



# northstar



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## Project Marvel, Moorebank

### Air Quality Impact Assessment

Addressee(s):	Mapletree
Site Address:	20 Kelso Crescent, Moorebank NSW
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## Quality Control

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LEGISLATION, REGULATION AND GUIDANCE	Final	Northstar	GCG, MD	MD
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CONSTRUCTION AIR QUALITY RISK ASSESSMENT	Final	Northstar	GCG, MD	MD
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## Report Status

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## Final Authority

This report must be regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below.



**Martin Doyle**

**7 September 2023**

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## Non-Technical Summary

Northstar Air Quality Pty Ltd was engaged by Mapletree to perform an air quality impact assessment for the construction and operation of an industrial warehouse development to be located at 20 Kelso Crescent, Moorebank, NSW.

Construction phase activities would involve demolition, earthworks, construction works and associated vehicle traffic. The associated risks of impacts have been assessed using the published Guidance on the Assessment of Dust from Demolition and Construction, developed in the United Kingdom by the Institute of Air Quality Management, and adapted by Northstar Air Quality Pty Ltd for use in Australia. This methodology has been used in a similar context in numerous other similar air quality impact assessment studies.

That assessment showed there to be a high risk of health impacts and a medium risk of dust soiling associated with demolition activities should no mitigation measures be applied. All other construction phase activities are associated with medium risks of health impacts and low risks of dust soiling. Correspondingly, a range of standard mitigation measures are available to ensure that short-term impacts associated with construction activities are minimised.

The prediction of potential impacts associated with operational activities has been performed in general accordance with the requirements of the New South Wales Environment Protection Authority Approved Methods for the Modelling and Assessment of Air Pollutants in NSW document, using an approved and appropriate dispersion modelling technique. The estimation of emissions has been performed using referenced emission factors.

The findings of the operational phase assessment indicate that the operation of the Proposal is not predicted to result in any additional exceedances of relevant air quality criteria. Good site management practices such as the minimisation of vehicle idling whilst on site would be sufficient to ensure that impacts are minimised during Proposal operation.

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# 1. INTRODUCTION

Mapletree (the Applicant) has engaged Northstar Air Quality Pty Ltd (Northstar) to perform an air quality impact assessment (AQIA) for the construction and operation of an industrial warehouse development (the Proposal) to be located at 20 Kelso Crescent, Moorebank, NSW (the Proposal site).

This AQIA has been undertaken to support the development application (DA) to the City of Liverpool in order to assess the risks to local air quality associated with construction and operation of the Proposal.

## 1.1. Secretary Environmental Assessment Requirements

While project specific Secretary’s Environmental Assessment Requirements (SEARs) have not been received for the Proposal, this assessment is based on industry specific SEARs relevant for warehouse and distribution facilities.

Table 1 below identifies the SEARs relevant to this AQIA report and the relevant sections of the report in which they have been addressed.

**Table 1 Industry Specific Secretary’s Environmental Assessment Requirements**

Issue	Requirement	Addressed
Air Quality	Identify significant air emission sources at the proposed development (during construction and operation), assess their potential to cause adverse off-site impacts, and detail proposed management and mitigation measures that would be implemented. Where air emissions during operation have the potential to cause adverse off-site impacts, provide a quantitative air quality impact assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines.	Section 2.3  Section 6 & Section 7 Section 8  Section 6 & Section 7

## 1.2. Purpose of the Report

The purpose of this report is to identify and examine whether impacts associated with the construction and operation of the Proposal may adversely affect local air quality.

To allow assessment of the level of risk associated with the Proposal in relation to air quality, the AQIA has been performed in accordance with and with due reference to:

- *Protection of the Environment Operations Act 1997;*
- Protection of the Environment Operations (Clean Air) Regulation 2022;

- 
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA, 2022); and
  - Technical Framework and Notes – Assessment and Management of Odour from Stationary Sources in NSW (NSW DEC, 2006).

## 2. THE PROPOSAL

The following provides a description of the context, location and scale of the Proposal, and a description of the processes and development activities on site. It also identifies the potential for emissions to air associated with the construction and operation of the Proposal.

### 2.1. Environmental Setting

The Proposal site is located at 20 Kelso Crescent, Moorebank in the Liverpool Council Local Government Area (LGA). A map showing the location of the Proposal site is provided in Figure 1.

The closest residential property is located approximately 359 meters (m) from the Proposal site boundary to the northeast on Whelan Avenue. The immediate area surrounding the Proposal site is generally zoned for commercial and industrial uses (refer Section 4.1).

### 2.2. Overview and Purpose

DA approval is sought for the construction and operation of an industrial warehouse development comprising five warehouses split over two storeys, including ancillary offices at the Proposal site. The intended use of the warehouses located at the Proposal site is not yet determined.

The overall scope of the Proposal is briefly outlined below:

- Demolition of all existing buildings and structures;
- Site preparation works including tree clearing;
- Earthworks and additional site retaining;
- Infrastructure comprising civil works and utilities servicing;
- Construction of five warehouse buildings, split over two storeys with ramp-up access, and car parking;
- At grade on-site car parking and a total of 34 loading docks across the two storeys;
- Complementary landscaping and offset planting; and
- Diversion of overhead electricity transmission lines.

The gross floor areas (GFA) of the warehouses are outlined in Table 2 and layouts of the Proposal site are provided in Appendix B.

Table 2 Warehouse gross floor areas

Warehouse	Gross floor area (m <sup>2</sup> )
Warehouse 1	5 700
Warehouse 2	5 820
Warehouse 3	5 820
Warehouse 4	11 530
Warehouse 5	5 820

Figure 1 Proposal site location



Source: Northstar

## 2.3. Identification of Potential Emissions to Atmosphere

Given the nature of the Proposal described above, emissions to air would likely be generated as described below.

### 2.3.1. Construction Phase

Construction of the Proposal would involve demolition of the existing structures, earthworks, construction of a warehouse development, ancillary offices, car parking areas, and associated infrastructure. These activities will generate emissions of 'construction dust', which is particulate matter that is typically of larger aerodynamic diameter, and which are more commonly experienced as nuisance dust effects rather than health effects if not adequately controlled.

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

- Excavators;
- Front end loaders;
- Graders;
- Light vehicles;
- Heavy vehicles;
- Drills;
- Pneumatic and or power tools;
- Cranes;
- Commercial vans; and
- Cherry pickers.

A summary of the assessment of the potential air quality risks resulting from construction activities is presented in Section 6, while the full risk assessment is provided in Appendix E.

### 2.3.2. Operational Phase

During the operation of the Proposal, the following activities are anticipated to result in potential emissions to air:

- Movement of vehicles around the internal roadways of the Proposal site on paved road surfaces;
- Diesel and petrol combustion emissions from the consumption of fuel in trucks importing and exporting materials, and cars accessing the car park. The potential emissions would include smaller diameter particulates than construction emissions (assessed as PM<sub>10</sub> and PM<sub>2.5</sub>) and oxides of nitrogen (NO<sub>x</sub>), including nitrogen dioxide (NO<sub>2</sub>). There would additionally be some less significant emissions of carbon monoxide (CO), sulphur dioxide (SO<sub>2</sub>) and air toxics (including benzene and

1,3-butadiene) but for the purposes of this assessment, it is comfortably assumed that the principal gaseous pollutant would be NO<sub>x</sub>.

Experience in performing assessments of the impact of combustion-related emissions from the use of vehicles indicates that the principal indicator pollutants are particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) and NO<sub>2</sub> associated with relevant short-term criteria. NO<sub>x</sub>/NO<sub>2</sub> concentrations have been used within this assessment as an indicator pollutant for all other combustion-related gaseous emissions resulting from traffic.

Experience gained across a number of similar developments and review of other air quality reports for comparable developments, indicates that in relation to road traffic emissions, impacts associated with particulate matter and NO<sub>2</sub> are the 'limiting factor' to compliance with air quality criteria.

For clarity, SO<sub>2</sub> and CO would not be routinely assessed as part of an air quality study of this nature and scale as the risks are very low.

The hardstand nature of the Proposal site, and the nature of the activities being performed (i.e. warehousing and distribution, with no notable 'dust-generating' activities) would result in the Proposal site roads having a low silt loading, and correspondingly the potential for wheel generated particulate matter at the Proposal site is anticipated to be minimal and has not been subject to quantitative assessment. It is noted however that particulate emissions from brake and tyre wear, in addition to that generated through fuel combustion, have been assessed in this AQIA, associated with both truck and passenger vehicle movements.

A summary of the emission sources and potential emissions to air during the construction and operation of the Proposal, which have been subject to assessment, is presented in Table 3.

**Table 3 Identified potential sources of air emissions**

Source	Particulate emissions			Gaseous emissions
	TSP	PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>x</sub>
<b>Construction phase</b>				
Construction activities	✓	✓	✓	
<b>Operational phase</b>				
Exhaust emissions and brake and tyre wear – trucks and passenger vehicles	✓	✓	✓	✓

Given the nature of the development at this Proposal site, it is not anticipated that odour would be emitted in any significant quantity during construction or operation. Any potential contamination identified through detailed site investigation would be managed to ensure that no odour would impact upon surrounding receptor locations during construction. During operation, no odorous activities are anticipated, and correspondingly, odour has not been considered further as part of this AQIA.

### 3. LEGISLATION, REGULATION AND GUIDANCE

The following outlines the legislation and air quality criteria which are applicable to the activities being performed at the Proposal site.

#### 3.1. 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 *Protection of the Environment Operations Act 1997*, and the *Protection of the Environment Operations (Clean Air) Regulation 2022*. 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 regards to the relevance of the NSW Government's drive to improve air quality across the State and this AQIA, it is imperative that this Proposal demonstrates leadership in the development of the NSW economy (in terms of activity and employment) and concomitantly not cause detriment in achieving its objectives.

#### 3.2. Ambient Air Quality Standards

State air quality guidelines adopted by the NSW EPA are published in the '*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*' (the Approved Methods (NSW EPA, 2022)), which has been consulted during the preparation of this AQIA.

The Approved Methods lists the statutory methods that are to be used to model and assess emissions of criteria air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria to be applied.

The criteria listed in the Approved Methods (NSW EPA, 2022) 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 pollutants relevant to the Proposal are presented in Table 4.

**Table 4 NSW EPA impact assessment criteria for air pollutants and substances**

Air Pollutant	Averaging period	Units	Criterion	Notes
Nitrogen dioxide (NO <sub>2</sub> )	1 hour	µg·m <sup>-3</sup> (a)	164	Numerically equivalent to the AAQ NEPM <sup>(b)</sup> standards and goals.
	Annual	µg·m <sup>-3</sup> (a)	31	
Particulates (as PM <sub>10</sub> )	24 hours	µg·m <sup>-3</sup> (a)	50	
	1 year	µg·m <sup>-3</sup> (a)	25	
Particulates (as PM <sub>2.5</sub> )	24 hours	µg·m <sup>-3</sup> (a)	25	
	1 year	µg·m <sup>-3</sup> (a)	8	
Particulates (as TSP)	1 year	µg·m <sup>-3</sup> (a)	90	Assessed as insoluble solids as defined by AS 3580.10.1
Particulates (as dust deposition)	1 year <sup>(c)</sup>	g·m <sup>-2</sup> ·month <sup>-1</sup>	2	
	1 year <sup>(d)</sup>	g·m <sup>-2</sup> ·month <sup>-1</sup>	4	

- Notes:**
- (a) micrograms per cubic metre of air
  - (b) National Environment Protection (Ambient Air Quality) Measures
  - (c) Maximum increase in deposited dust level
  - (d) Maximum total deposited dust level

Dust deposition is not anticipated to be an issue of concern during the operational phase of the Proposal, given the nature of the emission sources identified. It is generally more of an issue of concern during the construction phase of developments of this nature (see Section 2.3.1), and the construction phase risk assessment (Section 6) considers measures to minimise those impacts.

## 4. EXISTING CONDITIONS

### 4.1. Surrounding Land Sensitivity

#### 4.1.1. Land Use Zoning

The Proposal site and immediate surrounds is currently zoned IN1 (General Industrial) under the Liverpool City Council Local Environmental Plan (LCC, 2008). The closest residential dwelling is located approximately 359 m to the northwest of the Proposal site.

#### 4.1.2. Discrete 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. Typically, these locations are identified as residential properties, although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

It is noted that in addition to the identified 'discrete' receptor locations, the entire modelling area is gridded with 'uniform' receptor locations (see Section 4.1.3) that are used to plot out the predicted impacts, and as such the accidental non-inclusion of a location sensitive to changes in air quality does not render the AQIA invalid, or otherwise incapable of assessing those potential risks.

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 Proposal site reside, population density data has been examined. Population density data based on the 2021 census have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre (km<sup>2</sup>) grid, covering mainland Australia (ABS, 2022). Using a Geographical Information System (GIS), the locations of sensitive receptor locations have been confirmed with reference to their population densities.

For clarity, the ABS use the following categories to analyse population density (persons·km<sup>-2</sup>):

- Very high >8,000
- High >5,000
- Medium >2,000
- Low >500
- Very low <500
- No population 0

Using ABS data in a GIS, the population density of the area surrounding the Proposal site is presented in Figure 2. The Proposal site is located in an area of low and medium population densities (between 500 and 5 000 persons·km<sup>-2</sup>).

Identified receptors adopted for use within this AQIA are presented in Table 5.

**Table 5 Receptor locations used in the AQIA**

ID	Location	Land use	Coordinates (UTM)	
			mE	mS
R1	Kelso Crescent, Moorebank	Industrial	309 588	6 243 642
R2	Kelso Crescent, Moorebank	Industrial	309 577	6 243 576
R3	Kelso Crescent, Moorebank	Industrial	309 600	6 243 439
R4	Iraking Avenue, Moorebank	Industrial	309 679	6 243 382
R5	Seton Road, Moorebank	Industrial	309 576	6 243 314
R6	Seton Road, Moorebank	Industrial	309 470	6 243 327
R7	Field Close, Moorebank	Industrial	309 374	6 243 465
R8	Field Close, Moorebank	Industrial	309 388	6 243 561
R9	Field Close, Moorebank	Industrial	309 412	6 243 608
R10	Newbridge Road, Chipping Norton	Industrial	309 477	6 243 704
R11	Whelan Avenue, Chipping Norton	Residential	309 762	6 243 895
R12	Jack O'Sullivan Road, Moorebank	Residential	309 962	6 243 543
R13	Swain Street, Moorebank	Residential	308 941	6 243 508
R14	Metcalfe Avenue, Moorebank	Childcare	310 362	6 242 953

#### 4.1.3. Uniform Receptor Locations

Additional to the sensitive receptors identified in Section 4.1.2, a grid of uniform receptor locations has been used in the AQIA to allow presentation of contour plots of predicted impacts.

Figure 2 Receptor locations



Source: Northstar

## 4.2. Meteorology

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 Proposal site have been characterised using data collected by the Australian Government Bureau of Meteorology (BoM) at a number of surrounding automatic weather stations (AWS).

Two meteorological stations operated by BoM were identified proximate to the Proposal site. A summary of the relevant AWS is provided in Table 6 below (listed by proximity).

