This document has been prepared on behalf of **Newcastle Jockey Club Ltd** by:

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# New Stables Complex – Newcastle Jockey Club

# Air Quality & Odour Risk Assessment

| | |
|---|---|
| **Addressee(s):** | **Newcastle Jockey Club Ltd** |
| **Report Reference:** | **21.1029.FR1V4** |
| **Date:** | **14 July 2022** |

## Quality Control

| Study | Status | Prepared | Checked | Authorised |
|---|---|---|---|---|
| INTRODUCTION | Final | Northstar | MD | MD |
| THE PROPOSAL | Final | Northstar | MD | MD |
| LEGISLATION, REGULATION AND GUIDANCE | Final | Northstar | MD | MD |
| EXISTING CONDITIONS | Final | Northstar | MD | MD |
| CONSTRUCTION PHASE RISK ASSESSMENT | Final | Northstar | MD | MD |
| OPERATIONAL PHASE RISK ASSESSMENT | Final | Northstar | MD | MD |
| MITIGATION, MONITORING AND RESIDUAL RISK | Final | Northstar | MD | MD |
| CONCLUSION | Final | Northstar | MD | MD |

## Report Status

| Northstar References | | Report Status | Report Reference | Version |
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| Year | Job Number | (Draft: Final) | (R*x*) | (V*x*) |
| 21 | 1029 | F | R1 | V4 |
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## Final Authority

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

**Martin Doyle** **14 July 2022**

## Non-Technical Summary

Northstar Air Quality was engaged by Newcastle Jockey Club Ltd, to perform an Air Quality and Odour Risk Assessment for the construction and operation of a new stables complex.

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

That assessment showed there to be a low to medium risk of dust soiling and health risk impacts during demolition and construction activity (including grouting of mine voids), should no mitigation measures be applied. Based upon that assessment, a range of mitigation measures are recommended to ensure that short-term impacts associated with construction activities are minimised.

The potential impacts associated with operational activities including the management of solid and liquid stable wastes, horse foodstuffs and animal sweat, the movement of horses from the stables to the track, training, thoroughbred racing and training have been assessed using a risk-assessment approach.

The risk assessment found there to be a high risk of potential odour emissions generated from solid and liquid stable wastes, and a number of required mitigation methods have been determined, including recommendations for air pollution control to manage emissions of dust and odour.

As the waste removal store shields the proximate residences from prevailing winds, and the waste will be contained in sealed, non-vented lidded bins, no offensive odour should be detectable should the management plan be implemented and carried out effectively.

As discussed within this report, the Proposal will manage dust and odour using lidded, non-vented "mega bins". In addition, the separation distance between residences and the source of any generated and stored waste will be far greater under the proposed development than it is currently, with the residences positioned on the opposite side of the road to the development, and the waste store and stables themselves will set well back from the boundary and protected by enclosed structures. These factors considered together would result in a far greater odour performance than is currently experienced.

Based upon the assumptions presented in the report and the implementation of the recommended mitigation methods, the site is assessed as being capable to not give rise to significant air quality and odour impacts during the construction and operational phases associated with the Development.

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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 |
|---|---|
| AADT | annual average daily traffic |
| AHD | Australian height datum |
| AQMS | air quality monitoring station |
| AQRA | air quality risk assessment |
| BoM | Bureau of Meteorology |
| CO | carbon monoxide |
| DPIE | Department of Planning, Industry and Environment |
| EPA | Environmental Protection Authority |
| $m^{-2}$ | per square metre |
| $m^{-3}$ | per cubic metre |
| $mg \cdot m^{-3}$ | milligram per cubic metre of air |
| $\mu g \cdot m^{-3}$ | microgram per cubic metre of air |
| mE | metres East |
| mS | metres South |
| NEPM | National Environment Protection Measure |
| $NO_X$ | oxides of nitrogen |
| $NO_2$ | nitrogen dioxide |
| OU | odour unit |
| $PM_{10}$ | 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 |
| TSP | total suspended particulates |
| US EPA | United States Environmental Protection Agency |
| VOC | volatile organic compounds |

# 1. INTRODUCTION

Northstar Air Quality Pty Ltd has been commissioned by Newcastle Jockey Club Ltd (NJC) (the Applicant) to prepare an air quality and odour risk assessment report in accordance with the Secretary's Environmental Assessment Requirements (SEARs) associated with State Significant Development (SSD) 12982045. SSD-12982045 is associated with the construction of new, and demolition of old stables (the Proposal) at 125 Chatham Street, Broadmeadow (the Proposal site).

