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GPT Industrial Estate, Kemps Creek

Air Quality Impact Assessment

Addressee(s):	The GPT Group
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Date:	27 April 2021

Quality Control

Study	Status	Prepared	Checked	Authorised
INTRODUCTION	Final	Northstar	GCG,MD	MD
THE PROPOSAL	Final	Northstar	GCG,MD	MD
LEGISLATION, REGULATION AND GUIDANCE	Final	Northstar	GCG,MD	MD
EXISTING CONDITIONS	Final	Northstar	GCG,MD	MD
METHODOLOGY	Final	Northstar	GCG,MD	MD
CONSTRUCTION AIR QUALITY IMPACT ASSESSMENT	Final	Northstar	GCG,MD	MD
OPERATIONAL AIR QUALITY IMPACT ASSESSMENT	Final	Northstar	GCG,MD	MD
MITIGATION AND MONITORING	Final	Northstar	GCG,MD	MD
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Report Status

Northstar References		Report Status	Report Reference	Version
Year	Job Number	(Draft: Final)	(R*x*)	(V*x*)
21	1040	F	R1	V1
Based upon the above, the specific reference for this version of the report is:				**21.1040.FR1V1**

Final Authority

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

Martin Doyle **27th April 2021**

Non-Technical Summary

Northstar Air Quality was engaged by The GPT Group, to perform an air quality impact assessment for the construction and operation of a warehouse and distribution centre, associated offices and hardstand/car parking areas.

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

The assessment showed there to be a low risk of health or nuisance impacts during demolition works and construction works. Nevertheless, a range of standard mitigation measures are proposed to ensure that short-term impacts associated with construction activities are further 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 using an approved and appropriate dispersion modelling technique. It is demonstrated that the operation of the Proposal does not cause any exceedances of the air quality criteria.

It is respectfully suggested that the State Significant Development application should not be refused on the grounds of air quality issues.

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Units Used in the Report

All units presented in the report follow International System of Units (SI) conventions, unless derived from references using non-SI units. 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 expressed as 50 $\mu g \cdot m^{-3}$ and not 50 $\mu g/m^3$.

Common Abbreviations

Abbreviation	Term
ABS	Australian Bureau of Statistics
AHD	Australian height datum
AQIA	air quality impact assessment
AQMS	air quality monitoring station
BoM	Bureau of Meteorology
CO	carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DPI&E	Department of Planning, Industry and Environment
EETM	emission estimation technique manual
EPA	Environmental Protection Authority
m^{-2}	per square metre
m^{-3}	per cubic metre
$mg \cdot m^{-3}$	milligram per cubic metre of air
$mg \cdot Nm^{-3}$	milligram per normalised cubic metre of air
$\mu g \cdot m^{-3}$	microgram per cubic metre of air
mE	metres East
$month^{-1}$	per month
mS	metres South
NCAA	National Clean Air Agreement
NEPM	National Environment Protection Measure
NO	nitric oxide
NO_X	oxides of nitrogen
NO_2	nitrogen dioxide
O_3	ozone
PM	particulate matter

Abbreviation	Term
PM_{10}	particulate matter with an aerodynamic diameter of 10 µm or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 µm or less
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
TAPM	The Air Pollution Model
TSP	total suspended particulates
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VKT	vehicle kilometres travelled

1. INTRODUCTION

The GPT Group (the Applicant) has engaged Northstar Air Quality Pty Ltd (Northstar) to perform an air quality impact assessment for the construction and operation of an industrial estate comprising four (4) warehouses, an internal road network and associated carparking (the Proposal).

The Proposal will be located at 754-770 and 784-786 Mamre Road, Kemps Creek occupying Lot 59 and Lot 60 in Deposited Plan (DP) 259135 (the Proposal site). The Proposal site has an area of approximately 33.36 hectares (ha) and a total frontage of approximately 211 metres (m) to Mamre Road to the east.

This study presents an assessment of the risks to local air quality associated with the construction and operation of the Proposal. This study supports the State Significant Development (SSDA) for the Proposal and presents a range of recommended mitigation measures to minimise any identified air quality impacts, where required and relevant.

The *Environmental Planning and Assessment Act* 1979 (EP&A Act) forms the statutory framework for planning approval and environmental assessment in NSW. The Development qualifies as State Significant Development (SSD) under *State Environmental Planning Policy (State and Regional Development) 2011*, in accordance with Section 4.36 of the EP&A Act.

1.1. Secretary's Environmental Assessment Requirements

NSW Department of Planning, Industry & Environment (DPIE), issued the Planning Secretary's Environmental Assessment Requirements (SEARs) for the Proposal in November 2020. **Table 1** below identifies the SEARs relevant to this study and the relevant sections of the report in which they have been addressed.

Table 1 Secretary's Environmental Assessment Requirements (SSD 10272349)

Issue	Requirement	Addressed
Air quality	Including an assessment of the air quality impacts at sensitive receivers during construction and operation, in accordance with the relevant Environment Protection Authority guidelines, and details of proposed mitigation, management and monitoring measures.	Section 6, Section 7, Section 8

A number of Government agencies were consulted during the preparation of the SEARs. NSW Environment Protection Authority (EPA) provided comments and recommendations relating to air quality and energy efficiency on 29 October 2020:

> *"The Western City District Plan includes as an objective under a sustainable and resilient city, "exposure to natural and urban hazards is reduced", and states that, "effective planning can reduce the exposure to natural and urban hazards". Urban hazards are identified as including; noise, air pollution and soil contamination.*

The NSW Governments submission on the Western Sydney Airport draft EIS and Airport Plan dated the 17 December 2015 stated that the EIS had not fully explored the cumulative air quality impact of the airport in relation to urban development in Western Sydney. It also advised that Western Sydney's geography poses unique problems for air quality because the South Creek Valley traps pollution under certain meteorological conditions.

As stated in the Greater Sydney Regional Plan A Metropolis of Three Cities, it states that although Greater Sydney's air quality is good by world standards, air pollution can exceed national standards at times and continues to have an impact on human health. Even if air pollution is maintained at current levels, population growth in the north west and south west of Greater Sydney, which has greater exposure to air pollution, raises the risk of more people being exposed to pollution. This will also be further exacerbated with climate change.

The Concept Plan would benefit from a supporting air quality study to help identify management approaches for air quality that can help deliver expected planning outcomes for the precincts that support liveability and public health outcomes and reduces exposure to urban hazards. The greatest benefits to public health come from reducing long-term exposure to air pollution, particularly in highly populated areas. This is not only at a local level but also across Greater Sydney where local strategies are also needed to address cumulative air quality issues. This can be achieved in several ways:

• Delivering energy efficient buildings

• Minimising private vehicle use by promoting active transport opportunities and access to local services and employment

• Minimise exposure to existing and likely future sources of air pollution

• Minimise industrial and commercial emissions by avoiding new emissions sources and utilising best practice emission controls

• Restricting wood heaters through appropriate controls

• Avoiding land use conflict between sensitive uses and local emissions sources

• Controlling air emissions from construction sites and construction plant/equipment

There is a range of work being undertaken for the planning of the Western Sydney Aerotropolis that could assist to help inform the planning of the precinct. In the developing the study there is a range of EPA guidance available at https://www.epa.nsw.gov.au/yourenvironment/air that should be consulted."

1.2. Purpose of the Report

The purpose of this report is to examine and identify whether the impacts of 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, an Air Quality Impact Assessment (AQIA) has been performed in accordance with and with due reference to:

- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA, 2016);
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC, 2007);

- Technical Framework and Notes - Assessment and Management of Odour from Stationary Sources in NSW (NSW DEC, 2006);
- *Protection of the Environment Operations Act* 1997;
- Protection of the Environment Operations (Clean Air) Regulation 2010; and
- State Environmental Planning Policy (State and Regional Development) 2011.

1.3. Scope of Assessment

This report presents data that summarises and characterises the existing environmental conditions and identifies the potential emissions to air associated with the construction and operational phases of the Proposal. It examines the potential for off-site impacts and identifies appropriate mitigation measures that would be required to reduce those potential impacts.

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 Proposal.

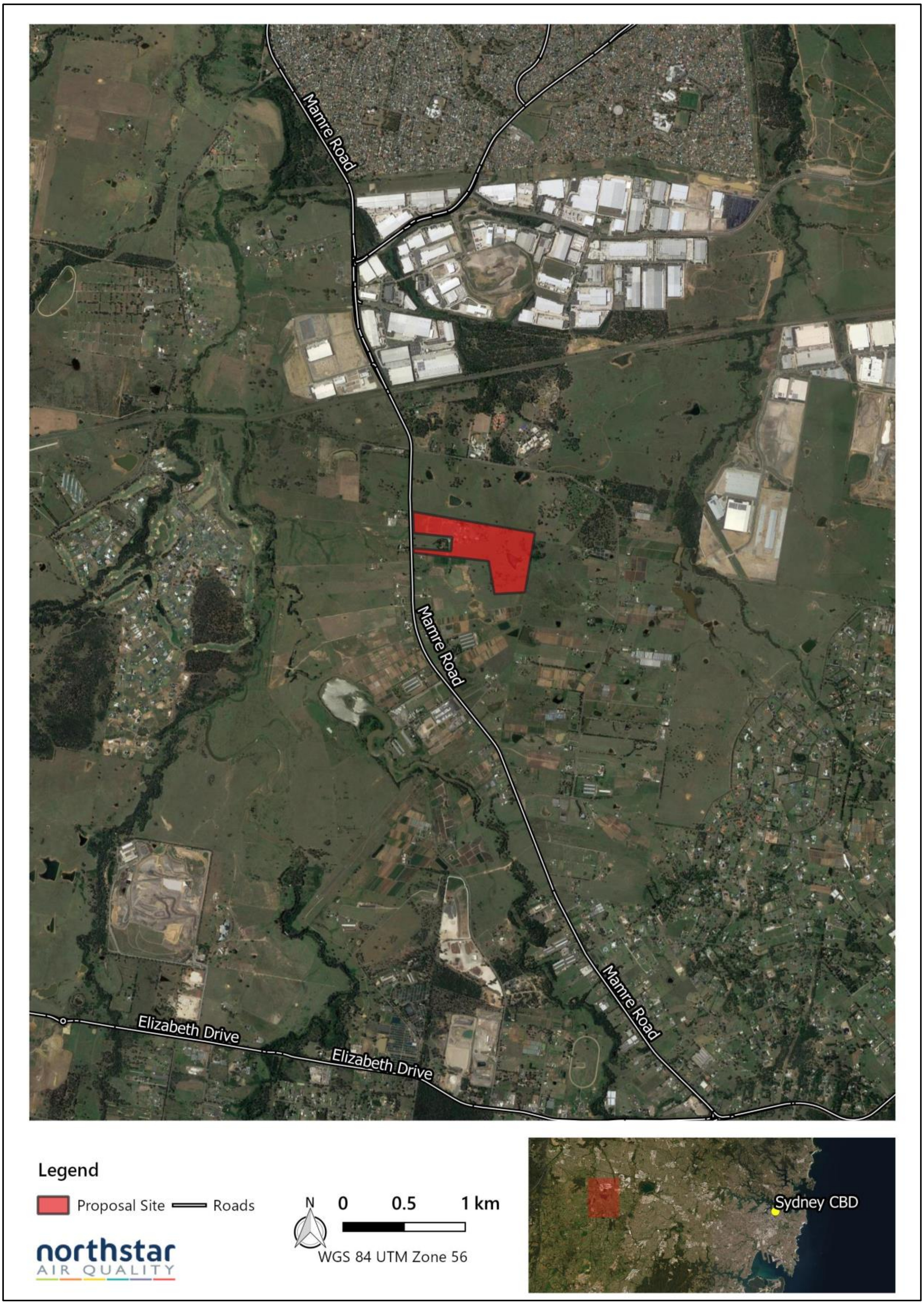
2.1. Environmental Setting

The Proposal site is located at 754-770 and 784-786 Mamre Road, Kemps Creek in the Penrith Local Government Area (LGA). The Proposal site is approximately 27 kilometres (km) west of the Sydney Central Business District (CBD). A map showing the location of the Proposal site is provided in **Figure 1**.

The closest residential property is approximately 52 m from the Proposal site boundary to the west, on Mamre Road, Kemps Creek (see **Section 4.1.2** of this Report).

A full description of the sensitivity of the surrounding land, and the identification of discrete receptor locations used in the AQIA, is provided in **Section 4.1**.

Figure 1 Proposal site location



Source: Northstar Air Quality

2.2. Overview and Purpose

The Proposal seeks to gain approval to construct and operate four new warehouses for distribution or general warehouse purposes and other manufacturing industries. The intended use of the warehouses located at the Proposal site is not yet determined.

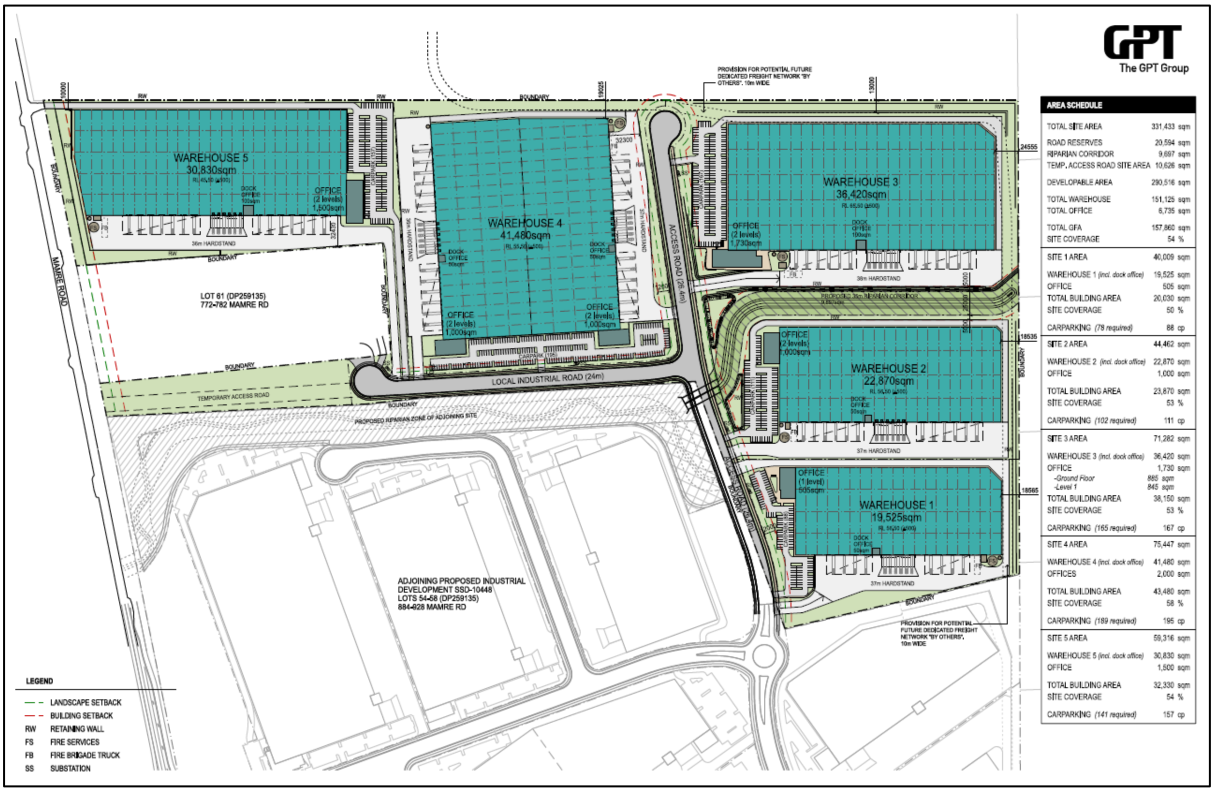
The overall scope of the proposed development is outlined as follows:

- Demolition of the existing structures and landscaping;
- Bulk earthworks;
- Construction of warehouses and associated offices;
- Construction of internal road network and associated service infrastructure;
- Construction of retaining walls; and,
- Car and van parking.