**Table 6 Details of meteorological monitoring surrounding the Proposal site**

Site name	Source	Approximate location		Approximate distance
		mE	mS	km
Bankstown Airport AWS -Station #066137	BoM	313 855	6 245 099	4.6
Holsworthy Aerodrome AWS – Station #067161	BoM	310 553	6 236 779	5.4

Data from Bankstown Airport AWS for the period 2018-2022 (the most recent five years of completed data) have been analysed for use in this study. The wind roses presented in Appendix C indicate that from 2018 to 2022, winds at Bankstown Airport AWS show generally similar wind distribution patterns across the years assessed, with predominant south-westerly wind direction with north-westerly and south-easterly components also evident.

The majority of wind speeds experienced at the Bankstown Airport AWS between 2018 and 2022 are generally in the range 1.5 meters per second ( $\text{m}\cdot\text{s}^{-1}$ ) to  $5.5 \text{ m}\cdot\text{s}^{-1}$  with the highest wind speeds (greater than  $8 \text{ m}\cdot\text{s}^{-1}$ ) occurring from mostly north-westerly directions. Winds of this speed are rare and occur during 2.3 % of the observed hours during the years while calm winds ( $< 0.5 \text{ m}\cdot\text{s}^{-1}$ ) occur during 19.5 % of hours on average across the years 2018-2022.

An analysis of the correlation coefficients between each year for wind speed, wind direction and particulate matter data distribution was performed to select a representative year for the meteorological modelling (refer Appendix C). Following this analysis, the year 2020 was selected as the most representative year for further assessment.

To provide a characterisation of the meteorology which would be expected at the Proposal site, a meteorological modelling exercise has also been performed. A summary of the inputs and outputs of the meteorological modelling assessment, including validation of those outputs is presented in Appendix C.

### 4.3. 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.

Two AQMS have been identified proximate to the Proposal site, operated by NSW Department of Planning and Environment (NSW DPE). These locations (listed by proximity) are briefly summarised in Table 7.

**Table 7 Closest AQMS to the Proposal site**

AQMS location	Distance to site (km)	2020 data	Measurements				
			PM <sub>10</sub>	PM <sub>2.5</sub>	TSP	NO <sub>2</sub>	O <sub>3</sub>
Liverpool	3.0	✓	✓	✓	✗	✓	✓
Chullora	10.6	✓	✓	✓	✗	✓	✓

The closest representative AQMS with data available for the year 2020 (consistent with the meteorological modelling) is noted to be located at Liverpool. Correspondingly, PM and NO<sub>2</sub> data from Liverpool for the year 2020 have been adopted for use in this assessment.

Appendix D provides a detailed assessment of the background air quality monitoring data used in this AQIA.

It is noted that none of the AQMS identified in Table 7 measure concentrations of TSP. This pollutant is of relevance to the expected emissions from the Proposal. Other sources of data have been adopted to allow representation of the TSP environment in the area surrounding the Proposal site, and a full discussion is provided in Appendix D.

It is noted that a number of AQMS in NSW metropolitan and regional population centres recorded particulate matter concentrations above the national standard on a number of days towards the start of 2020. This was mainly driven by intense drought conditions and a high frequency of bushfires occurring across NSW in early 2020 (NSW DPIE, 2021).

A summary of the air quality monitoring data and assumptions used to produce this AQIA are presented in Table 8. It is noted that although impacts of ozone (O<sub>3</sub>) have not been considered in this assessment, O<sub>3</sub> data

have been adopted to assist in calculating the conversion of  $\text{NO}_x$  to  $\text{NO}_2$  for the dispersion modelling assessment (refer Section 5.2.3).

**Table 8 Summary of background air quality used in the AQIA**

Pollutant	Averaging Period	Units	Measured Value	Notes
Particles (as TSP)	Annual	$\mu\text{g}\cdot\text{m}^{-3}$	42.7	Estimated on a TSP:PM <sub>10</sub> ratio of 2.0551: 1
Particles (as PM <sub>10</sub> )	24-hour	$\mu\text{g}\cdot\text{m}^{-3}$	Daily varying	The 24-hour maximum PM <sub>10</sub> concentration in 2020 was 195.1 $\mu\text{g}\cdot\text{m}^{-3}$
	Annual	$\mu\text{g}\cdot\text{m}^{-3}$	20.8	
Particles (as PM <sub>2.5</sub> )	24-hour	$\mu\text{g}\cdot\text{m}^{-3}$	Daily varying	The 24-hour maximum PM <sub>2.5</sub> concentration in 2020 was 73.6 $\mu\text{g}\cdot\text{m}^{-3}$
	Annual	$\mu\text{g}\cdot\text{m}^{-3}$	9.1	
Nitrogen dioxide (NO <sub>2</sub> )	1-hour	$\mu\text{g}\cdot\text{m}^{-3}$	98.4	Hourly maximum 1-hr average in 2020
	Annual	$\mu\text{g}\cdot\text{m}^{-3}$	22.0	Annual average in 2020
Photochemical oxidants (as ozone)	1-hour	$\mu\text{g}\cdot\text{m}^{-3}$	218.3	Hourly maximum 1-hr average in 2020
	Annual	$\mu\text{g}\cdot\text{m}^{-3}$	34.3	Annual average in 2020

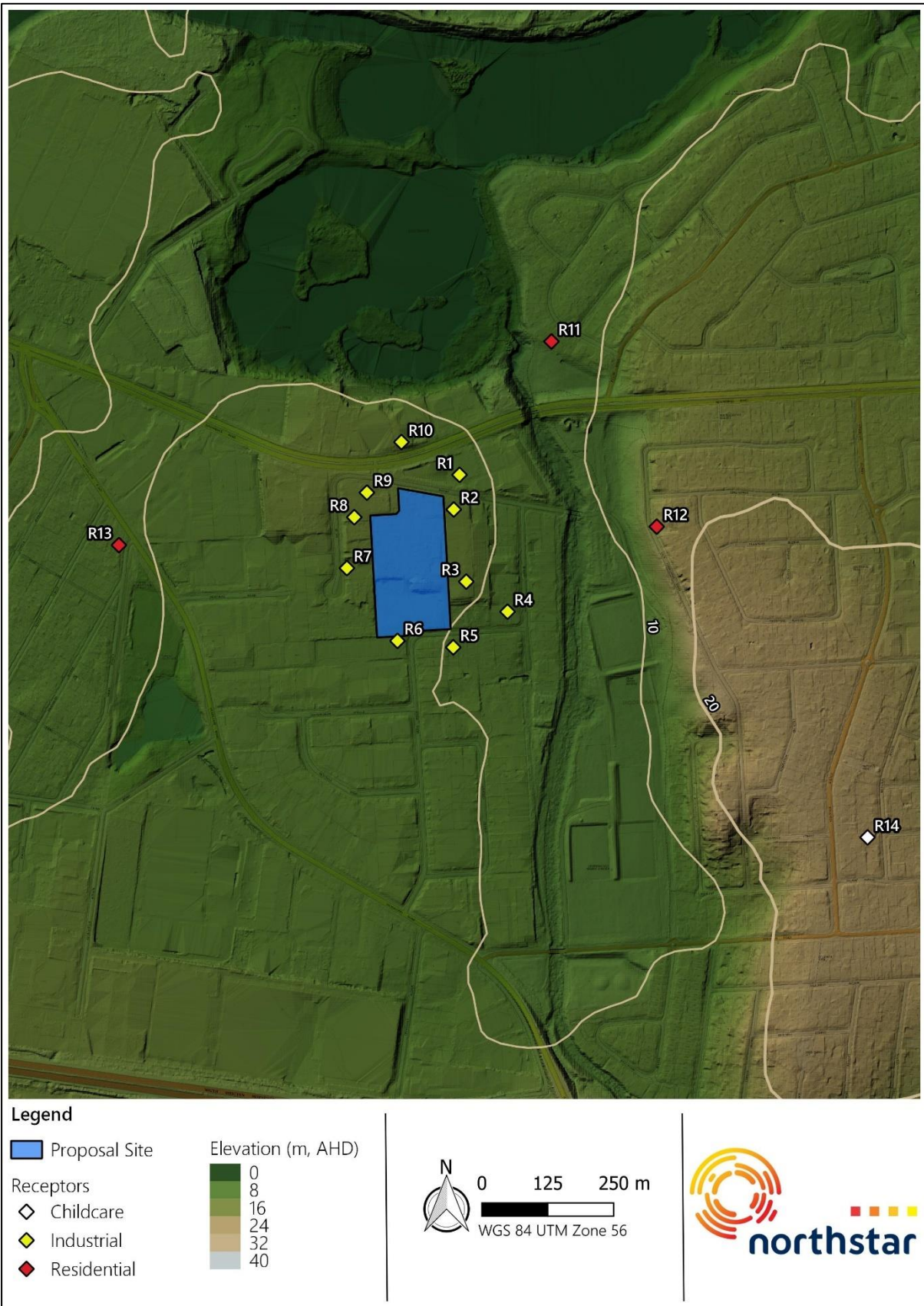
**Note:** Reference should be made to Appendix D

#### 4.4. Topography

The Proposal site is located within an area which has a relatively flat surface terrain with little height variation. The elevation of the Proposal site is approximately 10 m Australian Height Datum (AHD). The topography between the Proposal site and the nearest identified sensitive receptor locations is relatively consistent with elevation variances of less than 10 m within the immediate locality. In dispersion modelling terms, the topography is relatively uncomplicated, and does not need to be explicitly accounted for in the dispersion modelling exercise.

The topography surrounding the Proposal site is presented in Figure 3.

Figure 3 Local topography surrounding Proposal site



Source: Northstar

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#### 4.5. Potential for Cumulative Impacts

Given the industrial nature of the area surrounding the Proposal site, there is the potential for emissions generated as part of the Proposal and other surrounding facilities to impact cumulatively on nearby sensitive receptors.

A desktop survey identified two warehousing and distribution facilities proximate to the Proposal site as follows:

- JB Metropolitan Distributors located at 368-370 Newbridge Road, Moorebank approximately 0.2 km to the west of the Proposal site; and
- TL Distribution located at 11a Greenhills Avenue, Moorebank approximately 0.8 km to the southwest of the Proposal site.

It is noted that no publicly available documentation could be found regarding potential air quality impacts on the local environment associated with the abovementioned facilities. Given the nature of those neighbouring activities, it is considered that operational phase air emissions would be relatively low and the potential for cumulative impacts would also be low. Correspondingly, it is considered that the inclusion of background air quality data as described in Section 4.3 would appropriately account for any potential cumulative impacts associated with surrounding land uses.

## 5. APPROACH TO ASSESSMENT

### 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 very minor 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 Proposals 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 Proposal 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 a methodology presented in *Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM, 2014). Reference should be made to Appendix E for the methodology.

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 E.

## 5.2. Operational Phase

### 5.2.1. Emission Estimation

The estimation of emissions from a process is typically performed using direct measurement or through the application of factors which appropriately represent the processes under assessment. For road-traffic emissions, the assessment considered the applicability of emission factors presented in the National Pollutant Inventory (NPI) *Emission estimation technique manual for aggregated emissions from motor vehicles* (NPI, 2000). The emission factors were discounted due to the age of the emission factors, and the rapid improvements in engine performance over the last two decades. For example, a data set published in the year 2000 would utilise emission standards for passenger cars performing to Australian Design Rule (ADR) 37/01 (at best) which specifies (by way of example) a NO<sub>x</sub> emission of 1.93 g·km<sup>-1</sup> for petrol fuelled cars. For comparison, ADR7904 (type approval 2016) specify NO<sub>x</sub> emission standard of 0.06 g·km<sup>-1</sup> for petrol fuelled cars respectively, which represents 3 % of the ADR37/01 standard<sup>1</sup>.

To better represent more modern emission performance, reference has been made to the fleet-average NSW EPA GMR Emission Inventory On-Road emission assessment, adapted for this study by assumptions relating to site-specific fleet composition, road gradient and traffic conditions. The model is a development of ADR emission performance standards, fleet distribution published by the Motor Vehicle Census for Australia, and numerous sources of published road-traffic emission databases, including COPERT4.

It is noted that for the purposes of this study, the fleet composition at the Proposal site has been disaggregated by light vehicles (cars) and heavy vehicles (rigid). Appropriate emission factors for the differing vehicles at the Proposal site have been adopted from NSW EPA GMR Emission Inventory On-Road emission assessment and COPERT4. Impacts from diesel and petrol-fuelled vehicles have also been considered following a review of the Motor Vehicle Census of Australia to estimate the distribution of diesel and petrol vehicles from the traffic generation resulting from the Proposal.

Emissions of non-exhaust PM, including brake wear, tyre wear and road wear are included as factors in the assessment of PM<sub>10</sub> and PM<sub>2.5</sub> emissions.

The emission factors are provided as weighted by the road type, which helps provide definition of base vehicle speed and general traffic flow characteristics. For the purposes of this assessment, the roads at the Proposal site have been assessed as being typified as an “local / residential” road (to represent conditions within the Proposal site):

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<sup>1</sup> [https://www.infrastructure.gov.au/vehicles/environment/emission/files/Emission\\_Standards\\_for\\_Petrol\\_Cars.pdf](https://www.infrastructure.gov.au/vehicles/environment/emission/files/Emission_Standards_for_Petrol_Cars.pdf)

*Secondary roads with prime purpose of access to property. Characterised by low congestion and low levels of heavy vehicles. Generally one lane each way, undivided with speed limits of 50 km·h<sup>-1</sup> maximum. Regular intersections, mostly unsignalised, low intersection delays.*

Traffic data for the Proposal has been provided by Genesis Traffic, with a summary presented in Table 9. Note that the AM peak traffic data has been adopted for the assessment against short-term (1-hour) air quality criteria, with the daily total used to assess against longer term (24-hour and annual) criteria.

The data presented in Table 9 has been adopted as part of the operational AQIA. Additionally, the height of emissions, specifically associated with the ramp up to, and down from, the ground floor and level 1 (refer Appendix B) at the Proposal site has been taken into account in the modelling assessment.

**Table 9 Adopted traffic data for this AQIA**

Vehicle	AM peak (vehicles·hr <sup>-1</sup> )	PM peak (vehicles·hr <sup>-1</sup> )	Daily total (vehicles·day <sup>-1</sup> )
Light	69	52	754
Heavy	20	15	225
Total	89	67	979

In relation to emissions associated with idling trucks at the Proposal site, trucks are assumed to be idling at all docking locations at all times, which is considered to be conservative. In reality, given the layout of the Proposal site, the likelihood of trucks idling at all docks at all times is considered low.

Emission factors associated with idling trucks have been sourced from (USEPA, 2008). A summary of data used in the calculation of vehicle flows and emissions is presented in Table 10.