The SEARs as presented in **Table 1** are associated with the Proposal.

**Table 1 Secretary's Environmental Assessment Requirements (SSD 12982045)**

| Issue | Requirement | Addressed |
|---|---|---|
| 5. Impacts on Existing Operations During Construction | The EIS must outline how the existing racecourse activities will be managed as a result of construction occurring on site and provide information relating to the staging of the proposal. Detail should be provided on any proposed temporary structures. | Section 7 |
| 6. Environmental and Residential Amenity | Provide an Odour Impact Assessment which is to include consideration of the following:<br>• impacts of the proposed development including storage of waste on site.<br>• the elimination or minimisation of any unsealed surfaces to prevent wind-blown or traffic generated dust.<br>• management of planned unsealed areas to minimise dust generation.<br>• assessment of any relevant Guidelines. | Section 5 and 6<br>Section 7<br>Section 7<br>This report |
| 24. Air Quality | Assess the construction and operation air quality impacts and ensure they meet the requirements of the City of Newcastle and/or the Environment Protection Authority. | This report |

## 1.1. Purpose of the Report

The purpose of this report is to examine and identify potential air quality risks associated with the construction and operation of the Proposal, in accordance with the SEARS, and identify mitigation and monitoring requirements commensurate with those anticipated potential impacts.

It also identifies all potential wastes which are likely to be generated during the operation of the stables, including details of waste collection points and frequencies and a description of how waste would be handled, processed and disposed of.

To allow assessment of the level of risk associated with the Proposal in relation to air quality (including odour), an Air Quality Risk Assessment (AQRA) has been performed in accordance with and with due reference to:

- ISO 31000 Risk Management (ISO, 2018);
- 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);
- *Waste Avoidance and Resource Recovery Act* (2001)
- *Protection of the Environment Operations Act* 1997;
- *Protection of the Environment Operations (Waste) Regulation* (2014) and,
- Protection of the Environment Operations (Clean Air) Regulation 2010.

## 1.2. Scope of Assessment

This report presents information and 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 risk of 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 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 legally described as (Lot 13 DP227704, Lot 82 DP1138209 and Lot 14 DP227704), commonly known as 125 Chatham Street, Broadmeadow, NSW, approximately 4 kilometres (km) from the Newcastle CBD (see **Figure 1**). The Proposal will be located on the south-western corner of the Proposal site at the corner of Darling and Chatham Streets (hereafter, the Development site) (see **Figure 2**).

The overall Proposal site has an area of around 48.33 hectares (ha) with the Development site being approximately 2.55 ha.