The Proposal site would be operational on a 24-hour, 7-day basis.

A layout of the Proposal site is provided in **Figure 2**.

Figure 2 Proposal site layout



Source: SBA 22/04/2021

2.3. Identification of Potential Emissions to Atmosphere

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

2.3.1. Construction Phase

Construction of the Proposal would involve demolition of existing structures, bulk earthworks, construction of warehouses, ancillary offices, internal road network, car and van parking, docking areas, associated infrastructure, site access points and landscaping.

The total volume of the construction required for the Proposal is anticipated to be approximately 2 304 756 cubic metres (m^3), assuming a combined total footprint of the warehouses and office areas of 157 860 square metres (m^2) and a maximum building height of 14.6 m.

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 hand or power tools;
- Cranes;
- Commercial vans; and
- Cherry pickers.

The assessment of the potential impacts upon local air quality, resulting from construction activities, is presented in **Section 6**.

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 combustion emissions from the consumption of diesel fuel, in the truck movements importing and exporting materials. The potential emissions would include particulate matter (as PM_{10} and $PM_{2.5}$) and oxides of nitrogen (NO_X), including nitrogen dioxide (NO_2). There would additionally be some less significant emissions of carbon monoxide (CO), sulphur dioxide (SO_2) and air toxics (including benzene and 1,3-butadiene) but for the purposes of this assessment, it is comfortably assumed that the principal gaseous pollutants would be particulate matter and NO_X.

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_{10} and $PM_{2.5}$) and NO_X associated with relevant short-term criteria. NO_X/NO_2 concentrations have been used within this assessment as an indicator pollutant for all other combustion-related gaseous emissions resulting from traffic.

A summary of the emission sources and potential emissions to air during the construction and operation of the Proposal, is presented in **Table 2**.

Table 2 Identified potential sources of air emissions

Source	Particulate Emissions			Gaseous Emissions
	TSP	PM_{10}	$PM_{2.5}$	NO_X
Construction Phase				
Construction activities	✓	✓	✓	
Operational Phase				
Wheel generated emissions – trucks	✓	✓	✓	
Exhaust emissions – truck engine	✓	✓(1)	✓	✓

Note (1) Particulate emissions from diesel combustion are predominantly less than 1 micrometre (1 µm) in diameter and are therefore assessed as $PM_{2.5}$. As $PM_{2.5}$ is essentially a subset of PM_{10}, PM_{10} has been assessed at an equivalent rate to $PM_{2.5}$ for the relevant sources.

Given the nature of the development at this site, it is not anticipated that odour would be emitted in any significant quantity during construction. Any potential contamination identified through detailed site investigation would be managed to ensure that no odour would impact upon surrounding residences.

The operation of the Proposal site is considered not likely to be significantly odorous. All goods would be stored within the warehouse and any waste materials would be stored appropriately and removed from site on a daily basis. In light of the above, odour has not been considered further as part of this AQIA.

3. LEGISLATION, REGULATION AND GUIDANCE

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, 2016)), which has been consulted during the preparation of this AQIA.

3.1. Ambient Air Quality Standards

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 for the Proposal. The criteria listed in the Approved Methods are derived from a range of sources (including National Health and Medical Research Council (NHMRC), National Environment Protection Council (NEPC), Department of Environment (DoE), World Health Organisation (WHO), and Australian and New Zealand Environment and Conservation Council (ANZECC)). Where relevant to this AQIA (coincident with the potential emissions identified in **Section 2.3** and **Table 2**), the criteria have been adopted as set out in Section 7.1 of NSW EPA (2016) which are presented in **Table 3** below.

Table 3 NSW EPA air quality standards and goals

Pollutant	Averaging period	Units	Criterion	Notes
Nitrogen dioxide (NO_2)	1 hour	$\mu g \cdot m^{-3}$	246	Numerically equivalent to the AAQ NEPM(b) standards and goals.
	Annual	$\mu g \cdot m^{-3}$	62	
Particulates (as PM_{10})	24 hours	$\mu g \cdot m^{-3}$	50	
	1 year	$\mu g \cdot m^{-3}$	25	
Particulates (as $PM_{2.5}$)	24 hours	$\mu g \cdot m^{-3}$	25	
	1 year	$\mu g \cdot m^{-3}$	8	
Particulates (as TSP)	1 year	$\mu g \cdot m^{-3}$	90	
Particulates (as dust deposition)	1-year(c)	$g \cdot m^{-2} \cdot month^{-1}$	2	Assessed as insoluble solids as defined by AS 3580.10.1
	1-year(d)	$g \cdot m^{-2} \cdot month^{-1}$	4	

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

3.2. 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) Regulations 2010. The overall objective of this legislative instruments is to achieve the requirements of the National Environment Protection (Ambient Air Quality) Measure;
- Clean Air for NSW: The 10-year plan for the improvement in air quality;
- Inter-agency Taskforce on Air Quality in NSW: a vehicle to co-ordinate cross-government incentives and action on air quality;
- Managing particles and improving air quality in NSW; and
- Diesel and marine emission management strategy.

In regard to the relevance of the NSW Government's drive to 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 a detriment in achieving its objectives.

4. EXISTING CONDITIONS

4.1. Surrounding Land Sensitivity

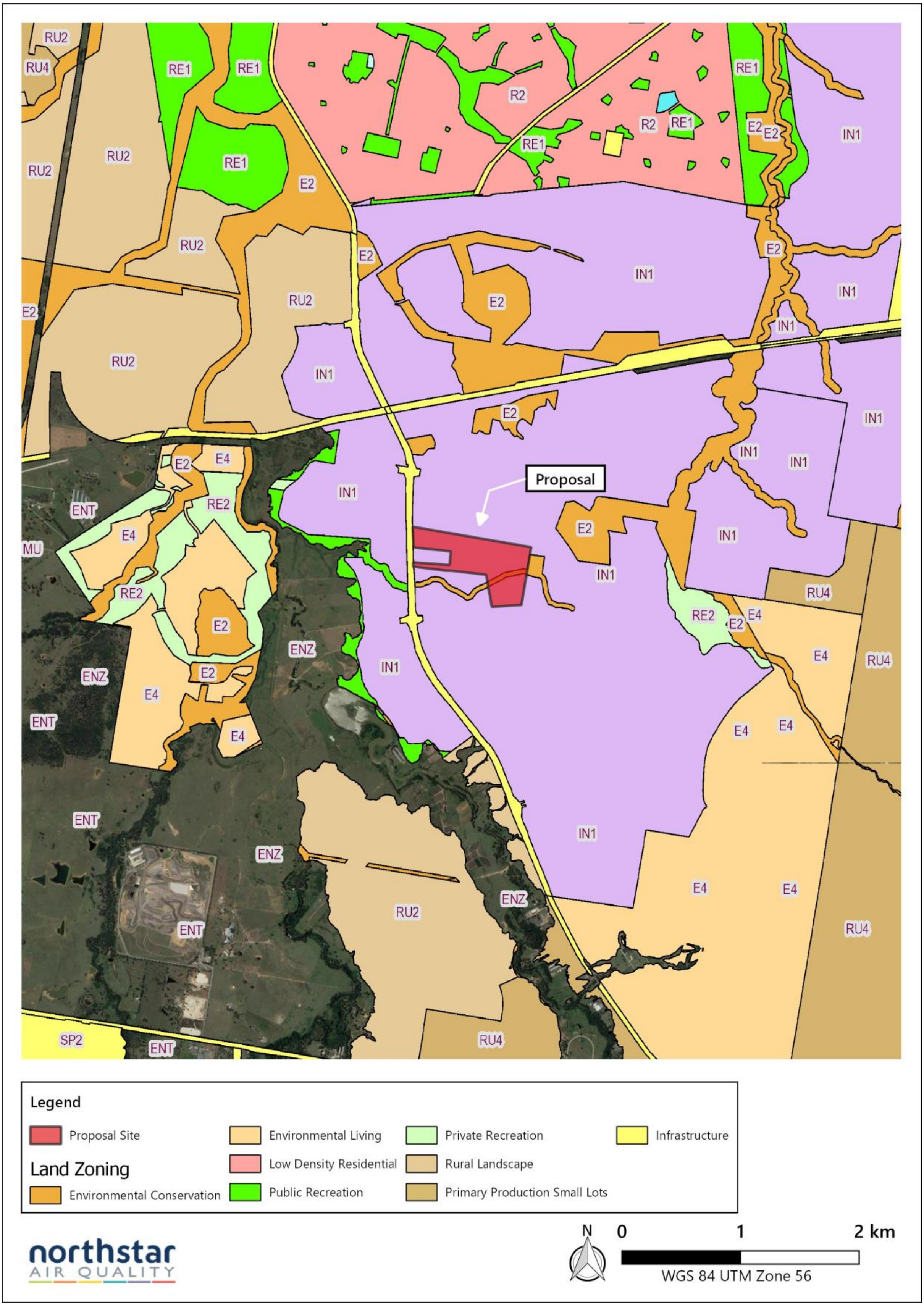
4.1.1. Land Use Zoning

The land use surrounding the Proposal site is zoned IN1 (General Industrial) under the provision of the State Environmental Planning Policy (Western Sydney Employment Area) WSEA SEPP. **Figure 3** presents the current land use zoning.

Lands to the north and east are zoned E2 (Environmental Conservation). The closest residential land use zoning to the Proposal site is approximately 3 km to the north.

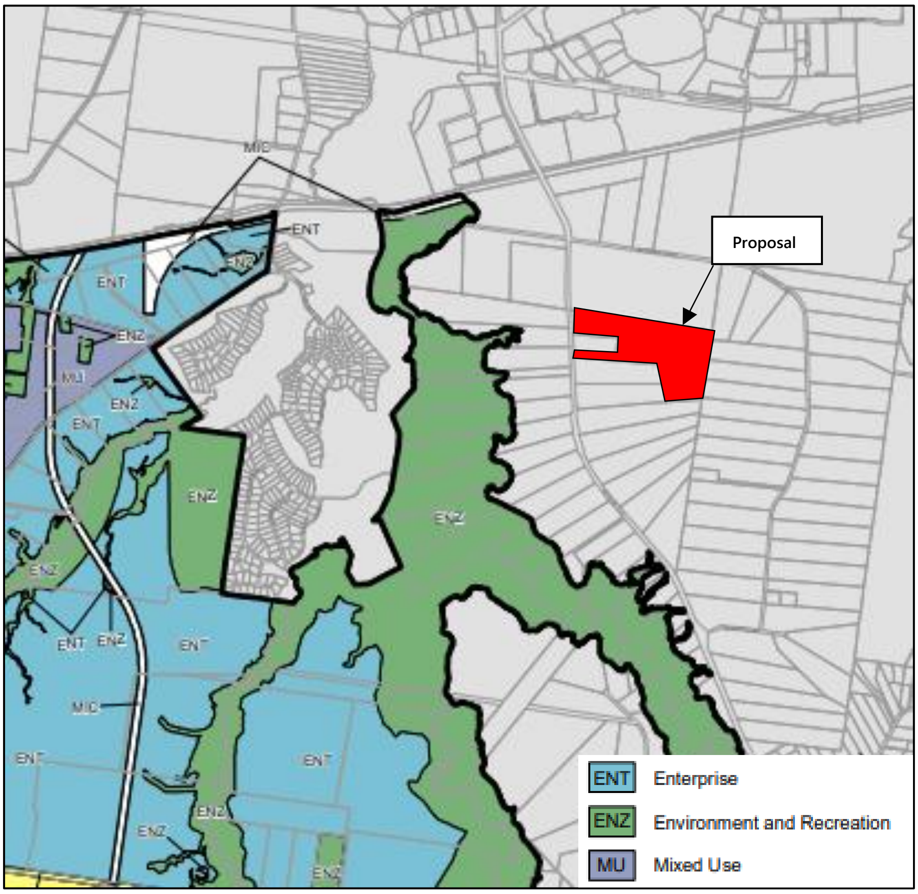
Land to the west is zoned ENZ (Environment and Recreation) under the State Environmental Planning Policy (Western Sydney Aerotropolis) 2020 as show in **Figure 4**.

Figure 3 Current land use zoning



Source: NSW Department of Planning and Environment, adapted by Northstar Air Quality

Figure 4 Land Zoning Map (Western Sydney Aerotropolis)



Source: NSW State Environmental Planning Policy (Western Sydney Aerotropolis) 2020, adapted by Northstar Air Quality

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 the assessment criteria applied to particulates (see **Table 3**) is as a 24-hour averaging period, and as such the predicted impacts need to be interpreted at commercial and industrial receptor locations with care. It is considered to be atypical for a person to be at those locations for a complete 24-hour period and as such, the exposure risks at those locations would be over-estimated by adoption of those locations in the modelling assessment.

It is important to note that the selection of discrete receptor locations is not intended to represent a fully inclusive selection of all sensitive receptors across the study area. The location selected should be considered to be representative of its broader location and may be reasonably assumed to be representative of the immediate environs. In some instances, several viable receptor locations may be identified in a small area, for example a school neighbouring a medical centre. In this instance the receptor closest to the potential sources to be modelled would generally be selected and would be used to assess the risk to other sensitive land uses in the area.

It is further 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 that is 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 2016 census, have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre (km^2) grid, covering mainland Australia (ABS, 2017). 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^{-2}):

- 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 are presented in **Figure 4**.

The Proposal site and receptors are located in an area of 'very low' population densities. Generally, the broader context of the Proposal site is currently typified by employment-generating land uses and also agricultural areas.

In accordance with the requirements of the NSW EPA, several receptors have been identified and the receptors adopted for use within this AQIA are presented in **Table 4**. This selection is derived from the information presented in **Figure 3** and **Figure 4**. **Table 4** is not intended to represent a definitive list of sensitive land uses, but a cross section of available locations, that are used to characterise larger areas, or selected as they represent more sensitive locations, which may represent people who are more susceptible to changes in air pollution.