**Table 10 Data used in the calculation of vehicle flows and emissions**

Parameter	Source	Comments
Traffic flows for the Proposal	Genesis Traffic (refer Table 9)	Traffic data split by car (light) and rigid (heavy) vehicles
Peak hour traffic flows	Genesis Traffic (refer Table 9)	Peak AM adopted as conservative
Vehicle types	Genesis Traffic (refer Table 9)	Traffic data split by cars (light) and rigid (heavy) vehicles
Fuel types	ABS Motor Vehicle Census, 2020	Diesel and petrol fuel split for car, light commercial, light rigid, heavy rigid, articulated vehicles (most recent data available, not available by State or Territory)
Emissions	NSW EPA GMR Emissions Inventory 2008	NO <sub>x</sub> , PM <sub>10</sub> exhaust emissions, PM <sub>2.5</sub> from exhaust emission calculated to be 71.4% of PM <sub>10</sub> PM <sub>10</sub> , PM <sub>2.5</sub> brake and tyre wear emissions calculated for local/residential roads

### 5.2.2. Atmospheric Dispersion Modelling

A dispersion modelling assessment has been performed using the GRAz Lagrangian model (GRAL). GRAL is developed at the Graz University of Technology, Austria, and supported by the Federal State Government of Styria, Austria.

The GRAL modelling system is commonly used in Australia and New Zealand, with the 2019 Clean Air Society of Australia and New Zealand (CASANZ) conference featuring a GRAL stream for the first time due to its increased use in AQIA in Australia. The air quality assessments for the WestConnex M4 East (Pacific Environment, 2015) and New M5 (Pacific Environment, 2015b) used the GRAL model to predict operational impacts on ambient air quality and it is the preferred model of Traffic for NSW (TfNSW) for assessment of recent road infrastructure projects.

The GRAL model was selected for the dispersion modelling for this assessment for the following reasons:

- It is suitable for regulatory applications and can utilise a full year of meteorological data;
- It is a particle model and has the ability to predict concentrations under low-wind-speed conditions (i.e.  $< 1 \text{ m}\cdot\text{s}^{-1}$ ) which is better performance under these conditions than most Gaussian models (e.g. CALINE, Cal3QHCR, Cal3/4);
- It is specifically designed for the simultaneous modelling of road transport networks, including line sources (surface roads), point sources (tunnel ventilation outlets) and other sources; and
- It can characterise pollution dispersion in complex local terrain, accounting for the effects of obstacles (e.g. buildings, walls and vegetation) on flow and turbulence patterns by using a microscale prognostic flow field model.

### 5.2.3. $\text{NO}_x$ to $\text{NO}_2$ Conversion

The conversion of  $\text{NO}_x$  to  $\text{NO}_2$  has been assumed to be in accordance with Method 2 of the NSW EPA Approved Methods (section 8.1.2 of (NSW EPA, 2022)), commonly known as the 'Ozone Limiting Method' (OLM). This method assumes that all the available ozone ( $\text{O}_3$ ) in the atmosphere will react with nitrous oxide (NO) in the plume until either all the  $\text{O}_3$  or the NO is depleted, thus estimating instantaneous and complete formation of  $\text{NO}_2$  in the near-field. This approach assumes that the atmospheric reaction is instantaneous, although in reality the reaction takes place over a number of hours and typically at distance from the point of emission.

A level 2 assessment has been performed which uses the contemporaneous hourly model predictions of  $\text{NO}_x$  and measured hourly  $\text{NO}_2$  and  $\text{O}_3$  concentrations at the Liverpool AQMS in 2020 (see Section 4.3).

The assumed  $\text{NO}_x$  to  $\text{NO}_2$  reaction algorithm is represented as:

$$[\text{NO}_2]_{total} = \{0.1 \times [\text{NO}_x]_{pred}\} + \text{MIN}\left\{0.9 \times [\text{NO}_x]_{pred} \text{ or } \left(\frac{46}{48}\right) \times [\text{O}_3]_{bkgrd}\right\} + [\text{NO}_2]_{bkgrd}$$

where:

$[NO_2]_{total}$  = the predicted concentration of  $NO_2$  in  $\mu g \cdot m^{-3}$

$[NO_x]_{pred}$  = the dispersion model prediction of the ground level concentration of  $NO_x$  in  $\mu g \cdot m^{-3}$

$[O_3]_{bkgrd}$  = the background ambient  $O_3$  concentration in  $\mu g \cdot m^{-3}$

$\left(\frac{46}{48}\right)$  = the ratio of molar mass of  $NO_2$  and  $O_3$

$[NO_2]_{bkgrd}$  = the background ambient  $NO_2$  concentration in  $\mu g \cdot m^{-3}$

## 6. CONSTRUCTION AIR QUALITY RISK ASSESSMENT

The methodology adapted by Northstar from IAQM *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014) has been used to assess construction phase risk. The methodology and the full risk assessment are provided in Appendix E.

Briefly, the adapted method uses a six-step process for assessing dust impact risks from construction activities as a function (product) of receptor sensitivity and potential impact magnitude and identifies key activities for control (refer Section 5.1).

### 6.1. Risk (Pre-Mitigation)

Given the sensitivity of the identified receptors is classified as low for dust soiling, and medium for health effects, and the dust emission magnitudes for the various construction phase activities as presented in Appendix E, the resulting risk of air quality impacts (without mitigation) is as presented in Table 11.

**Table 11 Risk of air quality impacts from construction activities**

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

**Note:** Med. = Medium

The risks summarised in Table 11 show that for demolition activities, there is a medium risk of adverse dust soiling impacts and a high risk of human health impacts. All other construction phase activities are associated with low risks of dust soiling impacts and medium risks of health impacts if no mitigation measures were to be applied to control emissions associated with construction-phase activities.

The risk assessment therefore provides recommendations for construction phase mitigation, commensurate with those identified risks as provided in Appendix E.

### 6.2. Risk (Post Mitigation)

For almost all construction activity, the adapted methodology notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible.

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

### **6.3. Air Quality Monitoring – Construction Phase**

Based on the findings of the construction phase risk assessment, it is not considered that any air quality monitoring would be required during the construction phase. Daily site inspections under the Construction Environmental Management Plan (CEMP) would allow the identification of any issues, which should be rectified as soon as practicable.

## 7. OPERATIONAL AIR QUALITY IMPACT ASSESSMENT

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

- **Incremental impact** – relates to the concentrations predicted due to the operation of the Proposal in isolation; and
- **Cumulative impact** – relates to the incremental concentrations predicted due to the operation of the Proposal PLUS background air quality concentrations discussed in Section 4.3.

The results are presented in this manner to allow examination of the likely impact of the Proposal 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
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### 7.1. Particulate Matter

#### 7.1.1. Annual Average TSP, PM<sub>10</sub> and PM<sub>2.5</sub>

The predicted annual average particulate matter concentrations (as TSP, PM<sub>10</sub> and PM<sub>2.5</sub>) resulting from the operations at the Proposal site are presented in Table 12.

No contour plots of annual average TSP, PM<sub>10</sub> or PM<sub>2.5</sub> are presented, given the minor contribution from the Proposal at the nearest relevant sensitive receptors.

Table 12 Predicted annual average TSP, PM<sub>10</sub> and PM<sub>2.5</sub> concentrations

Receptor	Annual Average Concentration (µg·m <sup>-3</sup> )								
	TSP			PM <sub>10</sub>			PM <sub>2.5</sub>		
	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.
Criterion	90			25			8		
Max. % of criterion	<0.1	47.4	47.5	<0.1	83.2	83.4	1.0	113.8	114.4
R1	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R2	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R3	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R4	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R5	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R6	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R7	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R8	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R9	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R10	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R11	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R12	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R13	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2
R14	<0.1	42.7	42.8	<0.1	20.8	20.9	<0.1	9.1	9.2

Note: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

The performance of the Proposal does not result in any additional exceedances of the annual average particulate matter impact assessment criteria.

The existing PM<sub>2.5</sub> background is already in exceedance of the relevant criterion, and the operation of the Proposal is predicted to result in minimal impacts at all surrounding receptors.

### 7.1.2. Maximum 24-hour PM<sub>10</sub> and PM<sub>2.5</sub>

Presented in Table 13 are the maximum 24-hour average PM<sub>10</sub> and PM<sub>2.5</sub> concentrations predicted to occur at the nearest sensitive receptors as a result of the operation of the Proposal. No background concentrations are included within this table.

The predicted incremental concentrations of PM<sub>10</sub> and PM<sub>2.5</sub>, are demonstrated to be minor.

**Table 13 Predicted maximum incremental 24-hour PM<sub>10</sub> and PM<sub>2.5</sub> concentrations**

Receptor	Maximum 24-hour average concentration (µg·m <sup>-3</sup> )	
	PM <sub>10</sub>	PM <sub>10</sub>
Criterion	50	25
Max. % of criterion	1.6	2.8
R1	0.2	0.2
R2	0.2	0.2
R3	0.7	0.6
R4	0.5	0.4
R5	0.2	0.2
R6	0.6	0.6
R7	0.8	0.7
R8	0.7	0.6
R9	0.4	0.4
R10	0.6	0.5
R11	0.1	0.1
R12	0.2	0.2
R13	0.1	0.1
R14	<0.1	<0.1

Table 14 and Table 15 present the predicted maximum 24-hour average PM<sub>10</sub> and PM<sub>2.5</sub> concentrations resulting from the operation of the Proposal, with background included.

Results are presented for the receptor at which the highest incremental PM<sub>10</sub> and PM<sub>2.5</sub> impacts have been predicted, and for the receptors at which the highest cumulative impacts (increment plus background) have been predicted. These may be different receptors than those at which the highest incremental impacts are predicted.

The left side of the tables show the predicted concentration on days with the highest cumulative impact (principally driven by the highest background concentrations), and the right side shows the total predicted concentration on days with the highest predicted incremental concentrations with the contemporaneous background values to derive the respective cumulative predictions.

For PM<sub>10</sub>, the maximum cumulative impact (the left hand side of Table 14), and the maximum incremental impact (the right hand side of Table 14) are predicted at receptor R6 and R7 respectively.

For PM<sub>2.5</sub>, the maximum cumulative impact (the left hand side of Table 15), and the maximum incremental impact (the right hand side of Table 15) are predicted at receptors R10 and R7 respectively.

**Table 14 Summary of contemporaneous impact and background – PM<sub>10</sub>**

Date	24-hour average PM <sub>10</sub> concentration (µg·m <sup>-3</sup> ) – R6			Date	24-hour average PM <sub>10</sub> concentration (µg·m <sup>-3</sup> ) – R7		
	Incr.	Bg.	Cumul.		Incr.	Bg.	Cumul.
23/01/2020	0.2	195.1	195.3	13/12/2020	0.8	9.4	10.2
24/01/2020	<0.1	102.2	102.3	25/01/2020	0.7	59.9	60.6
8/01/2020	<0.1	100.6	100.7	10/02/2020	0.6	14.4	15.0
2/09/2020	0.1	66.4	66.5	14/12/2020	0.6	14.3	14.9
26/01/2020	<0.1	59.9	60.0	14/01/2020	0.6	18.3	18.9
28/01/2020	<0.1	59.9	60.0	6/01/2020	0.5	42.0	42.5
25/01/2020	<0.1	59.9	60.0	7/02/2020	0.5	8.8	9.3
27/01/2020	<0.1	59.9	60.0	9/02/2020	0.5	11.8	12.3
13/01/2020	<0.1	59.4	59.5	16/12/2020	0.5	15.6	16.1
12/01/2020	<0.1	59.4	59.5	15/12/2020	0.5	14.1	14.6
11/01/2020	<0.1	59.4	59.5	27/01/2020	0.5	59.9	60.4
22/07/2020	<0.1	54.3	54.4	13/02/2020	0.4	18.9	19.3
29/08/2020	<0.1	46.0	46.1	11/03/2020	0.4	12.0	12.4
These data represent the highest Cumulative Impact 24-hour PM <sub>10</sub> predictions (outlined in red) as a result of the operation of the Proposal				These data represent the highest Incremental Impact 24-hour PM <sub>10</sub> predictions (outlined in blue) as a result of the operation of the Proposal.			

**Note:** Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

**Table 15 Summary of contemporaneous impact and background – PM<sub>2.5</sub>**

Date	24-hour average PM <sub>2.5</sub> concentration (µg·m <sup>-3</sup> ) – R10			Date	24-hour average PM <sub>2.5</sub> concentration (µg·m <sup>-3</sup> ) – R7		
	Incr.	Bg.	Cumul.		Incr.	Bg.	Cumul.
8/01/2020	0.2	73.6	73.8	13/12/2020	0.7	3.1	3.8
11/01/2020	0.1	42.9	43.0	25/01/2020	0.7	14.7	15.4
12/01/2020	<0.1	42.9	43.0	14/12/2020	0.6	3.1	3.7
13/01/2020	<0.1	42.9	43.0	10/02/2020	0.6	4.7	5.3
24/01/2020	<0.1	41.5	41.6	14/01/2020	0.5	6.5	7.0
17/01/2020	0.5	31.1	31.6	9/02/2020	0.5	2.5	3.0
30/08/2020	<0.1	28.1	28.2	6/01/2020	0.5	24.0	24.5
29/08/2020	<0.1	26.2	26.3	15/12/2020	0.5	4.3	4.8
31/05/2020	<0.1	25.6	25.7	7/02/2020	0.4	2.9	3.3
23/01/2020	<0.1	24.8	24.9	8/02/2020	0.4	2.1	2.5
These data represent the highest Cumulative Impact 24-hour PM <sub>2.5</sub> predictions (outlined in red) as a result of the operation of the Proposal.				These data represent the highest Incremental Impact 24-hour PM <sub>2.5</sub> predictions (outlined in blue) as a result of the operation of the Proposal.			

**Note:** Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

It is noted that a number of exceedances are indicated in the 'background' air quality data, and as discussed in Section 4.3, these were due to regional air quality episodes. However, the operation of the Proposal is not predicted to result in any additional exceedances of that criterion.

The performance of the Proposal does not result in any additional exceedances of the 24-hour average particulate matter impact assessment criteria.

## 7.2. Nitrogen Dioxide

Results are presented in this section for the predictions of nitrogen dioxide ( $\text{NO}_2$ ). The averaging periods associated with the criteria for these pollutants is 1 hour maximum and annual average as specified in Table 4.

Emissions of  $\text{NO}_x$  have been calculated, with subsequent ground-level concentrations predicted using dispersion modelling techniques. Given that  $\text{NO}_x$  is a mixture of  $\text{NO}_2$  and nitric oxide (NO), conversion of  $\text{NO}_x$  predictions to  $\text{NO}_2$  concentrations may be performed. Within this assessment, the OLM method has been adopted as outlined in Section 5.2.3.

The predicted maximum 1-hour and annual average  $\text{NO}_2$  concentrations resulting from the Proposal operations are presented in Table 16.

It is noted that the predicted 1-hour average concentrations are shown for the hour resulting in the maximum cumulative impacts at sensitive receptor locations rather than the hour resulting in the maximum incremental concentrations.

