidated into the State Environmental Planning Policy (Industry and Employment) 2021 (IE SEPP), specifically Chapter 2, Parts 2.1 to 2.5 and is the primary planning instrument applicable to the Project site.

The Project site is zoned IN1 General Industrial under the IE SEPP. Data centres are classified as a type of 'light industry' which falls within the broader 'industry' group term. As such, data centres are permitted with consent in the IN1 zone under the IE SEPP. The Proposed Modification and wider Project would support the efficient use of employment lands for data storage purposes.

The IE SEPP does not include explicit air quality provisions. As such, environmental assessment is deferred to the *Environmental Planning and Assessment Act* 1979 (EP&A Act) and relevant environmental controls, which are managed either by local consent authorities for non-scheduled activities or by NSW EPA for scheduled activities.

3.5. Blacktown Local Environmental Plan 2015

The Blacktown Local Environmental Plan 2015 (BLEP2015) provides the legislative framework for developments and land use within the Blacktown LGA. Specifically, the aims of the BLEP2015 are as follows:

(aa) to protect and promote the use and development of land for arts and cultural activity, including music and other performance arts,

(a) to recognise the role of the urban renewal precincts as the major locations for higher density residential and employment development for the city,

(b) to ensure that appropriate housing opportunities are provided for all current and future residents through diversity of housing choice,

(c) to provide land for community facilities, public purposes and recreational pursuits,

(d) to encourage development opportunities for business and industry so as to deliver local and regional employment growth,

(e) to minimise risk to the community by restricting development in sensitive areas that are subject to flooding and other hazards,

(f) to provide for infrastructure to maintain and meet demands arising from housing and employment growth,

(g) to conserve and enhance Blacktown's built, natural and cultural heritage,

(h) to conserve, restore and enhance biological diversity and ecosystem health, particularly threatened species, populations and communities.

It is noted that the BLEP2015 does not outline any specific requirements for the development of data centres with regard to air quality and correspondingly, potential air quality impacts would be managed under the requirements of the POEO Act, POEO CAR and the Approved Methods.

3.6. NSW Government Air Quality Planning

NSW EPA has formed a comprehensive strategy with the objective of driving improvements in air quality across the State. This comprises several drivers, including:

- **Legislation**: formed principally through the implementation of the POEO Act and POEO CAR. The overall objective of the legislative instruments is to achieve the requirements of the National Environment Protection (Ambient Air Quality) Measure;
- **Clean Air for NSW**: The 10-year plan for the improvement in air quality;
- **Inter-agency Taskforce on Air Quality in NSW**: a vehicle to co-ordinate cross-government incentives and action on air quality;
- **Managing Particles and Improving Air Quality in NSW**; and
- **Diesel and Marine Emission Management Strategy**.

In regard to the relevance of the NSW Government's drive to maintain and improve air quality across the State and this AQIA, it is imperative that the Project would lead to the development of the NSW economy (in terms of activity and employment) and concomitantly not cause a detriment in air quality in achieving its objectives.

4. EXISTING CONDITIONS

The following information provides context around the location of sensitive receptor locations surrounding the Project site, the prevailing meteorology and air quality of the surrounding area and identifies other sources of air pollutants which have the potential to impact cumulatively with the Proposed Modification.

4.1. Surrounding Land Sensitivity

The Project site is located within an IN1 – General Industrial zone in accordance with the IE SEPP.

Surrounding land uses include IN1 – General Industrial to the north, and RE2 – Private Recreation to the west, unzoned land (Prospect Reservoir and bushland) to the east and south, in accordance with the zoning provisions of the IE SEPP.

4.2. Sensitive Receptor Locations

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors, refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed.

The Approved Methods defines a sensitive receptor location to be:

> *'A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area'.*

It is noted that the assessment criteria applied to particulates and sulphur dioxide (SO_2) (refer Table 4) are for a 24-hour averaging period, and as such the predicted impacts need to be interpreted at commercial and industrial receptor locations with care. It is considered to be atypical for a person to be at those locations for a complete 24-hour period and as such, the exposure risks associated with those pollutants at those locations would be over-estimated by adoption of those locations in the modelling assessment. However, these locations have been included within the assessment, as required by NSW EPA.

It is important to note that the selection of discrete receptor locations does not aim to cover all sensitive receptors within the study area. Rather, the selected locations are intended to be representative of their broader surroundings and can reasonably be assumed to reflect conditions in the immediate vicinity. In cases where multiple sensitive receptors exist in close proximity (such as a school adjacent to a medical centre) the receptor closest to the emission source is typically chosen to assess potential risks to other sensitive land uses in the area.

Beyond the identified discrete receptors, the entire modelling area has been overlaid with a grid of uniform receptor points to allow presentation of contour plots of predicted impacts in a comprehensive manner. As such the accidental omission of a particular sensitive location does not invalidate the AQIA or render it incapable of assessing potential risks.

In accordance with the requirements of the Approved Methods, several receptors have been identified and the receptors adopted for use within this AQIA are presented in Table 6 and illustrated in Figure 5. Table 6 is not intended to represent a definitive list of sensitive land uses, but a cross section of available locations, that are used to characterise larger areas, or selected as they represent more sensitive locations, which may represent people who are more susceptible to changes in air pollution.

To ensure that the selection of discrete receptors for the AQIA are reflective of the locations in which the population of the area surrounding the premises reside, population density data has been examined. Population density data based on the estimated residence population for 2024 have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre (km^2) grid, covering mainland Australia (ABS, 2025).

Using a Geographical Information System (GIS), the locations of sensitive receptor locations have been confirmed with reference to their population densities (refer Figure 5).

For clarity, the ABS use the following categories to analyse population density (persons·km^{-2}):

- No population Zero (0).
- Very low Up to 500.
- Low Between 500 and 2 000.
- Medium Between 2 000 and 5 000.
- High Between 5 000 and 8 000.
- Very high More than 8 000.

Using ABS data in a GIS application, the population density has been characterised as very low (i.e. up to 500 persons·km^{-2}), which is typical of the industrial environment in which the Project site is located, and consistent with the broader Raceway Precinct and WSEA.

Further to the north, the population density increases to a low to medium range (i.e. between 500 and 5 000 persons·km^{-2}), reflecting the transition into the Arndell Park and Blacktown suburbs, where commercial and residential uses are more prevalent. To the immediate east and south of the Project site, no population is observed due to the environment conservation zone.

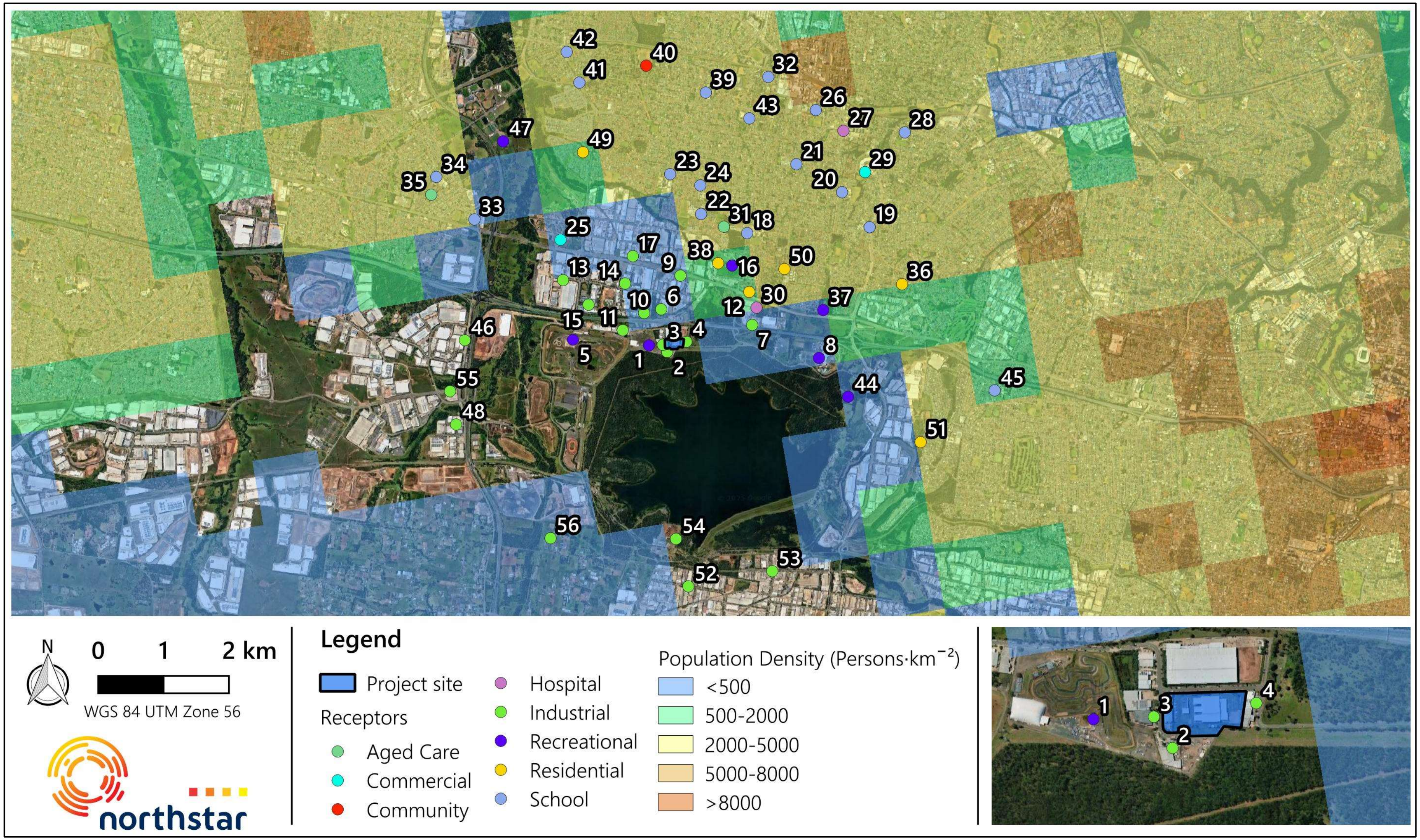
Table 6 Discrete sensitive receptor locations

Receptor ID	Location	Land use	Coordinates (UTM 56S)	
			mE	mS
R1	Eastern Creek International Karting Raceway	Recreational	303 952	6 257 425
R2	Raceway Place, Eastern Creek	Industrial	304 228	6 257 324
R3	Raceway Place, Eastern Creek	Industrial	304 163	6 257 434
R4	Peter Brock Dr before Auto Pl, Eastern Creek	Industrial	304 521	6 257 481
R5	Sydney Motorsport Park, Eastern Creek	Recreational	302 787	6 257 513
R6	Asahi Beverages, Huntingwood	Industrial	304 137	6 257 982
R7	Western Motorway Onramp, Blacktown	Industrial	305 528	6 257 743
R8	Raging Waters Sydney, Prospect	Recreational	306 550	6 257 232
R9	Great Western Highway, Huntingwood	Industrial	304 432	6 258 496
R10	AirTrunk Sydney West, Huntingwood	Industrial	303 876	6 257 925
R11	Peter Brock Dr after Udogie Lane, Eastern Creek	Industrial	303 550	6 257 662
R12	Great Western Highway, Blacktown	Residential	305 484	6 258 248
R13	Huntingwood Drive, Eastern Creek	Industrial	302 636	6 258 428
R14	Huntingwood Drive, Huntingwood	Industrial	303 585	6 258 376
R15	Arnott's Biscuits Huntingwood, Huntingwood	Industrial	303 026	6 258 052
R16	H Laybutt Sporting Complex, Arndell Park	Recreational	305 222	6 258 650
R17	Great Western Highway, Arndell Park	Industrial	303 703	6 258 794
R18	St Michael's Primary School, Blacktown	School	305 452	6 259 146
R19	Shelley Public School, Blacktown	School	307 324	6 259 237
R20	Mitchell High School, Blacktown	School	306 903	6 259 772
R21	Blacktown South Primary School, Blacktown	School	306 205	6 260 201
R22	Evans High School, Blacktown	School	304 747	6 259 439
R23	Tyndale Christian School, Blacktown	School	304 274	6 260 048
R24	Walters Road Primary School, Blacktown	School	304 735	6 259 877
R25	Primate Boulevard, Bungarribee	Commercial	302 597	6 259 045
R26	Patrician Brothers Blacktown, Blacktown	School	306 502	6 261 028
R27	Blacktown Hospital, Blacktown	Hospital	306 924	6 260 711
R28	Bert Oldfield Public School, Seven Hills	School	307 863	6 260 686
R29	Blacktown Mega Centre, Blacktown	Commercial	307 256	6 260 080
R30	Oatley Close, Blacktown	Hospital	305 595	6 258 007
R31	Highpoint Drive, Blacktown	Aged Care	305 097	6 259 245
R32	Blacktown Senior Citizens Center, Blacktown	School	305 775	6 261 534
R33	Eastern Creek Public School, Eastern Creek	School	301 280	6 259 356
R34	St Agnes Catholic High School, Rooty Hill	School	300 699	6 260 006
R35	Our Lady of Consolation Aged Care & Services, Rooty Hill	Aged Care	300 621	6 259 734
R36	Belrose Place, Prospect	Residential	307 820	6 258 366
R37	Great Western Highway, Prospect	Recreational	306 615	6 257 970
R38	H Laybutt Sporting Complex, Blacktown	Residential	305 008	6 258 687

Receptor ID	Location	Land use	Coordinates (UTM 56S)	
			mE	mS
R39	Blacktown West Public School, Blacktown	School	304 819	6 261 296
R40	Narang Muru Aboriginal Community Wellbeing Centre	Community	303 909	6 261 707
R41	Mountain View Adventist College, Doonside	School	302 886	6 261 448
R42	Doonside Public School, Doonside	School	302 692	6 261 917
R43	St Patrick's Primary School, Blacktown	School	305 485	6 260 900
R44	William Lawson Drive, Prospect	Recreational	306 996	6 256 640
R45	Greystanes High School, Greystanes	School	309 236	6 256 737
R46	Wallgrove Road, Eastern Creek	Industrial	301 134	6 257 506
R47	Field W4, Bungarribee	Recreational	301 721	6 260 549
R48	Clay Place, Eastern Creek	Industrial	301 000	6 256 216
R49	Sir Hercules Parade, Bungarribee	Residential	302 941	6 260 384
R50	Prospect, Prospect	Residential	306 022	6 258 598
R51	Dullai Avenue, Pemulwuy	Residential	308 104	6 255 947
R52	Newton Road, Wetherill Park	Industrial	304 553	6 253 744
R53	Davis Road, Wetherill Park	Industrial	305 836	6 253 977
R54	Cowpasture Road, Wetherill Park	Industrial	304 363	6 254 469
R55	BP, Eastern Creek	Industrial	300 909	6 256 724
R56	Chandos Road, Horsley Park	Industrial	302 444	6 254 481

Note: The requirements of this AQIA may vary from the specific requirements of other studies, and as such the selection and naming of receptor locations, may vary between technical reports. This does not affect or reduce the validity of those assumptions.

Figure 5 Sensitive receptors surrounding the Project site and population density



Source: Northstar

4.3. Meteorology

In accordance with the requirements of the Approved Methods, the AQIA is required to describe and account for the influence of the prevailing meteorological conditions.

The meteorology experienced within an area can govern the generation (in the case of wind-dependent emission sources), dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorological conditions surrounding the Project site have been characterised using data collected by the Australian Government Bureau of Meteorology (BoM) at surrounding Automatic Weather Stations (AWS).

To characterise local wind conditions, meteorological data from the Horsley Park Equestrian Centre AWS was analysed. This station, located approximately 5.5 km south east of the Project site, provided data from 2020 to 2024 (the most recent five years of complete records), as presented in Appendix C. Annual wind roses indicate a consistent wind distribution pattern across these years, with predominant south-westerly winds. The majority of wind speeds range between 0.5 $m{\cdot}s^{-1}$ and 5.5 $m{\cdot}s^{-1}$, with higher speeds (more than 8 $m{\cdot}s^{-1}$) occurring from mostly north-westerly directions. Calm conditions (less than 0.5 $m{\cdot}s^{-1}$) are more common, averaging 19.4 % of recorded hours.

Although the Horsley Park Equestrian Centre AWS is nearby, on-site meteorological analysis is required to establish baseline conditions for the Proposed Modification. In the absence of on-site data, site-representative conditions were generated using the CALMET model for use in CALPUFF (refer Section 5.2.1.2).

To ensure representativeness, a correlation analysis of observed wind characteristics (direction and speed) at the Horsley Park Equestrian Centre AWS was conducted (refer Appendix C), along with a comparison of nitrogen dioxide (NO_2) data from the Prospect AQMS (refer Appendix D). Based on this analysis, 2021 was selected as the most representative year for meteorological modelling.

For this AQIA, CALMET was run in no-observations ('no-obs') mode using gridded prognostic data generated by The Air Pollution Model (TAPM, v 4.0.5), developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), to determine surface and wind characteristics at the Project site. A summary of the inputs and outputs of the meteorological modelling assessment, including validation of those outputs is presented in Appendix C.

4.4. Background Air Quality

The air quality experienced at any location will be a result of emissions generated by natural and anthropogenic sources on a variety of scales (local, regional and global). The relative contributions of sources at each of these scales to the air quality at a location, will vary based on a wide number of factors including the type, location, proximity and strength of the emission source(s), prevailing meteorology, land uses and other factors affecting the emission, dispersion and fate of those pollutants.

When assessing the impact of any particular source of emissions on the potential air quality at a location, the impact of all other sources of an individual pollutant, should also be assessed. These 'background' (sometimes called 'baseline') air quality conditions will vary depending on the pollutants to be assessed and can often be characterised by using representative air quality monitoring data.

The nearest NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) Air Quality Monitoring Station (AQMS) relative to the Project site is located at William Lawson Park, Prospect. The Prospect AQMS is located approximately 2.7 km to the north east of the Project site and monitors a range of air pollutants including particles as PM_{10} and $PM_{2.5}$, NO_2, ozone (O_3), CO and SO_2.

A summary of the air quality monitoring data and assumptions used to produce this AQIA are presented in Table 7. It is noted that although impacts of O_3 have not been considered in this assessment, O_3 data has been adopted to assist in calculating the conversion of NO_X to NO_2 for the dispersion modelling assessment (refer Section 5.2.7).

It is noted that the Prospect AQMS does not measure concentrations of TSP. As TSP is not directly monitored, concentrations have been estimated using an analysis of co-located TSP and PM_{10} measurements from the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions. Further information is provided in Appendix D.

Table 7 Summary of background air quality data used in the AQIA

AQMS	Pollutant	Ave. period	Units	Measured value	Notes
Prospect	Particles (as TSP)	Annual	$\mu g{\cdot}m^{-3}$	35.3	Estimated on a TSP:PM_{10} ratio of 2.0551: 1
	Particles (as PM_{10})	24-hour	$\mu g{\cdot}m^{-3}$	Daily varying	The 24-hour max concentration in 2021 was 44.6 $\mu g{\cdot}m^{-3}$
		Annual	$\mu g{\cdot}m^{-3}$	17.2	
	Particles (as $PM_{2.5}$)	24-hour	$\mu g{\cdot}m^{-3}$	Daily varying	The 24-hour max concentration in 2021 was 37.3 $\mu g{\cdot}m^{-3}$
		Annual	$\mu g{\cdot}m^{-3}$	6.9	
	Nitrogen dioxide (NO_2)	1-hour	$\mu g{\cdot}m^{-3}$	Hourly varying	The 1-hour max concentration in 2021 was 88.2 $\mu g{\cdot}m^{-3}$
		Annual	$\mu g{\cdot}m^{-3}$	14.9	Annual average in 2021
	Carbon monoxide (CO)	15-minutes	$mg{\cdot}m^{-3}$	2.1	Calculated from 1-hour data (Section 5.2.8).
		1-hour	$mg{\cdot}m^{-3}$	1.6	Max 1-hour concentration in 2021
		8-hour	$mg{\cdot}m^{-3}$	1.2	Max 8-hour concentration in 2021
	Sulphur dioxide (SO_2)	1-hour	$\mu g{\cdot}m^{-3}$	42.9	Max 1-hour concentration in 2021
		24-hour	$\mu g{\cdot}m^{-3}$	7.9	Max 24-hour concentration in 2021

It is noted that a number of pollutants assessed as part of this AQIA are not routinely monitored at AQMS locations in NSW including:

- Polycyclic aromatic hydrocarbons (PAH).
- Benzene (C_6H_6), toluene (C_7H_8), and xylene (C_8H_{10}); and
- Formaldehyde (CH_2O).

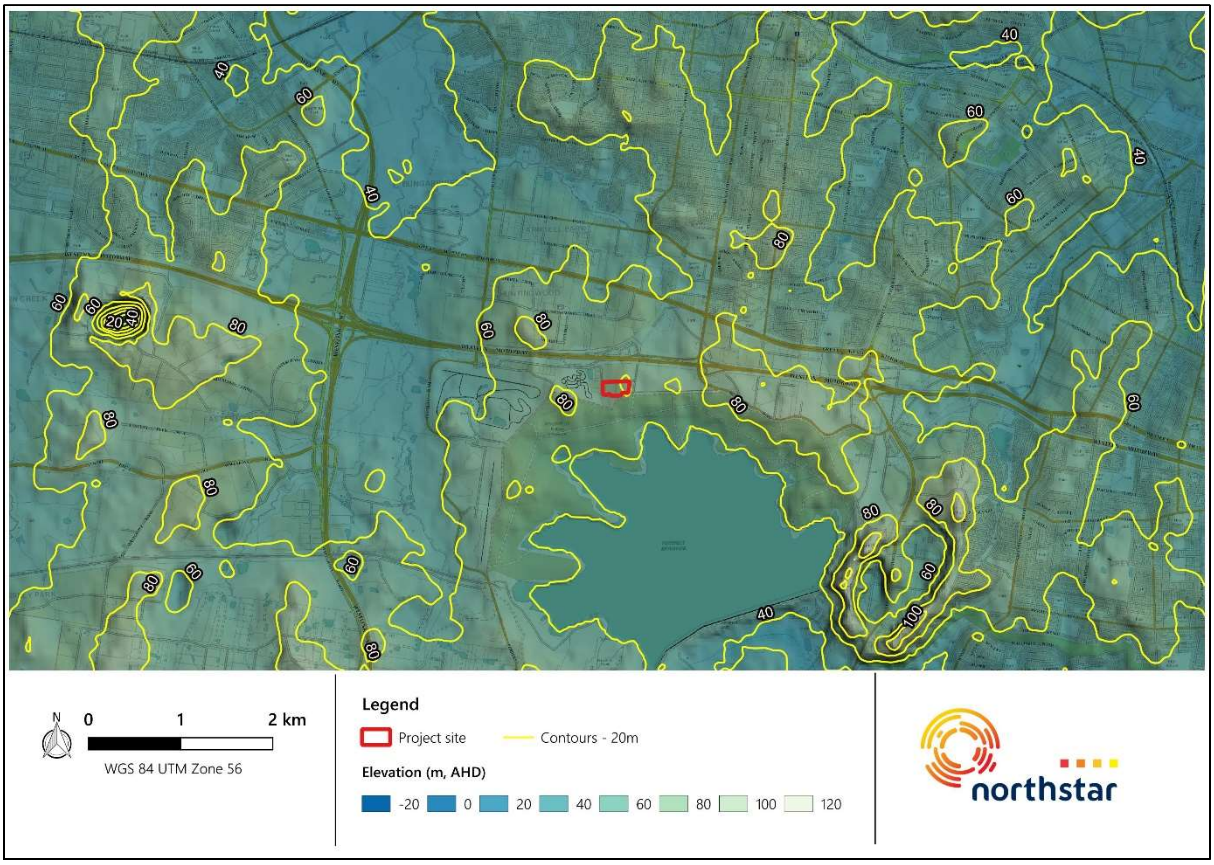
For the purposes of this AQIA, it has been assumed that background concentrations of the aforementioned pollutants are negligible. Section 7 of the Approved Methods requires assessment of only the 99.9th percentile incremental impacts for these pollutants and does not mandate inclusion of background levels of individual VOCs in cumulative impact assessments.