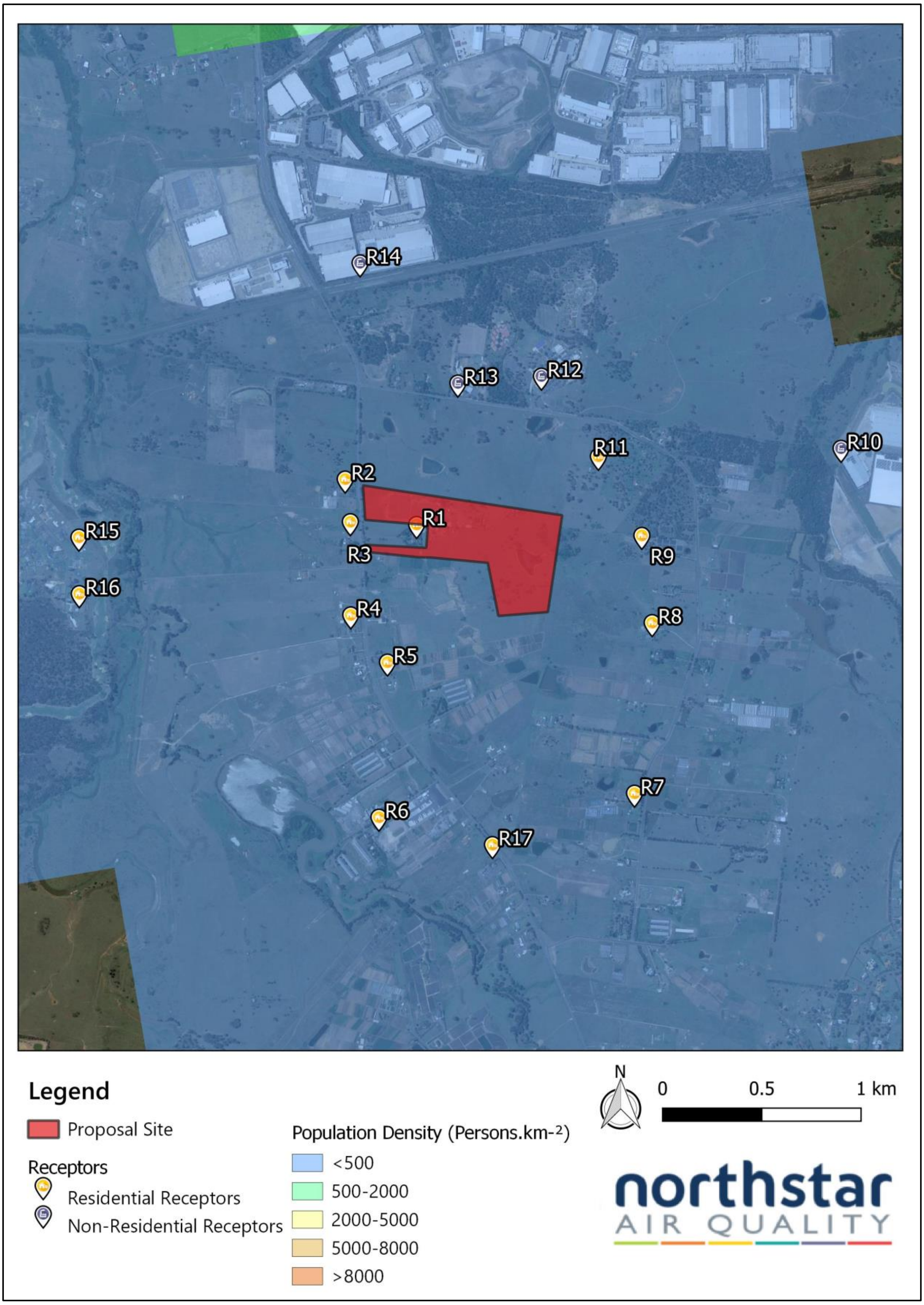
It is noted that a number of identified residential receptors will change status in the coming years as the area is developed to become an increasingly commercial/industrial area. However, for the purposes of this assessment, the receptors are assumed to be residential, which represents a worst case in terms of construction and operational impacts.

Table 4 Receptor locations used in the study

Rec	Location	Land use	Location (UTM)	
			mE	mS
R1	772-782 Mamre Road, Kemps Creek	Residential	294 937	6 253 549
R2	757-769 Mamre Road, Kemps Creek	Residential	294 577	6 253 778
R3	771-781 Mamre Road, Kemps Creek	Residential	294 603	6 253 563
R4	819-831 Mamre Road, Kemps Creek	Residential	294 605	6 253 093
R5	844-862 Mamre Road, Kemps Creek	Residential	294 790	6 252 855
R6	919-929 Mamre Road, Kemps creek	Residential	294 747	6 252 073
R7	235-251 Aldington Road, Kemps Creek	Residential	296 035	6 252 194
R8	141-153 Aldington Road, Kemps Creek	Residential	296 124	6 253 054
R9	99-111 Aldington Road, Kemps Creek	Residential	296 072	6 253 494
R10	3 Imperata Close, Kemps Creek	Industrial	297 076	6 253 933
R11	1-23 Aldington Road, Kemps Creek	Residential	295 853	6 253 893
R12	87-109 Bakers Lane, Kemps Creek	Education (High School)	295 566	6 254 297
R13	45-49 Bakers Lane, Kemps Creek	Education (Preschool)	295 145	6 254 262
R14	35-44 Sarah Andrews Close, Erskine Park	Industrial	294 652	6 254 868
R15	15 Medinah Avenue, Luddenham	Residential	293 235	6 253 485
R16	29 Medinah Avenue, Luddenham	Residential	293 236	6 253 200
R17	965 Mamre Road, Kemps Creek	Residential	295 319	6 251 935

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

Figure 5 Population density and sensitive receptors surrounding the Proposal site



Source: Google Maps and data sourced from the ABS, adapted by Northstar Air Quality

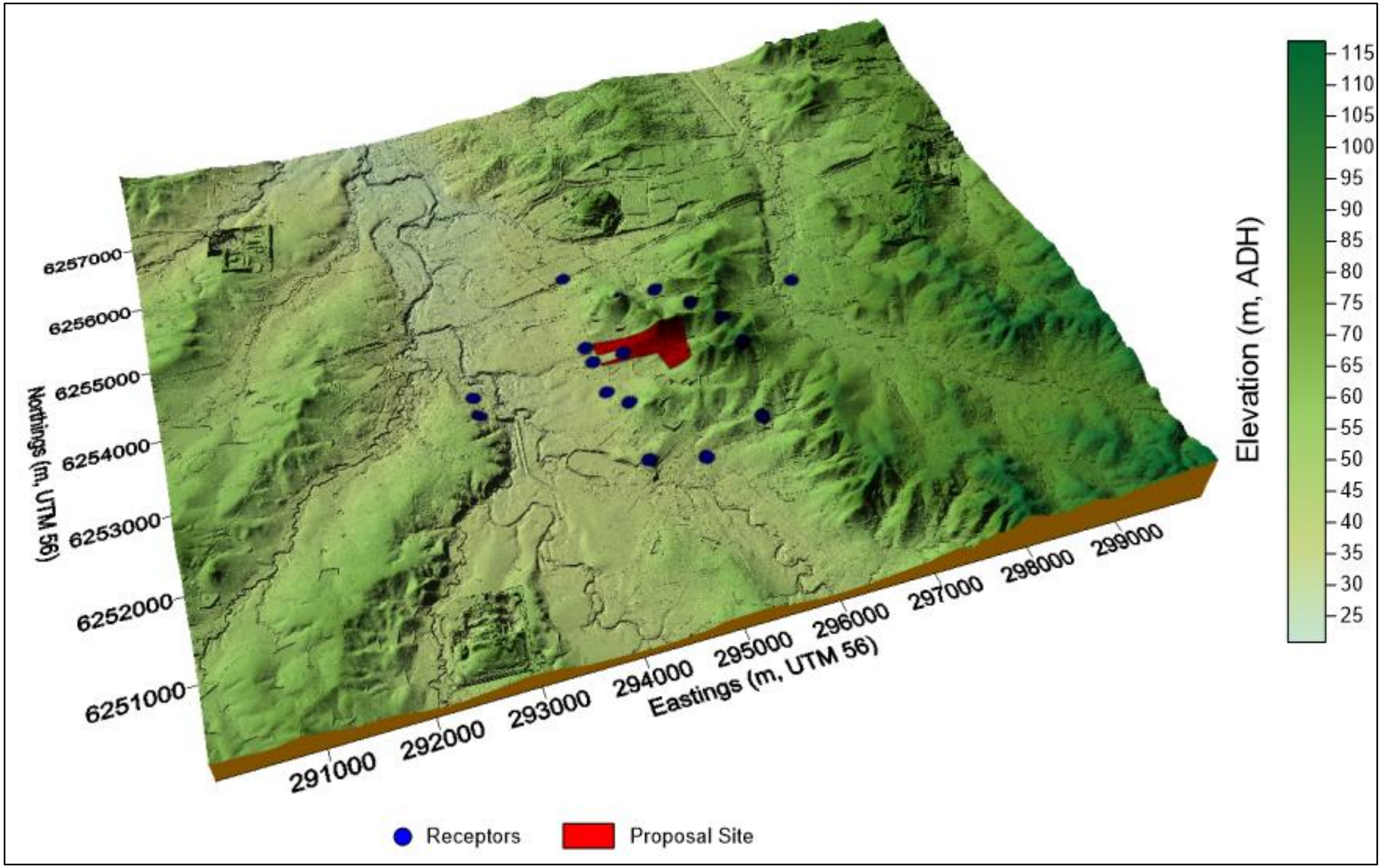
4.1.3. Uniform Receptor Locations

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.

4.2. Topography

The elevation of the Proposal site is approximately 42 m to 79 m Australian Height Datum (AHD). The topography between the Proposal site and nearest sensitive receptor locations is uncomplicated. An illustration of the topography of the area is illustrated in **Figure 6**.-dimensional representation of the topography surrounding the Proposal site is presented in **Figure 6**.

Figure 6 Three-dimensional representation of topography surrounding the Proposal site



Source: Northstar Air Quality

4.3. 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). Meteorology is also measured by the NSW Department of Planning, Industry & Environment (DPIE) at a number of Air Quality Monitoring Station (AQMS) surrounding the Proposal site (refer **Section 4.4**).

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 A**.

Two meteorological stations operated by BoM are located within a 9 km radius of the Proposal site. A summary of the relevant AWS is provided in **Table 5** below (listed by proximity).

Table 5 Details of meteorological monitoring surrounding the Proposal site

Site Name	Approximate Location (UTM)		Approximate Distance
	mE	mS	km
Horsley Park Equestrian Centre AWS - Station # 67119	301 708	6 252 298	6.2
Badgerys Creek AWS - Station # 67108	289 907	6 246 949	8.1

The meteorological conditions measured at the identified AWS, are presented in **Appendix A**.

It is considered that Horsley Park Equestrian Centre AWS is most likely to represent the conditions at the Proposal site, based upon its proximity and lack of significant topographical features between the two locations. The wind roses presented in **Appendix A** indicate that from 2016 to 2020, winds at Horsley Park Equestrian Centre AWS show similar wind distribution patterns across the years assessed, with a predominant south-westerly wind direction.

The majority of wind speeds experienced at the Horsley Park Equestrian Centre AWS between 2016 and 2020 are generally in the range 1.5 meters per second ($m{\cdot}s^{-1}$) to 5.5 $m{\cdot}s^{-1}$ with the highest wind speeds (greater than 8 $m{\cdot}s^{-1}$) occurring from south-easterly, south-westerly and north-westerly directions. Winds of this speed are rare and occur during 0.3 % of the observed hours during the years. Calm winds (<0.5 $m{\cdot}s^{-1}$) prevail and occur more than 18 % of hours across the years.

Based on the wind distributions across the years examined (see **Section 4.3** and **Appendix A**), data for the year 2017 has been selected as being appropriate for further assessment, as it best represents the general trend across the 5-year period studied.

4.4. Air Quality

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

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

The Proposal site is located proximate to a number of AQMS operated by NSW DPIE. These locations (listed by proximity) are briefly summarised in **Table 6**.

Table 6 Closest DPIE AQMS to the Proposal site

AQMS Location	Data Availability	Distance to Site (km)	Screening Parameters				
			2017 Data	Measurements			
				PM_{10}	$PM_{2.5}$	TSP	NO_2
St Marys	1992 - 2020	4.7	✓	✓	✓	×	✓
Bringelly	1992 - 2020	8.7	✓	✓	✓	×	✓
Prospect	2007 - 2020	12.2	✓	✓	✓	×	✓
Blacktown (Decommissioned)	Decommissioned	12.9	×	×	×	×	×

The closest active AQMS is noted to be located at St Marys and is generally considered to be the monitoring location most reflective of the conditions at the Proposal site.

Appendix B provides a detailed assessment of the background air quality monitoring data collected at the St Marys AQMS.

It is noted that none of the AQMS measure Total Suspended Particulate (TSP) which is of relevance to the expected emissions from the Proposal site. Based upon long-term historic monitoring data, a numerical relationship between TSP and PM_{10} has been established for the Sydney Metropolitan region. Based upon these data, a relationship between ambient concentrations of TSP : PM_{10} of 2.0551 : 1 is used to approximate background annual average TSP concentrations. This relationship is established and is used frequently to approximate background annual average TSP concentrations in similar locations (see **Appendix B**).

The impact assessment criteria used for deposited dust (see **Table 3**) are presented as (i) a cumulative deposition rate of 4 $g \cdot m^{-2} \cdot month^{-1}$ and (ii) a discrete deposition rate of 2 $g \cdot m^{-2} \cdot month^{-1}$. In lieu of a background deposition rate to derive a cumulative rate, the incremental impact assessment criterion (2 $g \cdot m^{-2} \cdot month^{-1}$) will be used. This is a commonly adopted approach when background deposition rates are not available.

A summary of the air quality monitoring data and assumptions used in this assessment are presented in **Table 7**.

Table 7 Summary of background air quality used in the AQIA

Pollutant	Ave Period	Measured Value	Notes
Particles (as TSP) (derived from PM_{10})	Annual $\mu g \cdot m^{-3}$	33.4	Estimated on a TSP:PM_{10} ratio of 2.0551 : 1
Particles (as PM_{10}) (St Marys)	24-hour $\mu g \cdot m^{-3}$	Daily Varying	The 24-hour maximum for PM_{10} in 2017 was 49.8 $\mu g \cdot m^{-3}$ (i.e. very close to the criterion)
	Annual $\mu g \cdot m^{-3}$	16.2	
Particles (as $PM_{2.5}$) (St Marys)	24-hour $\mu g \cdot m^{-3}$	Daily Varying	The 24-hour maximum for $PM_{2.5}$ in 2017 was 38.2 $\mu g \cdot m^{-3}$ (i.e. already exceeding – see below)
	Annual $\mu g \cdot m^{-3}$	7.0	
Dust deposition	Annual $g \cdot m^{-2} \cdot month^{-1}$	2.0	Difference in NSW EPA maximum allowable and incremental impact criterion
Nitrogen dioxide (NO_2) (St Marys)	1-hour $\mu g \cdot m^{-3}$	3.7	Hourly maximum 1-hr average in 2017
	Annual $\mu g \cdot m^{-3}$	0.4	Annual average in 2017

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

A number of AQMS in NSW metropolitan and regional population centres recorded particulate matter concentrations above the national standard on some days during 2017. This was mainly driven by an increase in hazard reduction burns around and agricultural activities (NSW OEH, 2019). The 24-hour NEPM PM_{10} standard was not exceeded on any calendar days at St Marys AQMS in 2017, however, the 24-hour NEPM $PM_{2.5}$ standard was exceeded on three calendar days in 2017 at St Marys due to exceptional events as presented in **Table 8**.