Table 16 Predicted 1-hour and annual NO<sub>2</sub> concentrations

Receptor	Nitrogen dioxide (NO <sub>2</sub> ) concentration (µg·m <sup>-3</sup> )					
	1-hour average			Annual average		
	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.
Criterion	164			31		
Max. % of criterion	0.3	60.0	60.3	8.1	71.2	79.3
R1	<0.1	98.4	98.5	0.8	22.1	22.9
R2	<0.1	98.4	98.5	0.6	22.1	22.7
R3	<0.1	98.4	98.5	1.9	22.1	24.0
R4	<0.1	98.4	98.5	1.2	22.1	23.3
R5	<0.1	98.4	98.5	0.7	22.1	22.8
R6	0.2	98.4	98.6	1.3	22.1	23.4
R7	0.5	98.4	98.9	2.5	22.1	24.6
R8	0.3	98.4	98.7	2.1	22.1	24.2
R9	<0.1	98.4	98.5	1.4	22.1	23.5
R10	<0.1	98.4	98.5	1.3	22.1	23.4
R11	<0.1	98.4	98.5	0.4	22.1	22.5
R12	<0.1	98.4	98.5	0.7	22.1	22.8
R13	0.3	98.4	98.7	0.2	22.1	22.3
R14	<0.1	98.4	98.5	0.2	22.1	22.3

**Note:** Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

The results indicate that predicted incremental concentrations of combustion-related pollutants (characterised by NO<sub>2</sub>), are below the criteria at all surrounding receptor locations. At the worst affected receptor (R7) and for the pollutant with the highest predicted concentrations (1-hour maximum NO<sub>2</sub>), predicted increments are shown to be less than 0.3 % of the relevant criterion as a result of the Proposal. The calculated cumulative impacts (Proposal plus background) are shown to result in impacts less than the criteria.

The performance of the Proposal does not result in any exceedances of the criteria for combustion related pollutants.

A contour plot of the predicted maximum 1-hour incremental NO<sub>2</sub> impact is presented in Figure 4.

Figure 4 Predicted maximum incremental 1-hour NOx as NO<sub>2</sub> impacts



Source: Northstar

Note: Criterion = 164 µg·m<sup>-3</sup> (cumulative)

## 8. MITIGATION AND MANAGEMENT

### 8.1. Construction Phase Mitigation

The potential impacts associated with construction phase activities has been performed using a risk-based assessment procedure. This approach is preferred, principally because emissions from construction activities are hard to estimate as they occur over short-term periods, and the rate of actual emissions is highly dependent upon the prevailing meteorology and conditions coincidental to the performance of the specific operations. Also, these can be influenced significantly by the manner in which those activities are performed and managed.

To offer a methodology to identify potential construction phase risks and where controls are required, the IAQM risk-based assessment procedure has been adopted. This methodology has been adapted for use in Australia by Northstar and used previously in NSW and Australia.

The published procedure assesses risk associated with various construction-phase activities, including demolition, earthworks, construction, and track-out. The identified risks are summarised in Section 6, and the mitigation measures identified to manage those risks are presented in Appendix E. Additionally, the identified mitigation measures are anticipated to be implemented in the Construction Environmental Management Plan (CEMP).

### 8.2. Operational Phase Mitigation

Based on the findings of the air quality impact assessment as presented in Section 7, it is considered that the level of activity being performed at the Proposal site would result in the achievement of all air quality criteria, even following the adoption of potential worst-case operating conditions. The existing background annual average PM<sub>2.5</sub> concentration is shown to be exceeding the criteria even without the operation of the Proposal. Impacts associated with the Proposal are minimal and would not result in the exacerbation of that existing exceedance.

Accounting for the background air quality assumptions, and adopting worst-case assumptions in relation to truck idling, the assessment does not predict any additional exceedances of the respective criteria as a result of the operation of the Proposal, for the pollutants assessed.

Good site management practices, including the observation of speed limits on site, and the minimisation of vehicle use (through avoidance of engine idling) would be sufficient to ensure that off-site impacts are minimised.

### 8.3. Monitoring

Given the discussion presented above, taking into consideration the incremental contribution of the Proposal to air quality impacts in the surrounding area, no air quality monitoring is required or proposed, for either the construction phase or the operational phase.

## 9. CONCLUSION

Northstar was engaged by Mapletree to perform an AQIA for the construction and operation of an industrial warehouse development to be located at 20 Kelso Crescent, Moorebank, NSW.

Construction phase activities would involve demolition, earthworks, construction works and associated vehicle traffic. The associated risks of impacts have been assessed using the published *Guidance on the Assessment of Dust from Demolition and Construction*, developed in the United Kingdom by the Institute of Air Quality Management (IAQM), and adapted by Northstar for use in Australia. This methodology has been used in a similar context in numerous other similar AQIA studies.

That assessment showed there to be a high risk of health impacts and a medium risk of dust soiling associated with demolition activities should no mitigation measures be applied. All other construction phase activities are associated with medium risks of health impacts and low risks of dust soiling. Correspondingly, a range of standard mitigation measures are available to ensure that short-term impacts associated with construction activities are minimised.

The prediction of potential impacts associated with operational activities has been performed in general accordance with the requirements of the NSW EPA Approved Methods (NSW EPA, 2022), using an approved and appropriate dispersion modelling technique. The estimation of emissions has been performed using referenced emission factors.

The potential impacts at all the identified receptor locations have been presented in this study which documents those predictions as:

- **Incremental impact** – relates to the concentrations predicted as a result of the operation of the Proposal in isolation.
- **Cumulative impact** – relates to the concentrations predicted as a result of the operation of the Proposal PLUS the background air quality concentrations.

The findings of the operational phase assessment indicate that the operation of the Proposal is not predicted to result in any additional exceedance of the air quality criteria. Good site management practices such as the minimisation of vehicle idling whilst on site, would be sufficient to ensure that impacts are minimised during Proposal operation.

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## APPENDIX A

### Commonly used units and abbreviations

## 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	Prefix	Symbol	Factor
T	tera-	$10^{12}$	p	pico-	$10^{-12}$
G	giga-	$10^9$	n	nano-	$10^{-9}$
M	mega-	$10^6$	μ	micro-	$10^{-6}$
k	kilo-	$10^3$	m	milli-	$10^{-3}$
h	hector-	$10^2$	c	centi-	$10^{-2}$
da	deca-	$10^1$	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  $50 \mu\text{g}\cdot\text{m}^{-3}$  and not  $50 \mu\text{g}/\text{m}^3$ ; and,

- 0.2 kilograms per hectare per hour would be presented as  $0.2 \text{ kg}\cdot\text{ha}^{-1}\cdot\text{hr}^{-1}$  and not  $0.2 \text{ kg}/\text{ha}/\text{hr}$ .

### Commonly used SI-derived and non-SI units

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

### Commonly used abbreviations

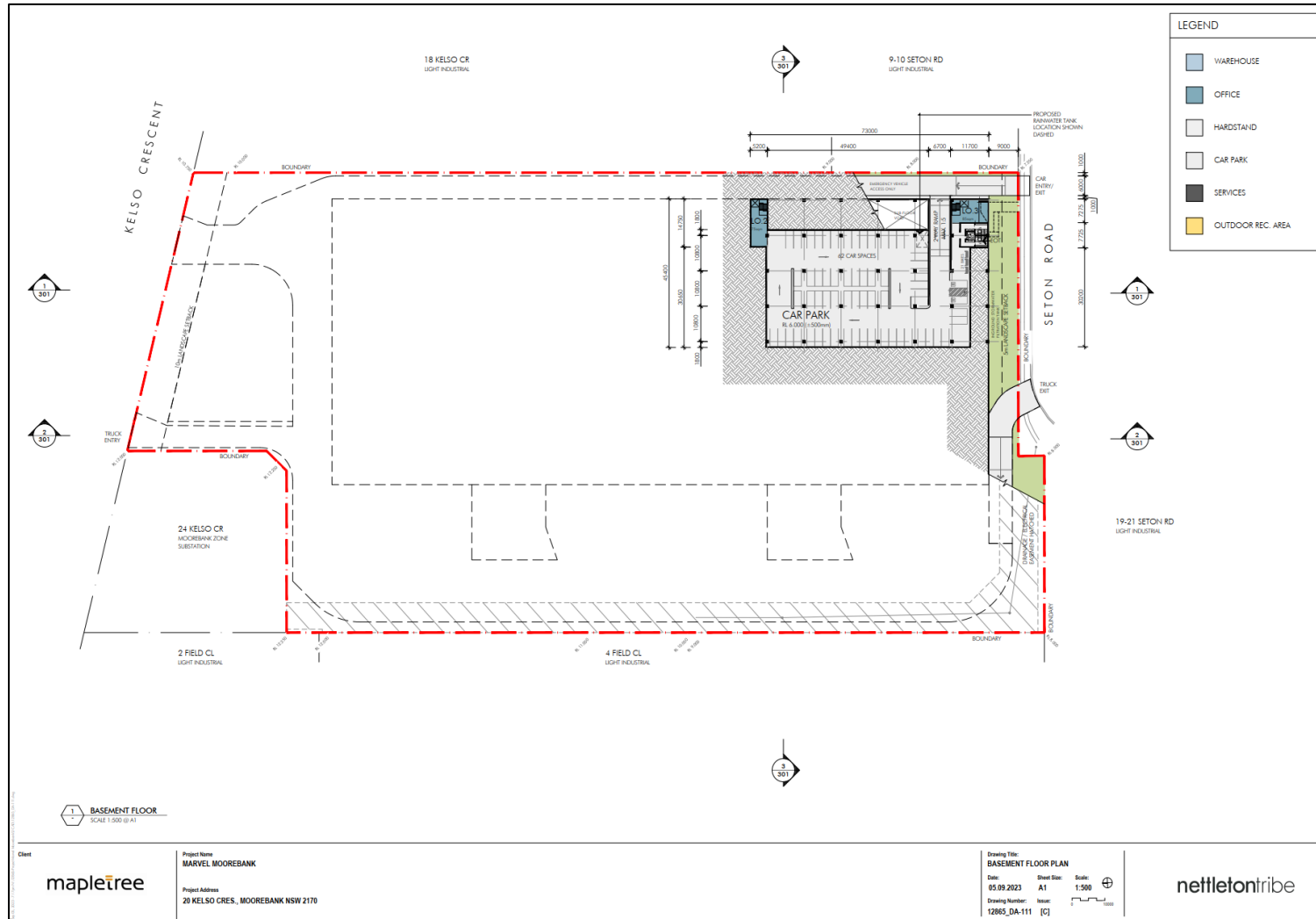
Abbreviation	Term
ABS	Australian Bureau of Statistics
ACT	Australian Commonwealth Territory
AGL	above ground level
AHD	Australian height datum
AQIA	air quality impact assessment
AQMS	air quality monitoring station
AQRA	air quality risk assessment
AS/NZS	Australian Standard / New Zealand Standard
AWS	automatic weather station
BGL	below ground level
BOM	Bureau of Meteorology
CEMP	construction environment management plan
CO	carbon monoxide
CO <sub>2</sub>	carbon dioxide
DEM	digital elevation model
EETM	emission estimation technique manual
EPA VIC	Environmental Protection Authority Victoria
GIS	geographical information system
IAQM	UK Institute of Air Quality Management
NCAA	National Clean Air Agreement

Abbreviation	Term
NEPM	National Environment Protection Measure
NO	nitric oxide
NO <sub>x</sub>	oxides of nitrogen
NO <sub>2</sub>	nitrogen dioxide
NSW	New South Wales
NSW DPE	New South Wales Department of Planning and Environment
NSW EPA	New South Wales Environment Protection Authority
NT	Northern Territory
OEMP	operational environmental management plan
O <sub>3</sub>	ozone
PM	particulate matter
PM <sub>10</sub>	particulate matter with an aerodynamic diameter of 10 µm or less
PM <sub>2.5</sub>	particulate matter with an aerodynamic diameter of 2.5 µm or less
SA	South Australia
SEPP	State Environmental Protection Policy
SO <sub>x</sub>	oxides of sulphur
SO <sub>2</sub>	sulphur dioxide
TAPM	The Air Pollution Model
TAS	Tasmania
TSP	total suspended particulates
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VIC	Victoria