Appendix D provides further analysis of the background air quality monitoring data used in this AQIA.

4.5. Topography

The Project site elevation ranges from approximately 73 m to 80 m AHD (refer Figure 6). The topography between the Project site and nearest sensitive receptor locations is uncomplicated (from an AQIA perspective). Nonetheless, the influence of topography has been included in the dispersion modelling assessment as described in Section 5.2.1.3).

Figure 6 Topography surrounding the Project site



Source: Northstar

4.6. Potential for Cumulative Impacts

The background air quality dataset described in Section 4.4 is likely to reflect the influence of both regional pollutant sources (e.g. particulate matter) and more localised contributions from nearby roads, commercial premises, and industrial locations at or near the AQMS. However, given the separation distance between the AQMS and the Project site, the dataset may not fully represent site-specific pollutant concentrations or conditions.

Standard environmental assessment practice requires that the impacts of the Proposed Modification be evaluated in the context of the existing environment, including both historical changes and the cumulative contribution of other developments. This includes existing facilities, approved but not yet operational projects, and development proposals currently under assessment. Where multiple sources have the potential to contribute emissions to shared receptor locations, the Approved Methods require cumulative impacts to be considered. While the most rigorous approach involves dispersion modelling of all contributing sources, this is often constrained by:

- A lack of detailed emissions or operational data for external sources, particularly where multiple operators are involved;
- Misalignment in assessment timeframes across developments; and,
- Differences in operating patterns, particularly where sources emit intermittently or unpredictably, such as standby backup generators at data centres, which may only be a source of air emissions for a short period in any year.

Given these constraints, a qualitative evaluation has been conducted with reference to the NSW Department of Planning and Environment's 'Cumulative Impact Assessment Guidelines for State Significant proposals' (CIA Guidelines) (NSW DPIE, 2022). The CIA Guidelines state that cumulative assessments should be proportionate to the nature of the potential impacts and focus on interactions between the Proposed Modification and 'relevant future projects' that is those within the same locality and timeframe.

Relevant future projects are defined as including:

- Other SSD or SSI proposals;
- Designated developments requiring an EIS under Division 5.1 of the EP&A Act;
- Controlled actions under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act); and
- Major greenfield or urban renewal developments identified via rezoning or government strategies.

Emerging projects may also be considered where there is a reasonable expectation of progression, such as:

- Developments with issued SEARs or undergoing pre-SEARs consultation;
- Publicly announced proposals with demonstrated market interest; and
- Projects identified in strategic planning instruments (e.g. the State Infrastructure Strategy).

Particular consideration has been given to other data centre proposals only (e.g. standby diesel generator exhausts via vertical stacks) within the assessment dispersion modelling domain (refer Table C3, Appendix C).

While broader industrial operations exist in the surrounding locality, including premises regulated under the POEO Act, many of these sources operate under different duty cycles, emit different pollutant profiles or lack sufficient publicly available data for inclusion within the dispersion modelling.

The outcomes of this review informed the cumulative impact assessment presented in Section 7.4. A summary of relevant developments is provided in Table 8 and their locations illustrated in Figure 7. Further discussion of the cumulative assessment methodology is provided in Section 5.3, with results presented in Section 7.5.

Table 8 Potential sources of air emissions proximate to the Project site

Reference	Facility	Status	Location	Approx. distance to Project site (km)
Data Centres				
A	CDC Data Centre (SSD-10330)	Operational	17 Roberts Road, Eastern Creek	4.9
B	AWS SYD57	Approved	10 Eastern Creek Drive, Eastern Creek	4.3
C	AWS SYD51	Operational	1 William Dean Street, Eastern Creek	2.3
D	Airtrunk SYD03	Approved	51 Huntingwood Drive, Huntingwood	1.1
E	DCI SYD01	Operational	90 Peter Brock Drive, Eastern Creek	0.2
F	MS SYD01	Under Assessment	6 Honeman Close, Huntingwood	1.2

Figure 7 Potential cumulative sources

Source: Northstar

5. APPROACH TO ASSESSMENT

This AQIA provides a qualitative assessment of dust impacts (soiling and human health) during the construction phase, adapted from (IAQM, 2024) (refer Section 5.1) and a quantitative assessment aligned with (NSW EPA, 2022) for evaluating operational phase air quality impacts (refer Section 5.2).

5.1. Construction Phase

Construction phase activities have the potential to generate short-term emissions of particulates. Generally, these are associated with uncontrolled (or 'fugitive') emissions and are typically experienced by neighbours as amenity impacts, such as dust deposition and visible dust plumes, rather than associated with health-related impacts. Localised engine-exhaust emissions from construction machinery and vehicles may also be experienced but given the scale of the proposed works, fugitive dust emissions would have the greatest potential to give rise to downwind air quality impacts.

Modelling of dust from construction projects is generally not considered appropriate as there is a lack of reliable emission factors from construction activities upon which to make predictive assessments, and the rates would vary significantly, depending upon local conditions. In lieu of a modelling assessment, the construction-phase impacts associated with the Proposed Modification have been assessed using a risk-based assessment procedure. The advantage of this approach is that it determines the activities that pose the greatest risk, which allows the Construction Environmental Management Plan (CEMP) to focus controls to manage that risk appropriately and reduce the impact through proactive management.

For this risk assessment, Northstar has adapted the published in (IAQM, 2024). The IAQM construction phase assessment approach is commonly used for evaluating fugitive dust and particulate matter emissions from construction activities in developments across NSW and Australia.

Briefly, the adapted method uses a six-step process for assessing dust impact risks from construction activities, and to identify key activities for control as outlined in Appendix B.

5.2. Operational Phase

5.2.1. Dispersion Modelling Approach

The air emissions assessment for the operational phase has utilised quantitative dispersion modelling techniques. This section outlines the approach taken in the AQIA for the operational phase of the Proposed Modification.

5.2.1.1. Dispersion Model

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF Atmospheric Dispersion Model. CALPUFF is a Lagrangian Gaussian (steady-state) plume dispersion model, recognised in the Approved Methods as a widely accepted model for regulatory applications in NSW, and is considered an appropriate model for this AQIA. It is used to predict pollutant concentrations from various sources typically found at industrial facilities.

The CALPUFF model uses hourly meteorological data to define conditions for plume rise, transport, diffusion, and deposition. It estimates concentrations or deposition values for each source-receptor combination on an hourly basis and calculates user-selected short-term averages. CALPUFF also accounts for local terrain, making it well-suited for modelling complex terrains, including slope flows, valley flows, terrain blocking, and kinematic effects.

Since most air quality standards are based on averages or percentiles, CALPUFF enables further analysis of results for comparison. The CALPUFF-percent post-processing utility calculates the maximum concentration of a pollutant at a specific percentile over a given period, across all receptors. This percentile approach helps omit unusual short-term meteorological events that may cause elevated concentrations, providing a more accurate representation of likely average pollutant concentrations over the averaging period.

Table 9 provides the model input configuration to assess the impact of generator emissions from the Proposed Modification, in consideration of the Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods (Barclay & Scire, 2011).

Table 9 General model parameters for CALPUFF dispersion modelling

Model parameter	Input
Model mode	CALPUFF Refined Mode CALMET No-Observations (No-Obs) Mode
Meteorological data	Prognostic Data (TAPM)
Terrain topography	SRTM1
Model / Grid domain size	13 .4 km × 13.4 km × 4 km
Grid resolution / spacing	0.1 km

(Barclay & Scire, 2011) recommend using CALMET No-Obs mode for regulatory screening when good-quality gridded prognostic meteorological data are available, which has been applied in the dispersion modelling process.

Given the variable topography, terrain data with a 1 arc-second resolution (approximately 30 m) were used, in consideration of (Barclay & Scire, 2011). The dispersion model was run over a 13.4 km × 13.4 km grid at ground level, encompassing the nearest sensitive receptors (see Section 4.2) and covering all potentially impacted nearby land uses.

5.2.1.2. Meteorological Modelling

Section 4 of the Approved Methods requires one-year of site-specific meteorological data or site-representative meteorological data, in the absence of site-specific data, to be used for dispersion modelling.

The 3-D meteorological dataset was derived using gridded prognostic data generated from The Air Pollution Model (TAPM, v 4.0.5) as developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), in conjunction with CALMET (refer Appendix C). Section 4.5 of the Approved Methods identifies TAPM as a commonly used prognostic meteorological model in NSW.

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 site-specific hourly meteorological observations at user-defined levels within the atmosphere.

CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field and thus the final wind field reflects the influences of local topography and current land uses.

Appendix C contains details on the meteorological model configuration and input parameters.

5.2.1.3. Terrain Effects

The CALPUFF model incorporates terrain information with heights being applied to all receptors and sources. In order to account for the potential influence on pollution dispersion and varying receptor elevations across the modelling domain, a gap filled and filtered (vegetation and obstacles removed) topography file with 1 second resolution (approximately 30 m) derived from the Shuttle Radar Topography Mission (SRTM) data was processed using CALPUFF's terrain pre-processing tools to prepare it for use in the dispersion modelling.

5.2.1.4. Building Wake Effects

For dispersion modelling assessments, the influence of surrounding buildings on emission transport is a material consideration. Nearby buildings can create turbulence and a building wake that can affect pollutant dispersion, particularly through a phenomenon known as building downwash. The ratio of stack height to building height also impacts this effect; if the stack is significantly taller than the building, downwash is minimal.

Section 5.3 of the Approved Methods outlines the following requirements for determining which buildings to consider within a dispersion modelling assessment:

> *"The location and dimensions of buildings located within a distance of 5L (where L is the lesser of the height or width of the building) from each release point for buildings with a height greater than 0.4 times the stack height…"*

The Building Profile Input Program – Plume Rise Model Enhancements (BPIP-PRIME) uses building heights and corner locations near the stack to simulate effective dimensions. The BPIP-PRIME downwash algorithm computes these dimensions in ten-degree intervals, allowing CALPUFF to assess the impact on plume dispersion and ground-level concentrations. While simplified, this building geometry offers a reasonable estimate of how structures disrupt wind flow nearby.

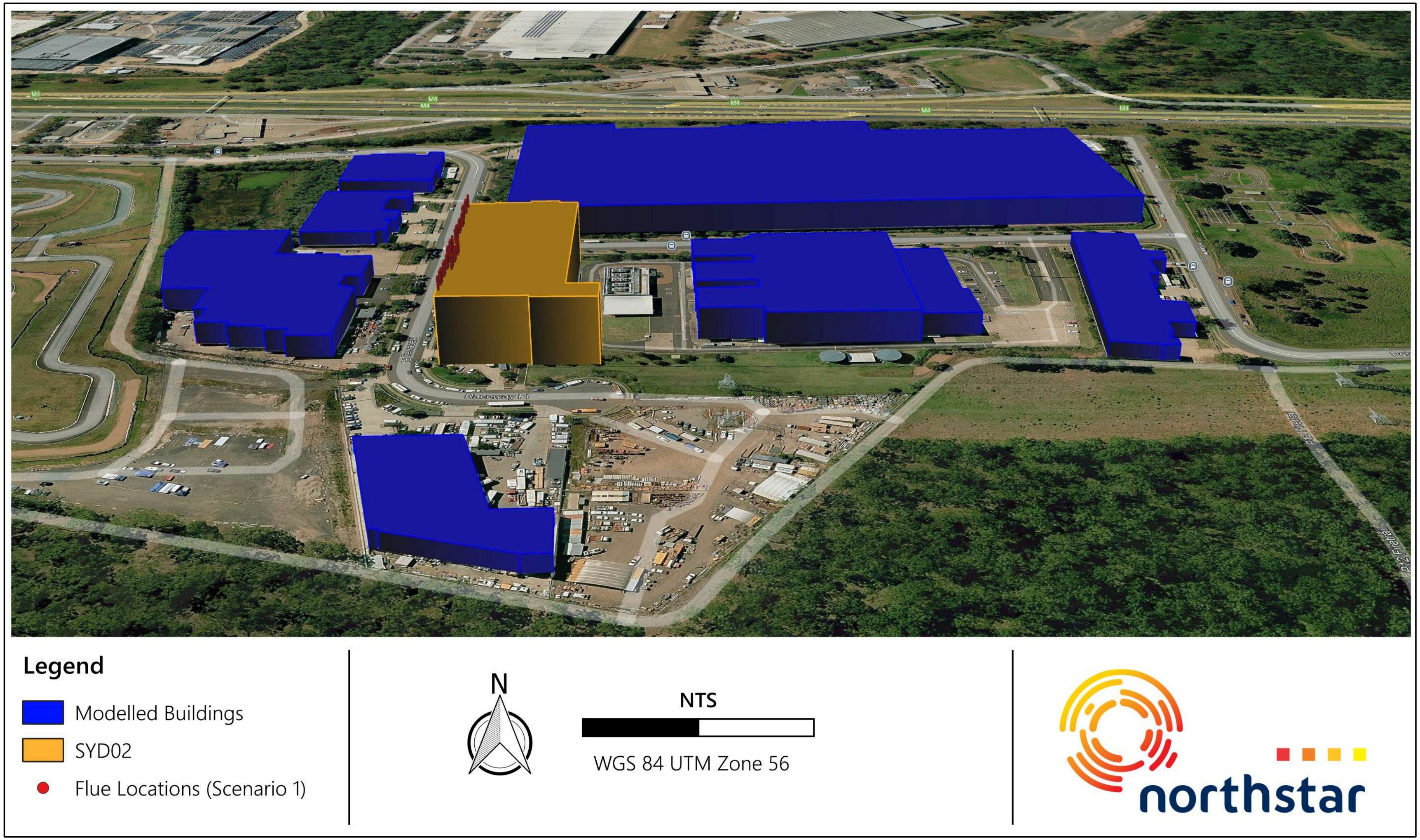
Therefore, to analyse downwash effects from point sources mimicking air emissions, the buildings surrounding the Project site were incorporated into the CALPUFF model.

With reference to the requirements outlined in the Approved Methods, Figure 8 illustrates the locations of the buildings included in the BPIP-PRIME model for downwash calculations, which are subsequently incorporated into the CALPUFF dispersion modelling process. Also shown are the emission discharge points for the scenario modelled (refer Section 5.2.2).

It is noted that the BPIP-PRIME model has a number of limitations. It identifies a single influencing building/tier for 36 wind directions, and depending on the wind direction, the algorithm selects the largest of the building width or length, which effectively overrides any intricacies in the buildings which may be presented in the model. The main components are the largest of the length, width and height of the building. Even with the adoption of tiered structures, the algorithm has analytical and logical relationships that merge buildings and ultimately calculate one effective width, length, height, and position to represent all buildings relative to the stack(s).

The BPIP-PRIME algorithm has been shown in some studies to result in the overprediction of concentrations by a factor two to eight for certain building types, whilst result in underpredictions for certain building and terrain configurations (Petersen, 2017). In conclusion, the use of the BPIP-PRIME algorithm is required by the NSW Approved Methods, although is not an advanced method, such as computational fluid dynamics, or wind tunnel modelling. Any minor disparities in building length, height, width and stack locations are most likely within the large margin of error associated with the use of the BPIP-PRIME algorithm.

Figure 8 Buildings and discharge points considered in dispersion modelling (Scenario 1)



Source: Northstar

5.2.2. Dispersion Modelling Scenario

One dispersion modelling has been completed to determine the potential impact under the anticipated operational conditions of the standby generators under emergency operations.

For the purpose of this AQIA, only the full-load emergency operation scenario of the standby generators has been modelled. Maintenance testing has not been explicitly assessed, as these activities are limited in duration and largely independent of the total number of generators (refer Section 2.3.2.1). Previous assessments (Todoroski Air Sciences, 2022; Todoroski Air Sciences, 2023) considered maintenance testing, with predicted cumulative concentrations of key criteria pollutants (NO_2, PM_{10} and $PM_{2.5}$) below relevant NSW impact assessment criteria.

For the Proposed Modification (MOD2), the maintenance schedule is anticipated to be similar to the approved Project. Accordingly, the exclusion of maintenance testing from this AQIA is acknowledged as a conservative limitation.

Further, dispersion modelling considers the proposed 52 generators only, as reflective of the Proposed Modification.

- **Scenario 1 – Emergency Operations** – Operating 52 generators at one time.
  - This represents an unlikely scenario, assumed to result from an unexpected power outage.
  - The Proposed Modification includes a total of 52 standby generator units supporting the critical IT load and associated operational functions.
  - The AQIA assesses cumulative air quality impacts from 42 IT generators operating at 85 % load and 10 mechanical generators at 80 % load. The modelling assumes full concurrent operation with no redundancy applied to provide a conservative estimate.
  - Each generator has been modelled as operating for all 8 760 hours of the meteorological year. Should a power outage event occur it is likely to be for a short-term period, and therefore the modelling presents a conservative assessment of the potential impacts.
  - As the standby generators are intended for short-duration use, only assessment against the short-term impact assessment criteria have been performed. Annual average concentrations are not presented, as results would be essentially meaningless.
  - The AQIA contextualises the likelihood of any exceedance of air quality criteria, considering the improbability of full-capacity operation through catastrophic failure.

5.2.3. Generator Emission Rates and Source Characteristics

As previously described in Section 2.3.2.1, this AQIA is based on US EPA Tier 2 emissions standards as representative of standby generators to be introduced for the Proposed Modification. The standby generators associated with the Proposed Modification will be housed within a four storey gantry building located on the western side of the Project site. A summary of the standby generator stack design parameters used in modelling the emergency operation scenario is provided in Table 10.

Table 10 Standby generator emissions and stack parameters

Parameter	Units	Scenario 1	
		Emergency operations	
Hour start	Hr	00:00	
Hour end	Hr	24:00	
Load Type	-	**IT**	**Mechanical**
% load	%	85	80
Standby generator model		**USEPA Tier 2 compatible**	
Number of generators active	no.	42	10
Diesel consumption rate (per generator)	$L \cdot hr^{-1}$	806 (a)	806 (a)
Power	kWe	1 530 (85 %)	1 440 (80 %)
Stack height (b)	m AGL	36.2	36.2
Stack diameter (b)	mm	700	700
Stack CSA	m^2	0.385	0.385
Exit temperature (b)	°C	308	308
Exit velocity	$m \cdot s^{-1}$	24.3	24.3
Generator emission specification			
NO_X (c)	$g \cdot kWh^{-1}$	6.08	6.08
CO (c)	$g \cdot kWh^{-1}$	3.50	3.50
TVOC (c)	$g \cdot kWh^{-1}$	0.32	0.32
PM (c)	$g \cdot kWh^{-1}$	0.20	0.20
Pollutant emission rates			
NO_X	$g \cdot s^{-1}$	2.58E+00	2.43E+00
CO	$g \cdot s^{-1}$	1.49E+00	1.40E+00
TVOC	$g \cdot s^{-1}$	1.36E-01	1.28E-01
PM (PM_{10} and $PM_{2.5}$) (d)	$g \cdot s^{-1}$	8.50E-02	8.00E-02
SO_2 (e)	$g \cdot s^{-1}$	9.52E-07	9.52E-07
Benzene (C_6H_6) (f)	$g \cdot s^{-1}$	1.32E-03	1.24E-03
Toluene (C_7H_8) (f)	$g \cdot s^{-1}$	4.76E-04	4.48E-04
Xylene (C_8H_{10}) (f)	$g \cdot s^{-1}$	3.32E-04	3.12E-04
PAH (f)	$g \cdot s^{-1}$	1.96E-08	1.84E-08
Formaldehyde (CH_2O) (f)	$g \cdot s^{-1}$	1.34E-04	1.26E-04

Notes: (a): Fuel consumption rate based on a similar sized generator unit ((MTU16V4000G23) (1 798 kW)).
(b): As supplied in an RFI request to LCI Consultants dated 22 September 2025.
(c): US EPA Tier 1-3 nonroad diesel engine emission standards (Kw ≥ 560 / Tier 2); https://dieselnet.com/standards/us/nonroad.php#tier3
(d): 100 % of PM is emitted as $PM_{2.5}$, and $PM_{2.5}$ = PM_{10}.
(e): Based on permissible level of sulphur content in non-road diesel fuel (5 ppm).
(f): Emission rates factored from TVOC using the emission factors from Table 43 of (NPI, 2008). Refer Section 5.2.5.

5.2.4. Calculated Standards of Concentrations

The anticipated in-stack emission concentrations for the proposed standby generators have been calculated based on the US EPA Tier 2 compliant engine emission standard. Emissions have been corrected to standard temperature and pressure (STP) conditions, dry gas, and 7 % oxygen (O_2) content to provide consistency with the POEO CAR reference conditions.

Note: Nitrogen dioxide (NO_2) is exempt from the standards of concentration under Clause 73, Part 5, Division 6 of the POEO CAR, as the standby generators are anticipated to operator under 200 hours per year (refer Section 3.2). Accordingly, NO_2 has not been included in Table 11.

Table 11 In-stack emissions concentrations for US EPA Tier 2 compliant engines

Parameter	USEPA Tier 2 compliant engine
VOCs	38.0
	415.7
Solid particles (total)	23.8

Note: The calculated actual volumetric flowrates were assumed to be at 9 % O_2 / wet gas.
These were converted to 7 % O_2 / dry gas.

A comparison against the respective POEO CAR standards of concentrations applicable for the Proposed Modification is provided in Section 7.3.

5.2.5. Speciated VOCs

To appropriately factor the emissions for benzene (C_6H_6), toluene (C_7H_8) and xylene (C_8H_{10}), reference has been made to the emission factors (EF) presented in table 43 of (NPI, 2008) which relate to stationary large (more than 450 kW) diesel engines. The emission factors for TVOC and the respective speciated VOCs have been factored to calculate the mass fractions of those species within TVOC. Table 12 presents the speciated VOC fraction assumptions that are used for this AQIA.

The impacts of odorants (toluene (C_7H_8) and xylene (C_8H_{10})) have been similarly assessed on a *pro-rata* basis as a fraction of TVOC, as published in the NPI (NPI, 2008) and multiplied by the measured source-specific TVOC emission rate.

Table 12 Speciated VOC fractions

Substance	EF % (of TVOC)
TVOC	100 %
Benzene (C_6H_6)	0.97 %
Toluene (C_7H_8) (odour)	0.35 %
Xylene (C_8H_{10}) (odour)	0.24 %

5.2.6. Particle Size Fractions

In regard to particulates from diesel, virtually 100 % of diesel particles are less than 1 µm in diameter (i.e. PM_1) and consequently particulates from diesel combustion are assessed as $PM_{2.5}$. In this AQIA, the emission rate of $PM_{2.5}$ is numerically identical to PM_{10}, as all PM_{10} particles are assessed as being ≤ 2.5 µm in diameter ($PM_{2.5}$).

5.2.7. NO_x to NO_2 Conversion

Emissions of NO_X have been calculated, with subsequent ground-level concentrations predicted using dispersion modelling techniques. Given that NO_X is a mixture of NO_2 and nitric oxide (NO), conversion of NO_X predictions to NO_2 concentrations is necessary to appropriately assess potential NO_2 impacts.