Extensive hazard reduction burns (HRB) throughout the NSW Greater Metropolitan Region were the major influences on elevated $PM_{2.5}$ levels throughout New South Wales. As presented in **Table 8**, all of these exceedances were due to fires[1].

[1] https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Air/national-environment-protection-measure-ambient-air-quality-nsw-compliance-report-2017-180635.pdf

Table 8 Days Exceeding $PM_{2.5}$ 24-hour AAQ NEPM Standard at St Marys AQMS - 2017

Date	Max. 24-hr PM_{10} concentration ($\mu g \cdot m^{-3}$)	Max. 24-hr $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$)	Event
11 May	33.2	25.3	Hazard reduction burn at Wentworth Falls, 40 km northwest of St Marys.
15 August	40.3	38.2	Effects of hazard reduction burn from 14 August.
3 September	35.8	26.0	Effects of hazard reduction burn from 2 September.

Source: New South Wales Annual Compliance Report 2017

The AQIA has been performed to assess the contribution of the Proposal to the air quality of the surrounding area, and to ensure that no additional exceedances of the air quality criteria are experienced as a result of the construction and operation of the Proposal. A full discussion of how the Proposal impacts upon the air quality is presented in **Section 6** and **Section 7**.

5. METHODOLOGY

5.1. Air Quality Impact Assessment Methodology

5.1.1. 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 the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM)[2]. Reference should be made to **Appendix C** 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 illustrated in **Figure 7**.

[2] www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

Figure 7 Construction phase impact risk assessment methodology

Step 1
- SCREENING
- A simple screening step accounting for seperation distance between the sources and the receptors

Step 2
- RISK FROM CONSTRUCTION ACTIVITIES
- Assess risk from activities based on the scale and nature of the works, which determines the potential dust emission magnitude

Step 3
- SENSITIVITY OF THE AREA
- Assess risk of dust effects from activities based on the sensitivity of the area surrounding dust-generating activities

Step 4
- RISK ASSESSMENT (PRE-MITIGATION)
- Based upon Steps 2 and 3, determine risks associated with the construction activities

Step 5
- IDENTIFY MITIGATION
- Based upon the risks assessed at Step 4, identify appropriate mitigation measures to control the risks

Step 6
- RISK ASSESSMENT (POST-MITIGATION)
- Based upon the mitigation measures identified at Step 5, reassess risk

The assessment approach, as illustrated above in **Figure 7**, is detailed in **Appendix C**.

5.1.2. Operational Phase

Dispersion Modelling

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF Atmospheric Dispersion Model. The modelling has been performed in CALPUFF 2-dimensional (2-D) mode. Given the flat (uncomplex) terrain and the proximity of the receptors to the Proposal site, a detailed assessment using a 3-D meteorological dataset is not warranted.

The 2-D meteorological dataset has been developed using The Air Pollution Model (TAPM, v 4.0.5) (see **Appendix A** for further information).

An assessment of the impacts of the operation of activities at the Proposal site has been performed, which characterises the likely day-to-day (and hour-to-hour) operation, approximating operational characteristics which are appropriate to assess against longer term (annual average) and shorter term (24-hr and 1-hr) criteria for emissions to air.

The modelling scenario provides an indication of the air quality impacts of the operation of activities at the Proposal site and the predictions are termed 'incremental impacts'. Added to the incremental impacts are background air quality concentrations (where available and discussed in **Section 4.4** and **Appendix B**), which represent the air quality which may be expected within the area surrounding the Proposal site, without the impacts of the Proposal itself. The addition of background assumptions to the incremental impacts derives the predicted 'cumulative impacts'.

The following provides a description of the determination of appropriate emissions of air pollutants resulting from the operation of the Proposal.

Emissions 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. This assessment has adopted emission factors from the US EPA AP42 emission factor compendium (US EPA, various) specifically Chapter 13 (Miscellaneous Sources) (USEPA, 2011) for the assessment of particulate matter emissions resulting from the use of paved roads by delivery vehicles. To account for gaseous emissions (of NO_X/NO_2) and particulate matter, resulting from idling vehicles at the delivery bays at the warehouse and industrial facility, emissions have been calculated using emission factors adopted from the US EPA document "*Idling Vehicle Emissions for Passenger Cars Light-Duty Trucks, and Heavy-Duty Trucks*" (USEPA, 2008).

Data has been provided by the Applicant to approximate the activities being performed at the Proposal site on a day-to-day basis. These data, and the relevant emission factors associated with each activity are presented in **Table 9** and in **Table 10**. Emissions data associated with the activities is presented in **Table 11** and in **Table 12**.

Vehicular access to the Proposal site is via an access road to the south of the Proposal site.

Heavy vehicle trip generation rates for the warehouse have been provided by the Proponent, which indicate that 2.9 vehicles per 100 m^2 of GFA per day are anticipated, with 27 % of those vehicles being commercial vehicles.

A total of 106 loading bays are associated with the Proposal. The potential for all bays to be occupied by vehicles at any one time is unlikely. Furthermore, the likelihood that all of those vehicles would be simultaneously idling is more unlikely still. However, this assessment needs to assess a potential likely worst-case scenario, especially to allow determination of the possible short term (1-hour) impacts at nearby receptor locations.

An assumption has been made that all 106 bays would be occupied simultaneously, and that the vehicles would be idling for a period of 10 minutes within each hour which is considered representative of typical loading / unloading times. **Section 9** provides a discussion of the sensitivity of this assumption to the conclusions of this study.

Operators of trucks actively seek to reduce operational costs and a reduction in vehicle idling time also presents associated reductions in fuel use and engine wear. Engine idling time can be reduced through:

- implementation of operational efficiencies (booking systems, parking rather than queueing vehicles, expanded hours of operation to avoid peak periods);
- the use of idle-off devices; and,
- the use of Auxiliary Power Units (APUs).

Table 9 Emission factors, particulate matter – vehicle transport

Source	Activity rate	Units	Emission factor source	Emission factor			Units
				TSP	PM_{10}	$PM_{2.5}$	
Trucks entering / leaving Proposal site	Various (see **Table 11**)	VKT·hr^{-1}	AP42 - 13.2.1 Paved Roads Assumed silt loading of road is 0.015 g·m^{-2} (ubiquitous baseline, >10 000 AADT flow, limited access (USEPA, 2011)). Average vehicle weight assumed to be 29 t (70 % Pick Up and Delivery [PUD] vehicles at average of 20 t, 30 % B-Double at average of 50 t).	2.42	0.46	0.11	VKT·hr^{-1}

Table 10 Emission factors – gaseous and particulate matter emissions, diesel engines

Source	Activity rate	Units	Vehicle type	Op. hours	Emission factor source	NO_X emission factor ($g{\cdot}hr^{-1}$)	PM_{10} emission factor ($g{\cdot}hr^{-1}$)	$PM_{2.5}$ emission factor ($g{\cdot}hr^{-1}$)
Trucks idling in bays at warehouses	Various (see **Table 12**)[(A)]	$veh{\cdot}hr^{-1}$	PUD	24	(USEPA, 2008).	3.705	-	-
			B-Double	24		33.763	1.196	1.1
			Average	24		24.746	0.837	0.77

Notes: A Vehicles assumed to be idling for a 10-minute period each hour

Table 11 Emission estimation, particulate matter - vehicle transport

Warehouse number	Area (m^2)	Number of daily trips (trucks)	Distance of road from Proposal site entrance to facility (m) (2-way)	$VKT{\cdot}day^{-1}$ (A)	TSP emission rate ($kg{\cdot}year^{-1}$) (A)	PM_{10} emission rate ($kg{\cdot}year^{-1}$) (A)	$PM_{2.5}$ emission rate ($kg{\cdot}year^{-1}$) (A)
1	19,525	157	501	78.8	69.7	13.4	3.2
2	22,870	188	888	166.5	147.2	28.3	6.8
3	36,420	300	1,366	409.3	361.9	69.5	16.8
4	41,480	342	2,760	942.7	833.5	160.0	38.7
5	30,830	254	2,103	534.1	472.2	90.6	21.9

Note: A: VKT and emissions presented as two-way totals

Table 12 Emission estimation – gaseous and particulate matter emissions, diesel engines

Warehouse number	Number of vehicle bays	NO_X emission rate ($kg{\cdot}year^{-1}$) (A)	PM_{10} emission rate ($kg{\cdot}year^{-1}$) (A)	$PM_{2.5}$ emission rate ($kg{\cdot}year^{-1}$) (A)
1	15	520.3	17.6	16.2
2	18	624.3	21.1	19.4
3	17	589.6	19.9	18.3
4	35	1,213.9	41.1	37.8
5	21	728.4	24.6	22.7

Notes: A: Vehicles assumed to be idling for a 10-minute period each hour

6. CONSTRUCTION AIR QUALITY IMPACT ASSESSMENT

The methodology used to assess construction phase risk is discussed in **Section 5.1** and **Appendix C**.

Briefly, after 'Step 1 Screening' (which excludes those receptors that are sufficiently distanced from construction phase activities to not warrant further assessment) *risk* is determined by the product of *receptor sensitivity* and the identified *magnitude of impacts* associated with the construction phase activities (construction, track-out, demolition and earthworks [as applicable]). The definitions used to screen receptors, determine receptor sensitivity and the magnitude of impacts are all presented in **Appendix C.**

6.1. Screening Based on Separation Distance

The screening criteria applied to the identified sensitive receptors, are whether they are located in excess of:

- 50 m from the route used by construction vehicles on public roads.
- 350 m from the boundary of the site.
- 500 m from the site entrance.
- Track-out is assumed to affect roads up to 100 m from the site entrance.

Further to the above distance-based screening criteria, the construction activities are screened by the required construction activities.

Table 13 overleaf presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria.

Table 13 Construction phase impact screening criteria distances

Rec	Location	Land Use	Screening Distance (m)		
			Boundary (350m)	Site Entrance (500m)	Construction route (50m)
R1	772-782 Mamre Road, Kemps Creek	Residential	52	267	267
R2	757-769 Mamre Road, Kemps Creek	Residential	91	309	87
R3	771-781 Mamre Road, Kemps Creek	Residential	93	107	96
R4	819-831 Mamre Road, Kemps Creek	Residential	385	400	118
R5	844-862 Mamre Road, Kemps Creek	Residential	602	641	74
R6	919-929 Mamre Road, Kemps creek	Residential	1 232	1 415	478
R7	235-251 Aldington Road, Kemps Creek	Residential	1 067	1 874	701
R8	141-153 Aldington Road, Kemps Creek	Residential	538	1 509	1 295
R9	99-111 Aldington Road, Kemps Creek	Residential	421	1 394	1 394
R10	3 Imperata Close, Kemps Creek	Industrial	1 432	2 440	2 440
R11	1-23 Aldington Road, Kemps Creek	Residential	299	1 244	1 244
R12	87-109 Bakers Lane, Kemps Creek	Education (High School)	619	1 203	1 203
R13	45-49 Bakers Lane, Kemps Creek	Education (Preschool)	522	906	906
R14	35-44 Sarah Andrews Close, Erskine	Industrial	1 062	1 382	1 381
R15	15 Medinah Avenue, Luddenham	Residential	1 442	1 443	1 427
R16	29 Medinah Avenue, Luddenham	Residential	1 465	1 469	1 453
R17	965 Mamre Road, Kemps Creek	Residential	1 213	1 678	50
R18	783A Mamre Road, Kemps Creek	residential	91	95	79

With reference to **Table 13**, sensitive receptors are noted to be within the screening distance boundaries and therefore require further assessment as summarised in **Table 14**.

Table 14 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		
Construction	350 m from boundary 500 m from site entrance		
Trackout	100 m from site entrance		
Construction Traffic	50 m from roadside		

6.2. Impact Magnitude

The footprint of the Proposal site (the area affected) is estimated as being approximately 333 600 m^2 (33.4 ha)) in area.

The Proposal would involve demolition of ten current structures within the Project site, constituting a volume of approximately 34 750 m^3. Earthworks have been assumed to be required to some degree over the whole 33.4 ha Project site are, and the total volume of construction required has been assumed to 2 304 756 m^3, assuming a footprint of the warehouse and office areas of 157 860 m^2 and an average building height of 14.6 m.

The assumed supply route around the Proposal site during construction works may be up 2 000 m in two-way length. It is anticipated that approximately 50 heavy vehicle movements per day would be required each day to service the Proposal site. For the purposes of the assessment, the route for construction traffic to/from the Proposal site is assumed to be along Mamre Road towards Elizabeth Drive and the M4 Western Motorway.

Based upon the above assumptions and the assessment criteria presented in **Appendix C**, the dust emission magnitudes are as presented in **Table 15**.

Table 15 Construction phase impact categorisation of dust emission magnitude

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

6.3. Sensitivity of an Area

6.3.1. Land Use Value

The assessment criteria as described in **Section 5.1**, including the conditions pertaining to land use value of the area surrounding the Proposal site, is provided in detail in **Appendix C** of this report.

The maximum land use value across the identified receptors has been taken forward to be conservative. It is concluded to be *high* for health impacts and for dust soiling, given the distance between the receptors and the Proposal site and the nature of receptors surrounding the site and the PM_{10} annual average concentration of 16.2 $\mu g \cdot m^{-3}$ as reported in **Section 4.4**.

6.3.2. Sensitivity of an Area

The dust soiling sensitivity of the area is assessed as being low because of the type of receptor and its range from the Proposal site. The human health sensitivity of the area is assessed as being low, for the same reasons stated above, including the influence of annual PM_{10} for the area.

6.4. Risk (Pre-Mitigation)

Given the sensitivity of the identified receptors is classified as 'low' for dust soiling and health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 15**, the resulting risk of air quality impacts (without mitigation) is as presented in **Table 16**.

Table 16 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	medium	large	large	large	large	low	low	low	low	low
Human Health	low	medium	large	large	large	large	low	low	low	low	low

The risks summarised in **Table 16** show that there is a *low* risk of adverse dust soiling and human health impacts at sensitive receptors, if no mitigation measures were to be applied to control emissions associated with all construction phase activities.

6.5. Identified Mitigation

The following represents a selection of recommended mitigation measures recommended by the IAQM methodology for a low risk site for construction phase activities. A detailed review of the recommendations would be performed once details of the construction phase are available.

Table 17 lists the relevant mitigation measures identified, and have been presented as follows:

- **N** = not required (although they may be implemented voluntarily).
- **D** = desirable (to be considered as part of the Construction Environment Management Plan (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 17 Site-specific management measures

Identified Mitigation		Unmitigated Risk
1	**Communications**	**Low**
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	N
1.1	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
1.2	Display the head or regional office contact information.	H
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	D
2	**Site Management**	Low
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

Identified Mitigation		Unmitigated Risk
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	N
3	**Monitoring**	Low
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.	D
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
3.4	Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	N
4	**Preparing and Maintaining the Site**	Low
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.	D
4.4	Avoid site runoff of water or mud.	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	D
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	D
4.7	Cover, seed or fence stockpiles to prevent wind erosion	D
5	**Operating Vehicle/Machinery and Sustainable Travel**	Low
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

Identified Mitigation		Unmitigated Risk
5.4	Impose and signpost a maximum-speed-limit of 25 km·h-1 on surfaced and 15 km·h-1 on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate	D
5.4	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	N
5.5	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	N
6	**Operations**	Low
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.	D
7	**Waste Management**	Low
7.1	Avoid bonfires and burning of waste materials.	H
8	**Measures Specific to Demolition**	Low
8.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D
8.2	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively 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
8.5	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	N
8.6	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	N
8.7	Only remove the cover in small areas during work and not all at once	N

Identified Mitigation		Unmitigated Risk
9	**Measures Specific to Construction**	Low
8.1	Avoid scabbling (roughening of concrete surfaces) if possible	D
8.2	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	D
8.3	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.	N
8.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	N
10	**Measures Specific to Track-Out**	Low
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.	D
10.2	Avoid dry sweeping of large areas.	D
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D
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.	D
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.	N
10.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D
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.	N
10.9	Access gates to be located at least 10 m from receptors where possible.	N
11	**Specific Measures to Construction Traffic (adapted)**	Low
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H
8.3	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.	N
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D
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.	D

Notes D = desirable (to be considered), H = highly recommended (to be implemented), N = not required (although can be voluntarily implemented)

6.6. 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 of the activities to be performed, residual impacts associated with fugitive dust emissions from the Proposal would be anticipated to be '*low*' for all activities. Careful implementation of the mitigation measures should act to ensure that those risks are minimised.