## APPENDIX B

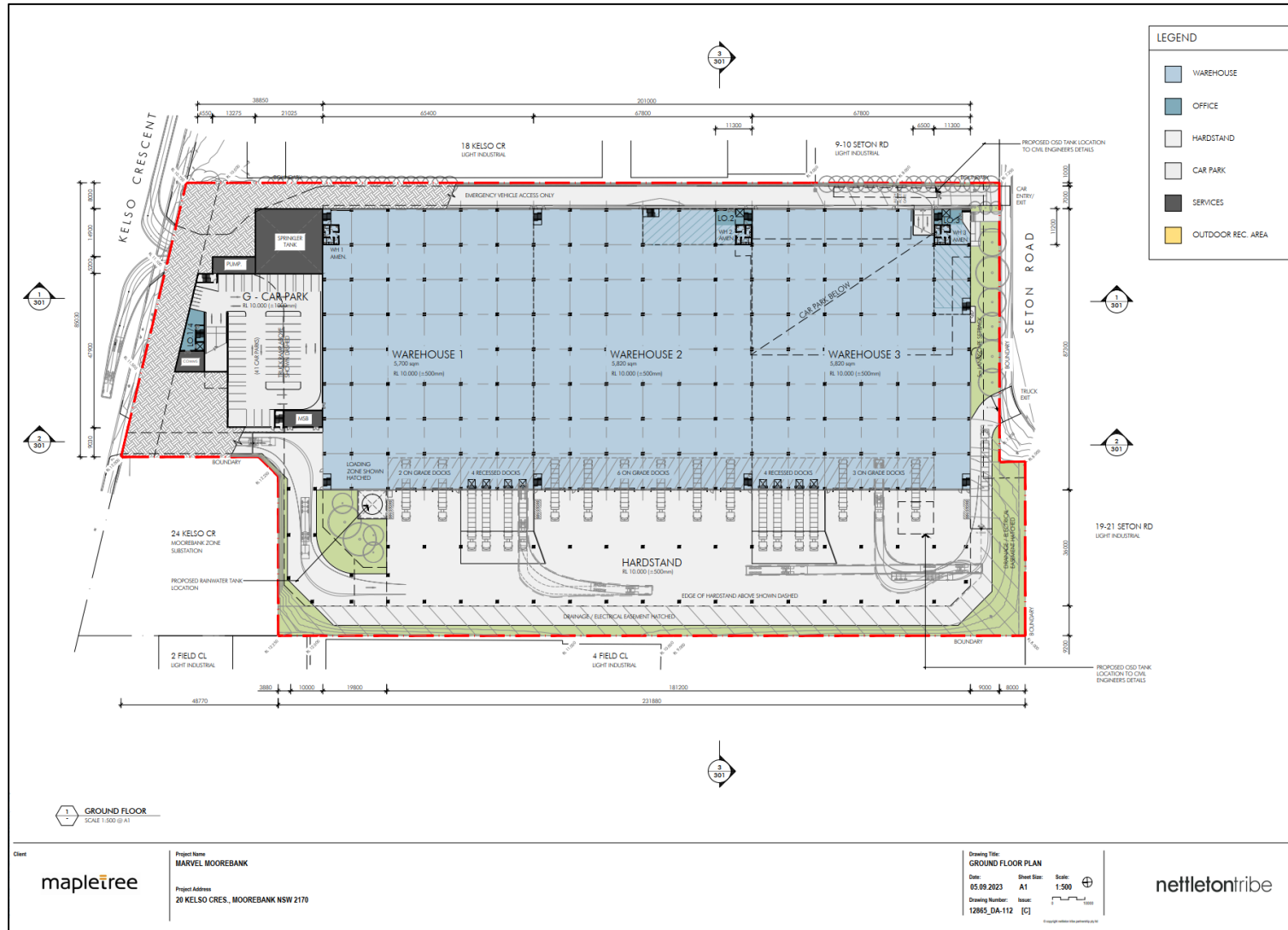
roposal Site Layouts

Figure B1 Proposal site layout – basement floor plan



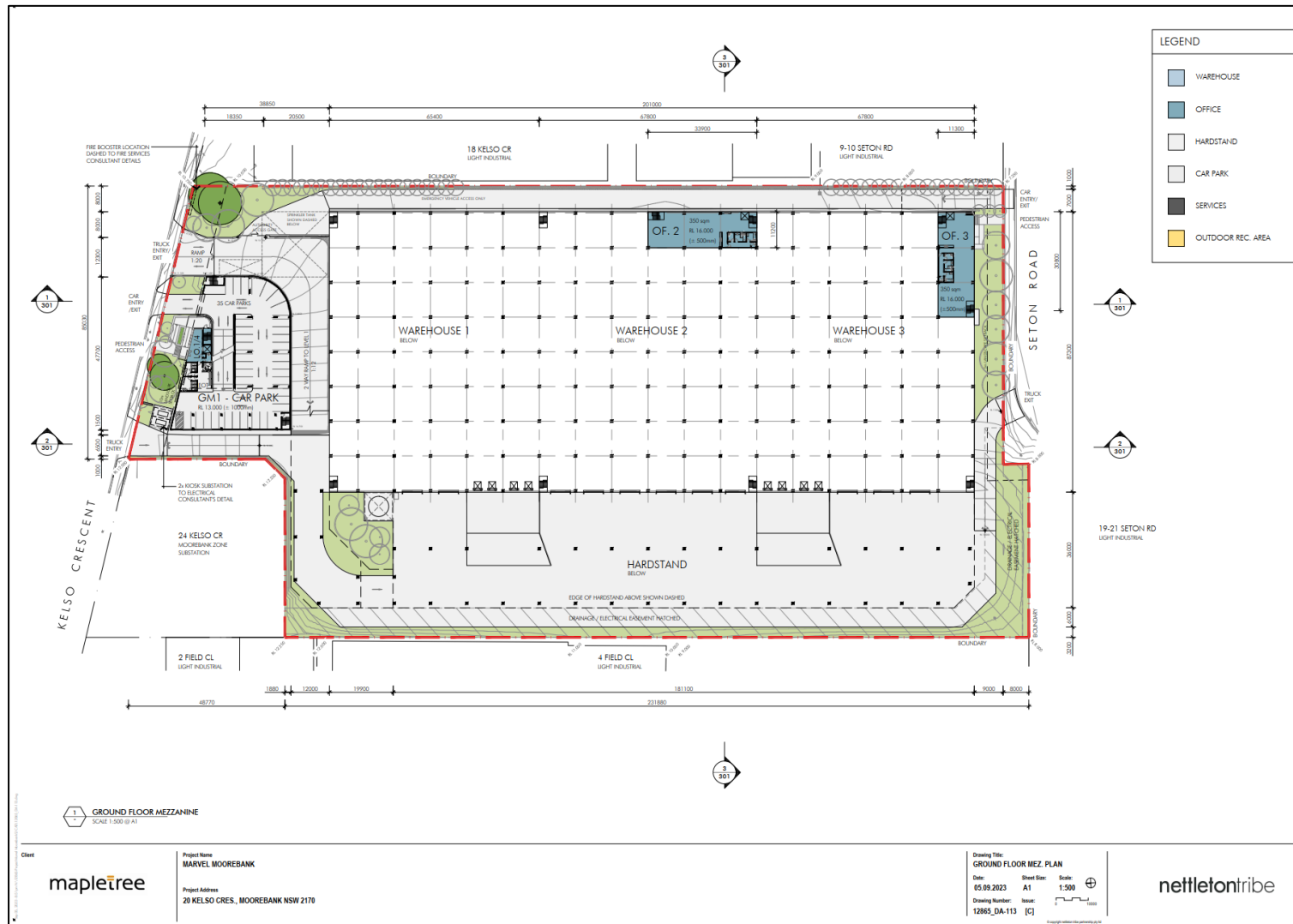
Source: nettletontribe

Figure B2 Proposal site layout – ground floor plan



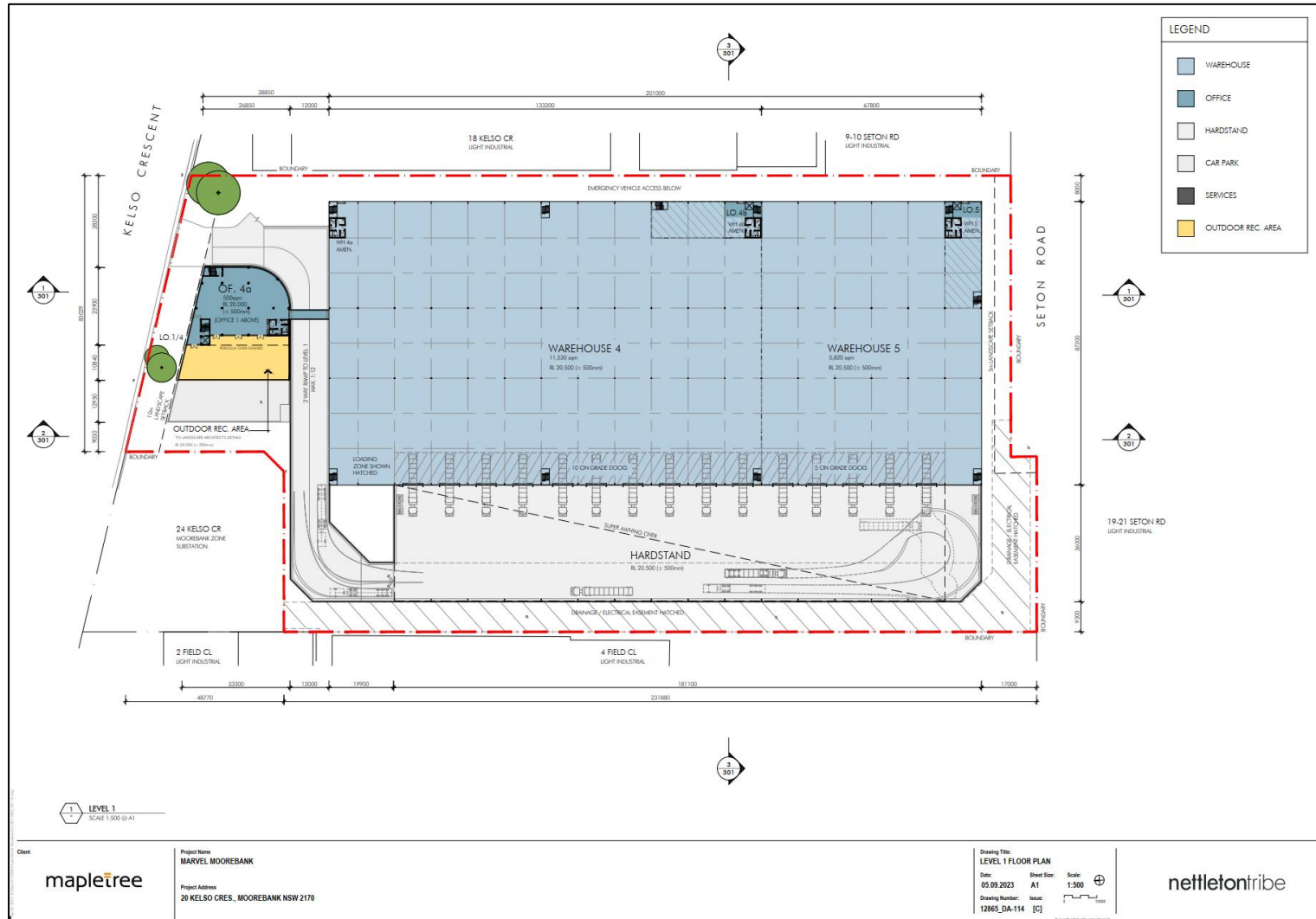
Source: nettleontribe

Figure B3 Proposal site layout – Ground floor mezzanine



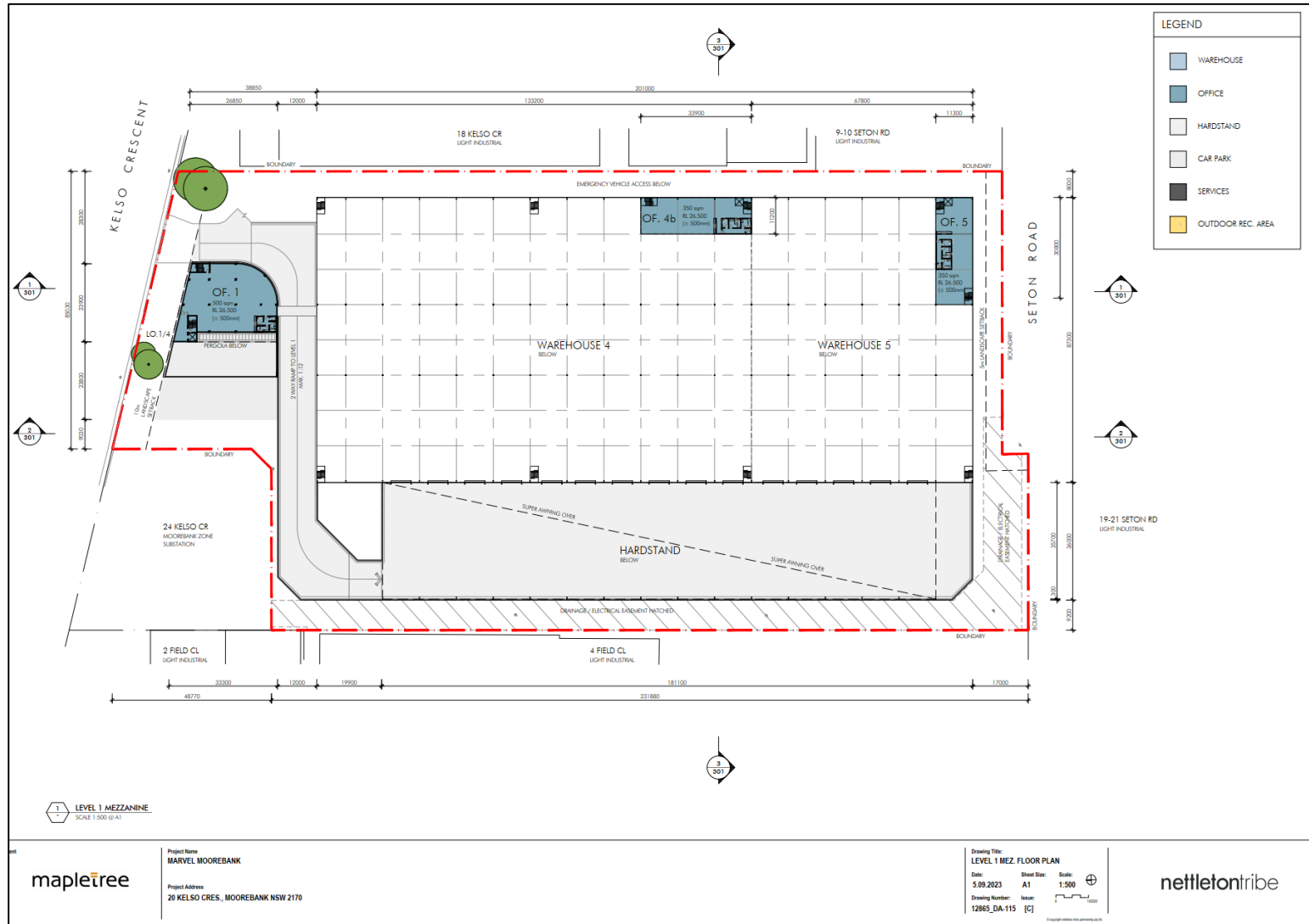
Source: nettleontribe

Figure B4 Proposal site layout – level 1 floor plan



Source: nettletontribe

Figure B5 Proposal site layout – level 1 mezzanine floor plan



Source: nettleontribe

## APPENDIX C

### Meteorology

As discussed in Section 4.2, a meteorological modelling exercise has been performed to characterise the meteorology of the Proposal 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 is provided in Table C1.

**Table C1 Details of the meteorological monitoring surrounding the Proposal site**

Site name	Source	Approximate location		Approximate distance
		mE	mS	km
Bankstown Airport AWS -Station #066137	BoM	313 855	6 245 099	4.6
Holsworthy Aerodrome AWS – Station #067161	BoM	310 553	6 236 779	5.4

As discussed in Section 4.2, meteorological conditions at Bankstown Airport AWS have been examined to determine a ‘typical’ or representative dataset for use in dispersion modelling. Annual wind roses for the most recent years of data (2018 to 2022) are presented in Figure C1. The annual wind speed frequency distribution for the five-year period is presented in Figure C2.

The correlation coefficient between each year and the five-year period for the distribution of wind speed, wind direction, PM<sub>10</sub> and PM<sub>2.5</sub> 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.

The wind roses indicate that from 2018 to 2022, winds at Bankstown Airport AWS show generally similar wind distribution patterns across the years assessed, with predominant south-westerly wind direction with north-westerly and south-easterly components also evident.

The majority of wind speeds experienced at the Bankstown Airport AWS between 2018 and 2022 are generally in the range 1.5 meters per second (m·s<sup>-1</sup>) to 5.5 m·s<sup>-1</sup> with the highest wind speeds (greater than 8 m·s<sup>-1</sup>) occurring from mostly north-westerly directions. Winds of this speed are rare and occur during 2.3 % of the observed hours during the years while calm winds (< 0.5 m·s<sup>-1</sup>) occur during 19.5 % of hours on average across the years 2018-2022.