**Figure 1 Aerial view of the Proposal site**

**Source**: Proposed New Stables Complex-NJC Report (11/01/2021)

**Figure 2 Development site**


**Source**: Northstar Air Quality

## 2.2. Overview and Purpose

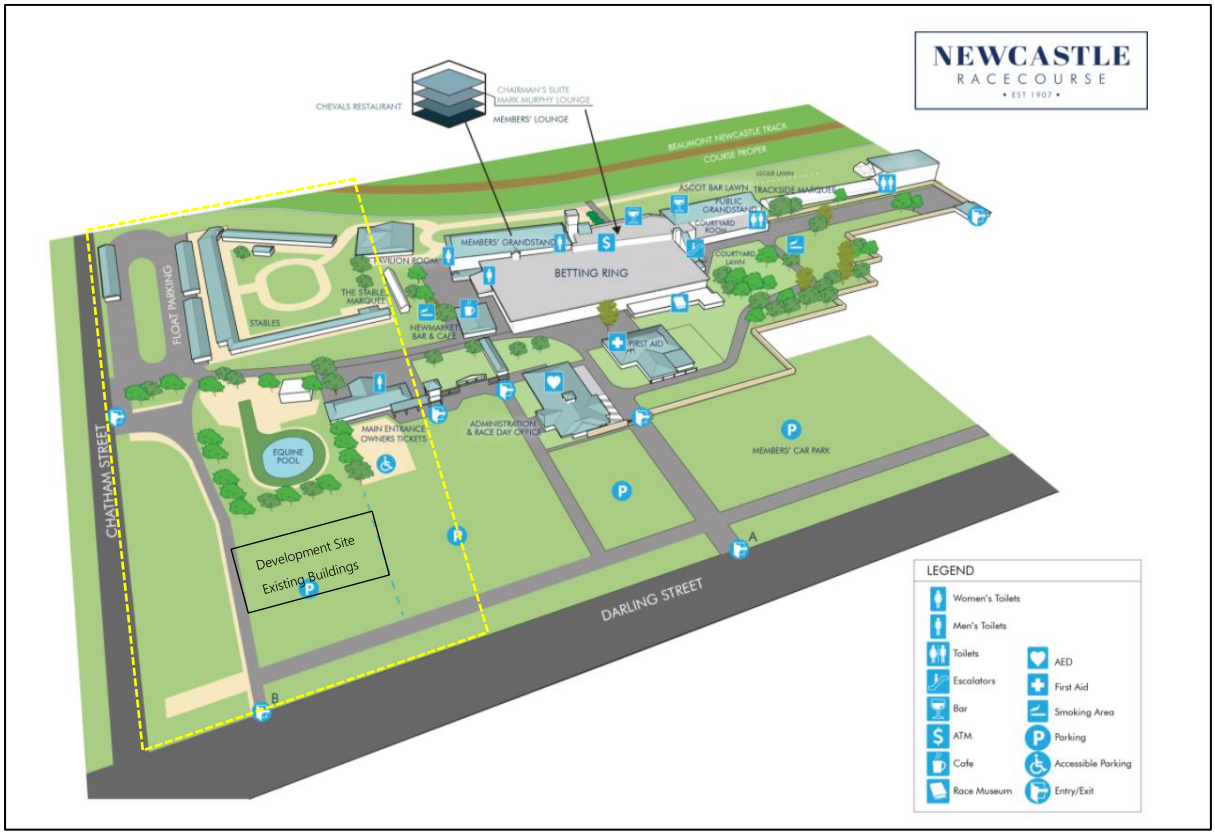
The key elements within and surrounding the Development site include:

- The site supports a number of structures, landscaping and fencing associated with the site's use as a recreation facility (major) / thoroughbred racing and training facility;
- Delivery vehicles and horse floats will enter via Chatham Street (Southern entrance) and exit the site via Darling Street. Staff/stable hand/trainer parking for approximately 121 vehicles is accessed via Darling Street;
- Vehicles associated with maintenance will enter and leave the site via Chatham Street at a reactivated access (northern entrance). The existing access of Chatham Street shall be removed with the kerb and guttering reinstated. Internally, the track access linking the site and the racecourse will be retained;
- The site is predominantly clear in the area of proposed development. A number of trees have been planted around the existing equine pool and a small number of trees are located within the centre of the site and a small number of street trees are located along the Darling Street frontage in the vicinity of the development site.
- The site operating hours will vary depending on the activity being undertaken:
  - Morning trackwork – 03:30 am to 08:30 am;

- General daytime – 08:30 am to 17:00 pm;
- Evening – 17:00 pm to 03:30 am

The Development site currently contains an equine pool and administration building, brick tie up-stalls, a warm-up ring, track supervisor's office, driveways, float parking and established landscaping, as illustrated in **Figure 3**.