NO_X from a combustion process will be emitted as NO and NO_2. Over time and after the point of discharge, NO in ambient air will be transformed by secondary atmospheric reactions with atmospheric ozone (O_3) to form NO_2, and this reaction often occurs at a considerable distance downwind from the point of emission, and by which time the plume will have dispersed and diluted significantly from the concentration at point of discharge.

AQIAs need to account for the conversion of NO to NO_2 to enable a comparison against the air quality criteria for NO_2. The Approved Methods outlines various methods of assessment, which range from the simple to the more detailed. The three methods outlined in the Approved Methods are briefly outlined below:

- **Method 1 - 100 % conversion**: the most conservative assumption is to assume that 100 % of the total NO_X emitted is discharged as NO_2, and that further reactions do not occur.
- **Method 2 - Ozone limiting method (OLM)**: this method uses contemporaneous ozone data to estimate that rate at which NO is oxidised to NO_2 hour-on-hour using an established relationship.
- **Method 3 – Janssen method**: where the location is represented by good monitoring data for NO and NO_X, the empirical relationship between NO and NO_2 to derive 'steady state' relationships.

Section 8.1 of the Approved Methods outlines the approach to NO_2 assessment, which clearly indicates that each stage should be performed sequentially. That is, Method 1, Level 1 should be performed first and *"if the impact assessment criteria are exceeded, a more refined assessment should be undertaken and/or additional management practices or emission controls applied"*.

If exceedances are predicted, then Method 1, Level 2 should be performed, with the same assessment of the potential for exceedance of the 1-hour NO_2 criterion applied. The process then continues through Method 2 (Level 1 and Level 2), and Method 3 (Level 1 and Level 2).

This AQIA utilises Method 3 to approximate the conversion of NO_X to NO_2, in accordance with the empirical equation described in (NSW EPA, 2022):

$$NO_2 \ / \ NO_x = A(1 - \exp(-\alpha x))$$

Where:

x = distance from the source (km)

A and α are classified according to O_3 concentration, wind speed and season, with (Janssen, Van Wakeren, Van Duuren, & Elshout, 1988) providing values for A and α.

At each receptor, the hourly varying NO_2/NO_X relationship has been calculated, based on the season, hourly varying O_3 concentration, and wind speed. Results are presented in Section 7.1.2 and Section 8.2 for the maximum predicted incremental NO_X / NO_2 concentration and the maximum predicted cumulative NO_2 concentration using the relevant NO_X / NO_2 conversion method(s).

5.2.8. Short Term Pollutant Concentrations

With reference to criteria air pollutants with sub-hourly criteria (CO, refer Section 3.3), hourly dispersion model outputs have been adjusted using the following Power Law adjustment:

$$C_{p,t} = C_{p,60} \left[\frac{60}{t}\right]^{0.2}$$

Where:

$C_{p,t}$ = concentration of pollutant (p) at averaging time (mins) (t)

$C_{p,60}$ = concentration of pollutant (p) at averaging time (60 mins)

t = time (mins)

5.3. Assessment of Cumulative Impacts

The cumulative impact assessment (CIA) methodology adopted for this AQIA is based on the CIA Guidelines (NSW DPIE, 2022), which recognise that cumulative assessments can be carried out at either a strategic or project level.

This AQIA represents a Project-level CIA, following the approach outlined in the CIA Guidelines. These Guidelines define cumulative impacts as those arising from the incremental, sustained, and combined effects of human actions and natural variations over time, which may be either adverse or beneficial. Such impacts can result from the compounding impacts of a single project or multiple projects in an area, and from the accumulation of impacts associated with past, present, and foreseeable future activities.

As noted in the CIA Guidelines (NSW DPIE, 2022):

> *"The cumulative impact assessment undertaken for a particular State significant projects are to be proportionate to the scale and potential significance of the cumulative impacts of the project combined with the impacts of other relevant future projects. This assessment is to focus on the key matters that could be materially affected by the cumulative impacts of the project and other relevant future projects - not on every conceivable cumulative impact on every matter."*

5.3.1. Assessment Approach

The methodology for the CIA involved the following steps:

- Identification of relevant future projects, based on publicly available information, and the associated issues that could contribute to cumulative impacts, using the screening criteria outlined in Section 3.4 of the CIA Guidelines;
- Determination of the applicable level of assessment (detailed, standard, or not applicable) for air quality matters, in accordance with Appendix B of the CIA Guidelines;
- Identification of the proposed approach and key uncertainties associated with assessing cumulative impacts; and
- Assessment and evaluation of cumulative impacts, including the recommendation of mitigation and management measures, where appropriate, to minimise the Proposed Modification's contribution to those impacts.

In consultation with NSW EPA, two additional developments in the locality (though not data centres) were identified for consideration in the cumulative impact assessment. While not originally scoped, their potential for concurrent emissions was assessed qualitatively in accordance with the CIA Guidelines.

5.3.2. Study Area and Scope

The study area for the CIA assessment aligns with the dispersion modelling domain (refer Appendix C). This approach is consistent with section 2.3 of the CIA Guidelines, which state:

> *"This assessment need only focus on the key matters that are within the immediate geographical area of influence of the project (i.e. within proximity to the project site) and within the relevant strategic context. It is not practical or reasonable to require proponents to assess cumulative impacts for all matters or across large areas."*

The scope of assessment includes:

- Review of the nature and scale of potential air quality impacts anticipated during the Proposed Modification's timeframe, based on publicly available planning documents for relevant future proposals;
- Evaluation of the potential for cumulative air quality impacts arising from these identified projects in combination with the Proposed Modification, including dust generation and gaseous emissions during construction, and gaseous emissions during operation; and,
- Identification and recommendation of mitigation measures, where necessary.

The assessment of cumulative impacts from this Proposed Modification and other nearby relevant sources is presented in Section 7.4.

6. CONSTRUCTION PHASE RISK ASSESSMENT

Northstar have adapted the methodology from the IAQM construction dust guidance (IAQM, 2024) to assess construction phase risk. This approach employed a six-step process to evaluate the risks associated with dust impact from construction activities (refer Appendix B). It considers receptor sensitivity and potential impact magnitude to identify key control measures, as detailed in Section 5.1.

6.1. Risk (Pre-Mitigation)

Given the sensitivity of the identified receptors is classified as medium for dust soiling, and low for health impacts, and the dust emission magnitudes for the various construction phase activities as presented in Appendix B, the resulting risk of air quality impacts (without mitigation) is as presented in Table 13.

Table 13 Risk of air quality impacts from construction activities

Sensitivity of area	Dust emission magnitude					Preliminary risk				
	Demolition	Earthworks	Construction	Track-out	Const. traffic	Demolition	Earthworks	Construction	Track-out	Const. traffic
Dust soiling										
Med.	Med.	Small	Med.	Med.	Med.	Med	Low.	Med.	Med.	Med.
Human health										
Low	Med.	Small	Med.	Med.	Med.	Low	Neg.	Low	Low	Low

Note: Med. = Medium, N/A. = Not Applicable, Neg. = Negligible

Table 13 shows that dust soiling impacts are considered a low risk for earthworks and a medium risk for all other construction activities, assuming no mitigation measures are in place to control emissions during the construction phase.

Table 13 shows that human health impacts are considered a negligible risk for earthworks and a low risk for all other construction activities, assuming no mitigation measures are in place to control emissions during the construction phase.

Notwithstanding, the mitigation measures in Appendix B are aligned with the Proposed Modification's risks and should be applied throughout the construction phase to effectively manage construction dust.

6.2. Risk (Post-Mitigation)

The adapted methodology emphasises the aim of preventing significant effects on receptors during construction activities through the implementation of effective mitigation measures. Experience demonstrates that achieving this goal is feasible. Considering the size of the Project site, the distance to sensitive receptors, and the nature of activities involved, residual impacts related to fugitive dust emissions from the Proposed Modification are anticipated to be 'negligible' if the mitigation measures outlined in Appendix B are implemented appropriately.

7. OPERATIONAL PHASE IMPACT ASSESSMENT

This section presents the results of the dispersion modelling assessment and uses the following terminology:

- **Incremental impact** – relates to the concentrations predicted as a result of the operation of the Proposed Modification in isolation.
- **Cumulative impact** – relates to the incremental concentrations predicted as a result of the operation of the Proposed Modification PLUS the background air quality concentrations discussed in Section 4.4.

The results are presented in this manner to allow examination of the likely impact of the facility in isolation and the contribution to air quality impacts in a broader sense. In the presentation of results, the tables included shaded cells which represent the following:

Model prediction	Pollutant concentration / deposition rate less than the relevant criterion	Pollutant concentration / deposition rate equal to, or greater than the relevant criterion

As discussed in Section 5.2.2, only the emergency scenario has been assessed and the results presented in the following sections.

7.1. Scenario 1 – Justified Worst-Case (Emergency Operations)

The following presents modelling results for Scenario 1 (refer Section 5.2.2), which assumes 52 stand-by generators are operating (42 IT generators at 85 % load and 10 mechanical generators at 80 % load), with background pollutant concentrations included where appropriate (refer Section 4.4). Results in this section are focused on short term criteria only (i.e. ≤ 24 hours).

Note: Care should be taken when interpreting 24-hour average impacts, as power outages are typically much shorter in duration. The assessment adopts a conservative approach by assuming generator operation over a full 24-hour period. Comparison against annual average criteria is not meaningful in this context given that generator use is limited to occasional, short-term operation during emergency scenarios.

7.1.1. Particulate Matter

Results are presented in this section for the predictions of particulate matter (PM_{10} and $PM_{2.5}$) associated with Scenario 1. The averaging periods associated with the criteria for these pollutants is 24-hour as specified in

Table 4. The emissions adopted for Scenario 1 reflect the operational profile of the Proposed Modification over that averaging period (refer Section 5.2.2).

7.1.1.1. Daily (24-Hour) PM_{10} and $PM_{2.5}$ Concentrations

Table 14 shows the predicted 24-hour PM_{10} and $PM_{2.5}$ concentrations at the considered receptors under Scenario 1. No background concentrations are included within this table.

Table 14 Predicted incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations – Scenario 1

Receptor	Maximum incremental 24-hour average concentration (µg·m^{-3})	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
Max. % of criterion	202.4	404.8
R1	26.7	26.7
R2	101.2	101.2
R3	43.5	43.5
R4	38.2	38.2
R5	8.7	8.7
R6	20.0	20.0
R7	9.7	9.7
R8	4.0	4.0
R9	11.9	11.9
R10	20.5	20.5
R11	10.6	10.6
R12	13.6	13.6
R13	6.2	6.2
R14	11.5	11.5
R15	8.0	8.0
R16	12.0	12.0
R17	7.4	7.4
R18	8.1	8.1
R19	6.5	6.5
R20	3.6	3.6
R21	4.0	4.0
R22	8.0	8.0
R23	4.7	4.7
R24	4.3	4.3
R25	5.5	5.5
R26	3.5	3.5
R27	2.8	2.8
R28	2.3	2.3

Receptor	Maximum incremental 24-hour average concentration (µg·m^{-3})	
	PM_{10}	$PM_{2.5}$
R29	3.0	3.0
R30	16.6	16.6
R31	6.1	6.1
R32	3.9	3.9
R33	2.4	2.4
R34	2.0	2.0
R35	1.9	1.9
R36	2.2	2.2
R37	4.3	4.3
R38	10.5	10.5
R39	1.8	1.8
R40	2.3	2.3
R41	2.4	2.4
R42	2.0	2.0
R43	4.9	4.9
R44	3.2	3.2
R45	1.4	1.4
R46	4.7	4.7
R47	2.2	2.2
R48	3.9	3.9
R49	2.5	2.5
R50	10.1	10.1
R51	2.6	2.6
R52	4.9	4.9
R53	3.3	3.3
R54	7.6	7.6
R55	2.7	2.7
R56	3.1	3.1

Note: All PM is assumed to be < 1 µm in diameter and therefore assessed as $PM_{2.5}$. In this instance, emissions of $PM_{2.5}$ will be the same as PM_{10} ($PM_{2.5}$ is a subset of PM_{10}) and therefore the results will be consistent between PM_{10} and $PM_{2.5}$.

Note: care must be applied when assessing 24-hour average impacts as the likely duration of a power outage event is likely to be significantly less than 24-hours, and as such the assessment should be considered to be highly conservative (i.e. reflective of the operation of back-up generators for an entire 24-hour period).

Table 14 indicates that the highest 24-hour average PM_{10} and $PM_{2.5}$ incremental concentrations related to the Proposed Modification are predicted at receptor R2.

A contemporaneous analysis of the 24-hour PM_{10} and $PM_{2.5}$ data has been performed where each predicted incremental concentration is added to the corresponding monitored background concentration, in accordance with Section 11.2.3(b) of the Approved Methods.

Table 15 and Table 16 present the predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the Proposed Modification through Scenario 1, with the corresponding background included for each day. Results are presented in Table 15 and Table 16 for those receptors at which the greatest impacts have been predicted (refer Table 14).

The left side of the tables show the predicted maximum cumulative impacts (typically the days with the highest regional background), and the right side shows the total predicted concentration on days with the highest predicted incremental concentrations respectively.

For both PM_{10} and $PM_{2.5}$, the maximum cumulative impact (the left-hand side of Table 15 and Table 16) and the highest maximum incremental impact (the right-hand side of Table 15 and Table 16) is predicted at receptor R2. Both tables highlight that exceedances of the respective air quality criteria are primarily driven by the additional of incremental impacts to background concentrations.

A contour isopleth plot of the predicted incremental 24-hour PM_{10} concentrations associated with the Proposed Modification under Scenario 1 are presented in Figure 9 to illustrate the spatial distribution of particulate matter in the area surrounding the Project site.

The number of additional exceedances of the 24-hour PM_{10} and $PM_{2.5}$ criteria predicted at various receptors resulting from emergency generator operation is presented in Section 7.2.

Further analysis and interpretation of the above predictions are discussed in Section 8.2.

Table 15 Summary of contemporaneous 24-hour PM_{10} concentrations – Scenario 1

Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) – Receptor R2			Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) – Receptor R2		
	Incr.	Bkg.	Cumul.		Incr.	Bkg.	Cumul.
21-08-21	84.1	42.4	126.5	15-07-21	101.2	14.7	115.9
20-04-21	75.4	42.3	117.7	13-07-21	92.6	12.2	104.8
15-07-21	101.2	14.7	115.9	27-07-21	90.4	11.2	101.6
13-07-21	92.6	12.2	104.8	04-09-21	89.6	13.2	102.8
04-09-21	89.6	13.2	102.8	21-08-21	84.1	42.4	126.5
27-07-21	90.4	11.2	101.6	28-07-21	80.6	10.8	91.4
08-03-21	71.7	23.9	95.6	08-06-21	79.2	10.9	90.1
28-07-21	80.6	10.8	91.4	11-08-21	76.3	13.2	89.5
08-06-21	79.2	10.9	90.1	02-07-21	75.6	12.2	87.8
11-08-21	76.3	13.2	89.5	20-04-21	75.4	42.3	117.7
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the Proposed Modification.				These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the Proposed Modification.			

Notes: Incr. – Incremental, Bkg. – Background, - Cumul. – Cumulative.

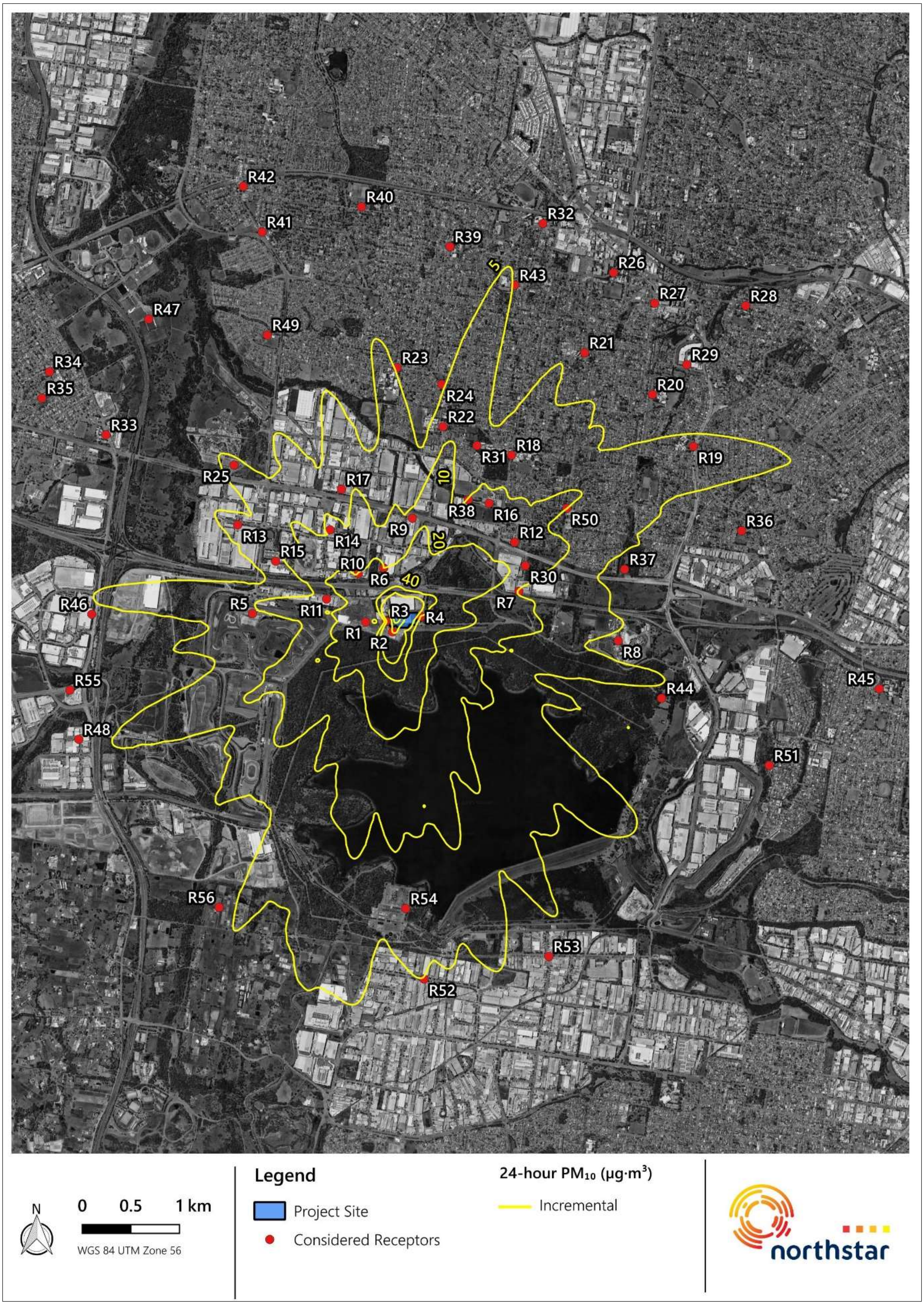
Table 16 Summary of contemporaneous 24-hour $PM_{2.5}$ concentrations – Scenario 1

Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) – Receptor R2			Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) – Receptor R2		
	Incr.	Bkg.	Cumul.		Incr.	Bkg.	Cumul.
21-08-21	84.1	37.3	121.4	15-07-21	101.2	6.0	107.2
15-07-21	101.2	6.0	107.2	13-07-21	92.6	6.6	99.2
13-07-21	92.6	6.6	99.2	27-07-21	90.4	4.2	94.6
27-07-21	90.4	4.2	94.6	04-09-21	89.6	5.0	94.6
04-09-21	89.6	5.0	94.6	21-08-21	84.1	37.3	121.4
20-04-21	75.4	12.6	88.0	28-07-21	80.6	3.5	84.1
08-06-21	79.2	5.4	84.6	08-06-21	79.2	5.4	84.6
28-07-21	80.6	3.5	84.1	11-08-21	76.3	5.1	81.4
02-07-21	75.6	7.7	83.3	02-07-21	75.6	7.7	83.3
22-08-21	67.1	14.8	81.9	20-04-21	75.4	12.6	88.0
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the Proposed Modification.				These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the Proposed Modification.			

Notes: Incr. – Incremental, Bkg. – Background, - Cumul. – Cumulative.

Note: care must be applied when assessing 24-hour average impacts as the likely duration of a power outage event is likely to be significantly less than 24-hours, and as such the assessment should be considered to be highly conservative (i.e. reflective of the operation of back-up generators for an entire 24-hour period).

Figure 9 Predicted incremental 24-hour PM_{10} impacts – Scenario 1



Source: Northstar

7.1.2. Nitrogen Dioxide

Results are presented in this section for the predictions of nitrogen dioxide (NO_2) under the assumptions of Scenario 1 (refer Section 5.2.2). The averaging period associated with the criterion for NO_2 is 1-hour as specified in Table 4. Note that impacts have not been compared with the annual average criterion for NO_2 as the generators would not be operating for an entire year, and the results would be meaningless.

Emissions of NO_X have been calculated with subsequent ground-level concentrations predicted using dispersion modelling techniques. Given that NO_X is a mixture of NO_2 and nitric oxide (NO), conversion of NO_X predictions to NO_2 concentrations may be performed. Within this assessment, the Janssen method (Method 3) has been adopted as outlined in Section 5.2.7.

The predicted 1-hour average NO_2 concentrations resulting from the Proposed Modification's operations and using the Janssen method under Scenario 1 are presented in Table 17.