Figure C1 Annual wind roses – Bankstown Airport AWS (2018 – 2022)

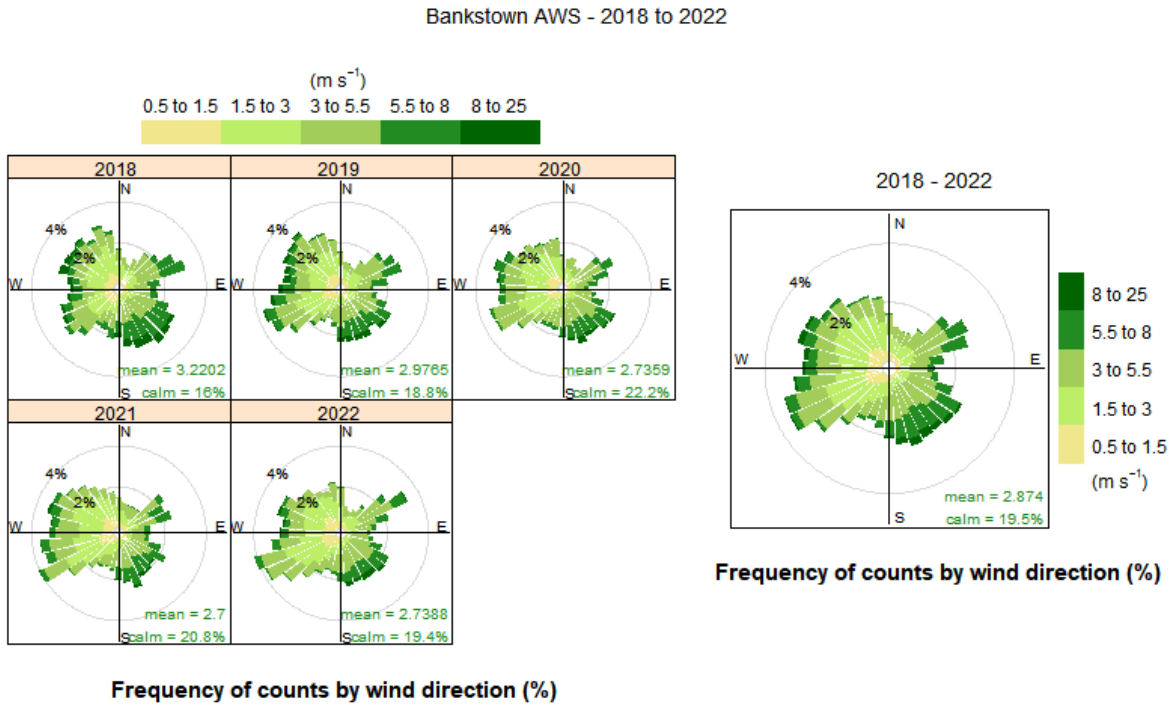
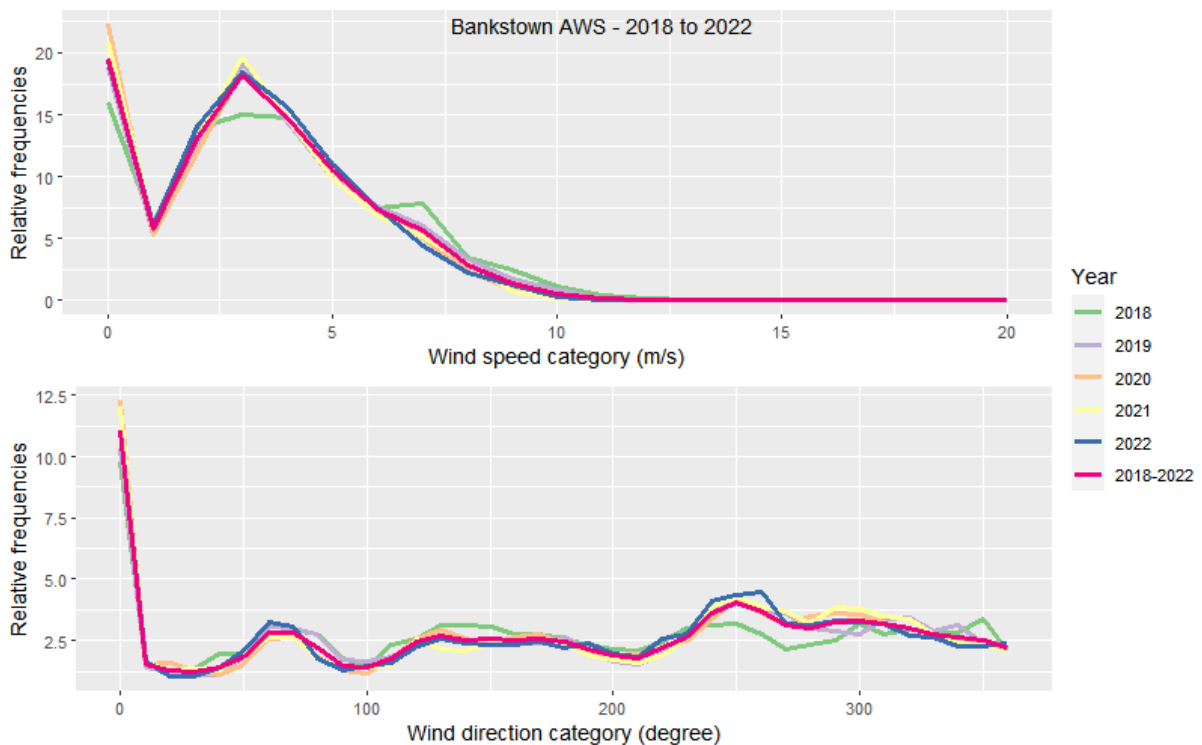


Figure C2 Annual wind speed and direction distributions – Bankstown Airport AWS (2018 – 2022)



**Table C2 Correlation coefficient analysis – Bankstown Airport AWS and Liverpool AQMS (2018 – 2022)**

Parameter	Wind speed		Wind direction		PM <sub>10</sub>		PM <sub>2.5</sub>		Aggregated rank
	Corr.	Rank	Corr.	Rank	Corr.	Rank	Corr.	Rank	
2018	0.9856	5	0.9578	5	0.9135	5	0.9105	4	5
2019	0.9982	2	0.9855	4	0.9276	3	0.9334	3	3
2020	0.9955	4	0.9926	1	0.9930	1	0.9912	1	1
2021	0.9980	3	0.9909	2	0.9859	2	0.9882	2	2
2022	0.9983	1	0.9875	3	0.9150	4	0.8932	5	4
2018-2022	1	-	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 0.98. The year 2022 is the highest ranked for correlation against the wind speed over the five-year period.

Wind direction observations for each year are reasonably well correlated against the wind direction over the five-year period, with each year having a correlation coefficient greater than of 0.95. The year 2020 is the highest ranked for correlation against the wind direction over the five-year period.

Particulate matter concentrations for each year are also well correlated against particulate matter concentrations over the five-year period. Each year resulted in having a correlation coefficient greater than 0.89. The year 2020 is the highest rank for both PM<sub>10</sub> and for PM<sub>2.5</sub>.

The correlation coefficient analysis indicates that 2020 is the most representative year for meteorological modelling.

### Meteorological Processing

The BoM data adequately covers the issues of data quality assurance; however, it is limited by its location compared to the Proposal 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 Air Pollution Model (TAPM, v 4.0.5) meteorological model in a format suitable for using in the GRAL dispersion model (refer Section 5.2.2).

Meteorological modelling using TAPM has been performed to predict the meteorological parameters required for GRAL. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water 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.

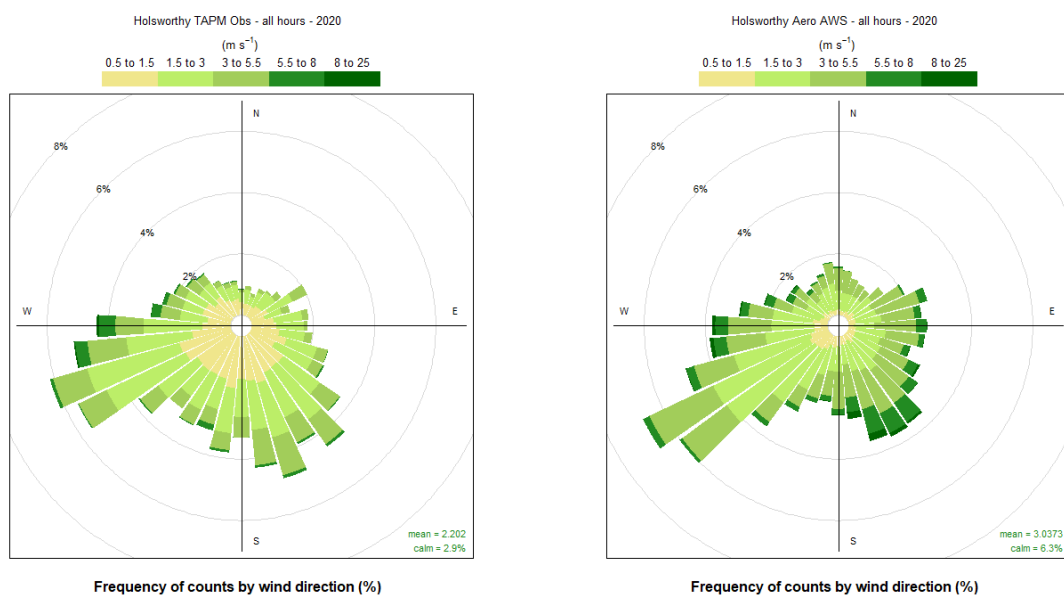
It is noted that an initial TAPM modelling run provided wind roses which did not validate well against observations at Bankstown Airport AWS. Given the poor validation, that initial TAPM modelling run has not been used in this AQIA. Subsequently, a second TAPM run was performed which used observations at Bankstown Airport AWS to ‘nudge’ model predictions towards those observations, and this has been used in this AQIA. To validate model outputs, a comparison of the TAPM generated meteorological data, and that observed at the Holsworthy Aerodrome AWS has been performed and is presented in Figure C3.

The parameters used in TAPM modelling are presented in Table C3.

**Table C3 TAPM meteorological parameters**

TAPM v 4.0.5	
Modelling period	1 January 2020 to 31 December 2020
Centre of analysis	311 276 mE, 6 244 283 mS (UTM Coordinates)
Number of grid points	25 x 25 x 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	Bankstown AWS

**Figure C3 Modelled and observed meteorological data – Holsworthy Aerodrome AWS (2020)**



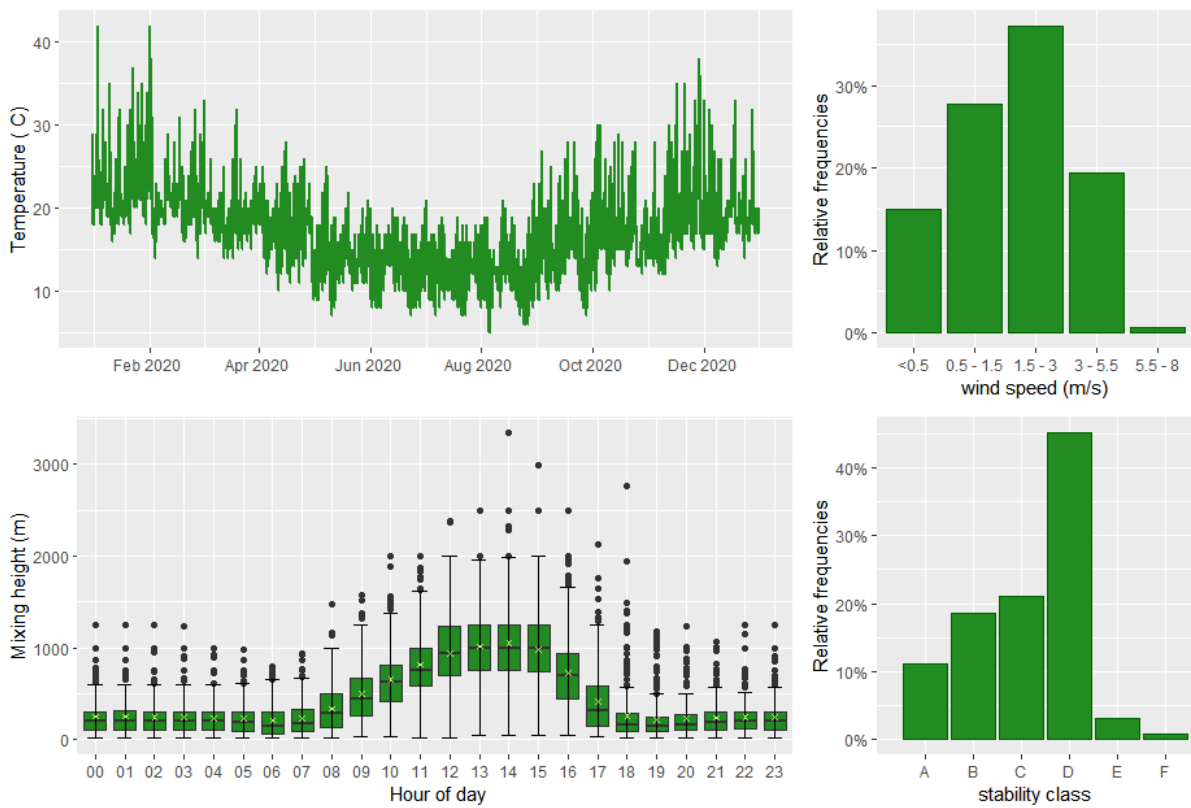
As generally required by the NSW EPA the following provides a summary of the modelled meteorological dataset. Given the nature of the pollutant emission sources at the Proposal site, detailed discussion of the

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 TAPM at the Proposal site during 2020 period are illustrated in Figure C4.

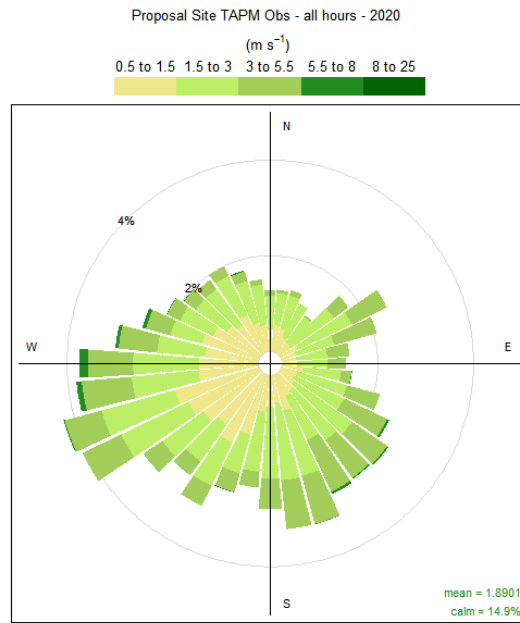
As expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and growth of the convective mixing layer.

**Figure C4 Predicted mixing height, wind speed and stability class frequency at the Proposal site (2020)**



The modelled wind speed and direction at the Proposal site during 2020 are presented in Figure C5.

Figure C5 Predicted wind speed and direction – Proposal site (2020)



Frequency of counts by wind direction (%)

## APPENDIX D

### Background Air Quality

Air quality is not monitored at the Proposal site and therefore air quality monitoring data measured at a representative location has been adopted for the purposes of this assessment. 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).

Air quality monitoring is performed by the NSW Department of Planning and Environment (DPE) at two air quality monitoring stations (AQMS) proximate to the Proposal site. Details of the monitoring performed at these AQMS is presented in Table D1.

**Table D1 Details of closest AQMS surrounding the site**

AQMS location	Distance to site (km)	2020 data	Measurements			
			PM <sub>10</sub>	PM <sub>2.5</sub>	TSP	NO <sub>2</sub>
Liverpool	3.0	✓	✓	✓	✗	✓
Chullora	10.6	✓	✓	✓	✗	✓

Given the availability of data and its proximity to the Proposal site, data from Liverpool AQMS is considered to be the most representative air quality dataset and has correspondingly been adopted for use in this assessment. Particulate matter data for the period 2018 to 2022 has been analysed. The annual frequency distribution for the five-year period is presented in Figure D1.

The results of the correlation coefficient analysis provided in Appendix C indicates that meteorological and PM data measured in 2020 is the most appropriate dataset for use within this study.

Concentrations of TSP are not measured at any AQMS surrounding the Proposal site. An analysis of co-located measurements of TSP and PM<sub>10</sub> 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<sub>10</sub> ratio of 2.0551 : 1 (i.e. PM<sub>10</sub> 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 42.7 µg·m<sup>-3</sup> being adopted.

Summary statistics for the selected data are presented in Table D2.