7. OPERATIONAL AIR QUALITY IMPACT ASSESSMENT

The methodology used to assess operational phase impacts is discussed in **Section 5.2**. This section presents the results of the dispersion modelling assessment and uses the following terminology:

- **Incremental impact** – relates to the concentrations predicted as a result of the operation of the 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 discussed in **Section 4.4**.

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

7.1. Particulate Matter

Results are presented in this section for the predictions of particulate matter (TSP, PM_{10}, $PM_{2.5}$ and dust deposition). The averaging periods associated with the criteria for these pollutants is 24-hour and annual averages, as specified in **Table 3**. The emissions adopted for this scenario reflect the operational profile of the Proposal over those averaging periods (refer **Section 5.1.2**).

7.1.1. Annual Average TSP, PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from the Proposal operations are presented in **Table 18** overleaf.

The results indicate that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at residential receptor locations are low and less than (<) 1 % of the annual average TSP criterion, <1.1 % of the annual average PM_{10} criterion and <1.7 % of the $PM_{2.5}$ criterion.

The addition of existing background concentrations (refer **Section 4.4**) results in predicted concentrations of annual average TSP being <38.1 %, annual average PM_{10} being ≤65.9 % and annual average $PM_{2.5}$ being ≤89.2 % of the relevant criteria, at the nearest receptors.

Table 18 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations

Receptor	Annual Average Concentration (µg·m^{-3})								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
R1	0.9	33.4	34.3	0.3	16.2	16.5	0.1	7.0	7.1
R2	0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R3	0.2	33.4	33.6	<0.1	16.2	16.3	<0.1	7.0	7.1
R4	0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R5	0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R6	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R7	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R8	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R9	0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R10	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R11	0.3	33.4	33.7	0.1	16.2	16.3	<0.1	7.0	7.1
R12	0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R13	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R14	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R15	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R16	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
R17	<0.1	33.4	33.5	<0.1	16.2	16.3	<0.1	7.0	7.1
Criterion	-	90		-	25		-	8	

No contour plots of annual average TSP, PM_{10} or $PM_{2.5}$ are presented, given the minor contribution from the Proposal at the nearest relevant sensitive receptors.

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

7.1.2. Annual Average Dust Deposition Rates

Table 19 below presents the annual average dust deposition predicted as a result of the operations at the Proposal site. An assumed background dust deposition of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ is presented in **Table 19**, although comparison of the incremental concentration with the incremental criterion of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ is also valid (as discussed within **Section 4.4**). In either case, the resulting conclusions drawn are identical. Annual average dust deposition is predicted to meet the criteria at all receptors surrounding the Proposal site where the predicted impacts are < 5 % of the incremental criterion at receptor locations. No contour plot of annual average dust deposition is presented, given the minor contribution from the Proposal at the nearest sensitive receptors.

Table 19 Predicted annual average dust deposition

Receptor	Annual Average Dust Deposition ($g{\cdot}m^{-2}{\cdot}month^{-1}$)		
	Incremental Impact	Background	Cumulative Impact
R1	<0.1	2.0	2.1
R2	<0.1	2.0	2.1
R3	<0.1	2.0	2.1
R4	<0.1	2.0	2.1
R5	<0.1	2.0	2.1
R6	<0.1	2.0	2.1
R7	<0.1	2.0	2.1
R8	<0.1	2.0	2.1
R9	<0.1	2.0	2.1
R10	<0.1	2.0	2.1
R11	<0.1	2.0	2.1
R12	<0.1	2.0	2.1
R13	<0.1	2.0	2.1
R14	<0.1	2.0	2.1
R15	<0.1	2.0	2.1
R16	<0.1	2.0	2.1
R17	<0.1	2.0	2.1
Criterion	2.0	-	4.0

The performance of the Proposal does not result in any exceedances of the annual average dust deposition impact assessment criteria.

7.1.3. Maximum 24-Hour PM_{10} and $PM_{2.5}$

Table 20 below presents the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest receptors, as a result of the Proposal operations. No background concentrations are included within this table.

Table 20 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations

Receptor	Maximum 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
R1	1.3	0.6
R2	0.5	0.3
R3	0.6	0.4
R4	0.4	0.2
R5	0.5	0.2
R6	0.2	<0.1
R7	0.2	<0.1
R8	0.3	0.1
R9	0.4	0.2
R10	0.2	<0.1
R11	0.5	0.2
R12	0.3	0.1
R13	0.3	0.1
R14	0.1	<0.1
R15	<0.1	<0.1
R16	0.1	<0.1
R17	0.2	<0.1
Criterion	50	25

The predicted incremental concentration of PM_{10} and $PM_{2.5}$, are demonstrated to be minor (refer **Table 20** above).

The predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the Proposal, with background included are presented in **Table 21** and **Table 22**, respectively. These results as presented, demonstrate that even with the addition of background concentrations, the cumulative impacts are not in exceedance of the relevant criterion.

Results are presented in **Table 21** and **Table 22** for those receptors at which the greatest impacts have been predicted.

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

For PM_{10}, the maximum cumulative impact (the left hand side of **Table 21**), and the maximum incremental impact (the right hand side of **Table 21**) is predicted at Receptor R1.

For $PM_{2.5}$, the maximum cumulative impact (the left hand side of **Table 22**), and the maximum incremental impact (the right hand side of **Table 22**) is also predicted at Receptor R1.

The analysis indicates that no additional exceedances of the 24-hour average impact assessment criteria for PM_{10} or $PM_{2.5}$ are likely to occur as a result of the operation of the Proposal. Examination of the results for all receptors indicates that no additional exceedances of the PM_{10} or $PM_{2.5}$ criteria are predicted at any receptor location. The results do indicate that the cumulative 24-hour PM_{10} concentration at receptor R1 is at the relevant criterion. The contribution from the Proposal at that receptor on that particular day is predicted to minor (< 0.5 µg·m^{-3}), and given the levels of conservatism within the assessment, impacts are likely to be lower than those predicted.

Table 21 Summary of contemporaneous impact and background – PM_{10} – Receptor 3

Date	24-hour average PM_{10} concentration (µg·m^{-3})			Date	24-hour average PM_{10} concentration (µg·m^{-3})		
	Incr.	BG	Cumul.		Incr.	BG	Cumul.
24/09/2017	0.2	49.8	50.0	12/11/2017	1.3	12.3	13.6
15/08/2017	0.3	40.3	40.6	20/05/2017	1.2	6.5	7.7
12/09/2017	0.4	37.4	37.8	4/02/2017	1.2	21.7	22.9
5/10/2017	0.5	35.7	36.2	13/03/2017	1.1	27.1	28.2
3/09/2017	0.2	35.8	36.0	25/11/2017	1.0	11.2	12.2
15/01/2017	0.5	35.5	36.0	13/12/2017	1.0	22.4	23.4
2/09/2017	0.2	35.5	35.7	19/03/2017	1.0	15.2	16.2
23/09/2017	0.3	34.8	35.1	22/04/2017	1.0	17.0	18.0
21/08/2017	0.4	33.3	33.7	19/05/2017	1.0	14.6	15.6
11/05/2017	0.2	33.2	33.4	18/11/2017	1.0	14.1	15.1
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the Proposal.				These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the Proposal.			

Note: Incr. = incremental impact, BG= background concentration, cumul. = cumulative impact (incr + BG)

Table 22 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor 1

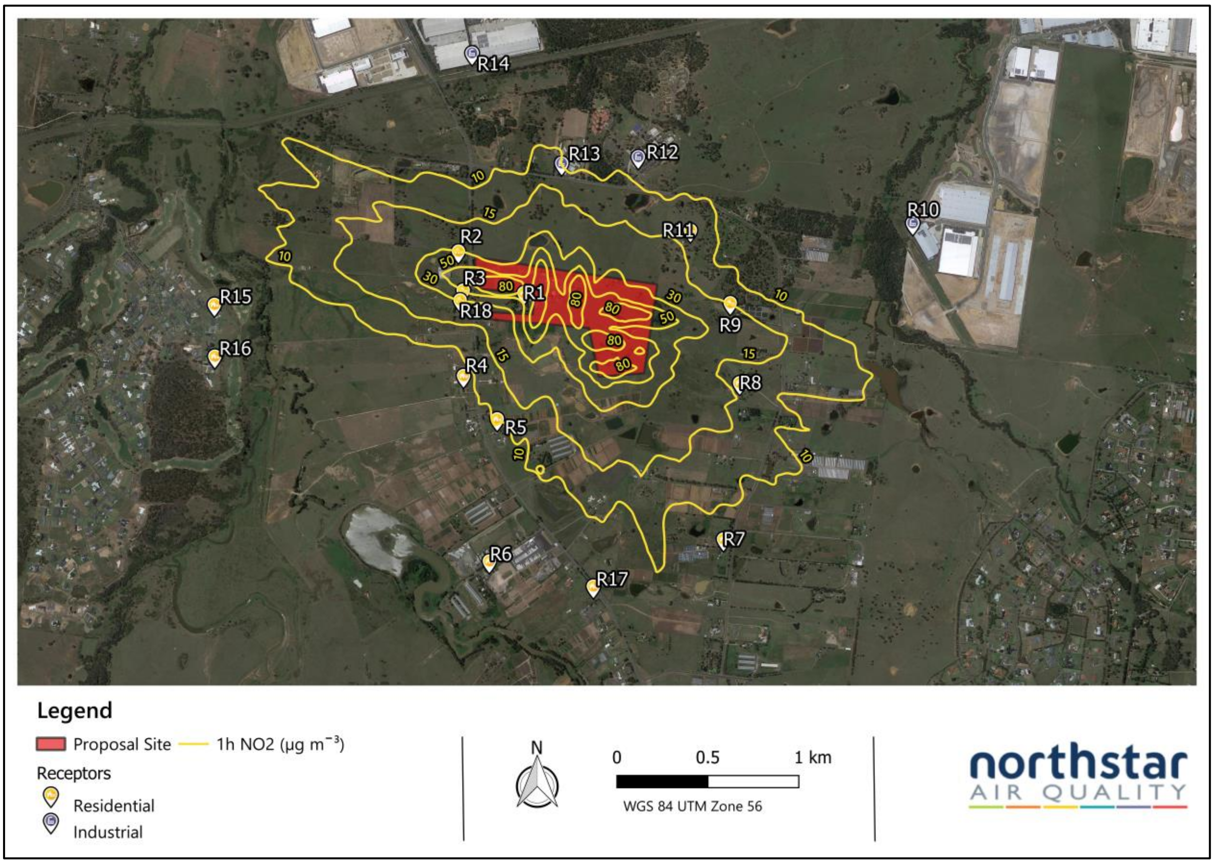
Date	24-hour average $PM_{2.5}$ concentration ($\mu g{\cdot}m^{-3}$)			Date	24-hour average $PM_{2.5}$ concentration ($\mu g{\cdot}m^{-3}$)		
	Incr.	BG	Cumul.		Incr.	BG	Cumul.
15/08/2017	0.1	38.2	38.3	20/05/2017	0.6	4.5	5.1
3/09/2017	0.1	26.0	26.1	22/04/2017	0.6	8.2	8.8
11/05/2017	<0.1	25.3	25.4	4/02/2017	0.5	10.1	10.6
14/08/2017	<0.1	24.3	24.4	12/11/2017	0.5	4.3	4.8
27/08/2017	<0.1	23.7	23.8	19/05/2017	0.5	9.4	9.9
2/09/2017	<0.1	23.5	23.6	18/11/2017	0.5	4.6	5.1
21/08/2017	0.2	21.7	21.9	25/11/2017	0.5	4.8	5.3
26/08/2017	<0.1	21.3	21.4	13/12/2017	0.5	9.7	10.2
12/05/2017	0.2	20.1	20.3	18/12/2017	0.4	11.4	11.8
12/09/2017	0.2	18.6	18.8	13/03/2017	0.4	9.9	10.3
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the Proposal.				These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the Proposal.			

Note: Incr. = incremental impact, BG= background concentration, cumul. = cumulative impact (incr + BG)

Contour plots of the predicted incremental 24-hour PM_{10} concentrations associated with the Proposal are presented in **Figure 8** to allow examination of the distribution of particulate matter in the area surrounding the Proposal.

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

Figure 8 Predicted maximum incremental 24-hour PM_{10} impacts



Note 1: Criterion = 50 µg·m^{-3} (cumulative)

7.2. Nitrogen Dioxide

Results are presented in this section for the predictions of nitrogen dioxide (NO_2). The averaging periods associated with the criteria for these pollutants are 1-hour and an annual average, as specified in **Table 3**. The emissions adopted for this scenario, reflect the operational profile of the Proposal over those averaging periods (refer **Section 5.1.2**).

Emissions of NO_X have been calculated, with subsequent ground-level concentrations predicted using dispersion modelling techniques. Given that NO_X is a mixture of NO_2 and nitric oxide (NO), conversion of NO_X predictions to NO_2 concentrations may be performed. Within this assessment, the conservative assumption that all NO is converted to NO_2 has been adopted (i.e. 100 % of NO_X is emitted as NO_2). This is in accordance with a Method 1, Level 1 assessment as outlined within the Approved Methods. In that method, the maximum dispersion model prediction is added to the maximum background concentration to provide a cumulative impact.

The predicted maximum 1-hour and annual average NO_2 concentrations resulting from the Proposal operations, are presented in **Table 23**.