Table 17 Predicted 1-hour NO_2 concentrations – Scenario 1

Receptor	Nitrogen dioxide (NO_2) concentration ($\mu g \cdot m^{-3}$)		
	1-hour average		
	Incremental impact	Background	Cumulative impact
Criterion	164		
Max % of criterion	91.7	40.0	107.8
R1	59.2	6.2	65.3
R2	63.4	<0.1	63.5
R3	23.2	8.2	31.4
R4	90.9	4.1	95.0
R5	95.7	4.1	99.8
R6	70.1	34.9	104.9
R7	139.8	30.8	170.6
R8	94.9	12.3	107.2
R9	87.3	22.6	109.8
R10	65.4	8.2	73.6
R11	86.8	8.2	95.0
R12	150.4	12.3	162.7
R13	86.2	8.2	94.4
R14	72.9	8.2	81.1
R15	69.5	24.6	94.1
R16	104.2	49.2	153.4
R17	93.9	8.2	102.1
R18	109.3	53.3	162.6
R19	111.0	24.6	135.6
R20	109.0	28.7	137.7
R21	98.3	53.3	151.6

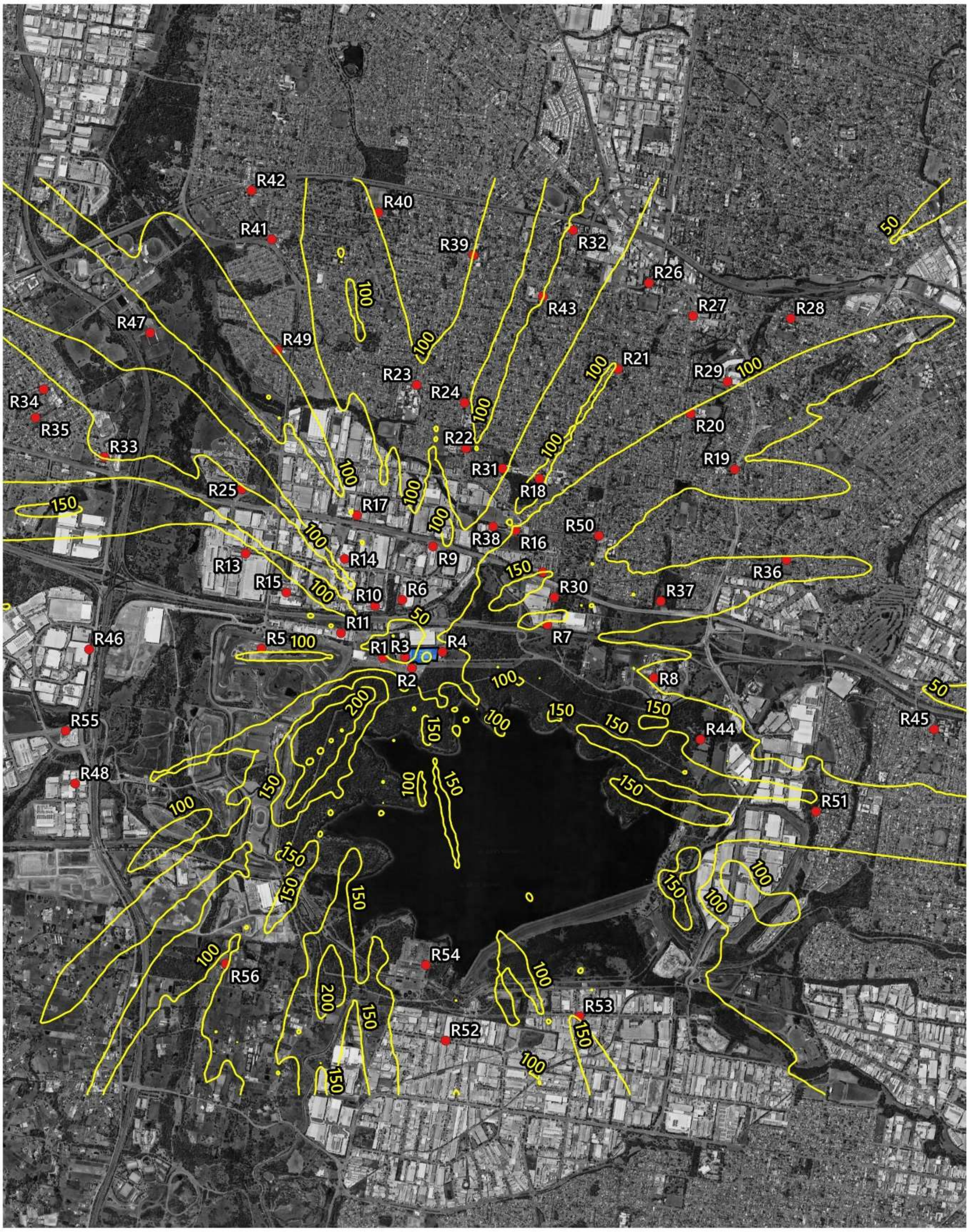
Receptor	Nitrogen dioxide (NO_2) concentration ($\mu g \cdot m^{-3}$)		
	1-hour average		
	Incremental impact	Background	Cumulative impact
R22	113.5	39.0	152.5
R23	106.4	41.0	147.4
R24	104.3	39.0	143.3
R25	94.5	8.2	102.7
R26	87.2	53.3	140.5
R27	71.8	26.7	98.4
R28	57.3	26.7	83.9
R29	81.5	28.7	110.2
R30	122.0	43.1	165.1
R31	110.3	32.8	143.1
R32	100.6	12.3	112.9
R33	101.9	8.2	110.1
R34	78.2	41.0	119.2
R35	85.3	41.0	126.3
R36	106.8	26.7	133.5
R37	112.3	30.8	143.0
R38	86.2	65.6	151.8
R39	101.1	16.4	117.5
R40	96.6	41.0	137.6
R41	68.9	6.2	75.0
R42	74.6	6.2	80.7
R43	97.8	24.6	122.4
R44	135.6	2.1	137.6
R45	58.4	28.7	87.1
R46	66.8	14.4	81.1
R47	83.1	8.2	91.3
R48	71.1	10.3	81.4
R49	98.5	8.2	106.7
R50	109.0	22.6	131.6
R51	130.8	30.8	161.5
R52	137.3	12.3	149.6
R53	146.1	30.8	176.8
R54	123.3	<0.1	123.4
R55	65.8	14.4	80.1
R56	94.2	10.3	104.5

The results indicate that there are three additional exceedances associated with cumulative concentrations of NO_2 under Scenario 1.

Figure 10 presents a contour plot of the predicted 1-hour incremental NO_2 impacts for Scenario 1, based on the Janssen method for converting NO_X to NO_2 (refer Section 5.2.7).

The number of additional exceedances of the 1-hour NO_2 criterion predicted at each receptor resulting from emergency generator operation is presented in Section 7.2. These values are discussed further in Section 8.2.

Figure 10 Predicted incremental 1-hour NO_2 impacts – Scenario 1



Legend
Project Site
Considered Receptors

1-hour NO_2 ($\mu g \cdot m^3$)
Incremental

N
0 0.5 1 km
WGS 84 UTM Zone 56

northstar

Source: Northstar

7.1.3. All Other Pollutants

The following presents the predicted concentrations associated with Scenario 1 for all other pollutants assessed in this AQIA (refer Section 5.2.2).

Presented in Table 18 to Table 20 are the predicted concentrations of CO, SO_2, PAHs, VOCs and formaldehyde at varying averaging periods (≤ 24 hours) at the surrounding receptors.

Note: care must be applied when assessing 24-hour average impacts as the likely duration of a power outage event is likely to be significantly less than 24-hours, and as such the assessment should be considered to be highly conservative (i.e. reflective of the operation of back-up generators for an entire 24-hour period).

The predicted cumulative concentrations for CO are below the relevant criteria for all averaging periods at all receptors as shown in Table 18.

The results presented in Table 19 indicate that predicted incremental impacts of SO_2 at all receptors are less than 1 % of the relevant criteria for all averaging periods. The addition of background concentrations does not result in any exceedances at any receptor.

Results in Table 20 indicate no exceedances of the 1-hour criteria for benzene are predicted at any identified receptors. The maximum predicted impact for benzene is experienced at receptor R2 (8.5 % of the relevant criterion).

Figure 11 presents a contour plot of the predicted maximum 1-hour incremental benzene impact under Scenario 1.

Table 18 Predicted 15-minutes, 1-hour and 8-hour average CO concentrations – Scenario 1

Receptor	Carbon monoxide (CO) concentration (mg·m^{-3})								
	15-minute			1-hour			8-hour		
	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.
Criterion	100			30			10		
Max. % of criterion	4.4	2.1	6.5	11.2	5.3	16.5	25.1	12.0	37.1
R1	1.1	2.1	3.2	0.9	1.6	2.5	0.7	1.2	1.9
R2	4.4	2.1	6.5	3.4	1.6	5.0	2.5	1.2	3.7
R3	1.6	2.1	3.7	1.2	1.6	2.8	1.1	1.2	2.3
R4	2.2	2.1	4.3	1.7	1.6	3.3	1.3	1.2	2.5
R5	0.5	2.1	2.6	0.4	1.6	2.0	0.3	1.2	1.5
R6	1.8	2.1	3.9	1.3	1.6	2.9	0.8	1.2	2.0
R7	1.3	2.1	3.4	1.0	1.6	2.6	0.6	1.2	1.8
R8	0.5	2.1	2.6	0.4	1.6	2.0	0.2	1.2	1.4
R9	1.0	2.1	3.1	0.8	1.6	2.4	0.5	1.2	1.7
R10	1.5	2.1	3.6	1.1	1.6	2.7	0.6	1.2	1.8
R11	1.5	2.1	3.6	1.2	1.6	2.8	0.5	1.2	1.7

Receptor	Carbon monoxide (CO) concentration (mg·m^{-3})								
	15-minute			1-hour			8-hour		
	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.
R12	1.8	2.1	3.9	1.4	1.6	3.0	0.7	1.2	1.9
R13	0.6	2.1	2.7	0.4	1.6	2.0	0.2	1.2	1.4
R14	0.8	2.1	2.9	0.6	1.6	2.2	0.4	1.2	1.6
R15	0.6	2.1	2.7	0.5	1.6	2.1	0.3	1.2	1.5
R16	1.3	2.1	3.4	0.9	1.6	2.5	0.4	1.2	1.6
R17	0.8	2.1	2.9	0.6	1.6	2.2	0.4	1.2	1.6
R18	0.7	2.1	2.8	0.5	1.6	2.1	0.3	1.2	1.5
R19	1.1	2.1	3.2	0.8	1.6	2.4	0.3	1.2	1.5
R20	0.4	2.1	2.5	0.3	1.6	1.9	0.1	1.2	1.3
R21	0.4	2.1	2.5	0.3	1.6	1.9	0.2	1.2	1.4
R22	0.7	2.1	2.8	0.6	1.6	2.2	0.4	1.2	1.6
R23	0.6	2.1	2.7	0.4	1.6	2.0	0.3	1.2	1.5
R24	0.6	2.1	2.7	0.4	1.6	2.0	0.2	1.2	1.4
R25	0.5	2.1	2.6	0.4	1.6	2.0	0.2	1.2	1.4
R26	0.4	2.1	2.5	0.3	1.6	1.9	0.2	1.2	1.4
R27	0.4	2.1	2.5	0.3	1.6	1.9	< 0.1	1.2	1.3
R28	0.3	2.1	2.4	0.2	1.6	1.8	< 0.1	1.2	1.3
R29	0.4	2.1	2.5	0.3	1.6	1.9	0.1	1.2	1.3
R30	1.1	2.1	3.2	0.9	1.6	2.5	0.5	1.2	1.7
R31	0.8	2.1	2.9	0.6	1.6	2.2	0.3	1.2	1.5
R32	0.4	2.1	2.5	0.3	1.6	1.9	0.2	1.2	1.4
R33	0.4	2.1	2.5	0.3	1.6	1.9	0.1	1.2	1.3
R34	0.3	2.1	2.4	0.2	1.6	1.8	0.1	1.2	1.3
R35	0.3	2.1	2.4	0.2	1.6	1.8	0.1	1.2	1.3
R36	0.4	2.1	2.5	0.3	1.6	1.9	0.1	1.2	1.3
R37	0.6	2.1	2.7	0.5	1.6	2.1	0.2	1.2	1.4
R38	0.8	2.1	2.9	0.6	1.6	2.2	0.5	1.2	1.7
R39	0.4	2.1	2.5	0.3	1.6	1.9	0.1	1.2	1.3
R40	0.3	2.1	2.4	0.3	1.6	1.9	0.1	1.2	1.3
R41	0.2	2.1	2.3	0.2	1.6	1.8	0.1	1.2	1.3
R42	0.2	2.1	2.3	0.2	1.6	1.8	< 0.1	1.2	1.3
R43	0.4	2.1	2.5	0.3	1.6	1.9	0.3	1.2	1.5
R44	0.6	2.1	2.7	0.4	1.6	2.0	0.2	1.2	1.4
R45	0.2	2.1	2.3	0.1	1.6	1.7	< 0.1	1.2	1.3
R46	0.3	2.1	2.4	0.2	1.6	1.8	0.2	1.2	1.4
R47	0.4	2.1	2.5	0.3	1.6	1.9	0.1	1.2	1.3
R48	0.2	2.1	2.3	0.2	1.6	1.8	0.1	1.2	1.3
R49	0.4	2.1	2.5	0.3	1.6	1.9	0.2	1.2	1.4
R50	1.3	2.1	3.4	0.9	1.6	2.5	0.5	1.2	1.7

Receptor	Carbon monoxide (CO) concentration (mg·m^{-3})								
	15-minute			1-hour			8-hour		
	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.
R51	0.5	2.1	2.6	0.3	1.6	1.9	0.1	1.2	1.3
R52	0.5	2.1	2.6	0.4	1.6	2.0	0.2	1.2	1.4
R53	0.6	2.1	2.7	0.4	1.6	2.0	0.2	1.2	1.4
R54	0.5	2.1	2.6	0.4	1.6	2.0	0.2	1.2	1.4
R55	0.3	2.1	2.4	0.2	1.6	1.8	0.1	1.2	1.3
R56	0.4	2.1	2.5	0.3	1.6	1.9	0.2	1.2	1.4

Notes: Incr. – Incremental, Bkg. – Background, - Cumul. – Cumulative.

Table 19 Predicted 1-hour and 24-hour SO_2 concentrations – Scenario 1

Receptor	Sulphur dioxide (SO_2) concentration (µg·m^{-3})					
	1-hour			24-hour		
	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.
Criterion	215			57		
Max. % of criterion	< 0.1	20.0	20.0	< 0.1	13.9	13.9
R1	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R2	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R3	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R4	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R5	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R6	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R7	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R8	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R9	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R10	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R11	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R12	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R13	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R14	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R15	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R16	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R17	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R18	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R19	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R20	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R21	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R22	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R23	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R24	< 0.1	42.9	43.0	< 0.1	7.9	8.0

Receptor	Sulphur dioxide (SO_2) concentration (µg·m^{-3})					
	1-hour			24-hour		
	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.
R25	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R26	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R27	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R28	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R29	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R30	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R31	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R32	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R33	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R34	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R35	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R36	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R37	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R38	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R39	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R40	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R41	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R42	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R43	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R44	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R45	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R46	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R47	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R48	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R49	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R50	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R51	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R52	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R53	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R54	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R55	< 0.1	42.9	43.0	< 0.1	7.9	8.0
R56	< 0.1	42.9	43.0	< 0.1	7.9	8.0

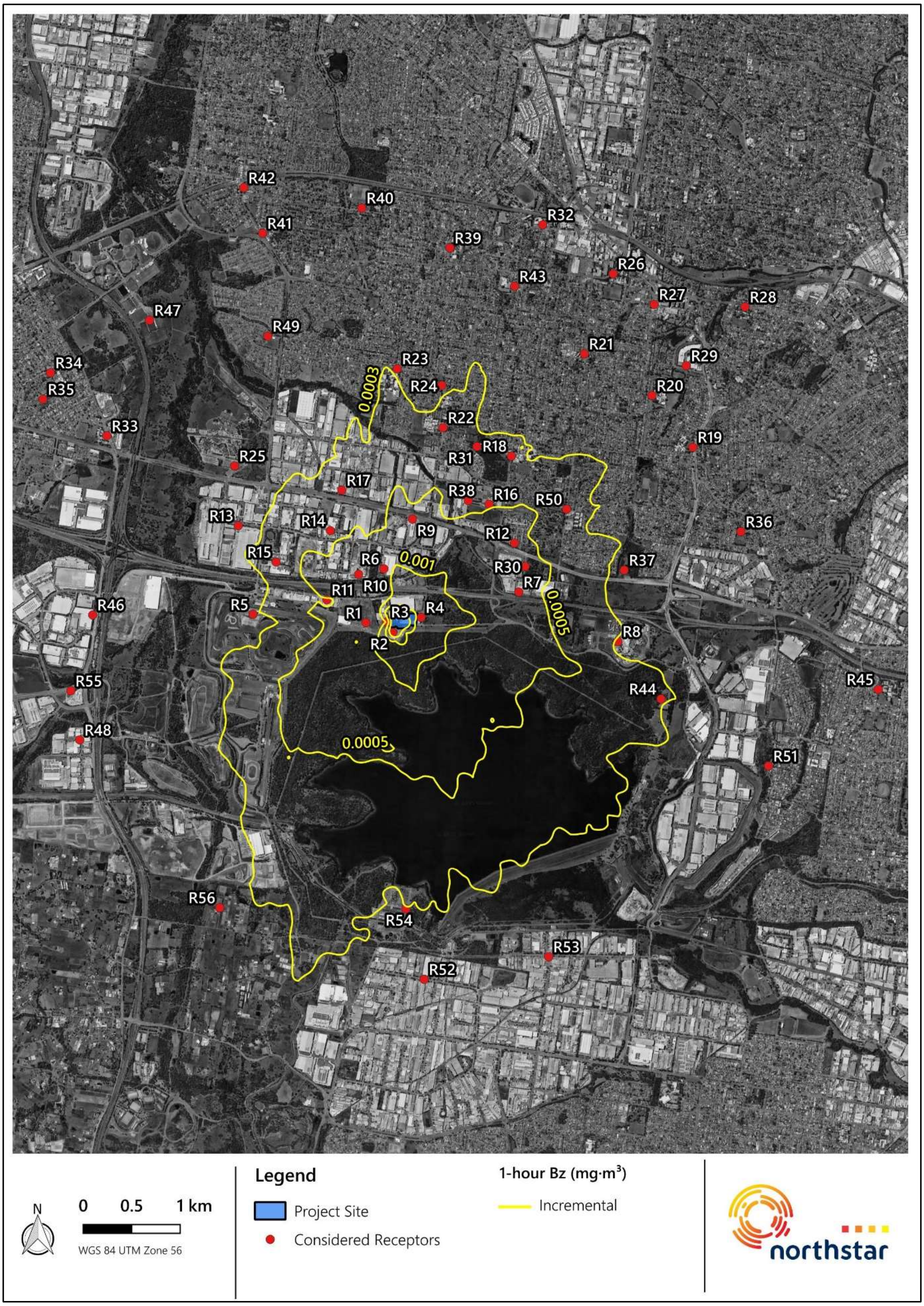
Notes: Incr. – Incremental, Bkg. – Background, - Cumul. – Cumulative.

Table 20 Predicted incremental 1-hour PAH, benzene, toluene, xylene and formaldehyde concentrations – Scenario 1

Receptor	Predicted 1-hour (99.9th %ile) average concentration ($mg \cdot m^{-3}$)				
	PAH	Benzene	Toluene (odour)	Xylene (odour)	Formaldehyde
Criterion	0.0004	0.029	0.36	0.19	0.02
Max. % of criterion	< 0.1	8.5	0.2	0.3	1.3
R1	1.00E-08	6.76E-04	2.44E-04	1.70E-04	6.87E-05
R2	3.68E-08	2.48E-03	8.94E-04	6.23E-04	2.51E-04
R3	1.53E-08	1.03E-03	3.71E-04	2.59E-04	1.04E-04
R4	2.02E-08	1.36E-03	4.92E-04	3.43E-04	1.38E-04
R5	4.14E-09	2.79E-04	1.01E-04	7.01E-05	2.83E-05
R6	1.13E-08	7.61E-04	2.75E-04	1.91E-04	7.73E-05
R7	1.00E-08	6.75E-04	2.44E-04	1.70E-04	6.85E-05
R8	4.24E-09	2.86E-04	1.03E-04	7.19E-05	2.90E-05
R9	8.64E-09	5.82E-04	2.10E-04	1.46E-04	5.91E-05
R10	9.13E-09	6.15E-04	2.22E-04	1.55E-04	6.24E-05
R11	7.35E-09	4.95E-04	1.79E-04	1.25E-04	5.03E-05
R12	8.45E-09	5.69E-04	2.05E-04	1.43E-04	5.78E-05
R13	3.78E-09	2.55E-04	9.19E-05	6.41E-05	2.59E-05
R14	6.70E-09	4.51E-04	1.63E-04	1.14E-04	4.58E-05
R15	5.53E-09	3.72E-04	1.34E-04	9.36E-05	3.78E-05
R16	7.01E-09	4.72E-04	1.70E-04	1.19E-04	4.79E-05
R17	5.47E-09	3.68E-04	1.33E-04	9.27E-05	3.74E-05
R18	4.91E-09	3.31E-04	1.19E-04	8.32E-05	3.36E-05
R19	3.14E-09	2.12E-04	7.64E-05	5.33E-05	2.15E-05
R20	2.51E-09	1.69E-04	6.10E-05	4.25E-05	1.72E-05
R21	3.09E-09	2.08E-04	7.52E-05	5.24E-05	2.11E-05
R22	5.51E-09	3.71E-04	1.34E-04	9.34E-05	3.77E-05
R23	4.04E-09	2.72E-04	9.82E-05	6.85E-05	2.76E-05
R24	3.96E-09	2.67E-04	9.63E-05	6.71E-05	2.71E-05
R25	3.58E-09	2.41E-04	8.70E-05	6.06E-05	2.45E-05
R26	2.67E-09	1.80E-04	6.48E-05	4.52E-05	1.82E-05
R27	1.81E-09	1.22E-04	4.41E-05	3.07E-05	1.24E-05
R28	1.56E-09	1.05E-04	3.80E-05	2.65E-05	1.07E-05
R29	2.09E-09	1.41E-04	5.08E-05	3.54E-05	1.43E-05
R30	8.47E-09	5.71E-04	2.06E-04	1.44E-04	5.80E-05
R31	4.83E-09	3.25E-04	1.17E-04	8.18E-05	3.30E-05
R32	2.84E-09	1.91E-04	6.90E-05	4.81E-05	1.94E-05
R33	2.32E-09	1.56E-04	5.64E-05	3.93E-05	1.59E-05
R34	2.00E-09	1.35E-04	4.86E-05	3.39E-05	1.37E-05
R35	1.86E-09	1.25E-04	4.52E-05	3.15E-05	1.27E-05

Receptor	Predicted 1-hour (99.9th %ile) average concentration (mg·m^{-3})				
	PAH	Benzene	Toluene (odour)	Xylene (odour)	Formaldehyde
R36	2.09E-09	1.41E-04	5.08E-05	3.54E-05	1.43E-05
R37	4.15E-09	2.80E-04	1.01E-04	7.04E-05	2.84E-05
R38	6.85E-09	4.61E-04	1.67E-04	1.16E-04	4.69E-05
R39	2.20E-09	1.48E-04	5.35E-05	3.73E-05	1.50E-05
R40	1.99E-09	1.34E-04	4.84E-05	3.37E-05	1.36E-05
R41	1.69E-09	1.14E-04	4.10E-05	2.86E-05	1.16E-05
R42	1.52E-09	1.03E-04	3.70E-05	2.58E-05	1.04E-05
R43	3.52E-09	2.37E-04	8.56E-05	5.96E-05	2.41E-05
R44	4.82E-09	3.25E-04	1.17E-04	8.17E-05	3.30E-05
R45	1.40E-09	9.45E-05	3.41E-05	2.38E-05	9.60E-06
R46	2.54E-09	1.71E-04	6.18E-05	4.31E-05	1.74E-05
R47	2.04E-09	1.37E-04	4.96E-05	3.46E-05	1.40E-05
R48	2.03E-09	1.37E-04	4.94E-05	3.44E-05	1.39E-05
R49	2.34E-09	1.57E-04	5.68E-05	3.96E-05	1.60E-05
R50	5.23E-09	3.52E-04	1.27E-04	8.87E-05	3.58E-05
R51	2.65E-09	1.78E-04	6.44E-05	4.49E-05	1.81E-05
R52	3.56E-09	2.40E-04	8.65E-05	6.03E-05	2.43E-05
R53	3.77E-09	2.54E-04	9.16E-05	6.38E-05	2.58E-05
R54	4.40E-09	2.97E-04	1.07E-04	7.46E-05	3.01E-05
R55	1.97E-09	1.33E-04	4.80E-05	3.34E-05	1.35E-05
R56	3.04E-09	2.05E-04	7.39E-05	5.15E-05	2.08E-05

Figure 11 Predicted 99.9th percentile incremental 1-hour benzene impacts – Scenario 1



Source: Northstar

7.2. Assessment of Criteria Exceedances

Presented in Table 21 is a summary of the number of additional exceedances of the short-term PM_{10}, $PM_{2.5}$ and NO_2 criteria predicted under Scenario 1 (justified worst case), and those values presented as a probability (*p*) (*p*=0 being impossible, *p*=1 being certain). These values are discussed further in Section 8.2.