**Figure 3 Existing site layout**



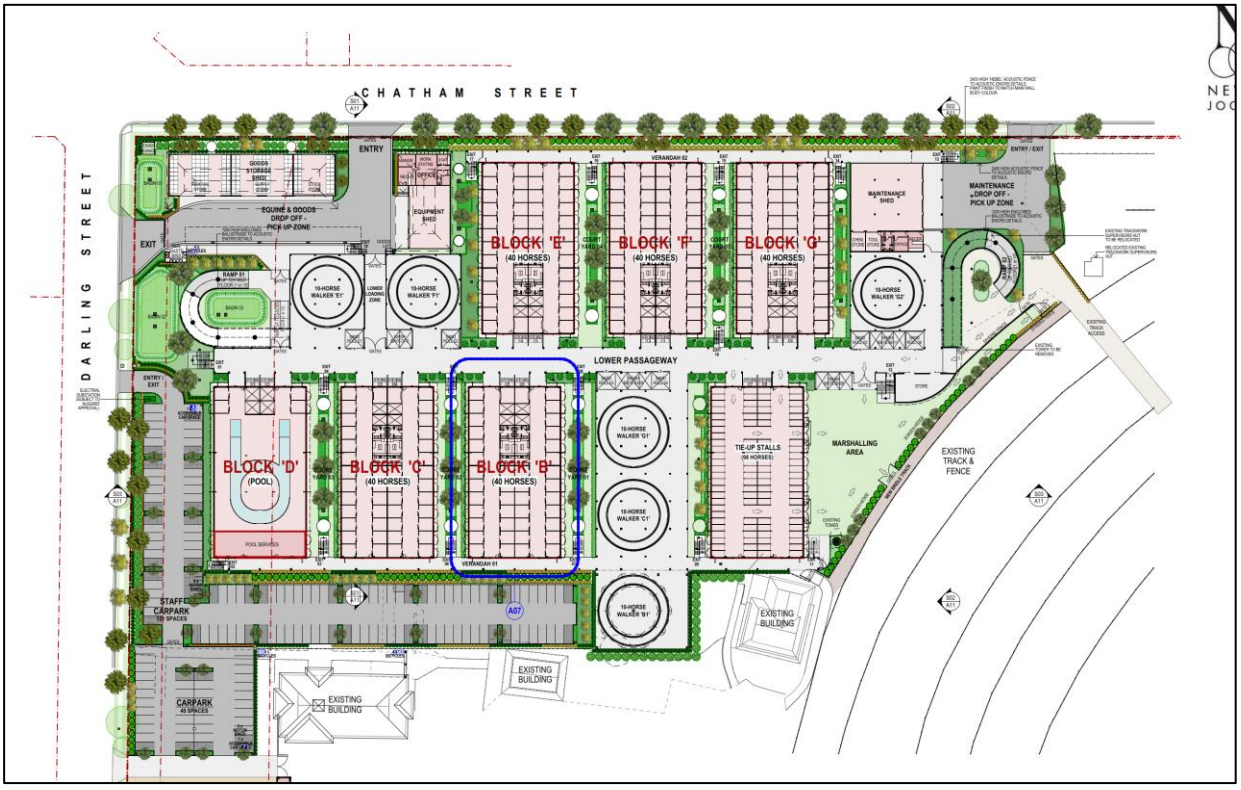

**Source**: https://www.newcastleracecourse.com.au/racecourse-map/ adapted by Northstar

The Proposal includes the demolition of the existing structures, and the construction and operation of new horse stables and training facilities, as illustrated in **Figure 4** and **Figure 5**.

**Figure 4 Development site (oblique view)**


**Source**: Eje architecture DA-A13 20/04/20221 revD

**Figure 5 Proposal site layout**




Source: EJE Architecture DA-A06 22/04/2022 revD

The Proposal seeks to provide accommodation for up to 480 horses, improve training facilities, significantly reduce vehicle movements associated with the transportation of horses to and from NJC from adjacent and

offsite stables, meet best practice standards for thoroughbred stabling and training, improve environmental and waste management measures and explore sustainable solar and water reuse opportunities at the site.