Figure D1 Annual distribution at Liverpool AQMS for PM<sub>10</sub> (2018 – 2022)

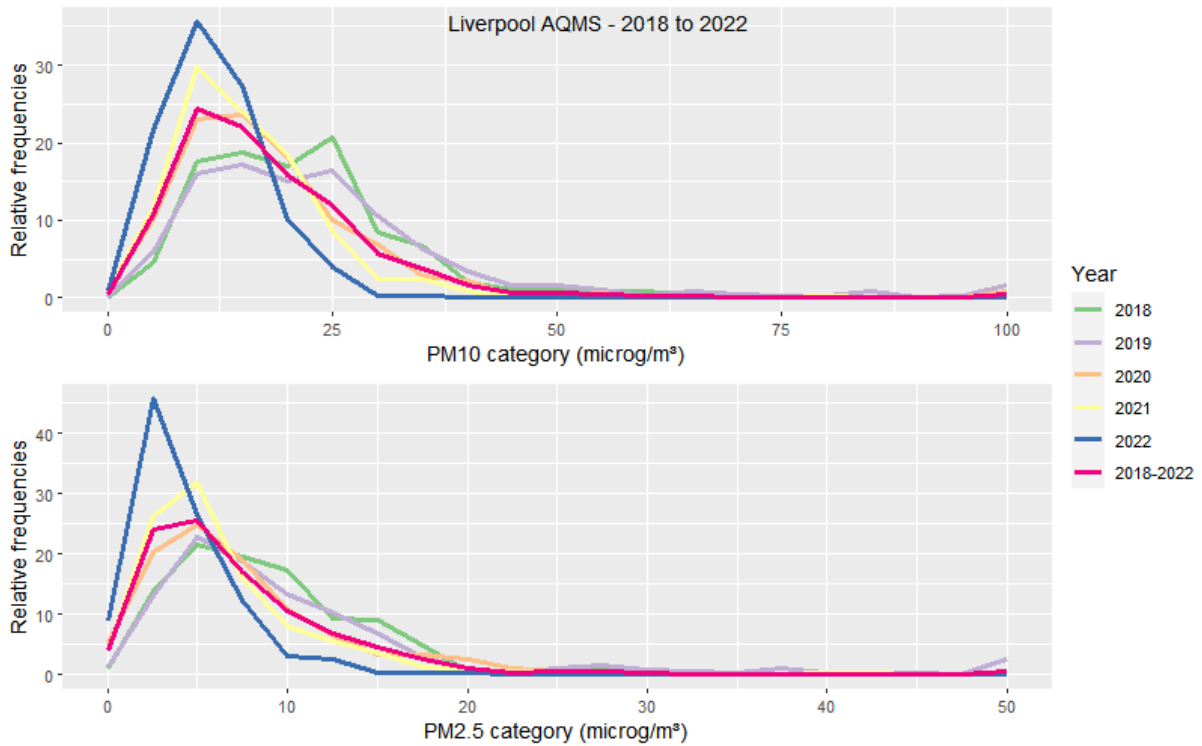


Figure D2 Co-located TSP and PM<sub>10</sub> measurements – Lower Hunter, Sydney Metro and Illawarra

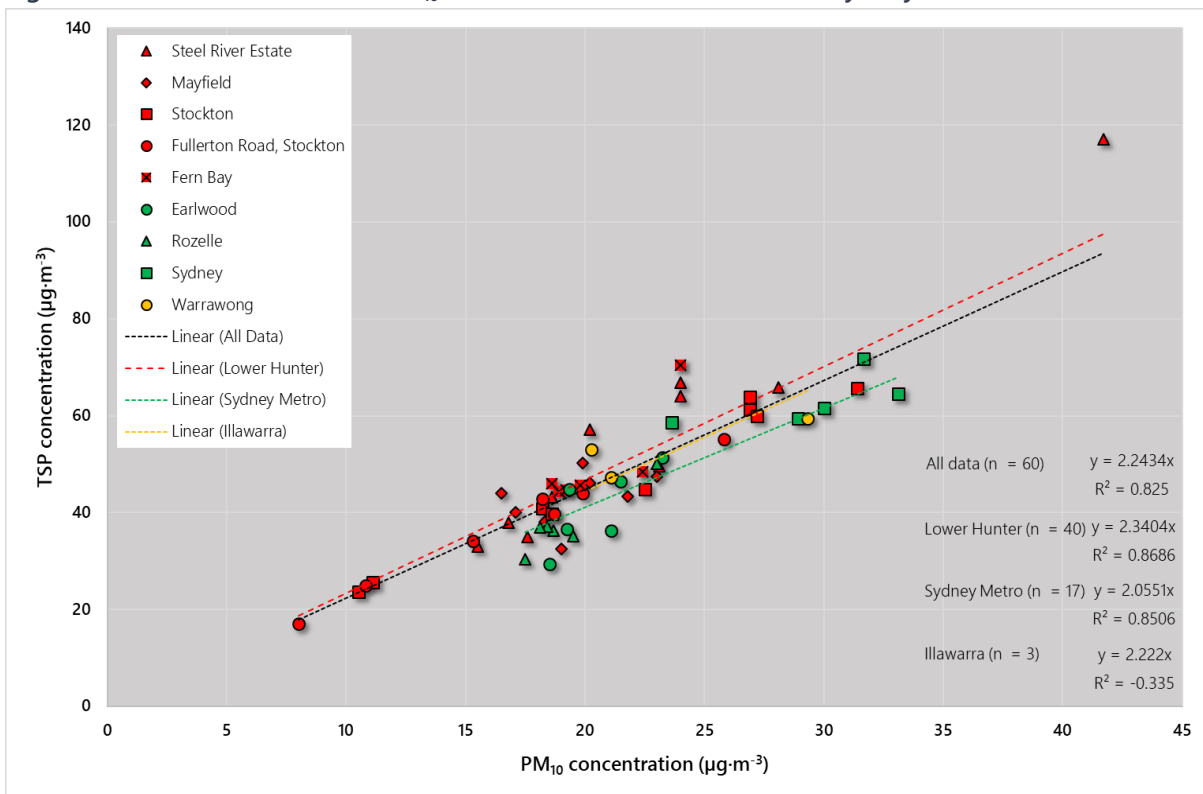


Table D2 Background air quality statistics – Liverpool AQMS (2020)

Pollutant	TSP ( $\mu\text{g}\cdot\text{m}^{-3}$ )	PM <sub>10</sub> ( $\mu\text{g}\cdot\text{m}^{-3}$ )	PM <sub>2.5</sub> ( $\mu\text{g}\cdot\text{m}^{-3}$ )	NO <sub>2</sub> ( $\mu\text{g}\cdot\text{m}^{-3}$ )	O <sub>3</sub> ( $\mu\text{g}\cdot\text{m}^{-3}$ )
Averaging period	Annual	24-Hour	24-Hour	1 hour	1 hour
Data Points (number)	352	352	347	7 956	8 137
Mean	42.7	20.8	9.1	22.0	34.3
Standard deviation	-	14.6	6.8	16.2	27.9
<i>Skew</i> <sup>1</sup>	-	<i>6.1</i>	<i>3.7</i>	<i>0.9</i>	<i>0.8</i>
<i>Kurtosis</i> <sup>2</sup>	-	<i>61.8</i>	<i>25.8</i>	<i>0.3</i>	<i>1.1</i>
Minimum	-	2.0	0.9	0.0	0.0
Percentiles					
25 <sup>th</sup>	-	13.0	5.0	8.2	6.4
50 <sup>th</sup>	-	18.3	7.5	18.5	34.2
75 <sup>th</sup>	-	24.7	11.2	32.8	53.5
90 <sup>th</sup>	-	32.5	16.7	45.1	66.3
95 <sup>th</sup>	-	38.3	20.7	53.3	81.3
97 <sup>th</sup>	-	42.4	22.4	59.5	92.0
98 <sup>th</sup>	-	46.0	24.9	63.6	102.7
99 <sup>th</sup>	-	63.1	29.7	67.7	117.7
Maximum	-	195.1	73.6	98.4	218.3
Data Capture (%)	96.2	96.2	94.8	90.6	92.6

**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 skew represents a more peaked distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Graphs presenting the daily varying PM<sub>10</sub>, PM<sub>2.5</sub> and NO<sub>2</sub> data recorded at Liverpool AQMS in 2020 are presented in Figure D3, Figure D4 and Figure D5 respectively.

Figure D3 PM<sub>10</sub> concentrations –Liverpool AQMS (2020)

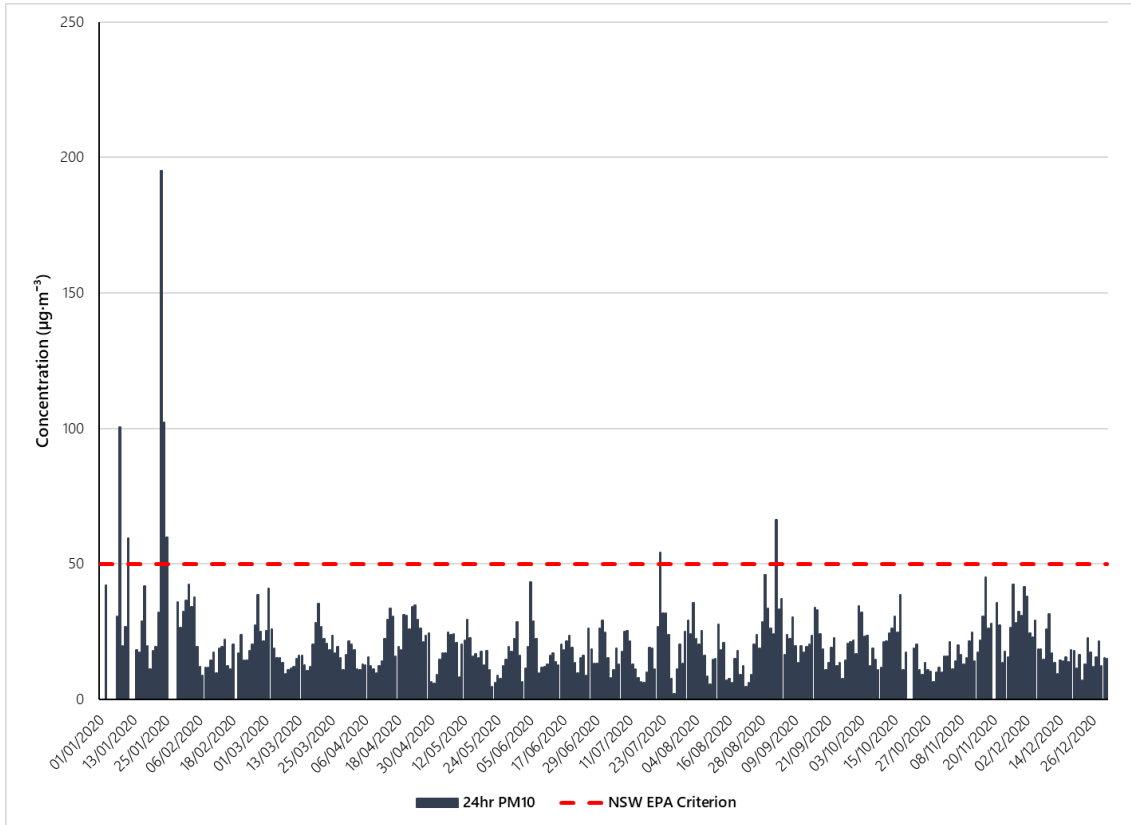


Figure D4 PM<sub>2.5</sub> concentrations –Liverpool AQMS (2020)

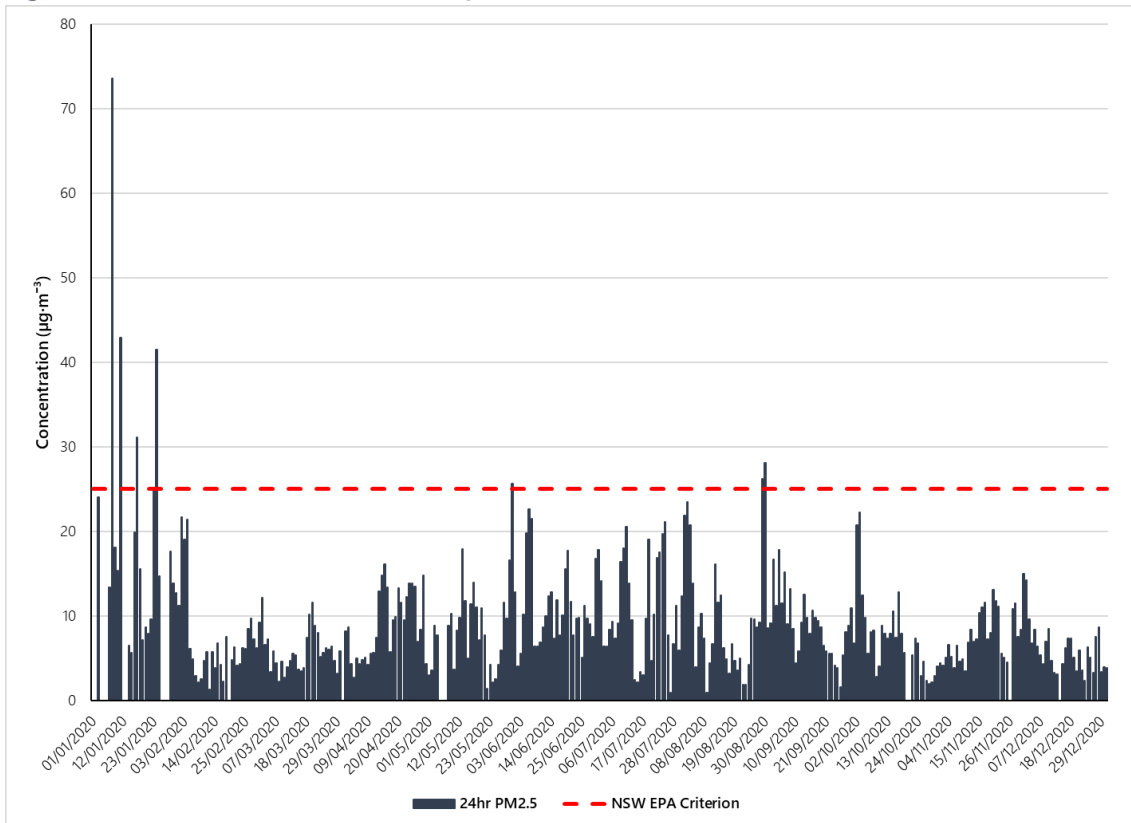
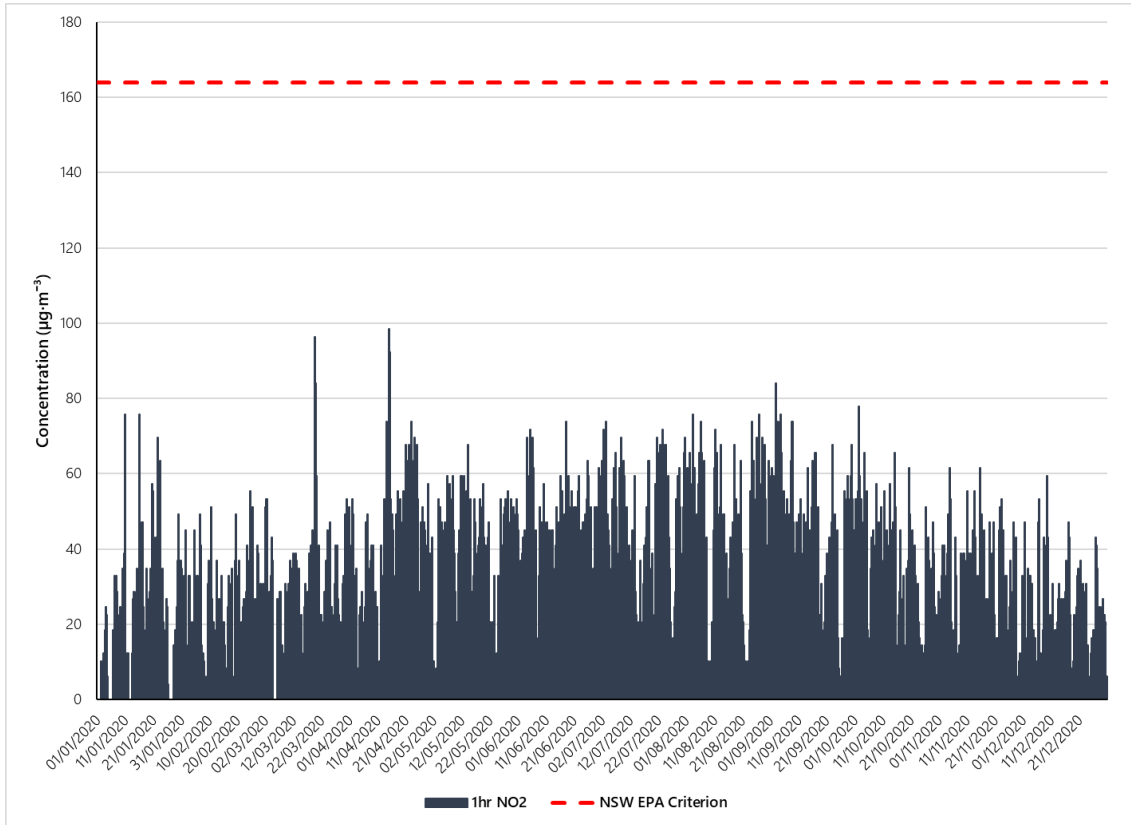