Table 21 Assessment of the number of additional exceedances – Scenario 1

Receptor	Number of additional exceedances of the criterion			Probability that an exceedance is predicted in one year		
	24-hour PM_{10}	24-hour $PM_{2.5}$	1- hour NO_2	24-hour PM_{10}	24-hour $PM_{2.5}$	1- hour NO_2
R1	0	2	0	-	0.0055	-
R2	75	103	0	0.2055	0.2822	-
R3	4	24	0	0.0110	0.0658	-
R4	8	30	0	0.0219	0.0822	-
R5	0	0	0	-	-	-
R6	0	3	0	-	0.0082	-
R7	0	2	1	-	0.0055	0.0001
R8	0	1	0	-	0.0027	-
R9	0	2	0	-	0.0055	-
R10	1	3	0	0.0027	0.0082	-
R11	0	1	0	-	0.0027	-
R12	1	2	0	0.0027	0.0055	-
R13	0	1	0	-	0.0027	-
R14	0	1	0	-	0.0027	-
R15	0	2	0	-	0.0055	-
R16	0	2	0	-	0.0055	-
R17	0	1	0	-	0.0027	-
R18	0	1	0	-	0.0027	-
R19	0	1	0	-	0.0027	-
R20	0	1	0	-	0.0027	-
R21	0	0	0	-	-	-
R22	0	1	0	-	0.0027	-
R23	0	1	0	-	0.0027	-
R24	0	1	0	-	0.0027	-
R25	0	1	0	-	0.0027	-
R26	0	0	0	-	-	-
R27	0	0	0	-	-	-
R28	0	0	0	-	-	-
R29	0	0	0	-	-	-
R30	0	1	1	-	0.0027	0.0001
R31	0	1	0	-	0.0027	-
R32	0	0	0	-	-	-

Receptor	Number of additional exceedances of the criterion			Probability that an exceedance is predicted in one year		
	24-hour PM_{10}	24-hour $PM_{2.5}$	1- hour NO_2	24-hour PM_{10}	24-hour $PM_{2.5}$	1- hour NO_2
R33	0	1	0	-	0.0027	-
R34	0	1	0	-	0.0027	-
R35	0	1	0	-	0.0027	-
R36	0	1	0	-	0.0027	-
R37	0	1	0	-	0.0027	-
R38	0	2	0	-	0.0055	-
R39	0	0	0	-	-	-
R40	0	1	0	-	0.0027	-
R41	0	1	0	-	0.0027	-
R42	0	1	0	-	0.0027	-
R43	0	0	0	-	-	-
R44	0	1	0	-	0.0027	-
R45	0	1	0	-	0.0027	-
R46	0	0	0	-	-	-
R47	0	1	0	-	0.0027	-
R48	0	0	0	-	-	-
R49	0	1	0	-	0.0027	-
R50	0	2	0	-	0.0055	-
R51	0	1	0	-	0.0027	-
R52	0	1	0	-	0.0027	-
R53	0	1	1	-	0.0027	0.0001
R54	0	1	0	-	0.0027	-
R55	0	0	0	-	-	-
R56	0	0	0	-	-	-

Note: care must be applied when assessing 24-hour average impacts as the likely duration of a power outage event is likely to be significantly less than 24-hours, and as such the assessment should be considered to be highly conservative (i.e. relevant to the operation of back-up generators for an entire 24-hour period).

7.3. Comparison with POEO CAR Standards of Concentrations

Section 3.2 outlines the context of the POEO CAR and the emission standards applicable to activities and plants, categorised as scheduled or non-scheduled under the regulation. As detailed in Section 2.2 and Section 2.3, the Project on account of the Proposed Modification includes the following relevant characteristics:

- 52 diesel-fuelled standby generators;
- A maintenance testing regime anticipated to be less than 200 hours per year; and

- Diesel fuel storage capacity of up to 860 kL or approximately 735.9 t.

Clause 73, Part 5, Division 6 of the POEO CAR exempts emergency electricity generation using stationary reciprocal internal combustion engines from the air impurities standards for nitrogen dioxide (NO_2) and nitric oxide (NO) specified in Schedule 2, Part 2, Division 3, provided the engines operate for no more than 200 hours per year.

Based on the information presented in Section 2.3.2, non-scheduled activities for electricity generation and chemical storage under the POEO Act are to be conducted at the Project site. Notwithstanding, Table 22 below compares the emissions from individual data centre generators considered for the Proposed Modification against the respective concentration standards.

Table 22 POEO CAR – Standards of concentrations comparison

Air impurity	Standard of concentration ($mg{\cdot}m^{-3}$) (A)	Standby generator emissions ($mg{\cdot}m^{-3}$) (per generator)
Solid particles (Total)	100	23.8

Notes: (a) Standard of emissions concentration under dry, 273 K, 101.3 kPa, 7 % O_2 conditions

Table 22 shows that the respective concentration standards can be met with the use of US EPA Tier 2 emissions rated standby generators at the Project site.

7.4. Cumulative Impact Assessment

Table 23 presents an assessment of potential cumulative air quality impacts arising from the Proposed Modification in combination with other relevant emission sources, as identified in Section 4.6.

The assessment considers cumulative impacts on nearby sensitive receptors during both the construction and operational phases. This includes potential dust soiling and human health effects from overlapping construction activities, as well as operational impacts under grid outage scenarios, where emergency generators at the Project site and nearby facilities may operate concurrently which may also present limited potential for overlap.

While the CIA Guidelines recommend consideration of all relevant future projects, this assessment adopts a proportionate approach based on the status and likely influence of surrounding data centre developments. Background air quality data has been used to characterise existing ambient conditions, independent of the Proposed Modification. However, given the location of the Prospect AQMS (2.7 km from the Project site (refer Section 4.4)), and their separation from identified sources (refer Figure 7 and Table 8), emissions from some nearby operations, particularly those newly approved, under construction, or still in planning may not be fully representative in the adopted background dataset. Accordingly, all identified similar sources i.e. data centres are discussed in Table 23. Reference should be made to Section 8.3 which discusses the outcomes of the CIA.

Table 23 Local air pollutant sources with potential for cumulative impacts

Reference / Project Distance (km)	Project status / indicative timeframe / overlap	Potential overlap between impact of Proposed Modification on assessment matter and impact of other project on the same assessment matter	Potential cumulative risk
A) CDC Data Centre (SSD-10330) 17 Roberts Road, Eastern Creek 4.9 km Operational	The construction, fit-out, and operation of a data storage and distribution centre including associated infrastructure located on the eastern portion of the site was approved in December 2010 (Project reference: 10_0142). SSD-10330, approved in July 2020, involved the staged construction of a data centre development, including two office and administration buildings and four three-storey warehouse facilities. A total of 63 backup generators were approved, with a combined electrical generation capacity of 169 MW. The facility was constructed in stages, with complying development certificates obtained to allow commencement of operations in September 2020.	There is no potential for cumulative air quality impacts during construction, as this development is already constructed and operational.	The Proposed Modification does not result in cumulative air quality impacts during construction.
		In the event of a widespread grid outage affecting the area, it is likely that both facilities would be impacted simultaneously, triggering concurrent operation of backup generators. There is potential for cumulative operational impacts between this data centre (169 MW) and the Proposed Modification (63 MW). Generator testing to occur for approximately 20 minutes per session, between 9:00 am and 4:00 pm, two days per week, with no more than five generators tested per day (not necessarily concurrently). Total annual testing time is estimated at 174 hours or less. There is limited potential for cumulative impacts between the Proposed Modification and this project, if testing schedule overlaps, though this is considered unlikely due to limited duration and staggered operation.	The Proposed Modification is considered to result in significant cumulative air quality impacts under the emergency scenario. Most likely in winds with south westerly/westerly components. The large separation distance (~4.9 km) will further assist in the dispersion of pollutants reducing the ground level concentrations. Impacts may be limited in nature due to the large separation distance and frequency of conducive winds. The probability of concurrent power feeder failures is considered to be low.

Reference / Project Distance (km)	Project status / indicative timeframe / overlap	Potential overlap between impact of Proposed Modification on assessment matter and impact of other project on the same assessment matter	Potential cumulative risk
B) AWS SYD51 (SSD-47320208) 4.3 km 10 Eastern Creek Drive, Eastern Creek	Project consented in April 2024 for the construction and operation of a 35.2 MW data centre comprising data halls, mechanical and electrical plant rooms, office areas, secure entry points, a loading dock, and other ancillary spaces. The facility is to be supported by rooftop mechanical equipment, external backup generators, and water storage tanks. A total of 18 backup generators were proposed, which would be tested periodically, amounting to approximately 162 hours of operation across the site per year.	The project will be delivered as a single planning stage, constructed in two phases: Phase 1 with Initial construction and fit-out (data centre shell, admin areas) and Phase 2 with remaining internal fit-out, subject to demand. Construction is expected to take around two years, with Phase 1 spanning 18 months and Phase 2 an additional six months. A gap may occur between phases. Construction planned to start in early 2023.	The Proposed Modification is unlikely to result in significant cumulative impacts during construction, due to the physical separation between construction sites and the implementation of CEMPs with appropriate mitigation measures at each location.
		Up to three generators will be tested concurrently under the fortnightly no-load scenario, while quarterly and yearly tests (at 70 % and 100 % load, respectively) will involve one generator at a time. Total annual test runtime is estimated at 162 hours. As a mission-critical facility, the data centre includes 18 standby generators (2.8 MW each) to support critical loads. While there is limited potential for cumulative impacts if testing overlaps with the Proposed Modification, this is considered unlikely due to the short duration and staggered nature of testing. Similarly, due to large separation distance, under emergency conditions, concurrent operation of backup generators at this facility (35.2 MW) and the Proposed Modification (63 MW) are unlikely to have cumulative impacts.	The Proposed Modification is considered to result in significant cumulative air quality impacts under the emergency scenario. Most likely in winds with south westerly components. The large separation distance (~ 4.3 km) will further assist in the dispersion of pollutants reducing the ground level concentrations. Impacts may be limited in nature due to the large separation distance and frequency of conducive winds. The probability of concurrent power feeder failures is considered to be low.

Reference / Project Distance (km)	Project status / indicative timeframe / overlap	Potential overlap between impact of Proposed Modification on assessment matter and impact of other project on the same assessment matter	Potential cumulative risk
C) AWS SYD51 Data Centre 2.3 km 1 William Dean Drive, Eastern Creek	Limited public information available for this project	It is understood that this data centre is already constructed	The Proposed Modification does not result in cumulative air quality impacts during construction.
		There is no publicly available information on standby generator use, maintenance schedules, or the number of generators at this facility. While routine testing may present limited potential for cumulative impacts if it overlaps with the Proposed Modification, this is considered unlikely due to the short duration and staggered timing of activities. In the event of a widespread grid outage, however, concurrent operation of backup generators at this facility (unknown capacity) and the Proposed Modification (63 MW) could temporarily increase localised emissions.	The Proposed Modification is considered to result in significant cumulative air quality impacts. Most likely in winds with north-westerly components. It is noted that even under conducive wind conditions, there is absence of immediate downwind sensitive receptors (Prospect Reservoir). Impacts may be limited in nature due to the absence of downwind sensitive receptors distance and frequency of conducive winds. The probability of concurrent power feeder failures is considered to be low.
D) Airtrunk SYD03 Data Centre (SSD-41589232)	A total of 316 backup generators with a total capacity of 400 MW. The project was approved in September 2023.	There is no potential for cumulative air quality impacts during construction, as this development is already under construction, and unlikely to overlap with the Proposed Modification construction.	The Proposed Modification does not result in cumulative air quality impacts during construction.

Reference / Project Distance (km)	Project status / indicative timeframe / overlap	Potential overlap between impact of Proposed Modification on assessment matter and impact of other project on the same assessment matter	Potential cumulative risk
1.1 km 51 Huntingwood Drive, Huntingwood	It is understood that the site is under construction at the time of writing this report.	While routine testing may present limited potential for cumulative impacts if it overlaps with the Proposed Modification, this is considered unlikely due to the short duration and staggered timing of activities. In the event of a widespread grid outage, however, concurrent operation of backup generators at this facility (400 MW) and the Proposed Modification (63 MW) could temporarily increase localised emissions.	The Proposed Modification Is considered to result in significant cumulative air quality impacts. Most likely in winds with north-westerly components. It is noted that even under conducive wind conditions, there is absence of immediate downwind sensitive receptors (Prospect Reservoir). Impacts may be limited in nature due to the absence of downwind sensitive receptors distance and frequency of conducive winds. The probability of concurrent power feeder failures is considered to be low.
E) DCI SYD01 Data Centre 0.2 km 90 Peter Brock Drive, Eastern Creek	Existing data centre provides approximately 13 MW capacity. (4 x 2.2 MW + 2 x 2 MW)	There is no potential for cumulative air quality impacts during construction, as this development is already operational.	The Proposed Modification does not result in cumulative air quality impacts during construction.
		While there is limited potential for cumulative impacts if routine testing overlaps with the Proposed Modification, this is considered unlikely due to the short duration and staggered timing of such activities. However, under emergency conditions, such as a widespread grid outage, concurrent operation of backup generators at this facility (13 MW) and the Proposed Modification (63 MW) could temporarily increase localised emissions and downwind air quality impacts at the sensitive receptors.	The Proposed Modification is considered to result in significant cumulative air quality impacts. Most likely in winds with southerly and easterly components. The probability of concurrent power feeder failures is considered to be low.

Reference / Project Distance (km)	Project status / indicative timeframe / overlap	Potential overlap between impact of Proposed Modification on assessment matter and impact of other project on the same assessment matter	Potential cumulative risk
F) MS SYD01 1.2 km 6 Honeman Close, Huntingwood	Currently under assessment, this project relates to a new 5 storey 96 MW data centre facility which will operate 24 hours a day, 7 days a week. (44 × MTU 3,050 kWe) + (2 × MTU 732 kWe)	The Project is anticipated to give rise to limited is some potential for cumulative air quality impacts during construction, as the construction may occur at the same time as the Proposed Modification.	The Proposed Modification is unlikely to result in significant cumulative impacts during construction, due to the physical separation between construction sites and the implementation of CEMPs with appropriate mitigation measures at each location.
		While routine testing may present limited potential for cumulative impacts if it overlaps with the Proposed Modification, this is considered unlikely due to the short duration and staggered timing of activities. In the event of a widespread grid outage, however, concurrent operation of backup generators at this facility (96 MW) and the Proposed Modification (63 MW) could temporarily increase localised emissions. The Proposed Modification involves the operation of standby diesel generators, which may emit NO_x, PM, and VOCs during grid outage events or routine maintenance testing. These emissions are intermittent and of short duration.	The Proposed Modification is considered to result in significant cumulative air quality impacts. Most likely in winds with north easterly components. The probability of concurrent power feeder failures is considered to be low.

8. DISCUSSION AND CONCLUSION

This AQIA has been prepared by Northstar for LCI Consultants on behalf of DC for the Proposed Modification at the Project site.

The assessment evaluates the potential air quality impacts during both construction and operation phases, with a focus on dust soiling and increased ambient PM_{10} (including $PM_{2.5}$) concentrations due to dust arising from construction activities at the Project site, and combustion emissions from standby diesel generator engines during operations.

Data from available sources, including publicly accessible environmental data, were utilised. The routine testing and emergency use of diesel generators has the potential to lead to the exceedance of air quality criteria at nearby sensitive receptor locations from associated emissions to air. Therefore, operational impacts were evaluated based on a realistic and justified worst case emissions scenarios.

8.1. Construction Phase Risk Assessment

The construction phase risk assessment for the Proposed Modification, presented in Section 6 indicates that:

- dust soiling impacts are considered a low risk for earthworks and a medium risk for all other construction activities, assuming no mitigation measures are in place to control emissions during the construction phase.
- human health impacts are considered a negligible risk for earthworks and a low risk for all other construction activities, assuming no mitigation measures are in place to control emissions during the construction phase.

Based upon that assessment, a range of mitigation measures are recommended to ensure that short-term impacts associated with construction phase activities are minimised, as presented in Appendix B.

8.2. Operational Phase Impact Assessment

The predicted impacts of operational phase activities under an emergency scenario (Scenario 1) is presented in Section 7.

8.2.1. Scenario 1 – Emergency operations

Under Scenario 1, a number of additional exceedances of the short-term air quality criteria for NO_2, PM_{10} and $PM_{2.5}$ are predicted.

Note: care must be applied when assessing 24-hour average impacts as the likely duration of a power outage event is likely to be significantly less than 24-hours, and as such the assessment should be considered to be highly conservative (i.e. relevant to the operation of back-up generators for an entire 24-hour period).

That scenario assumes that 52 generators would be operational at one time. The predicted incremental concentrations under Scenario 1 show exceedances of particulate matter and NO_2 at sensitive receptor locations if a power outage occurred, and 52 generators were operating continuously (refer Section 5.2.2) to assess emissions under all potential meteorological conditions.

An assessment of the probability (*p*) of an exceedance of the relevant short-term criteria has been performed and is presented in Section 7.1. As a maximum across all receptors, the probability of an exceedance of the NO_2, PM_{10} or $PM_{2.5}$ criterion (where p=0 is an impossible event, and p=1 is a certain event) in any year is:

- NO_2: $p = 0.2055$;
- PM_{10}: $p = 0.2822$; and,
- $PM_{2.5}$: $p = 0.0001$.

To predict the likelihood of exceedances under the worst-case scenario (i.e. all 52 generators operating continuously), the reliability of the power network has been considered against the latest information contained in the Endeavour Energy 2024 Distribution Annual Planning Report (DAPR) (Endeavour Energy, 2024).

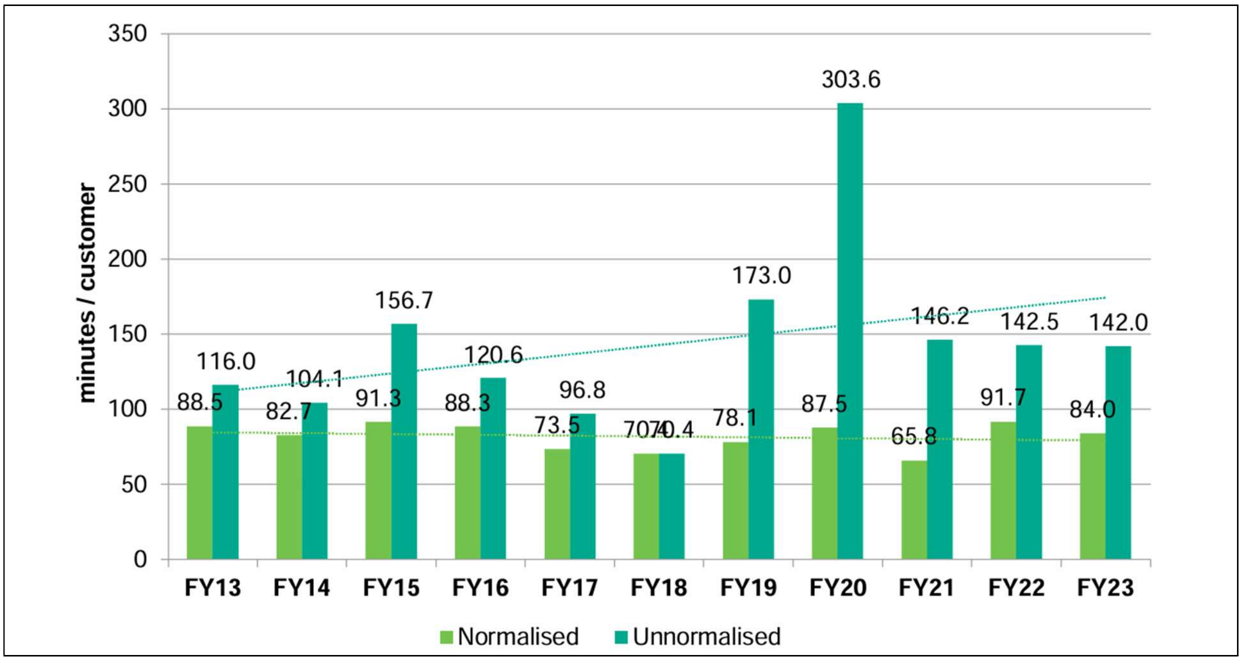
Based on the DAPR and associated network reliability statistics, the average unplanned outage duration per year per customer over a 10-year period from financial-year 2013 (2013/14) to financial-year 2023 (2023/24) equated to approximately 82.0 minutes, although exact duration of power outages requiring standby generators cannot be determined. Correspondingly, the likelihood of power interruptions occurring is approximately 0.016 % of the time per year (82.0 / (8 760 × 60)) or have a probability of p=0.00016.

Figure 12 depicts the normalised (i.e. Major Event Days data excluded) system average interruption duration index (SAIDI, in minutes) and unnormalised (i.e. inclusion of all events) SAIDI trends over the 10-year period from financial year 2013/2014 to financial year 2023/2024.

The probability of both the interruption to the power supply, and an exceedance of the relevant air quality criteria occurring can be calculated through the multiplication of the probability of each event occurring. Those values are incredibly small and have been placed into context by calculating the percentage chance that the event could occur in a number of years. Table 24 presents the results of those calculations.

The results indicate that the chance of an additional exceedance of the air quality criteria during a power outage is low.

Figure 12 Endeavour Energy SAIDI performance information



Source: (Endeavour Energy, 2024)

Table 24 Probability of an exceedance during a power outage

Number of years	Probability of an additional exceedance of the short-term criterion during a power outage (expressed as %)		
	1-hour NO_2	24-hour PM_{10}	24-hour $PM_{2.5}$
100	< 0.01	0.32	0.44
200	< 0.01	0.64	0.88
500	< 0.01	1.59	2.18
1 000	< 0.01	3.15	4.31
1 250	< 0.01	3.93	5.35

8.2.2. Odour

Operational phase activities are unlikely to result in any odour emissions, except for the periodic operation of the diesel-fuelled generators for testing and back-up power generation purposes, as outlined in Section 2.3.3.

Toluene (C_7H_8) and xylene (C_8H_{10}) emissions have been assessed and compared against the relevant odour impact assessment criteria.

No exceedances of the relevant odour criteria are predicted in the emergency operations scenario.

8.2.3. POEO (Clean Air) Regulation – Standard of Concentrations

Section 7.3 presents a comparison of the generator emissions against the applicable POEO CAR Schedule 2 concentration standards, demonstrating compliance with the relevant regulatory limits for the Proposed Modification. Although the operations may be exempt from the relevant emission limit regulations pertaining to NO_2 (i.e. in-stack emission concentrations), the Proponent would not be exempt from ensuring the emissions do not exceed ambient air quality criteria.

8.2.4. Mitigation and Regulatory Controls

The AQIA conducted as part of SSD-21342738 (Todoroski Air Sciences, 2022; Todoroski Air Sciences, 2023) indicates that maintenance testing is unlikely to cause exceedances of the considered impact assessment criteria at sensitive receptor locations surrounding the Project site.

NSW EPA may impose conditions of consent and / or EPL limits to manage and mitigate potential air quality impacts associated with the operation of the Proposed Modification and wider Project, consistent with those applied to the development consent for SSD-21342738.

To reduce pollutant emissions and ensure future flexibility for emissions control, the following measures may be implemented:

- Design Safeguards
  - The Proponent must ensure that the design, installation and operation of the standby generators and associated enclosures do not preclude the future retrofitting of additional air pollution control equipment.
- Operational Limits
  - The Proponent must ensure:
    - Operation of the standby generators (including testing) does not exceed 200 hours per year; and
    - The on-site diesel fuel storage capacity does not exceed 2 000 t at any one time.

Note: For the purposes of calculating annual operational hours, concurrent testing of multiple generators is counted as a single hour. For example, five generators tested simultaneously over one hour would count as one hour toward the annual limit.