Table 23 Predicted 1 hour and annual average nitrogen dioxide concentrations

Rec.	Nitrogen dioxide (NO_2) concentration ($\mu g \cdot m^{-3}$)					
	1 hour			Annual Average		
	Increment	Background	Cumulative	Increment	Background	Cumulative
R1	42.3	3.7	46.0	2.7	0.4	3.1
R2	40.1	3.7	43.8	0.5	0.4	0.9
R3	28.6	3.7	32.3	0.8	0.4	1.2
R4	8.1	3.7	11.8	0.4	0.4	0.8
R5	9.4	3.7	13.1	0.4	0.4	0.8
R6	6.1	3.7	9.8	0.2	0.4	0.6
R7	7.7	3.7	11.4	<0.1	0.4	0.5
R8	14.5	3.7	18.2	0.2	0.4	0.6
R9	18.3	3.7	22.0	0.4	0.4	0.8
R10	6.0	3.7	9.7	0.1	0.4	0.5
R11	14.0	3.7	17.7	0.9	0.4	1.3
R12	9.2	3.7	12.9	0.6	0.4	1.0
R13	11.2	3.7	14.9	0.4	0.4	0.8
R14	6.1	3.7	9.8	<0.1	0.4	0.5
R15	5.9	3.7	9.6	<0.1	0.4	0.5
R16	4.3	3.7	8.0	<0.1	0.4	0.5
R15	4.4	104.5	108.9	<0.1	16.9	17.0
Criterion	-	-	246	-	-	62

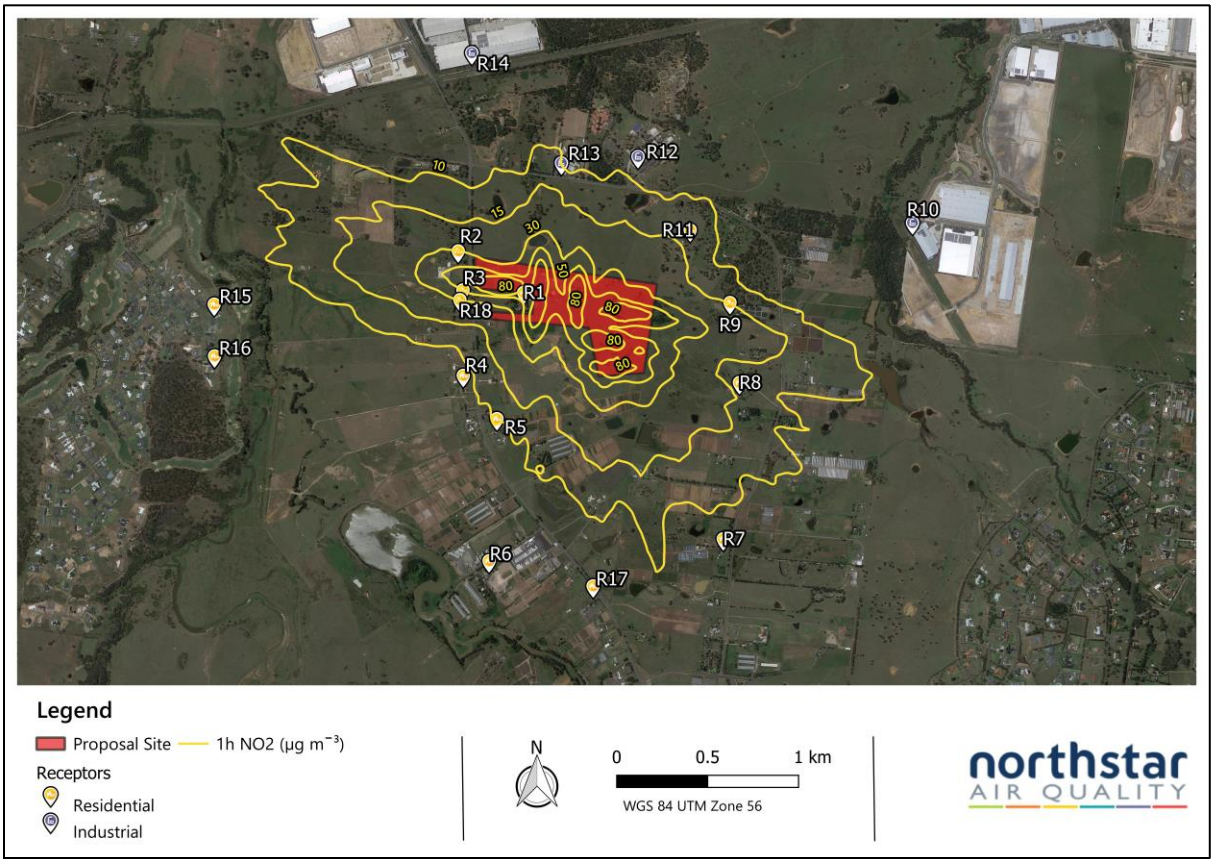
The results indicate that predicted incremental concentrations of combustion-related pollutants (characterised by NO_2), are below the criteria at all surrounding receptor locations. At the worst affected receptor (R1) and for the pollutant with the highest predicted concentrations (1-hour maximum NO_2), predicted increments are shown to be less than 18 % 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_2 impact is presented in

Figure 9.

Figure 9 Predicted maximum incremental 1-hour NO_2 impacts



Note 1: Criterion = 246 µg·m-3 (cumulative)

8. MITIGATION AND MONITORING

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 with 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 6.4**, and the mitigation measures identified to manage that risk are presented in **Section 6.5**. To manage the risks, the identified mitigation measures presented in **Table 16** are anticipated to be implemented in the Construction Environmental Management Plan (CEMP)[3].

8.2. Operational Phase Mitigation

Based on the findings of the air quality impact assessment, it is considered that the level of activity being performed at the Proposal site would result in minor incremental impacts at all surrounding receptor locations.

In the case of predicted incremental annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$), the predicted maximum ground-level concentrations (at any receptor) are predicted to be low:

- TSP: 0.9 $\mu g \cdot m^{-3}$;
- PM_{10}: 0.3 $\mu g \cdot m^{-3}$; and
- $PM_{2.5}$: 0.1 $\mu g \cdot m^{-3}$.

The maximum incremental dust deposition rate is predicted to be < 0.1 $g \cdot m^{-2} \cdot month^{-1}$.

In the case of predicted incremental 24-hour average particulate matter concentrations (as PM_{10} and $PM_{2.5}$), the predicted maximum ground-level concentrations are predicted to be minor:

- PM_{10}: 1.3 $\mu g \cdot m^{-3}$; and

[3] https://www.planning.nsw.gov.au/~/media/Files/DPE/Guidelines/guideline-for-the-preparation-of-environmental-management-plans-2004.ashx?la=en

- $PM_{2.5}$: 0.6 µg·m^{-3}.

Accounting for the background air quality assumptions, the assessment does not predict any additional exceedances of the respective criteria as a result of the operation of the Proposal.

In regard to nitrogen dioxide, the predicted maximum increment 1-hour and annual average predictions are 42.3 µg·m^{-3} and 2.7 µg·m^{-3} respectively. Accounting for the relevant background assumptions, the assessment does not predict an exceedance of the relevant impact assessment criteria.

No specific mitigation measures are considered to be required to minimise impacts on surrounding receptor locations. 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 no off-site impacts are experienced.

8.3. Monitoring

Given the discussion presented above, taking into consideration the minor 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 Air Quality was engaged by The GPT Group, to perform an AQIA for the construction and operation of a warehouse and distribution centre, associated offices and hardstand/car parking areas.

Construction phase activities will involve demolition works and earthworks, construction works and associated vehicle traffic. The associated risks of impacts from demolition, construction, track-out and construction traffic have been assessed using the published guidance in *IAQM 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 Air Quality 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 low risk of health or nuisance impacts during demolition works and construction works. Nevertheless, a range of standard mitigation measures are proposed to ensure that short-term impacts associated with construction activities are further minimised.

The prediction of potential impacts associated with operational activities has been performed in general accordance with the requirements of the NSW Approved Methods (NSW EPA 2017), using an approved and appropriate dispersion modelling technique. The estimation of emissions has been performed using referenced emission factors, and this is documented in **Section 5.1.2**.

The potential incremental impacts (i.e. without consideration of assumed background air quality conditions) at all the identified receptor locations, are presented in **Section 7** 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 discussed in **Section 4.4.**

Conclusion: It is demonstrated that the operation of the Proposal does not cause any exceedances of the air quality criteria.

It is respectfully suggested that the SSD application should not be refused on the grounds of air quality issues.

10. REFERENCES

ABS. (2017). *Australian Bureau of Statistics*. Retrieved from 3101.0 - Australian Demographic Statistics: http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3101.0Jun%202015?OpenDocument

DEC. (2006). *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW.* NSW Environment Protection Authority.

NSW DEC. (2006). Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW.

NSW DEC. (2006). Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW.

NSW EPA. (2016). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.* NSW Environment Protection Authority.

NSW OEH. (2019). *New South Wales Annual Compliance Report 2017.*

USEPA. (2008). *Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks .*

USEPA. (2011). *AP-42 Compilation of Air Pollutant Emission Factors, Chapter 13.2.1 Paved Roads.*

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Appendix A

Meteorology

As discussed in **Section 4.3** 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 taken at a number of surrounding automatic weather stations (AWS) operated by the Bureau of Meteorology (BoM). Two stations were identified within a 10 km radius of the Proposal site.

A summary of the relevant monitoring sites is provided in **Table A1** and also displayed in **Figure A1**.

Table A1 Details of the meteorological monitoring surrounding the Proposal site

Site Name	Approximate Location (UTM)		Approximate Distance
	mE	mS	km
Horsley Park Equestrian Centre AWS - Station # 67119	301 708	6 252 298	6.2
Badgerys Creek AWS - Station # 67108	289 907	6 246 949	8.1

Figure A1 Meteorological and air quality monitoring surrounding the Proposal site

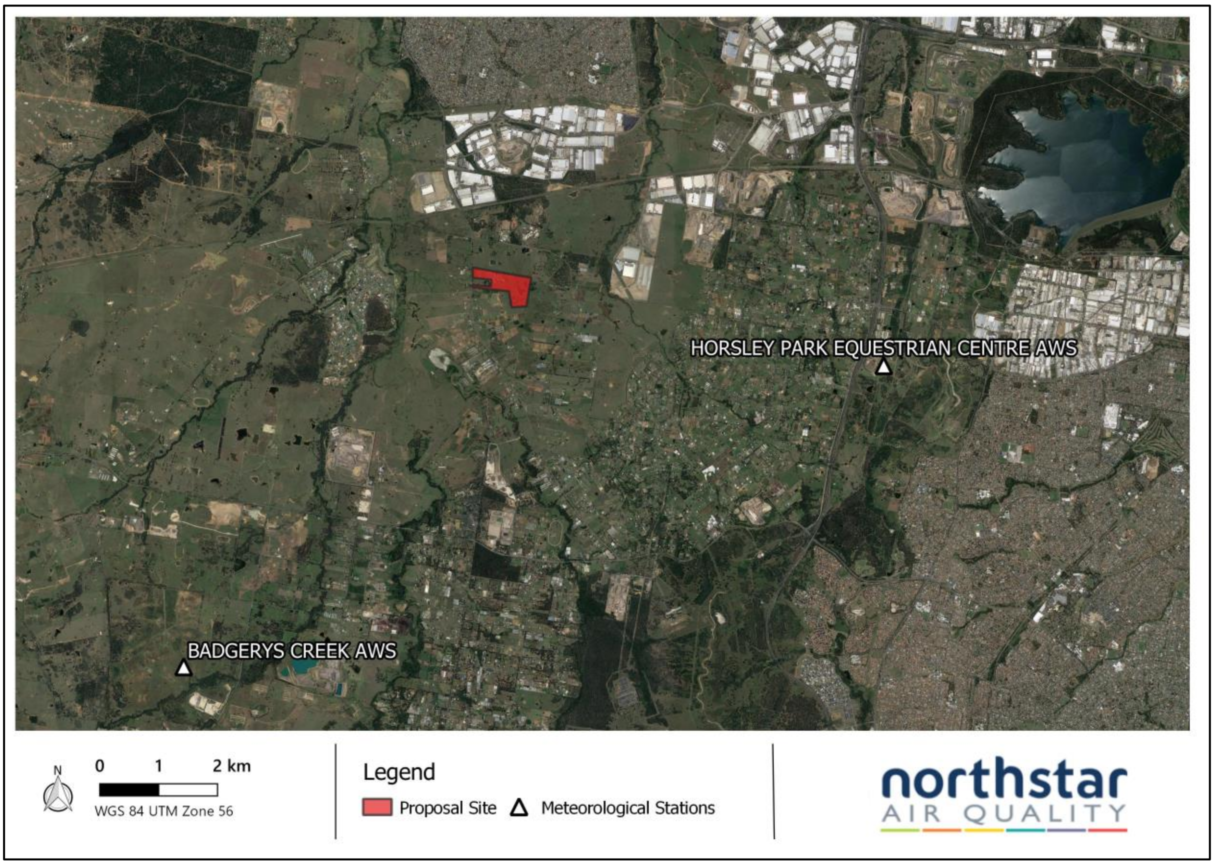


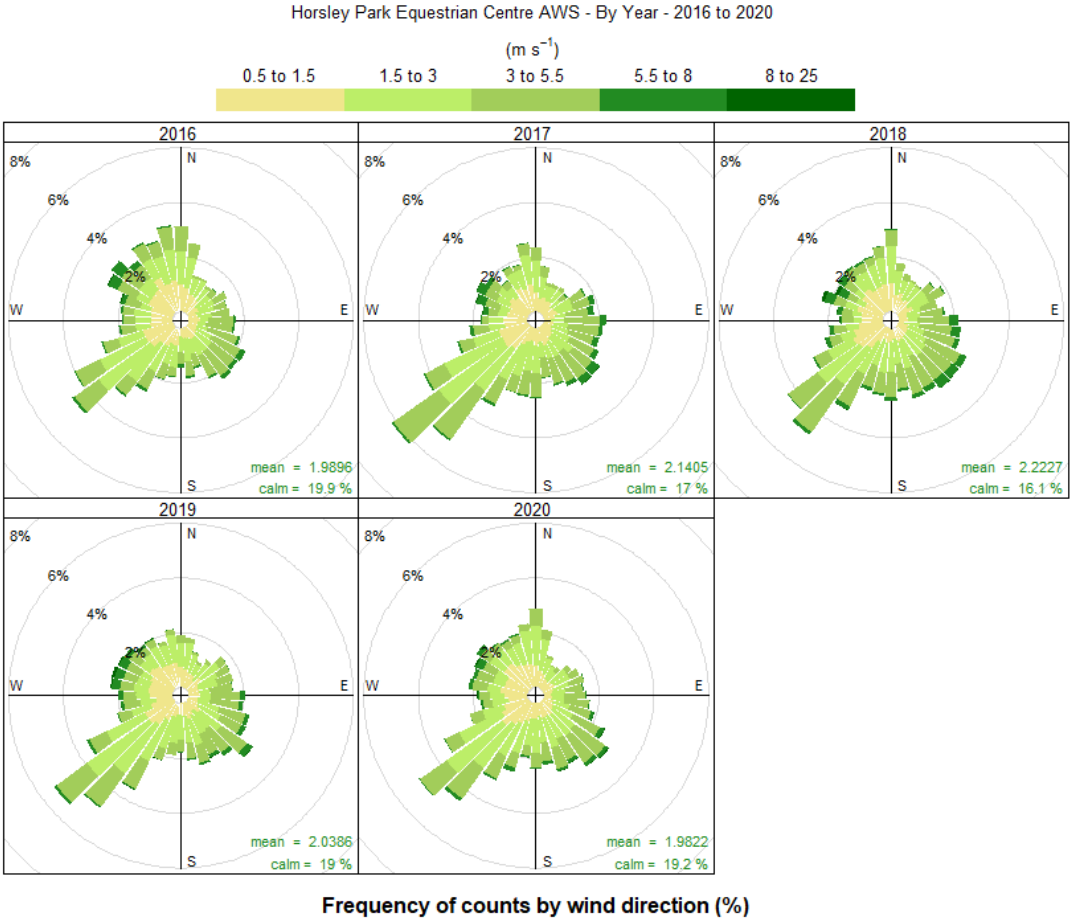
Image courtesy of Google Earth, adapted by Northstar Air Quality

Meteorological conditions at Horsley Park Equestrian Centre 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 (2016 to 2020) are presented in **Figure A2**.