Figure D5 NO<sub>2</sub> concentrations – Liverpool AQMS (2020)



## APPENDIX E

### Construction Phase Air Quality Risk Assessment

Provided below is a summary of the risk assessment methodology used in this assessment. It is based upon IAQM (2014) *Guidance on the assessment of dust from demolition and construction* (version 1.1) and adapted by Northstar Air Quality.

### Adaptions to the Published Methodology Made by Northstar Air Quality

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

- **PM<sub>10</sub> criterion:** an amended criterion representing the annual average PM<sub>10</sub> 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 Air Quality 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:

- more than 350 m from the boundary of the site;
- more than 50 m from the route used by construction vehicles on public roads; and
- more than 500 m from the site entrance.

This step is noted as having deliberately been chosen to be conservative and would require assessments for most developments.

Table E1 overleaf presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria. It is noted that given the Proposal site includes multiple lots and warehouse structures, the distances between receptor locations and boundary / site entrance locations have been measured from the closest lot boundary or site entrance.

**Table E1 Construction phase impact screening criteria distances**

Rec	Location	Land Use	Screening distance (m)		
			Boundary (350m)	Site entrance (500m)	Construction route (50m)
R1	Kelso Crescent, Moorebank	Industrial	51	113	110
R2	Kelso Crescent, Moorebank	Industrial	18	106	106
R3	Kelso Crescent, Moorebank	Industrial	34	215	214
R4	Iraking Avenue, Moorebank	Industrial	109	308	308
R5	Seton Road, Moorebank	Industrial	35	316	316
R6	Seton Road, Moorebank	Industrial	9	289	288
R7	Field Close, Moorebank	Industrial	50	183	181
R8	Field Close, Moorebank	Industrial	30	105	86
R9	Field Close, Moorebank	Industrial	44	66	33
R10	Newbridge Road, Chipping Norton	Industrial	88	89	67
R11	Whelan Avenue, Chipping Norton	Residential	359	399	390
R12	Jack O'Sullivan Road, Moorebank	Residential	401	489	489
R13	Swain Street, Moorebank	Residential	479	547	32
R14	Metcalfe Avenue, Moorebank	Childcare	884	1104	1104

With reference to Table E1, sensitive receptors are noted to be within the screening distance thresholds and therefore require further risk assessment as summarised in Table E2.

**Table E2 Application of step 1 screening**

Construction Impact	Screening Criteria	Step 1 Screening	Comments
Demolition	350 m from boundary 500 m from site entrance	Not screened	Receptors identified within the screening distance
Earthworks	350 m from boundary 500 m from site entrance	Not screened	Receptors identified within the screening distance
Construction	350 m from boundary 500 m from site entrance	Not screened	Receptors identified within the screening distance
Trackout	100 m from site entrance	Not screened	Receptors identified within the screening distance
Construction Traffic	50 m from roadside	Not screened	Receptors identified within the screening distance

## Step 2 – Risk from Construction Activities

Step 2 of the assessment provides “dust emissions magnitudes” for each of the dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles) and construction traffic.

The magnitudes are: Large; Medium; or Small, with suggested definitions for each category as follows:

**Table E3 Dust emission magnitude activities**

Activity	Large	Medium	Small
<b>Demolition</b>			
total building volume*	> 50 000 m <sup>3</sup>	20 000 m <sup>3</sup> to 50 000 m <sup>3</sup>	<20 000 m <sup>3</sup>
demolition height	> 20m AGL	10 m and 20 m AGL	<10 m AGL
onsite crushing	yes	no	no
onsite screening	yes	no	no
demolition of materials with high dust potential	yes	yes	no
demolition timing	any time of the year	any time of the year	wet months only
<b>Earthworks</b>			
total area	>10 000 m <sup>2</sup>	2 500 m <sup>2</sup> to 10 000 m <sup>2</sup>	<2 500 m <sup>2</sup>
soil types	potentially dusty soil type (e.g. clay which would be prone to suspension when dry due to small particle size)	moderately dusty soil type (e.g. silt)	soil type with large grain size (e.g. sand)
heavy earth moving vehicles	>10 heavy earth moving vehicles active at any time	5 to 10 heavy earth moving vehicles active at any one time	<5 heavy earth moving vehicles active at any one time
formation of bunds	>8m AGL	4m to 8m AGL	<4m AGL
material moved	>100 000 t	20 000 t to 100 000 t	<20 000 t
earthworks timing	any time of the year	any time of the year	wet months only
<b>Construction</b>			
total building volume	100 000 m <sup>3</sup>	25 000 m <sup>3</sup> to 100 000 m <sup>3</sup>	<25 000 m <sup>3</sup>
piling	yes	yes	no
concrete batching	yes	yes	no
sandblasting	yes	no	no
materials	concrete	concrete	metal cladding or timber
<b>Trackout (within 100 m of construction site entrance)</b>			
outward heavy vehicles movements per day	>50	10 to 50	<10
surface materials	high potential	moderate potential	low potential
unpaved road length	>100m	50m to 100m	<50m
<b>Construction Traffic (from construction site entrance to construction vehicle origin)</b>			

Activity	Large	Medium	Small
Demolition traffic - total building volume	>50 000 m <sup>3</sup>	20 000 m <sup>3</sup> to 50 000 m <sup>3</sup>	<10 000 m <sup>3</sup>
Earthworks traffic total area	>10 000 m <sup>2</sup>	2 500 m <sup>2</sup> to 10 000 m <sup>2</sup>	<2 500 m <sup>2</sup>
Earthworks traffic soil types	potentially dusty soil type (e.g. clay which would be prone to suspension when dry due to small particle size)	moderately dusty soil type (e.g. silt)	soil type with large grain size (e.g. sand)
Earthworks traffic material moved	>100 000 t	20 000 t to 100 000 t	<20 000 t
Construction traffic total building volume	100 000 m <sup>3</sup>	25 000 m <sup>3</sup> to 100 000 m <sup>3</sup>	<25 000 m <sup>3</sup>
Total traffic heavy vehicles movements per day when compared to existing heavy vehicle traffic	>50% of heavy vehicle movement contribution by Proposal	10% to 50% of heavy vehicle movement contribution by Proposal	<10% of heavy vehicle movement contribution by Proposal

The footprint of the Proposal site (the area affected) is estimated as being approximately 35 190 m<sup>2</sup> (3.5 hectares [ha]) in area.

The Proposal would involve the demolition of the existing structures, construction of the warehouse development as outlined in Section 2.2 and illustrated in Appendix B. A desktop review of the existing structures at the Proposal site indicate that total volume of those structures may exceed 50 000 m<sup>3</sup>.

Based on review of layouts provided in Appendix B, the proposed building is assumed to be greater than 100 000 m<sup>3</sup> (threshold for large dust emission magnitude [refer Table E3]). Given the volume of construction to be performed, it is expected that the number of vehicle movements to service the Proposal site each day would exceed 50 movements (threshold for large dust emission magnitude for trackout [refer Table E3]).

Based upon the above assumptions and the assessment criteria presented in Table E3, the dust emission magnitudes are as presented in Table E4.

**Table E4 Construction phase impact categorisation of dust emission magnitude**

Activity	Dust Emission Magnitude
Demolition	Large
Earthworks and enabling works	Large
Construction	Large
Track-out	Large
Construction traffic routes	Large

### Step 3 – Sensitivity of the Area

Step 3 of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

- The specific sensitivities that identified land use values have to dust deposition and human health impacts;
- The proximity and number of those receptors locations;
- In the case of PM<sub>10</sub>, 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.

### Land Use Value

Individual receptor locations may be attributed different land use values based on the land use of the land, and may be classified as having high, medium or low values relative to dust deposition and human health impacts (ecological receptors are not addressed using this approach).

Essentially, land use value is a metric of the level of amenity expectations for that land use.

The IAQM method provides guidance on the land use value with regard to dust soiling and health effects and is shown in the table below. It is noted that user expectations of amenity levels (dust soiling) are dependent on existing deposition levels.

Table E5 IAQM guidance for categorising land use value

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

### Sensitivity of the Area

The assessed land use value (as described above) is then used to assess the sensitivity of the area surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM<sub>10</sub> 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 the IAQM document.

### **Sensitivity of the Area - Health Impacts**

For high land use values, the method takes the existing background concentrations of PM<sub>10</sub> (as an annual average) experienced in the area of interest into account, and professional judgement may be used to determine alternative sensitivity categories, taking into account the following:

- 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 / seasonal meteorological data;
- any conclusions drawn from local topography; and
- 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 the IAQM document.

The assumed existing background annual average PM<sub>10</sub> concentrations, as measured at Liverpool AQMS (in 2020 was 20.8 µg·m<sup>-3</sup>), which, along with the land use value calculated above, classifies the sensitivity of the area as low for dust health impacts and medium for dust soiling effects.

**Table E6 IAQM guidance for categorising the sensitivity of an area of dust health effects**

Land Use Value	Annual Mean PM <sub>10</sub> Concentration (µg·m <sup>-3</sup> )	Number of Receptors <sup>(a)</sup>	Distance from the Source (m) <sup>(b)</sup>				
			<20	<50	<100	<200	<350
High	>30	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	26 – 30	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	22 – 26	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	≤22	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	High	High	High	Medium	Low

**Note:** (a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m), noting that only the highest level of area sensitivity from the table needs to be considered. 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 <20m and <50m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

### Sensitivity of the Area - Dust Soiling

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in Table E7.

**Table E7 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects**

Land Use Values	Number of receptors <sup>(a)</sup>	Distance from the source (m) <sup>(b)</sup>			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

**Note:** (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 <20m and <50m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50m 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 for each activity determine the risk category with no mitigation applied.

**Table E8 Risk of dust impacts from demolition activities**

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (Demolition)		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

**Table E9 Risk of dust impacts from earthworks**

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (Earthworks)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

**Table E10 Risk of dust impacts from construction activities**

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (Construction)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

**Table E11 Risk of dust impacts from trackout (within 100m of construction site entrance)**

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (Trackout)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

**Table E12 Risk of dust impacts from construction traffic (from construction site entrance to origin)**

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (Construction Traffic)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Given the sensitivity of the identified receptors is classified as low for dust soiling and medium health effects, and the dust emission magnitudes for the various construction phase activities as shown in Table E4, the resulting risk of air quality impacts (without mitigation) is as presented in Table E13.

**Table E13 Risk of air quality impacts from construction activities**

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

**Note:** Med. = Medium

The risks summarised in Table E13 show that for demolition activities, there is a medium risk of adverse dust soiling impacts and a high risk of human health impacts. All other construction phase activities are associated with low risks of dust soiling impacts and medium risks of health impacts if no mitigation measures were to be applied to control emissions associated with construction-phase activities.

The 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).

Table E14 represents a selection of recommended mitigation measures recommended by the IAQM methodology for construction activities commensurate with the risks identified in Table E13.

Table E14 Site-specific management measures

Identified Mitigation		Unmitigated Risk
<b>1</b>	<b>Communications</b>	<b>High</b>
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
<b>2</b>	<b>Site Management</b>	<b>High</b>
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 local 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.	H
<b>3</b>	<b>Monitoring</b>	<b>High</b>
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 local 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.	H
3.2	Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to the local 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
<b>4</b>	<b>Preparing and Maintaining the Site</b>	<b>High</b>
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

Identified Mitigation		Unmitigated Risk
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
<b>5</b>	<b>Operating Vehicle/Machinery and Sustainable Travel</b>	<b>High</b>
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H
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 <sup>-1</sup> on surfaced and 15 km·h <sup>-1</sup> 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 local authority, where appropriate	H
5.5	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	H
5.6	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	H
<b>6</b>	<b>Operations</b>	<b>High</b>
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
<b>7</b>	<b>Waste Management</b>	<b>High</b>
7.1	Avoid bonfires and burning of waste materials.	H
<b>8</b>	<b>Measures Specific to Demolition</b>	<b>High</b>
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).	H
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 bring the dust particles to the ground.	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

Identified Mitigation		Unmitigated Risk
8.5	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	H
8.6	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	H
8.7	Only remove the cover in small areas during work and not all at once	H
<b>9</b>	<b>Measures Specific to Construction</b>	<b>Medium</b>
9.1	Avoid scabbling (roughening of concrete surfaces) if possible	D
9.2	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
9.3	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
9.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	D
<b>10</b>	<b>Measures Specific to Track-Out</b>	<b>Medium</b>
10.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	H
10.2	Avoid dry sweeping of large areas.	H
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	H
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	H
10.6	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	H
10.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	H
10.8	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	H
10.9	Access gates to be located at least 10 m from receptors where possible.	H

### 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).

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

air quality | environment | sustainability

<b>air quality</b>	Northstar specialises in all aspects of air quality, dust, and odour management, covering monitoring, modelling and assessment, due diligence and process specification, licencing and regulatory advice, peer review and expert witness.
<b>environment</b>	Our team has extensive experience in environmental management, covering environmental policy and management plans, licencing, compliance reporting, auditing, data, and spatial analysis.
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