It is anticipated that any development approval conditions or EPL requirements will restrict the use of standby generators, preventing their operation for off-site electricity export or load curtailment purposes. Should approval for the Proposed Modification be granted, it is expected that a condition will also require periodic emissions testing of the standby generators.

8.3. Cumulative Impacts

The potential for cumulative air quality impacts has been evaluated in accordance with relevant CIA guidance (NSW DPIE, 2022), as presented in Section 7.4. The assessment identifies potential cumulative operational air quality impacts arising from several proximate similar sources (i.e. data centres).

While the assessment procedure highlights the potential for cumulative impacts, it does not provide detailed guidance on quantifying the risk of such impacts. Consideration of cumulative risk incorporates factors like:

- The physical distance between the contributing sources;
- The incidence of contributing sources operating on common electricity power supplies;
- The system average interruption duration indices (SAIDI) for the respective power supplies;
- The physical distance of contributing sources and common receptors along common wind vectors;
- The location and presence of identified sensitive receptors;
- The prevalence of those wind vectors occurring; and,
- The probability of emissions from (a) emergency operation and (b) during routine testing;

There is the potential for cumulative air quality impacts to arise from nearby data centres during concurrent operations (refer Section 7.4), particularly in the event of a regional grid outage where all facilities, including the Proposed Modification, simultaneously activate standby diesel generators. Such emergency operation scenarios, which may occur during widespread grid failures, are recognised by NSW EPA and subject to regulatory allowances. The probability of concurrent power feeder failures is considered to be low, particularly as it is common for data centres to be served by multiple power supply feeders to reduce this risk.

Routine maintenance testing may also contribute to cumulative impacts since most facilities conduct tests during daytime hours. Due to the distances between the Proposed Modification, other facilities, and sensitive receptors, as well as the low likelihood of concurrent testing with emissions transported downwind, these impacts are anticipated to be limited. Furthermore, the POEO Act restricts generator operating hours to 200 hours per year, with testing regulated to control pollutant emissions.

Limited cumulative impacts may also arise during overlapping construction phases, primarily related to dust soiling and human health risks. Nonetheless, each development is required to have a CEMP, including waste and traffic management measures. Dust emissions from construction are well understood and can be effectively mitigated to minimise significant cumulative impacts.

8.4. Conclusion

During the construction phase, potential dust soiling and human health risks are considered manageable through the implementation of recommended mitigation measures. With these controls in place as part of a CEMP, the residual construction-phase air quality impacts associated with the Proposal are considered acceptable.

With regard to operations, a dispersion modelling scenario for emergency operations has been assessed with reference to the SEARS issued for SSD-21342738. Although some exceedances of the short term pollutant criteria have been predicted, considering other factors (e.g. frequency of power outages, unlikely scenario of back-up generators running for an entire 24-hour period etc), the risk of exceedances at identified sensitive receptors is predicted to be low.

In accordance with the CIA Guidelines, this AQIA has proportionately addressed relevant cumulative air quality issues based on available information, the regulatory context, and the likely scale and influence of surrounding future developments.

Potential cumulative impacts during overlapping construction phases, primarily related to dust emissions and human health risks have been evaluated. These impacts are anticipated to be effectively mitigated through site-specific CEMPs and appropriate controls implemented across each project.

During the operational phase, a potential cumulative scenario was identified in the event of a regional or catastrophic grid outage, where multiple data centres, including the Proposed Modification could activate backup generators simultaneously, resulting in a temporary increase in emissions from each data centre. Such emergency events are recognised by the NSW EPA and are subject to regulatory allowances and controls. Routine maintenance testing presents limited potential for cumulative impacts, due to the short duration, staggered timing, and physical separation of facilities, alongside regulatory limits such as the 200-hour annual operating cap under the POEO Act.

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APPENDIX A

Commonly Used Abbreviations and Units

Units Used in the Report

Units presented in the report follow the International System of Units (SI) conventions, unless derived from references using non-SI units.

Commonly used SI units

The following units are commonly used in Northstar reports.

Symbol	Name	Quantity
SI base units		
K	Kelvin	thermodynamic temperature
kg	kilogram	mass
m	metre	length
mol	mole	amount of substance
s	seconds	time
Non-SI units mentioned in the SI or accepted for use		
°	degree	plane angle
d	day	time
h	hour	time
ha	hectare	area
J	joule	energy
L	litre	volume
min	minute	time
N	newton	force or weight
t	tonne	mass
V	volt	electrical potential
W	watt	power

Multiples of SI and non-SI units

The following prefixes are added to unit names to produce multiples and sub-multiples of units:

Prefix	Symbol	Factor
T	tera-	10^{12}
G	giga-	10^{9}
M	mega-	10^{6}
k	kilo-	10^{3}
h	hector-	10^{2}
da	deca-	10^{1}

Prefix	Symbol	Factor
p	pico-	10^{-12}
n	nano-	10^{-9}
µ	micro-	10^{-6}
m	milli-	10^{-3}
c	centi-	10^{-2}
d	deci-	10^{-1}

In this report, units formed by the division of SI and non-SI units are expressed as a negative exponent, and do not use the solidus (/) symbol.

For example:

- 50 micrograms per cubic metre would be presented as 50 $\mu g \cdot m^{-3}$ and not 50 $\mu g/m^3$; and,
- 0.2 kilograms per hectare per hour would be presented as 0.2 $kg \cdot ha^{-1} \cdot hr^{-1}$ and not 0.2 kg/ha/hr.

Commonly used SI-derived and non-SI units

Symbol	Name	Quantity
$g \cdot m^{-2} \cdot s^{-1}$	gram per square metre per second	rate of mass deposition per unit area
$g \cdot s^{-1}$	gram per second	rate of mass emission
$kg \cdot ha^{-1} \cdot hr^{-1}$	kilogram per hectare per hour	rate of mass deposition per unit area
$kg \cdot m^{-3}$	kilogram per cubic metre	density
$L \cdot s^{-1}$	litres per second	volumetric rate
m^2	square metre	area
m^3	cubic metre	volume
$m \cdot s^{-1}$	metre per second	speed and velocity
$mg \cdot m^{-3}$	milligram per cubic metre	mass concentration per unit volume
$mg \cdot Nm^{-3}$	milligram per normalised cubic metre (of air)	mass concentration per unit volume
$\mu g \cdot m^{-3}$	microgram per cubic metre	mass concentration per unit volume
$mg \cdot m^{-3}$	milligram per cubic metre	mass concentration per unit volume
Pa	pascal	pressure
ppb	parts per billion ($1x10^{-9}$)	volumetric concentration
pphm	parts per hundred million (1×10^{-5})	volumetric concentration
ppm	parts per million ($1x10^{-6}$)	volumetric concentration

Commonly used abbreviations

Abbreviation	Term
ABS	Australian Bureau of Statistics
ACT	Australian Commonwealth Territory
AGL	above ground level
AHD	Australian height datum
APC	air pollution control
AQI	air quality index
AQIA	air quality impact assessment
AQMS	air quality monitoring station
AQRA	air quality risk assessment
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
AS/NZS	Australian Standard / New Zealand Standard
AWS	automatic weather station
BCA	Building Code of Australia
BGL	below ground level
BOM	Bureau of Meteorology

Abbreviation	Term
CEMP	construction environment management plan
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEM	digital elevation model
EETM	emission estimation technique manual
EPA VIC	Environmental Protection Authority Victoria
EPBC	Environment Protection and Biodiversity Conservation Act
FIBC	flexible intermediate bulk container
GIS	geographical information system
IAQM	UK Institute of Air Quality Management
IBC	intermediate bulk container
ID	internal diameter
LLV	low level waste
LoM	life of mine
MSDS	Material Safety Data Sheet
NCAA	National Clean Air Agreement
NEPM	National Environment Protection Measure
NH_3	ammonia
NO	nitric oxide
NO_X	oxides of nitrogen
NO_2	nitrogen dioxide
NORM	naturally occurring radioactive material
NSW	New South Wales
NSW DCCEEW	New South Wales Department of Climate Change, Energy, the Environment and Water
NSW DPE	New South Wales Department of Planning and Environment
NSW DPHI	New South Wales Department of Planning, Housing and Infrastructure
NSW EPA	New South Wales Environment Protection Authority
NT	Northern Territory
OEMP	operational environmental management plan
O_3	ozone
OU	odour unit
$OU{\cdot}m^3{\cdot}s^{-1}$	odour units times metres cubed per second
$OU{\cdot}s^{-1}$	odour units per second
Pb	lead
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 µm or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 µm or less
ROM	run of mine
SA	South Australia

Abbreviation	Term
SEPP	State Environmental Protection Policy
SO_X	oxides of sulphur
SO_2	sulphur dioxide
SRTM3	Shuttle Radar Topography Mission
SVOC	semi-volatile organic compound
TAPM	The Air Pollution Model
TAS	Tasmania
TEU	twenty-foot equivalent unit
TSP	total suspended particulates
TVOC	total volatile organic compounds
TWA	time weighted average
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VIC	Victoria
VLLW	very low-level waste
VOC	volatile organic compound

APPENDIX B

Construction Phase Dust Risk Assessment Methodology

Provided below is a summary of the risk assessment methodology applied in this AQIA which is based upon the UK IAQM's *Guidance on the assessment of dust from demolition and construction* (IAQM, 2024) and adapted by Northstar.

Adaptions to the Published Methodology Made by Northstar

The adaptions made by Northstar from the IAQM published methodology are:

- **PM_{10} criterion**: an amended criterion representing the annual average PM_{10} criterion relevant to Australia rather than the UK;
- **Nomenclature**: a change in nomenclature from 'receptor sensitivity' to 'land use value' to avoid misinterpretation of values attributed to 'receptor sensitivity' and 'sensitivity of the area' which may be assessed as having different values;
- **Construction traffic**: the separation of construction vehicle movements as a discrete risk assessment profile from those associated with the 'on-site' activities of demolition, earthworks and construction. The IAQM methodology considers four risk profiles of: 'demolition', 'earthworks', 'construction' and 'trackout'. The adaption by Northstar introduces a fifth risk assessment profile of 'construction traffic' to the existing four risk profiles; and,
- **Tables**: minor adjustments in the visualisation of some tables.

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:

- Beyond a distance of 250 m from the Project site boundary; and,
- At a distance greater than 50 m from the route(s) used by construction vehicles on public roads, beginning from the Project site entrance and extending past 250 m from the Project site entrance.

This step is noted as having deliberately been chosen to be conservative and would require assessments for the vast majority of development projects. Table B1 overleaf presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria.

As a screening exercise, it was noted there are four receptors within the 250 m of the Project site boundary, entrance and construction route as shown in Table B1.

Table B1 Construction phase impact screening criteria distances

Receptor ID	Location	Land use	Screening distance (m)		
			Project site boundary (250 m)	Project site entrance(s) (250 m)	Construction route(s) (50 m)
R1	Eastern Creek International Karting Raceway, Eastern Creek	Recreational	243	317	233
R2	Raceway Place, Eastern Creek	Industrial	53	56	44
R3	Raceway Place, Eastern Creek	Industrial	31	119	22
R4	Peter Brock Dr before Auto Pl, Eastern Creek	Industrial	40	282	282

With reference to Table B1 sensitive receptors are noted to be within the screening distance thresholds and therefore require further risk assessment as summarised in Table B2.

Table B2 Application of Step 1 screening

Construction impact	Screening criteria	screening	Comments
Demolition	250 m from boundary, 250 m from site entrance(s)	Not screened	Receptors identified within the screening distance
Earthworks	250 m from boundary, 250 m from site entrance(s)		
Construction	250 m from boundary, 250 m from site entrance(s)		
Trackout	250 m from site entrance(s)		
Construction Traffic	50 m from roadside, 250 m from site entrance(s)		

Step 2 – Define the Potential Dust Emission Magnitude

Step 2 of the assessment categorises dust-generating activities as demolition, earthworks, construction, track-out (material transported onto public roads), and construction traffic, by their 'dust emissions magnitude' (Small, Medium, or Large), as defined in Table B3.

Table B3 Dust emission magnitude activities

Activity	Small	Medium	Large
Demolition			
Total building volume	< 12 000 m^3	12 000 m^3 to 75 000 m^3	> 75 000 m^3
Demolition height	< 6 m AGL	6 m and 12 m AGL	> 12 m AGL
Onsite crushing	no	no	yes
Onsite screening	no	no	yes
Demolition of materials with high dust potential	no	yes	yes
Demolition timing	wet months only	any time of the year	any time of the year
Earthworks			
Total area	< 18 000m^2	18 000 m^2 to 110 000 m^2	> 110 000 m^2

Activity	Small	Medium	Large
Soil types	soil type with large grain size (e.g. sand)	moderately dusty soil type (e.g. silt)	potentially dusty soil type (e.g. clay)
Heavy earth moving vehicles	< 5 heavy earth moving vehicles active at any one time	5 to 10 heavy earth moving vehicles active at any one time	> 10 heavy earth moving vehicles active at any time
Formation of bunds	< 3 m AGL	3 m to 6 m AGL	> 6 m AGL
Construction			
Total building volume	< 12 000 m^3	12 000 m^3 to 75 000 m^3	> 75 000 m^3
Concrete batching	no	yes	yes
Sandblasting	no	no	yes
Materials	metal cladding or timber	concrete	concrete
Trackout			
Outward heavy vehicles movements per day	< 20	20 to 50	> 50
Surface materials	low potential	moderate potential	high potential
Unpaved road length	< 50 m	50 m to 100 m	> 100 m
Construction traffic (from construction site entrance to construction vehicle origin)			
Demolition traffic - total building volume	< 12 000 m^3	12 000 m^3 to 75 000 m^3	> 75 000 m^3
Earthworks traffic total area	< 18 000m^2	18 000 m^2 to 110 000 m^2	> 110 000 m^2
Earthworks traffic soil types	soil type with large grain size (e.g. sand)	moderately dusty soil type (e.g. silt)	potentially dusty soil type (e.g. clay)
Construction traffic total building volume	< 12 000 m^3	12 000 m^3 to 75 000 m^3	> 75 000 m^3
Total traffic outward heavy vehicles movements per day	< 20	20 to 50	> 50

Demolition works would be required for the two existing buildings along Raceway Place, with an estimated volume of approximately 37 240 m^3. Also, it is anticipated that there will be no onsite crushing or screening related activities. This corresponds to a 'medium' dust emissions magnitude for demolition works.

Earthworks are likely to include site preparation, bulk earthworks, landscaping and associated public domain works. The affected areas of earthworks have been estimated using a GIS application and are based on the provided site layout (refer Figure 2). For earthworks activities, the impacted area is estimated as being approximately 8 000 m^2, corresponding to a 'small' dust emission magnitude.

The construction phase of the Proposed Modification involves construction of a four-storey data centre development, including technical data halls, office and administrative areas, and ancillary circulation space.

At the time of assessment, the building material specifications are not available, however it is anticipated that:

- The floor system for the data halls and front-of-house areas will include concrete beams and slabs.
- Chiller rooms and cooling tower platforms will use a composite steel and concrete flooring system.
- Additional materials in the design may include window glazing, metal cladding, and perforated metal batten screens.

Although the proposed data centre development to be constructed is anticipated to be larger than 75 000 m^3 (approximately 110 m x 50 m x 35.7 m), considering that there will be no onsite concrete batching or sand blasting. Therefore, on balance this corresponds to a 'medium' dust emission magnitude.

Given the scale of the Proposed Modification, it is conservatively assumed that on a peak construction activity day, there may be between 20 to 50 outbound HDV movements, and it is noted that there are no unpaved road lengths existing in the surrounding area. This aligns with a 'medium' dust emission magnitude.

Based upon the discussion provided above and the criteria presented in Table B3, the assessed dust emission magnitudes are as presented in Table B4.

Table B4 Construction phase impact categorisation of dust emission magnitude

Activity	Dust emission magnitude
Demolition	Medium
Earthworks and enabling works	Small
Construction	Medium
Track-out	Medium
Construction traffic routes	Medium

Step 3 – Sensitivity of the Area

Step 3 of the process requires the sensitivity of the area to be defined. The sensitivity of the area considers:

- Specific sensitivities that identified land use values may have to dust deposition and health impacts;
- The proximity and number of those receptors locations;
- 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.

When assessing the area, sensitivity to dust impacts and soiling, human health receptors are evaluated independently.

Land Use Value

Individual receptor locations are assigned land use values (low, medium, or high) based on the land use and its sensitivity to dust deposition and human health impacts. The land use value reflects the expected level of amenity for a given land use. The IAQM methodology provides guidance on assigning land use values for dust soiling and human health impacts, as shown in Table B5. It is noted that amenity expectations (e.g. tolerance to dust soiling) depend on existing background deposition levels.

Table B5 IAQM guidance for categorising land use value

Land use value	Low	Medium	High
Dust soiling	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.	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 land use pattern.	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.
Examples	*Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*	*Parks and places of work.*	*Dwellings, museums, and other culturally important collections, medium- and long-term car parks and car showrooms*
Health impacts	Locations where human exposure is transient.	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 8 hours or more a day).	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 8 hours or more in a day).
Examples	*Public footpaths, playing fields, parks, and shopping street.*	*Office and shop workers but would generally not include workers occupationally exposed to PM_{10}.*	*Residential properties, hospitals, schools, and residential care homes.*

In the surrounding locality, sensitive receptors located within 100 m of the Project site boundary are predominantly industrial in nature, corresponding to a 'medium' land use sensitivity with respect to dust soiling and health impacts. Within 250 m of the Project site boundary there is the Eastern Creek International Karting Raceway which would also correspond to a 'medium' land use sensitivity. The closest residential land use is located more than 1 km from the Project site boundary. Correspondingly, the land use sensitivity has been classified as 'medium' for this AQIA.

Dust Soiling Impacts

To assess dust soiling impacts, the sensitivity of the local area is determined by considering the receptors and their quantity, as detailed in Table B6.

Table B6 IAQM guidance for categorising the sensitivity of an area to dust soiling impacts

Land use value	Number of receptors[a]	Distance from the source (m)[b]			
		< 20	< 50	< 100	< 250
Low	> 1	Low	Low	Low	Low
Medium	> 1	Medium	Low	Low	Low
High	1 – 10	Medium	Low	Low	Low
	10 – 100	High	Medium	Low	Low
	> 100	High	High	Medium	Low

Notes: (a) Estimate the total number of receptors within the stated distance. Only the highest level of area sensitivity from the table needs to be considered.

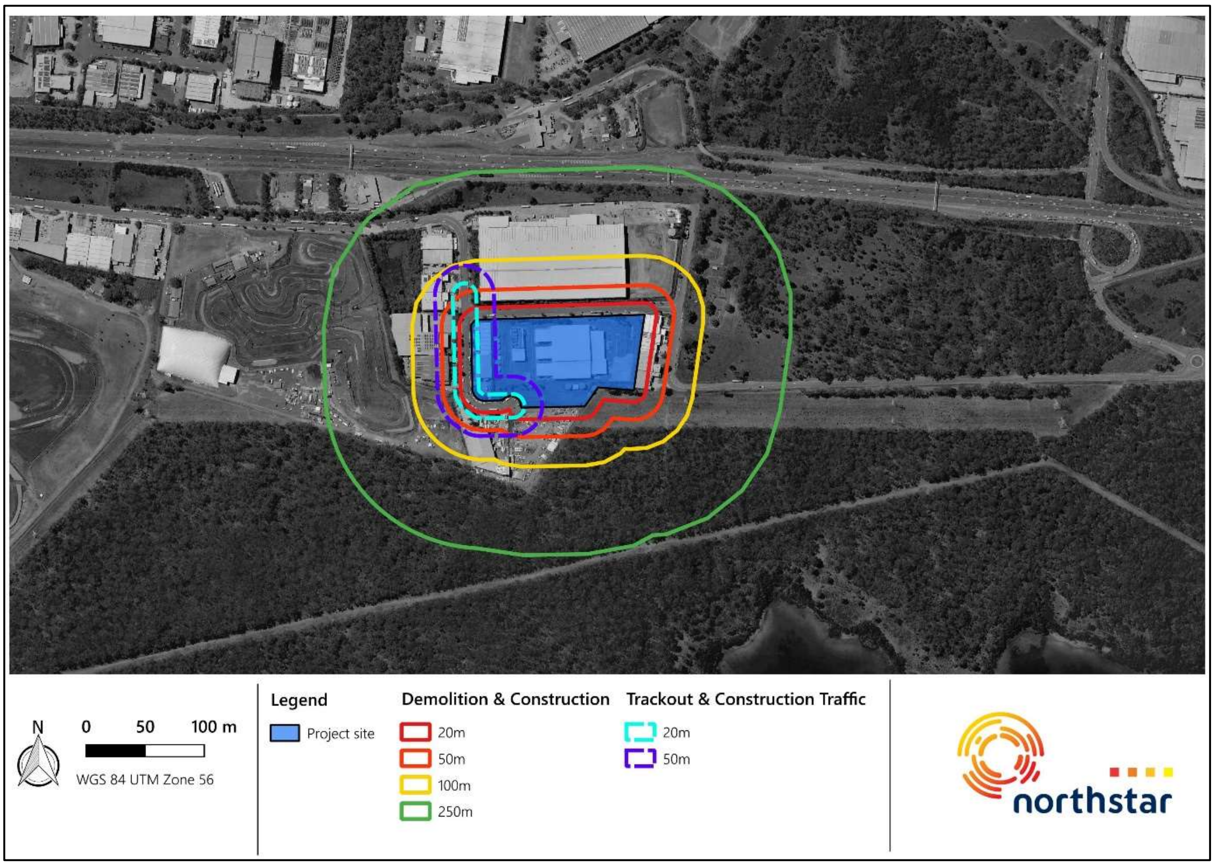
(b) With regard to potential 'construction traffic' impacts, the distance criteria of less than 20 m and less than 50 m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50 m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

Figure B1 illustrates the extent of works considered for this AQIA, delineating the outer envelope boundary of the anticipated construction works, the IAQM distance bands and the positions of receptors. Note that the buffers for trackout and construction traffic have been produced to account for potential construction routes.

The IAQM guidance does not require an exact count of human receptors, instead recommending professional judgment to estimate the number of buildings within each distance band and considering only the highest area sensitivity level from Table B5.

The Project site is situated in a largely industrial area, within the Raceway Precinct, zoned as IN1 – General Industrial under the IE SEPP. It is estimated that up to 10 receptors are located within 20 m of the Project site boundary. Based on land use and receptor density, the sensitivity to dust soiling impacts is considered 'medium.'

Figure B1 Scope of construction activities, buffer distances and surrounding environment



Source: Northstar

Human Health Impacts

The assessed land use value (as described in Table B5) is then used to assess the sensitivity of the area surrounding the active construction area, considering 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 would take place;
- Any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- Any known specific receptor sensitivities which go beyond the classifications given in (IAQM, 2024)

The IAQM guidance for assessing the sensitivity of an area of human health impacts is shown in Table B7. The background annual average PM_{10} concentration at Prospect AQMS in 2021 was 17.2 $\mu g \cdot m^{-3}$ (refer

Table D2). Together with the calculated land use value, this classifies the sensitivity as 'low' for human health impacts related to the Proposal.