The wind roses indicate that from 2016 to 2020, winds at Horsley Park Equestrian Centre AWS are predominantly experienced from the southwest with south-easterly components also evident.

The majority of wind speeds experienced at the Horsley Park Equestrian Centre AWS between 2016 and 2020 are generally in the range 1.5 metres per second ($m \cdot s^{-1}$) to 5.5 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from north-westerly directions. Winds of this speed are rare and occur during 0.3 % of the observed hours during the years. Calm winds (<0.5 $m \cdot s^{-1}$) prevail and occur more than 18 % of hours across the years.

Figure A2 Annual wind roses 2016 to 2020, Horsley Park Equestrian Centre



Given the similarities in the wind distribution across the years examined, data for the year 2017 has been selected for further assessment. Presented in **Figure A3** are the annual wind rose for the 2016 to 2020 period and the year 2017 and in **Figure A4** the annual wind speed distribution for Horsley Park Equestrian Centre AWS. These figures indicate that the distribution of wind speed and direction in 2017 is very similar to that experienced across the longer-term period.

It is concluded that conditions in 2017 may be considered to provide a suitably representative dataset for use in dispersion modelling.

Figure A3 Annual wind roses 2016 to 2020, and 2017 Horsley Park Equestrian Centre AWS

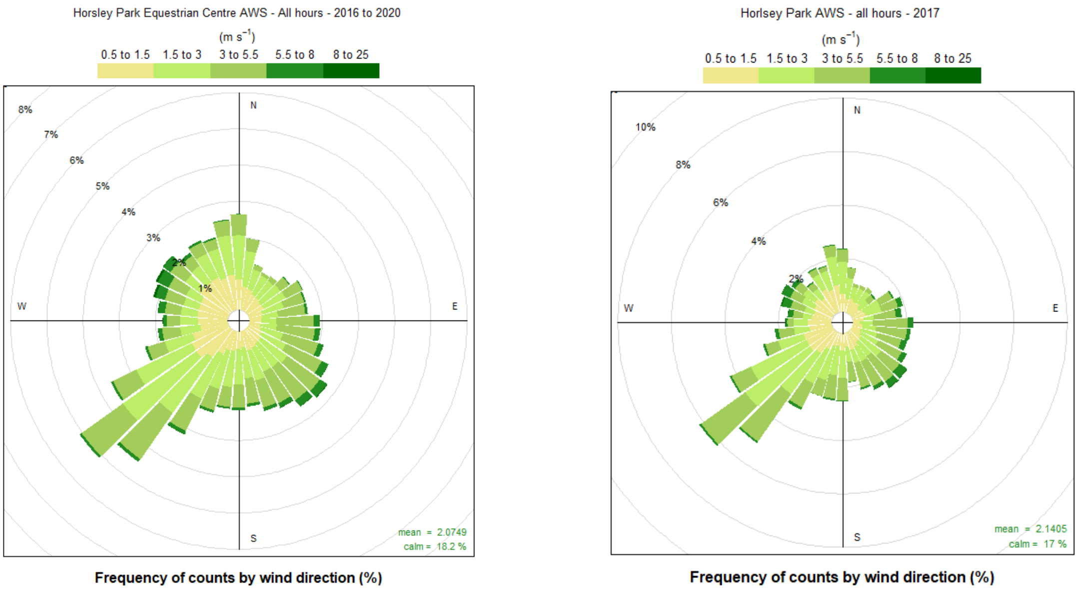
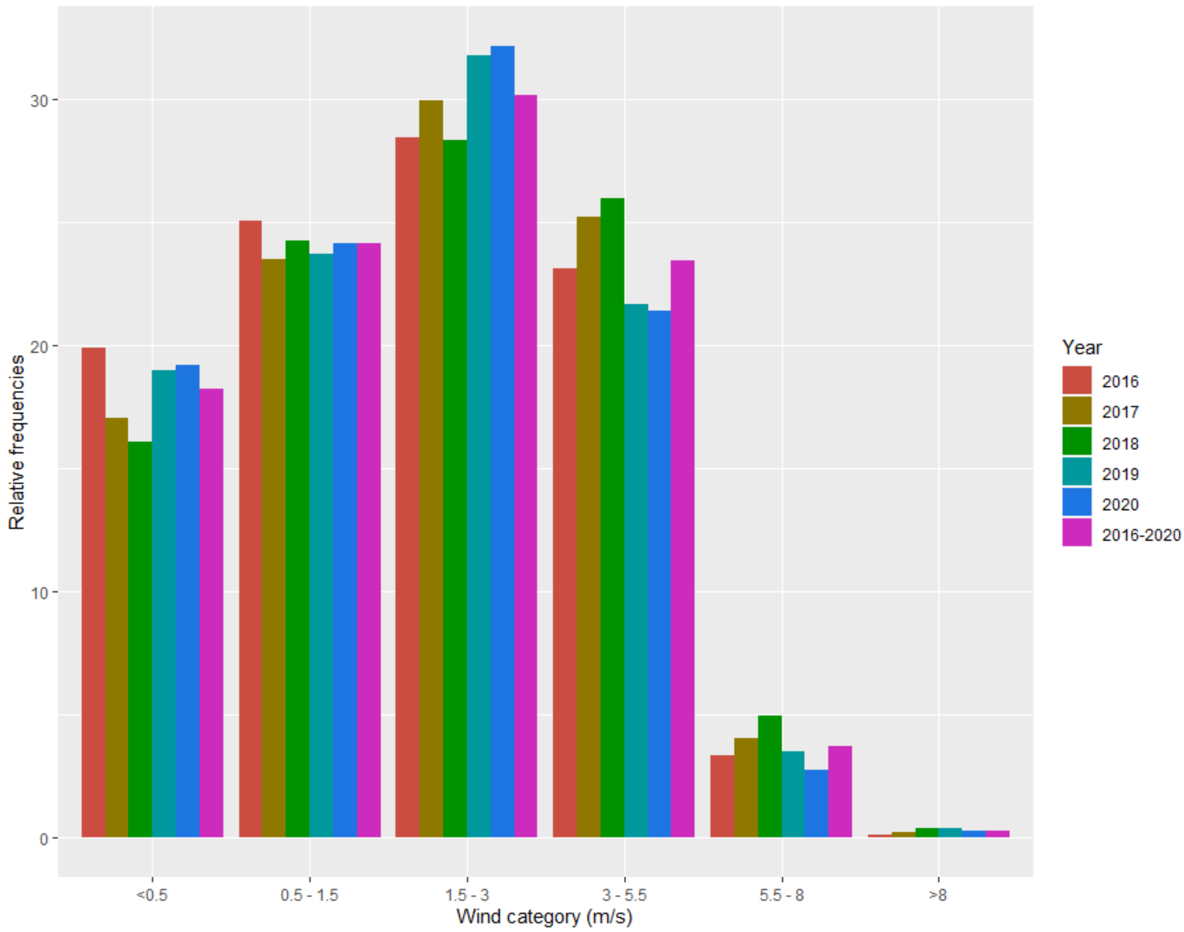


Figure A4 Annual wind speed distribution 2016 to 2020, Horsley Park Equestrian Centre AWS



Meteorological Processing

The BoM and DPIE data adequately addresses 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 TAPM meteorological model in a format suitable for using in the CALPUFF dispersion model (refer **Section 5.1)**.

Meteorological modelling using The Air Pollution Model (TAPM, v 4.0.5) has been performed to predict the meteorological parameters required for CALPUFF. 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.

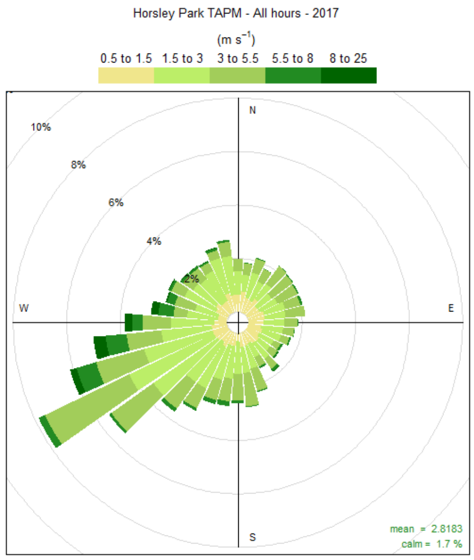
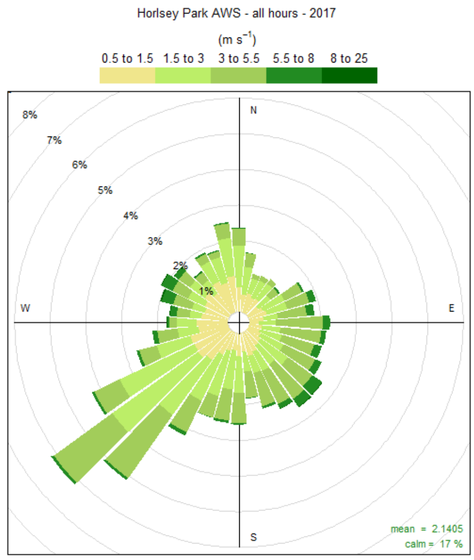
The parameters used in TAPM modelling are presented in **Table A2**.

Table A2 Meteorological parameters used for this study

TAPM v 4.0.5	
Modelling period	1 January 2017 to 31 December 2017
Centre of analysis	295,708 mE, 6,251,357 mN (UTM Coordinates)
Number of grid points	25 × 25 × 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	-

A comparison of the TAPM generated meteorological data, and that observed at the Horsley Park Equestrian Centre AWS, is presented in **Figure A5**.

Figure A5 Modelled and observed meteorological data – Horsley Park Equestrian Centre 2017

TAPM generated windrose	Observations at Horsley Park Equestrian Centre AWS
	

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 in **Figure A6**.

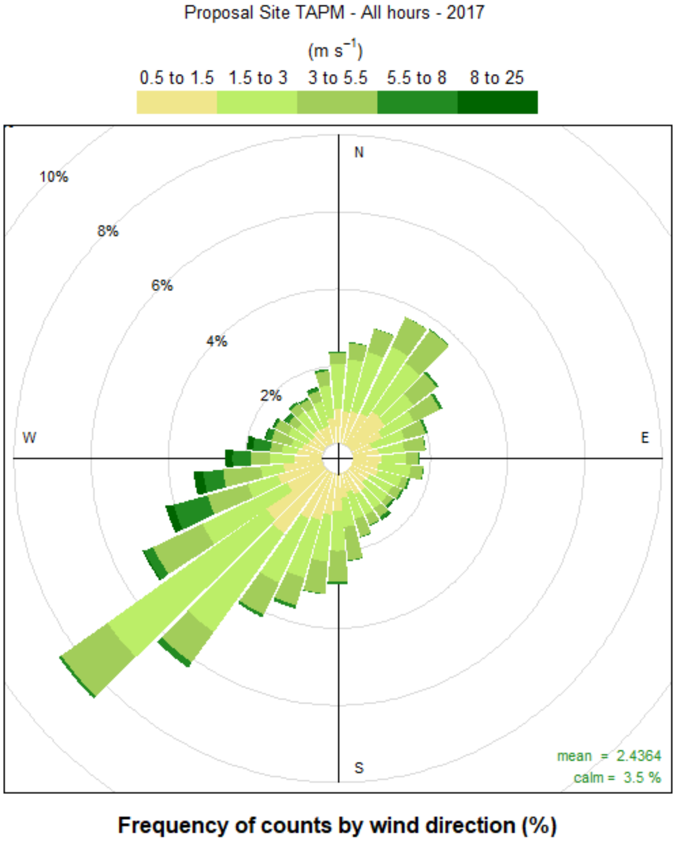
As expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground based temperature inversions and growth of the convective mixing layer.

The modelled temperature variations predicted at the Proposal site during 2017 are presented in **Figure A6**. The maximum temperature of 40°C was predicted on 13 January 2017 and the minimum temperature of 5°C was predicted on 20 August 2017.

Figure A6 Annual temperature, mixing height and wind speed distribution – Proposal site 2017

The modelled wind speed and direction at the Proposal site during 2017 are presented in **Figure A7**.

Figure A7 Predicted wind speed and direction – Proposal site 2017



Appendix B

Background Air Quality Data

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, Industry and Environment (DPIE) at five air quality monitoring station (AQMS) within a 13 km radius of the Proposal site. Details of the monitoring performed at these AQMS is presented in **Table B1** .

Table B1 Details of Closest AQMS Surrounding the Site

AQMS Location	Data Availability	Distance to Site (km)	Screening Parameters				
			2017 Data	Measurements			
				PM_{10}	$PM_{2.5}$	TSP	NO_2
St Marys	1992 - 2020	4.7	✓	✓	✓	×	✓
Bringelly	1992 - 2020	8.7	✓	✓	✓	×	✓
Prospect	2007 - 2020	12.2	✓	✓	✓	×	✓
Blacktown (Decommisioned)	Decommissioned	12.9	×	×	×	×	×

Based on the sources of AQMS data available and their proximity to the Proposal site, St Marys was selected as the source of air quality data for use in this assessment.

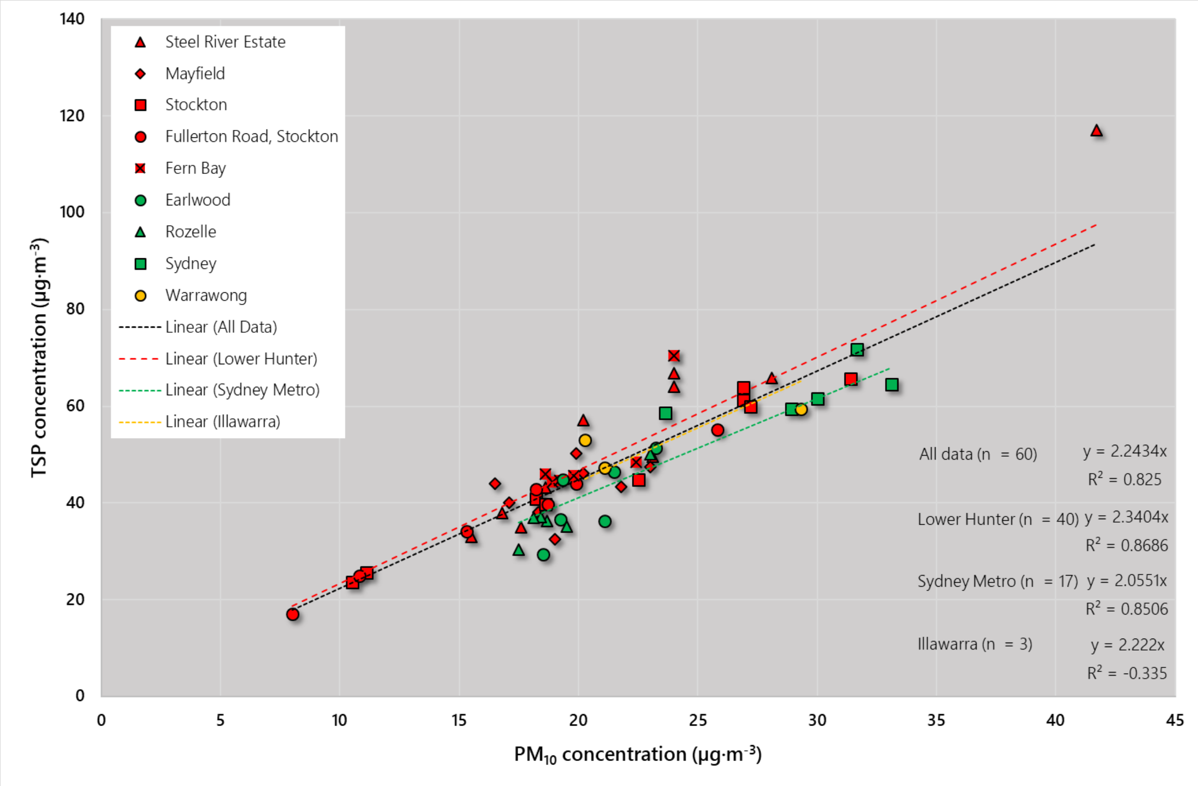
Summary statistics are for PM_{10} and $PM_{2.5}$ data are presented in **Table B2**.