Table B7 IAQM guidance for categorising the sensitivity of an area to human health impacts

Land use value	Annual mean PM_{10} concentration ($\mu g \cdot m^{-3}$)	Number of receptors[a]	Distance from the source (m)[b]			
			< 20	< 50	< 100	< 250
Low	-	> 1	Low	Low	Low	Low
Medium	≤ 22	1-10	Low	Low	Low	Low
		> 10	Low	Low	Low	Low
	22 - 26	1-10	Low	Low	Low	Low
		> 10	Low	Low	Low	Low
	26 - 30	1-10	Low	Low	Low	Low
		> 10	Medium	Low	Low	Low
	> 30	1-10	Medium	Low	Low	Low
		>10	High	Medium	Low	Low
High	≤ 22	1-10	Low	Low	Low	Low
		10-100	Low	Low	Low	Low
		> 100	Medium	Low	Low	Low
	22 – 26	1-10	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low
		> 100	High	Medium	Low	Low
	26 – 30	1-10	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		> 100	High	High	Medium	Low
	> 30	1-10	High	Medium	Low	Low
		10-100	High	High	Medium	Low
		> 100	High	High	High	Medium

Notes: (a) Estimate the total within the stated distance (e.g. the total within 250 m and not the number between 100 m and 250 m), noting that only the highest level of area sensitivity from the table needs to be considered. In the case of high sensitivity areas 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.
(b) With regard to potential 'construction traffic' impacts, the distance criteria of less than 20 m and less than 50 m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50 m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

Step 4 - Risk Assessment (Pre-Mitigation)

The matrices shown in Table B8 for each activity determine the risk category with no mitigation applied.

Table B8 Pre-mitigated risk of dust impacts from construction related activities

Sensitivity of area	Pre-mitigated dust emission magnitude		
	Small	Medium	Large
Demolition			
Low	Negligible risk	Low risk	Medium risk

Sensitivity of area	Pre-mitigated dust emission magnitude		
	Small	Medium	Large
Medium	Low risk	Medium risk	High risk
High	Medium risk	Medium risk	High risk
Earthworks, Construction and Trackout			
Low	Negligible risk	Low risk	Low risk
Medium	Low risk	Medium risk	Medium risk
High	Low risk	Medium risk	High risk
Construction traffic (from construction site entrance to origin)			
Low	Negligible risk	Low risk	Low risk
Medium	Negligible risk	Low risk	Medium risk
High	Low risk	Medium risk	High risk

Given the sensitivity of the identified receptors is classified as medium for dust soiling and low for human health impacts, and the dust emission magnitudes for the various construction phase activities as shown in Table B5, the resulting risk of air quality impacts (without mitigation) is presented in Table B9.

Table B9 Risk of air quality impacts from construction activities – pre-mitigation

Sensitivity of area	Dust emission magnitude					Preliminary risk				
	Demolition	Earthworks	Construction	Track-out	Const. traffic	Demolition	Earthworks	Construction	Track-out	Const. traffic
Dust soiling										
Med.	Med.	Small	Med.	Med.	Med.	Med	Low.	Med.	Med.	Med.
Human health										
Low	Med.	Small	Med.	Med.	Med.	Low	Neg.	Low	Low	Low

Note: Med. = Medium, Neg. = Negligible

Table B9 shows that dust soiling impacts are considered a low risk for earthworks and a medium risk for all other construction activities, assuming no mitigation measures are in place to control emissions during the construction phase.

Table B9 shows that human health impacts are considered a negligible risk for earthworks and a low risk for all other construction activities, assuming no mitigation measures are in place to control emissions during the construction phase.

The dust risk assessment therefore provides recommendations for construction phase mitigation, commensurate with those identified risks.

Step 5 – Identify 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.

The identified mitigation measures are presented as follows:

N = not required (although they may be implemented voluntarily);

D = desirable (to be considered as part of the CEMP, but may be discounted if justification is provided);

H = highly recommended (to be implemented as part of the CEMP and should only be discounted if site-specific conditions render the requirement invalid or otherwise undesirable).

The mitigation measures presented in Table B10 are commensurate with the risks associated for the Proposed Modification and are recommended to be applied during the construction stage to ensure construction dust will be adequately managed.

Step 6 – Risk Assessment (post-mitigation)

Following Step 5, the residual impact is then determined.

The objective of the mitigation is to manage the construction phase risks to an acceptable level, and therefore it is assumed that application of the identified mitigation would result in a low or negligible residual risk (post mitigation).

Given the size of the Proposed Modification, the distance to sensitive receptors and the activities to be performed, residual impacts associated with fugitive dust emissions from the Proposed Modification would be anticipated to be 'negligible', should the implementation of the mitigation measures outlined above be performed appropriately.

Table B10 Site specific management and mitigation measures

Identified mitigation		Unmitigated risk
1	**Communications**	**Medium**
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	H
1.2	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H
1.3	Display the head or regional office contact information.	H
1.4	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	H

Identified mitigation		Unmitigated risk
2	**Site management**	**Medium**
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H
2.2	Make the complaints log available to the relevant authority when asked.	H
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	H
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	N
3	**Monitoring**	**Medium**
3.1	Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the relevant authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary.	D
3.2	Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and maintain an inspection log available to the relevant authority when asked.	H
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H
3.4	Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	H
4	**Preparing and maintaining the site**	**Medium**
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
4.2	Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site.	H
4.3	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	H
4.4	Avoid site runoff of water or mud.	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	H
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	H
4.7	Cover, seed or fence stockpiles to prevent wind erosion	H
5	**Operating vehicle/machinery and sustainable travel**	**Medium**
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H

Identified mitigation		Unmitigated risk
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	H
5.3	Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable	H
5.4	Impose and signpost a maximum-speed-limit of 25 km·h^{-1} on surfaced and 15 km·h^{-1} on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the relevant authority, where appropriate	D
5.5	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	N
5.6	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	D
6	**Operations**	**Medium**
6.1	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems	H
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H
6.3	Use enclosed chutes and conveyors and covered skips	H
6.4	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H
6.5	Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	H
7	**Waste management**	**Medium**
7.1	Avoid bonfires and burning of waste materials.	H
8	**Measures specific to demolition**	**Medium**
8.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D
8.2	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively capture dust particles.	H
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H
8.4	Bag and remove any biological debris or damp down such material before demolition.	H
9	**Measures specific to earthworks**	**Low**
9.1	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	N
9.2	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	N
9.3	Only remove the cover in small areas during work and not all at once.	N

Identified mitigation		Unmitigated risk
10	**Measures specific to construction**	**Medium**
10.1	Avoid scabbling (roughening of concrete surfaces) if possible	D
10.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place	H
10.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	D
10.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	D
11	**Measures specific to Trackout**	**Medium**
11.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	H
11.2	Avoid dry sweeping of large areas.	H
11.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	H
11.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H
11.5	Record all inspections of haul routes and any subsequent action in a site log book.	H
11.6	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	H
11.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	H
11.8	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permit.	H
11.9	Access gates to be located at least 10 m from receptors where possible.	H

APPENDIX C

Meteorology

Meteorological Stations

A meteorological modelling exercise has been performed to characterise the meteorology of the Project site in the absence of site-specific measurements. The meteorological monitoring has been based on measurements acquired from surrounding automatic weather stations (AWS) operated by the Australian Government Bureau of Meteorology (BoM).

A summary of the relevant monitoring sites located within a distance of 20 km of the Project site is provided in Table C1.

Table C1 BoM meteorological monitoring sites within 20 km of the Proposal site

Site name	Station #	Approximate location		Approximate distance (km)
		mE	mS	
Horsley Park Equestrian Centre AWS	067119	301 708	6 252 298	5.9
Bankstown Airport AWS	066137	313 855	6 245 099	15.5
Sydney Olympic Park AWS (Archery Centre)	066212	321 576	6 254 599	17.7
Badgerys Creek AWS	067108	289 920	6 246 951	17.9

Note: Climate statistics available at http://www.bom.gov.au/climate/data/index.shtml

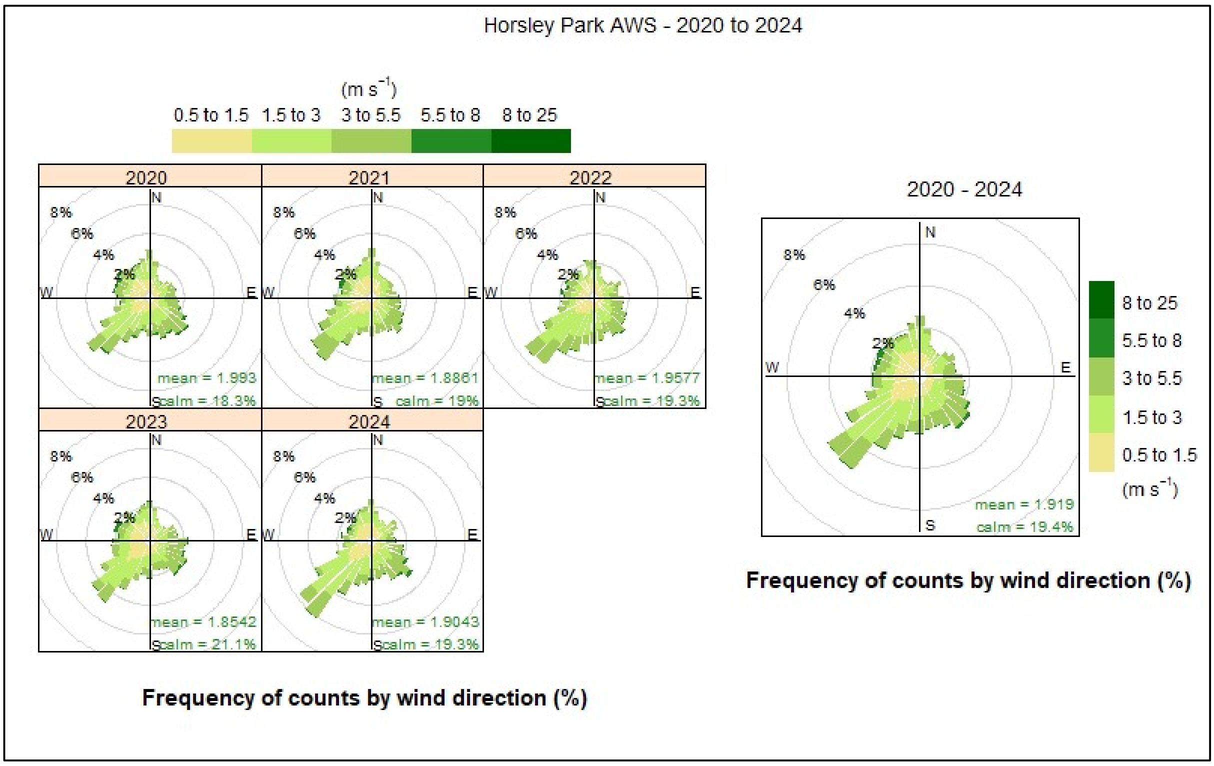
As outlined in Section 4.3, metrological conditions at Horsley Park Equestrian Centre AWS have been examined to be determine a 'typical' or representative dataset for use in dispersion modelling. Annual wind roses for the most recent years of data (2020 to 2024) are presented in Figure C1. The annual wind speed frequency distribution for the five-year period is presented in Figure C2.

The wind roses indicate that from 2020 to 2024, winds at Horsley Park Equestrian Centre AWS show generally similar wind distribution patterns across the years assessed, with predominant south westerly wind directions evident.

The majority of wind speeds experienced at Horsley Park Equestrian Centre AWS between 2020 and 2024 are generally in the range 0.5 meters per second ($m{\cdot}s^{-1}$) to 5.5 $m{\cdot}s^{-1}$ with the highest wind speeds (greater than 8 m·s-1) occurring from mostly north-westerly directions. Calm winds (less than 0.5 $m{\cdot}s^{-1}$) are more common and occur during 19.4 % of hours on average across the years between 2020 and 2024.

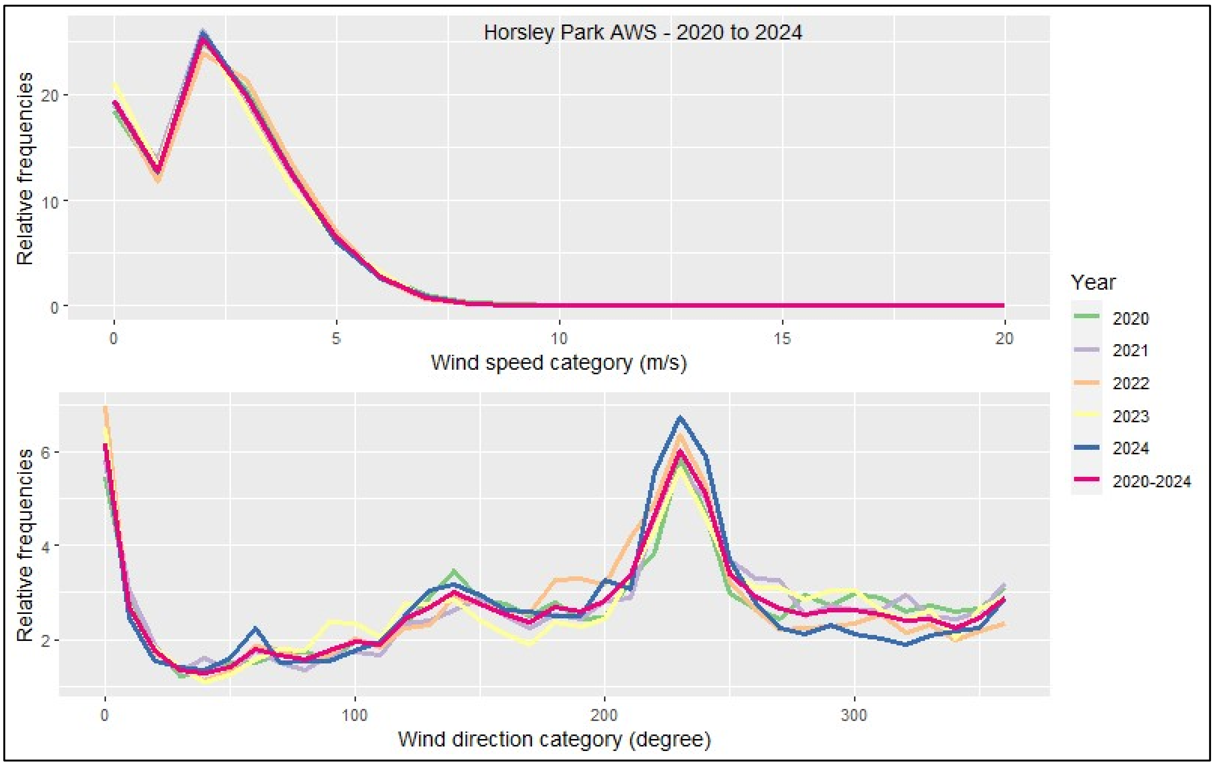
The correlation coefficient between each year and the five-year period for the distribution of wind characteristics (direction and speed), and nitrogen dioxide (NO_2) are summarised in Table C2. The correlation coefficients were ranked and aggregated to select the representative year for the meteorological modelling. The rankings are also presented in Table C2.

Figure C1 Annual wind roses – Horsley Park Equestrian Centre AWS (2020 – 2024)



Source: Northstar

Figure C2 Wind direction and speed frequency distribution – Horsley Park Equestrian Centre AWS (2020 – 2024)



Source: Northstar

Table C2 Correlation – Horsley Park Equestrian Centre AWS and Prospect AQMS (2020 – 2024)

Parameter	Wind speed		Wind direction		NO_2		Aggregated rank
	Corr.	Rank	Corr.	Rank	Corr.	Rank	
2020	0.9993	2	0.9680	4	0.9984	2	2
2021	0.9989	3	0.9744	1	0.9964	3	1
2022	0.9974	5	0.9730	2	0.9953	4	5
2023	0.9975	4	0.9640	5	0.9988	1	4
2024	0.9998	1	0.9708	3	0.9418	5	3
2020-2024	**1**	-	**1**	-	**1**	-	-

Note: Corr. = Correlation

Wind speed observations for each year correlated well against the wind speed over the five-year period, with each year having a correlation coefficient greater than 0.99. The year 2024 is the highest ranked for correlation against the wind speed over the five-year period. Wind direction observations for each year are well correlated against the wind direction over the five-year period, with each year having a correlation coefficient greater than of 0.96. The year 2021 is the highest ranked for correlation against the wind direction over the five-year period.

NO_2 concentrations for each year are also well correlated against NO_2 concentrations over the five-year period. Each year resulted in having a correlation coefficient greater than 0.94. The year 2023 holds the highest rank for NO_2.

Based on the aggregated rankings, the 2021 observations of wind characteristics (direction and speed) and NO_2 distribution most closely mirror the overall five-year (2020 – 2024) period. Consequently, the 2021 meteorological dataset is deemed suitably representative for dispersion modelling and is therefore adopted for the purposes of this AQIA.

Meteorological Processing

The BoM data adequately covers the issues of data quality assurance; however, it is limited by its location compared to the Project site. To address these uncertainties, a multi-phased assessment of the meteorology data has been performed.

In absence of any measured onsite meteorological data, site representative meteorological data for this Proposal was generated using the CALMET meteorological model in a format suitable for using in the CALPUFF dispersion model (refer Section 5.2.1).

CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field and thus the final wind field reflects the influences of local topography and current land uses.

For this AQIA, CALMET has been run in no-observations (no-obs) mode using gridded prognostic data generated by The Air Pollution Model (TAPM, v 4.0.5), developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The TAPM model is cited in the 'Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia' (Barclay & Scire, 2011) as a suitable prognostic meteorological model for applications involving complex meteorological conditions.

TAPM is a prognostic model which 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 site-specific hourly meteorological observations at user-defined levels within the atmosphere.

It is noted that outputs from the TAPM meteorological modelling run were validated through comparison with the observed meteorological data collected at the Horsley Park Equestrian Centre AWS. These data broadly compare and correspondingly, the initial TAPM modelling run has been used to represent meteorological parameters at the Proposal site in CALMET.

The parameters used in TAPM and CALMET modelling are presented in Table C3. Further, as per (Barclay & Scire, 2011), the seven critical parameters used in the CALMET modelling are presented in Table C4.

Table C3 CALMET and TAPM meteorological modelling parameters

TAPM v 4.0.5	
Modelling period	1 January 2021 to 31 December 2021
Centre of analysis	304 075 mE, 6 257 081 mS (UTM Coordinates)
Number of grid points	50 × 50 × 25
Number of grids (spacing)	5 (30 km, 10 km, 3 km, 1 km, 300 m)
Terrain	AUSLIG 9 second DEM
Data assimilation	No data assimilation
CALMET	
Modelling period	1 January 2021 to 31 December 2021
Southwest corner of analysis	297 704 mE, 6 250 780 mS (UTM Coordinates)
Meteorological grid domain (resolution)	13.4 km × 13.4 km (0.1 km)
Vertical resolution (cell heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1 200 m, 2 000 m, 3 000 m, 4 000 m)
Data assimilation	No-obs approach using TAPM – 3D.DAT file

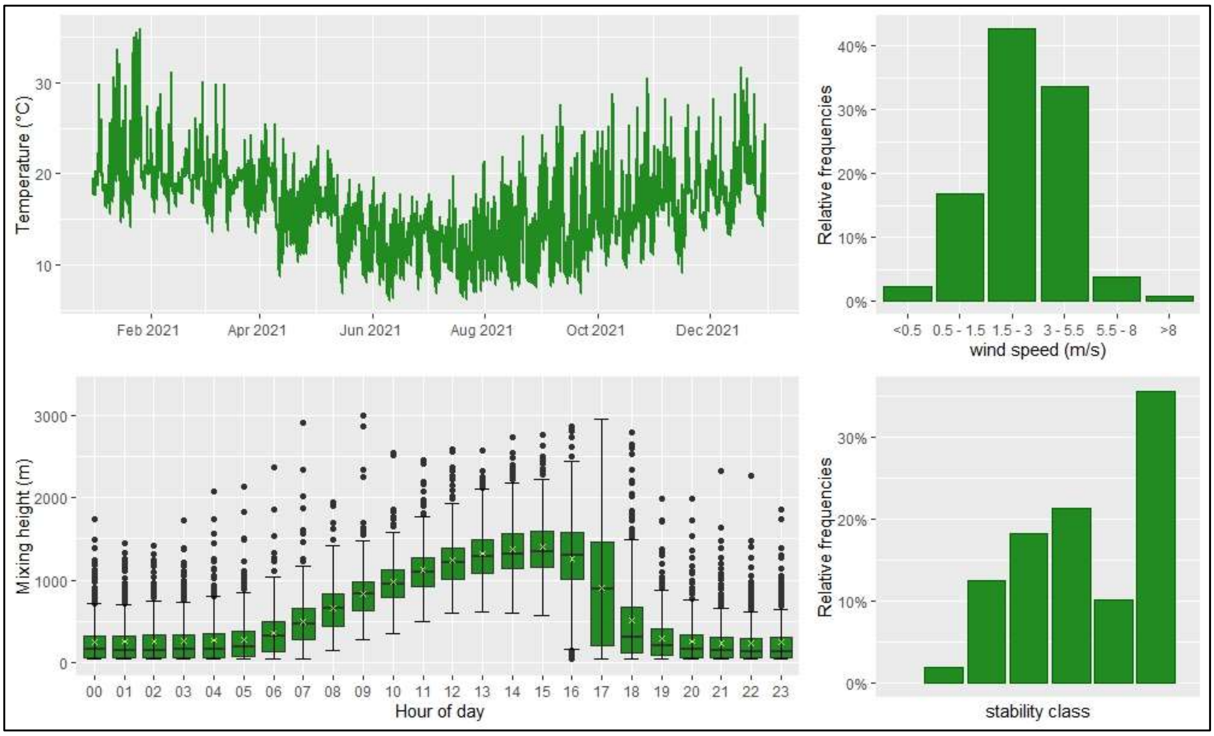
Table C4 Seven critical meteorological parameters used in CALMET

Parameter	Value
TERRAD	10.0
IEXTRP	1
BIAS (NZ)	0 × 10
R1 and R2	0, 0
RMAX1 and RMAX2	0, 0

As generally required by NSW EPA, the following provides a summary of the modelled meteorological dataset at the Proposal Site. Given the nature of the pollutant emission sources at the Proposal site, detail discussion of the humidity, evaporation, cloud cover, katabatic air drainage and air recirculation potential of the Proposal site has not been provided. Details of the predictions of wind speed and direction, mixing height and temperature at the Proposal site are provided below.

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Proposal site during 2021 are illustrated in Figure C3. As 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.