Concentrations of TSP are not measured by the NSW DPIE at any AQMS surrounding the Proposal site. An analysis of co-located measurements of TSP and PM_{10} in the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions is presented in **Figure B1**.

The analysis concludes that, on the basis of the measurements collected across NSW between 1999 to 2011, the derivation of a broad TSP:PM_{10} ratio of 2.0551 : 1 (i.e. PM_{10} represents ~48 % of TSP) is appropriate to be applied to measurements in the Sydney Metro area.

In the absence of any more specific information, this ratio has been adopted within this AQIA. These estimates have not been adjusted for background exceedances.

Figure B1 Co-located TSP and PM_{10} Measurements, Lower Hunter, Sydney Metro and Illawarra



Similarly, no dust deposition data is available for the area surrounding the Proposal site. The incremental impact criterion of 2 g·m^{-2}·month^{-1} as outlined within the Approved Methods has been adopted which effectively provides a background deposition level of 2 g·m^{-2}·month^{-1} (the total allowable deposition being 4 g·m^{-2}·month^{-1}).

A summary of background air quality data for the site for the year 2017 (consistent with the selected meteorological period) is presented in **Table B2**.

Graphs presenting the daily varying PM_{10} and $PM_{2.5}$ data recorded at St Marys in 2017 are presented in **Figure B2** and **Figure B3**, respectively.

Table B2 Summary of Background Air Quality Data (St Marys 2017)

Pollutant	TSP (µg·m^{-3})	PM_{10} (µg·m^{-3})	$PM_{2.5}$ (µg·m^{-3})	NO_2 (µg·m^{-3})
Averaging Period	Annual	24-Hour	24-Hour	1-Hour
Data Points (number)	360	360	360	8141
Mean	33.4	16.2	7.0	0.4
Standard Deviation		7.0	4.1	0.5
Skew[1]		*+1.1*	*+2.9*	*+1.6*
Kurtosis[2]		*+1.7*	*+13.8*	*+3.7*
Minimum	33.4	4.0	1.2	-0.2
Percentiles (µg·m^{-3})				
1		5.3	1.8	-0.2
5		7.6	2.9	-0.1
10		8.9	3.3	0.0
25		11.5	4.6	0.1
50		14.6	6.2	0.3
75		20.0	8.3	0.6
90		26.1	10.7	1.1
95		29.5	12.8	1.4
97		32.6	17.0	1.6
98		34.5	21.1	1.8
99		35.7	23.9	2.1
Maximum	33.4	49.8	38.2	3.7
Data Capture (%)	98.63%	98.63%	98.63%	92.92%

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.

Figure B2 PM$_{10}$ Measurements, St Marys 2017

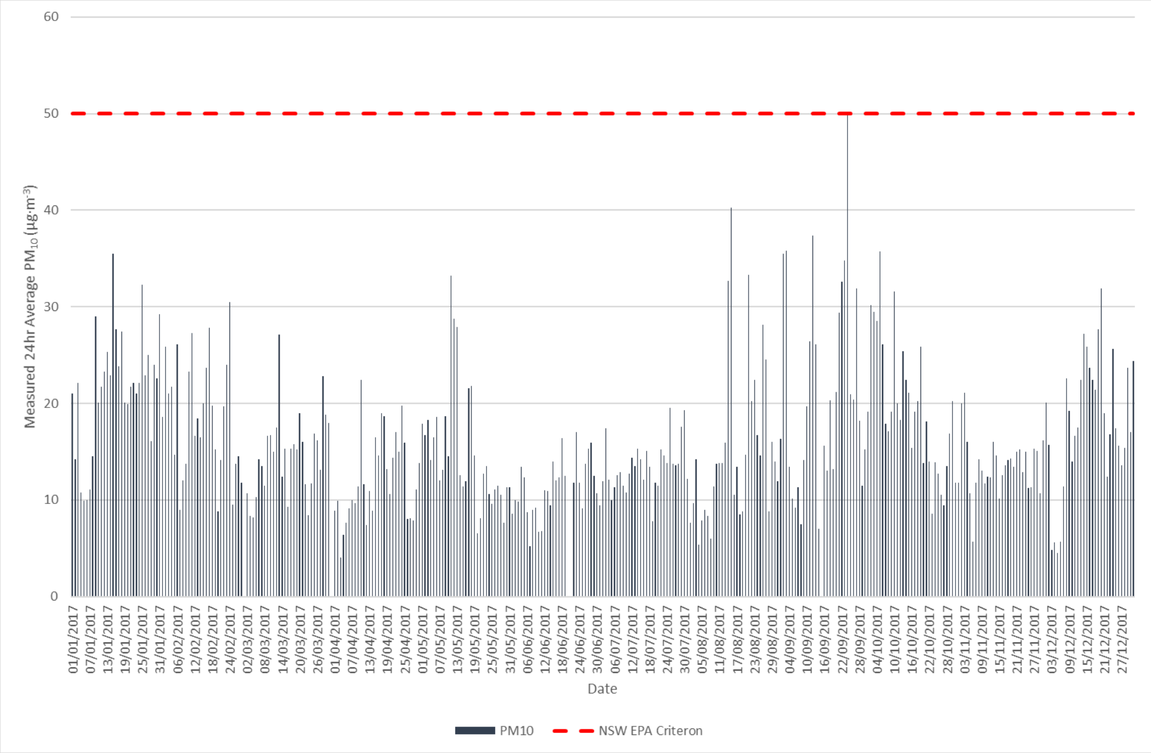
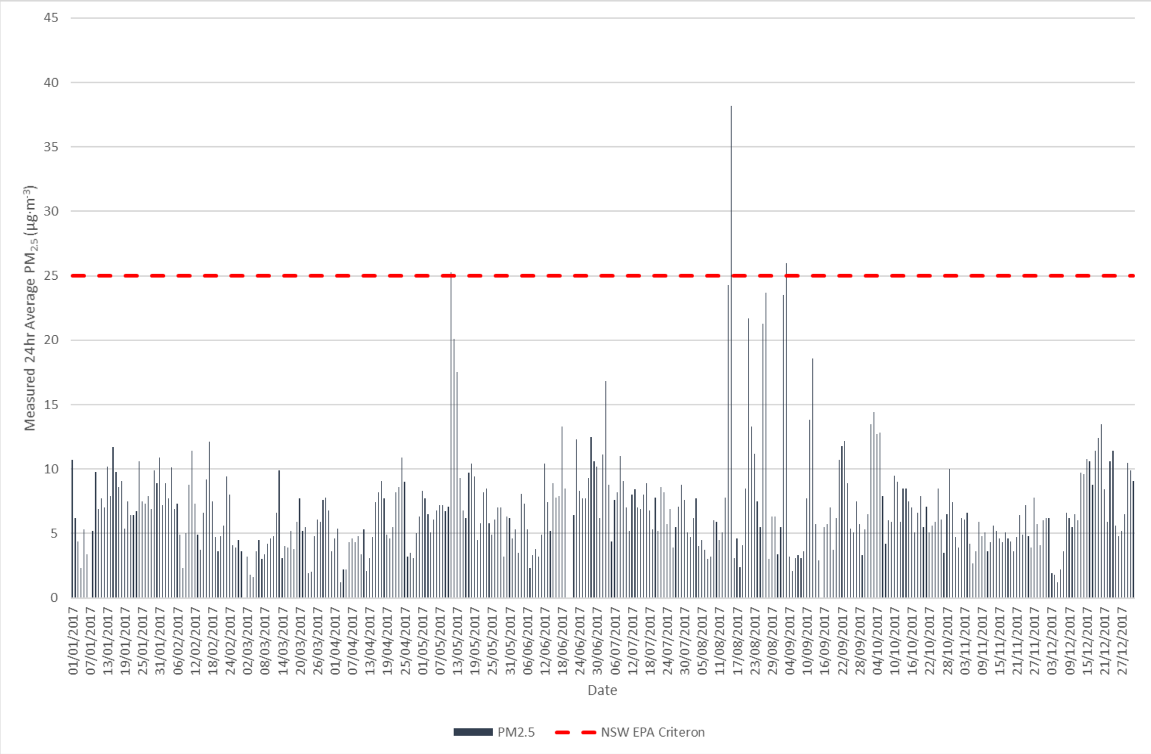


Figure B3 PM$_{2.5}$ Measurements, St Marys 2017



Appendix C

Construction Phase Risk Assessment Methodology

Provided below is a summary of the risk assessment methodology used in this assessment. It is based upon IAQM (2016) *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_{10} criterion:** an amended criterion representing the annual average PM_{10} criterion relevant to Australia rather than the UK;
- **Nomenclature:** a change in nomenclature from "receptor sensitivity" to "land use value" to avoid misinterpretation of values attributed to "receptor sensitivity" and "sensitivity of the area" which may be assessed as having different values;
- **Construction traffic:** the separation of construction vehicle movements as a discrete risk assessment profile from those associated with the 'on-site' activities of demolition, earthworks and construction. The IAQM methodology considers four risk profiles of: "demolition", "earthworks", "construction" and "trackout". The adaption by Northstar 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.

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:

Dust Emission Magnitude Activities

Activity	Large	Medium	Small
Demolition			
- total building volume*	• >50 000 m^3	• 20 000 m^3 to 50 000 m^3	• <20 000 m^3
- 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
Earthworks			
- total area	• >10 000 m^2	• 2 500 m^2 to 10 000 m^2	• <2 500 m^2
- 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
Construction			
- total building volume	• 100 000 m^3	• 25 000 m^3 to 100 000 m^3	• <25 000 m^3
- piling	• yes	• yes	• no
- concrete batching	• yes	• yes	• no
- sandblasting	• yes	• no	• no
- materials	• concrete	• concrete	• metal cladding or timber
Trackout (within 100 m of construction site entrance)			
- 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

Activity	Large	Medium	Small
Construction Traffic (from construction site entrance to construction vehicle origin)			
Demolition traffic - total building volume	• >50 000 m^3	• 20 000 m^3 to 50 000 m^3	• <10 000 m^3
Earthworks traffic - total area	• >10 000 m^2	• 2 500 m^2 to 10 000 m^2	• <2 500 m^2
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^3	• 25 000 m^3 to 100 000 m^3	• <25 000 m^3
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

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_{10}, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

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) is dependent on existing deposition levels.

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_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). *Examples: Residential properties, hospitals, schools and residential care homes.*	• Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). *Examples: Office and shop workers, but would generally not include workers occupationally exposed to PM_{10}.*	• Locations where human exposure is transient. *Examples: Public footpaths, playing fields, parks and shopping street.*

Value	High Land Use Value	Medium Land Use Value	Low Land Use Value
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. *Examples: Dwellings, museums, medium and long term car parks and car showrooms.*	• 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. *Examples: Parks and places of work.*	• 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: 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_{10} concentration (in the case of potential health impacts) and other site-specific factors.

Additional factors to consider when determining the sensitivity of the area include:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant, the season during which the works would take place;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

Sensitivity of the Area - Health Impacts

For high land use values, the method takes the existing background concentrations of PM_{10} (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;
- 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.

IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Land Use Value	Annual Mean PM_{10} Concentration ($\mu g \cdot m^{-3}$)	Number of Receptors[a]	Distance from the Source (m)[b]				
			<20	<50	<100	<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	Low	Low	Low	Low	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 the table below

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

Land Use Values	Number of receptors[a]	Distance from the source (m)[b]			
		<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.

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

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

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

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

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

Step 5 – Identify Mitigation

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

The identified mitigation measures are presented as follows:

- **N** = not required (although they may be implemented voluntarily)
- **D** = desirable (to be considered as part of the CEMP, but may be discounted if justification is provided);
- **H** = highly recommended (to be implemented as part of the CEMP, and should only be discounted if site-specific conditions render the requirement invalid or otherwise undesirable).

The table below presents the complete mitigation table, not that assessed as required for any specific project or activity:

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
1	Communications			
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	N	H	H
1.1	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	H	H
1.2	Display the head or regional office contact information.	H	H	H
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	D	H	H
2	Site Management			
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	H	H
2.2	Make the complaints log available to the local authority when asked.	H	H	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	H	H
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	N	N	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
3	Monitoring			
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.	D	D	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	H	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	H	H
3.4	Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	N	H	H
4	Preparing and Maintaining the Site			
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H	H	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	H	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.	D	H	H
4.4	Avoid site runoff of water or mud.	H	H	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	D	H	H
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	D	H	H
4.7	Cover, seed or fence stockpiles to prevent wind erosion	D	H	H
5	Operating Vehicle/Machinery and Sustainable Travel			
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H	H	H
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	H	H	H
5.3	Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable	H	H	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
5.4	Impose and signpost a maximum-speed-limit of 25 km·h^{-1} on surfaced and 15 km·h^{-1} on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate	D	D	H
5.5	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	N	H	H
5.6	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	N	D	H
6	**Operations**			
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	H	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	H	H
6.3	Use enclosed chutes and conveyors and covered skips	H	H	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	H	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.	D	H	H
7	**Waste Management**			
7.1	Avoid bonfires and burning of waste materials.	H	H	H
8	**Measures Specific to Demolition**			
8.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D	D	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	H	H
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H	H	H
8.4	Bag and remove any biological debris or damp down such material before demolition.	H	H	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
8.5	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	N	D	H
8.6	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	N	D	H
8.7	Only remove the cover in small areas during work and not all at once	N	D	H
9	Measures Specific to Construction			
9.1	Avoid scabbling (roughening of concrete surfaces) if possible	D	D	H
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	D	H	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.	N	D	H
9.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	N	D	D
10	Measures Specific to Track-Out			
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.	D	H	H
10.2	Avoid dry sweeping of large areas.	D	H	H
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D	H	H
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H	H	H
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	D	H	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.	N	H	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).	D	H	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.	N	H	H
10.9	Access gates to be located at least 10 m from receptors where possible.	N	H	H
11	Specific Measures to Construction Traffic (adapted)			
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H	H	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
8.3	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.	N	D	H
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D	H	H
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H	H	H
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	D	H	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).