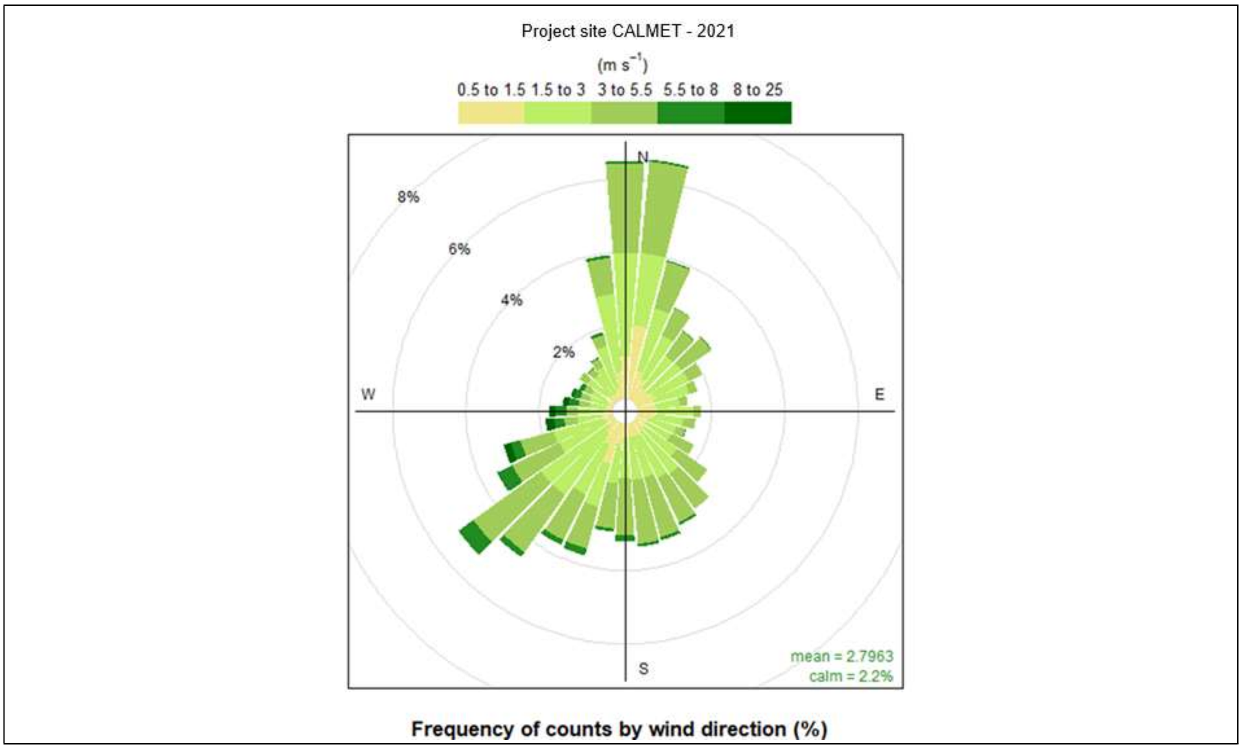
Figure C3 Predicted mixing height, wind and stability class frequency at the Proposal site (2021)



Source: Northstar

The modelled wind speed and direction at the Project site during 2021 are presented in Figure C4.

Figure C4 Predicted wind characteristics – Project site (2021)



Source: Northstar

APPENDIX D

Background Air Quality Data

Air quality is not monitored at the Project site and therefore air quality monitoring data measured at a representative location has been adopted for the purposes of this AQIA. Determination of data to be used as a location representative of the Proposal site and during a representative year can be complicated by factors which include:

- The sources of air pollutant emissions around the Proposal site and representative AQMS; and
- The variability of particulate matter concentrations (often impacted by natural climate variability).

One AQMS have been identified within a 10 km radius of the Project site, operated by NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW). This location is briefly summarised in Table D1.

Table D1 NSW DCCEEW AQMS within 10 km of the Proposal site

AQMS Location	Distance to Project site (km)	2021 data	Measurements					
			PM_{10}	$PM_{2.5}$	TSP	NO_2	CO	SO_2
Prospect	2.7	✓	✓	✓	×	✓	✓	✓

Concentrations of TSP are not measured at any AQMS surrounding the Project site. An analysis of co-located measurements of TSP and PM_{10} in the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions is presented in Figure D2.

The analysis concludes that, on the basis of the measurements collected in all regions between 1999 to 2011, the derivation of a broad TSP:PM_{10} ratio of 2.0551 : 1 (i.e. PM_{10} represents ~ 49 % of TSP) from the Sydney Metropolitan location is appropriate. In the absence of any more specific information, this ratio has been adopted within this AQIA, resulting in a background annual average TSP concentration of 35.3 $\mu g \cdot m^{-3}$.

Summary statistics for the selected data from the Prospect AQMS are provided in Table D1.

Graphs presenting the daily varying PM_{10}, $PM_{2.5}$, and hourly varying NO_2 and O_3 data recorded at Prospect AQMS in 2021 are presented in Figure D3 to Figure D6 respectively.

Table D1 Background air quality statistics – Prospect AQMS (2021)

Pollutant	TSP	PM_{10}	$PM_{2.5}$	NO_2	O_3	CO	CO	CO	SO_2	SO_2
Averaging period	Annual	24-hour	24-hour	1-hour	1-hour	15-minute	1-hour	8-hour (rolling)	1-hour	24-hour
Units	$\mu g \cdot m^{-3}$	$\mu g \cdot m^{-3}$	$\mu g \cdot m^{-3}$	$\mu g \cdot m^{-3}$	$\mu g \cdot m^{-3}$	$mg \cdot m^{-3}$	$mg \cdot m^{-3}$	$mg \cdot m^{-3}$	$\mu g \cdot m^{-3}$	$\mu g \cdot m^{-3}$
Statistics										
Data Points	362	362	361	8 120	8 257	8 190	8 190	8 632	8 193	354
Mean	35.3	17.2	6.9	14.9	36.7	0.1	0.1	0.1	1.5	1.3
Standard deviation	-	7.6	4.3	14.8	25.6	0.2	0.2	0.1	2.8	1.8
Skew[1]	-	*0.9*	*2.4*	*1.1*	*0.7*	*2.8*	*2.8*	*2.5*	*4.6*	*1.3*
Kurtosis[2]	-	*0.9*	*9.3*	*0.9*	*0.8*	*11.5*	*11.5*	*8.3*	*36.9*	*1.2*
Minimum	-	1.6	0.5	-4.1	0.0	-0.2	-0.1	-0.1	-2.9	0.0
Percentiles										
25^{th}	-	11.8	4.2	4.1	15.0	0.0	0.0	0.0	0.0	0.0
50^{th}	-	16.0	5.8	10.3	36.4	0.0	0.0	0.0	0.0	0.0
75^{th}	-	21.1	8.1	22.6	53.5	0.2	0.1	0.1	2.9	2.6
90^{th}	-	27.9	11.8	36.9	68.5	0.3	0.3	0.3	2.9	2.6
95^{th}	-	32.3	15.3	43.1	79.2	0.5	0.4	0.4	5.7	5.2
97^{th}	-	34.2	18.2	49.2	89.9	0.7	0.5	0.5	8.6	5.2
98^{th}	-	37.1	20.1	53.3	96.3	0.8	0.6	0.6	8.6	5.2
99^{th}	-	39.4	21.2	59.5	109.1	1.0	0.8	0.7	11.4	6.5
Maximum	**35.3**	**44.6**	**37.3**	**88.2**	**190.5**	**2.1**	**1.6**	**1.2**	**42.9**	**7.9**
Data Capture (%)	**98.9**	**98.9**	**98.6**	**92.4**	**94.0**	**93.2**	**93.2**	**98.3**	**93.3**	**96.7**

Notes: 1: Skew represents an expression of the distribution of measured values around the derived mean. Positive skew represents a distribution tending towards values higher than the mean, and negative skew represents a distribution tending towards values lower than the mean. Skew is dimensionless.

2: Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive kurtosis represents a more peaked distribution, and negative kurtosis represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Figure D1 Co-located TSP and PM_{10} measurements – Lower Hunter, Sydney Metro and Illawarra

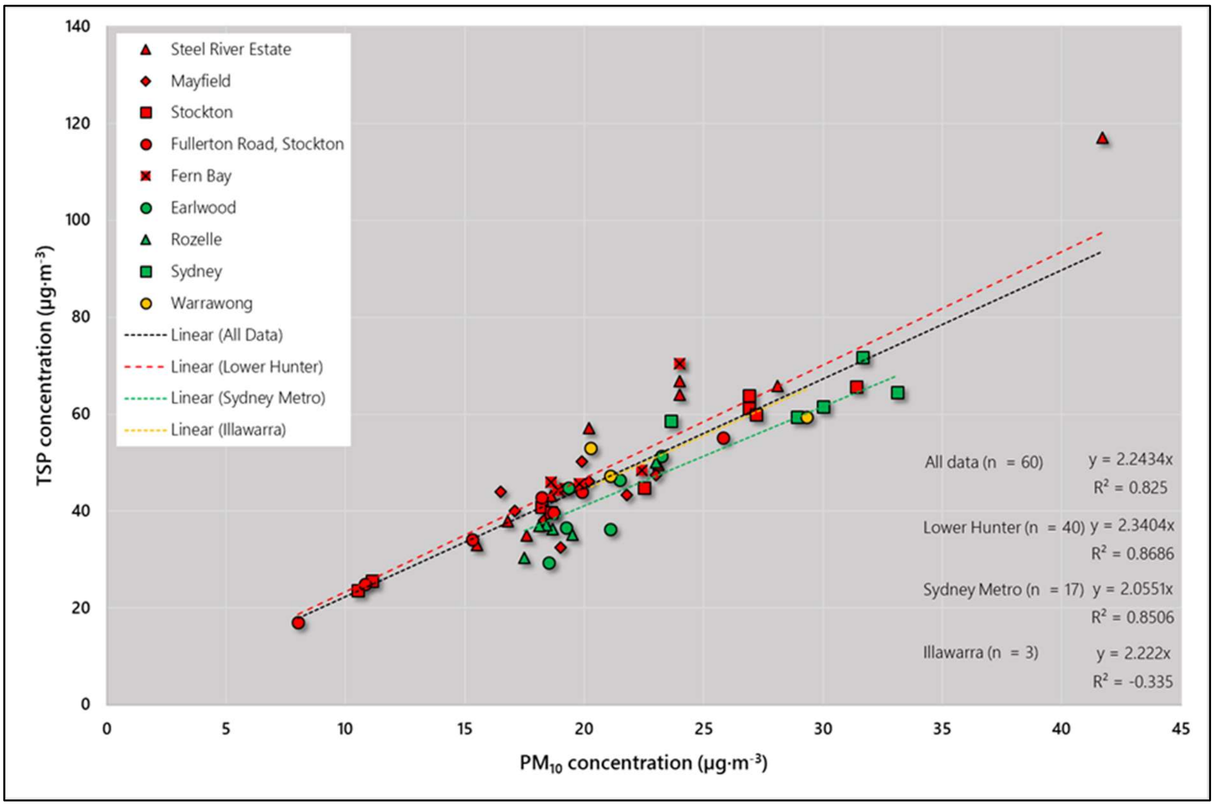
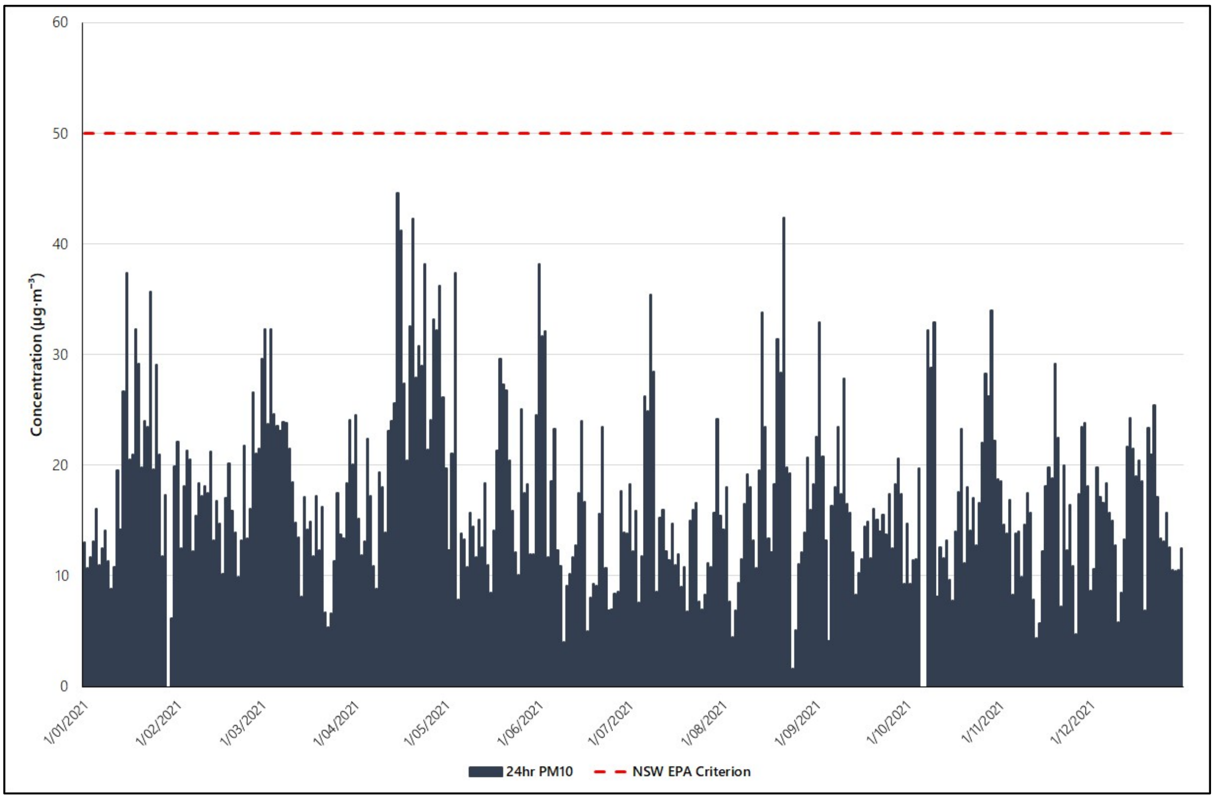
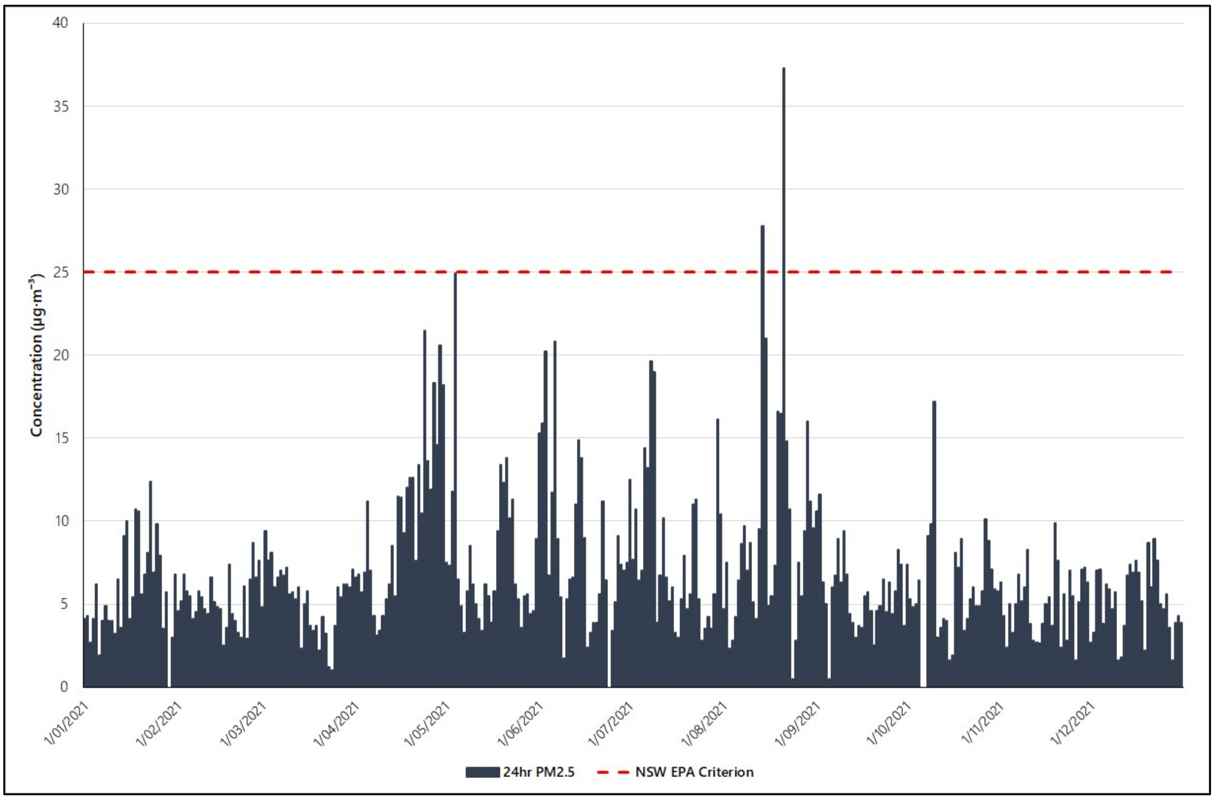


Figure D2 Daily varying PM_{10} measurements – Prospect AQMS (2021)



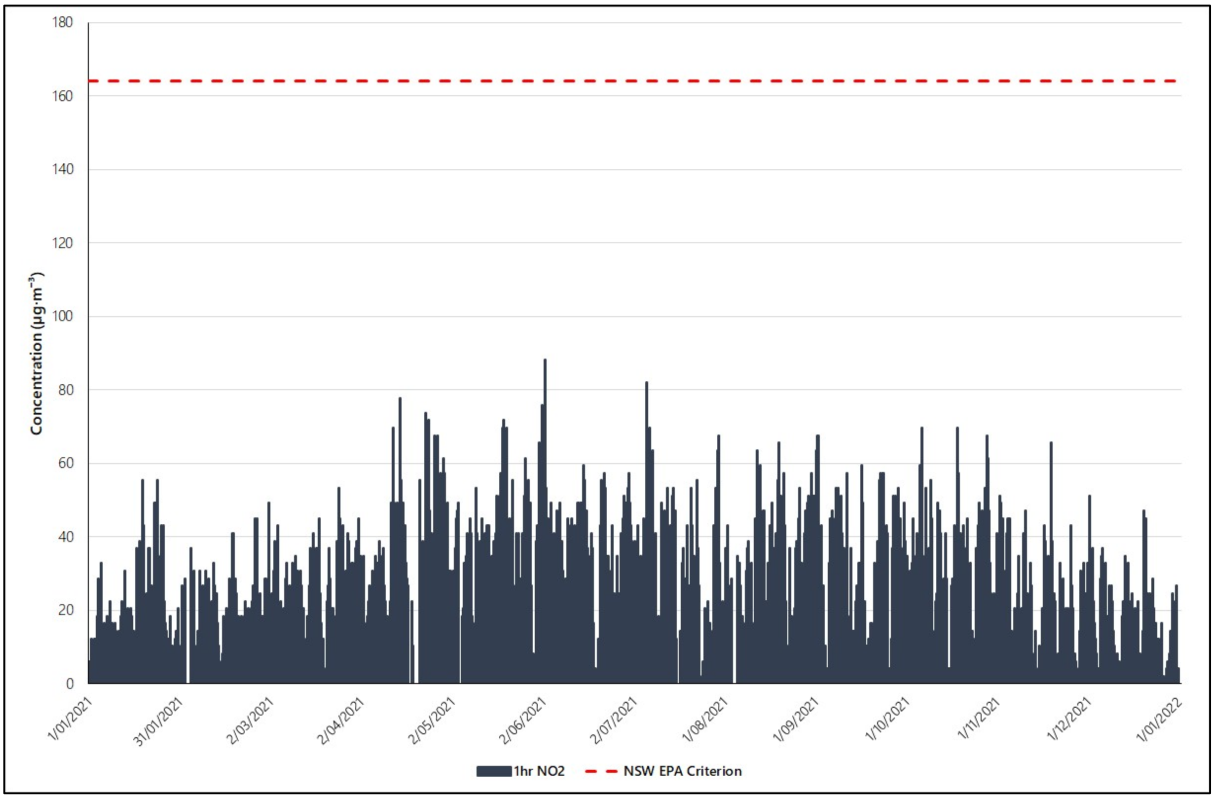
Source: Northstar

Figure D3 Daily varying $PM_{2.5}$ measurements – Prospect AQMS (2021)



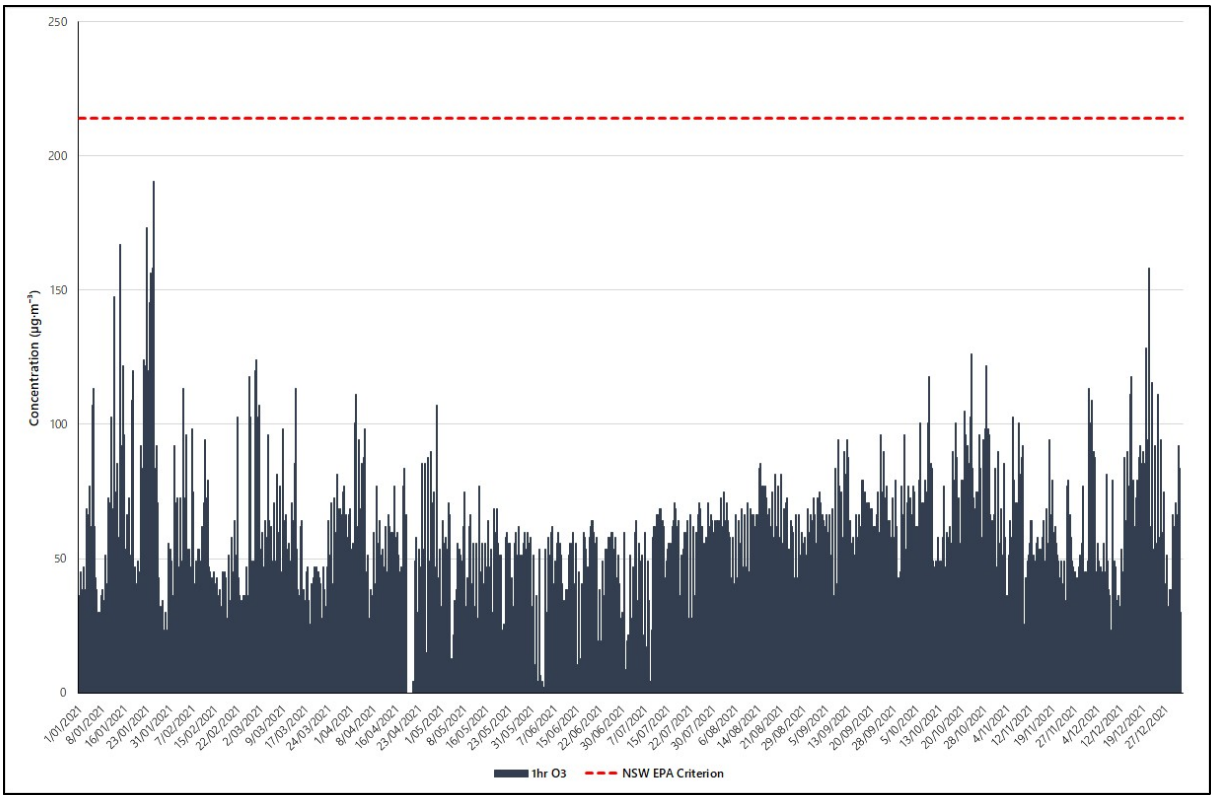
Source: Northstar

Figure D4 Hourly varying NO_2 measurements – Prospect AQMS (2021)



Source: Northstar

Figure D5 Hourly varying O_3 measurements – Prospect AQMS (2021)



Source: Northstar

It can be observed from Figure D3 that in 2021, the Prospect AQMS did not record any exceedance of the 24-hour PM_{10} criterion, however recorded exceedances of the 24-hour $PM_{2.5}$ criterion. Table D2 provides further details on the 24-hour $PM_{2.5}$ exceedances recorded at the Prospect AQMS in 2021.

Table D3 Calendar days in 2021 when 24-hour PM_{10} and $PM_{2.5}$ criteria were exceeded at Prospect AQMS

Date	Measured concentration ($\mu g{\cdot}m^{-3}$)	Comments
24-hour $PM_{2.5}$ concentrations		
21 August 2021	37.3	Exceptional – hazard reduction burning
14 August 2021	27.8	Exceptional – hazard reduction burning

The NSW 2021 annual compliance report (NSW DPE, 2023) attributes 2021 $PM_{2.5}$ exceedances primarily to hazard reduction burns in the Sydney region. These were classified as exceptional events under the National Environment Protection (Ambient Air Quality) Measure (NEPM) framework.

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