Seven, two storey stable blocks are proposed to be constructed. Horse training facilities will be provided, such as fourteen horse walkers capable of exercising up to 10 horses at a time and a new equine pool located on the ground level of Block D. Wash bays, sand rolls and adequate feed handling / storage facilities will be provided throughout the development. Additional structures such as storage and equipment sheds, a site office and loading areas will provide the necessary facilities for staff and trainers.

Delivery vehicles and horse floats will enter the site via Chatham Street (southern entrance) and exit the site in via Darling Street (SECA, 2021)(**Figure 4**). Staff parking for approximately 121 vehicles and six motorbike parking spaces is accessible via Darling Street. Vehicles associated with track maintenance will enter and leave the site via Chatham Street using a reactivated entry to the north of the site (northern entrance.

## 2.3. Identification of Potential Emissions to Atmosphere

As specified in the SEARs (see **Table 1**) the assessment report is required to address the potential impacts associated with the construction and operational phases of the Proposal. Briefly, the activities that may generate emissions to air during those development phases include:

- **Construction phase:** The construction phase will involve the demolition of the existing buildings and structures on-site, site clearance, and the construction of seven, two storey stable blocks as discussed in **Section 2.2** and illustrated in **Figure 4**. Grouting of mine voids may also be required to performed, for stabilisation purposes.
- **Operational phase**: The operational phase will involve the movement of horses from the stables to the track training, thoroughbred racing and training, and will include the stabling of those horses.

Given the nature of the Proposal described 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 (as illustrated in **Figure 3**), grouting of mine voids, earthworks (cut and fill), alterations to existing access locations (Chatham Street and Darling Street), driveways and parking, construction of stables, horse walkers, an administration office and ancillary facilities (Equine pool, wash bays, sand roll bays and feed bays, storage and equipment sheds), fit-out and commissioning.

Construction vehicles will range from light weight to large trucks, and equipment such as rigid trucks for deliveries, and a crane for lifting construction materials and equipment into position.

Emissions to atmosphere associated with the above construction activities relate to construction dust (particulates) which, if not adequately controlled, may be experienced in the surrounding areas as an amenity impact (such as visible dust plumes, dust soiling and dirt track-out onto surrounding roads) and as health impacts.

Construction phase dust emissions tend to be larger size particulates, typically in the range of 30 microns (µm) to 10 µm, and particles of this size are typically experienced as amenity impacts rather than health impacts.

*Road Traffic Emissions*

With regard to emissions from road traffic, the assessment should consider the potential impact of emissions associated with the construction and operational phases. Where changes to construction and/or operational traffic is significant a quantitative assessment is typically performed. Operational phase traffic emissions are discussed in **Section 2.3.2**.

Road traffic exhaust emissions may include a range of air pollutants, including 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 volatile organic compounds (VOCs) (including benzene and 1,3-butadiene).

In regard to construction traffic, there will be a sporadic increase in traffic during construction. Construction vehicles will access the site from Chatham Street and Darling Street.

In relation to pollutant emissions associated with construction phase vehicle traffic, reference is made to the guidance used to assess construction phase impacts (IAQM, 2014) which states:

> ***"Experience of assessing the exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed. For site plant and on-site traffic, consideration should be given to the number of plant/vehicles and their operating hours and locations to assess whether a significant effect is likely to occur. For site traffic on the public highway, if it cannot be scoped out (for example by using the EPUK's criteria), then it should be assessed using the same methodology and significance criteria as operational traffic impacts. The impacts of exhaust emissions from on-site plant and site traffic are not considered further in this Guidance."***

In relation to construction traffic, any impacts are not likely to be significant and are not considered to warrant a quantitative assessment. A qualitative level of assessment has been performed and is discussed further in **Section 2.3.2**.

To minimise impacts of traffic during construction, construction traffic would be managed through controls imposed through the Construction Environment Management Plan, including the Construction Traffic Management Plan.

The methodology used to assess the risk of construction phase emissions is introduced in **Section 2.4.1** and provided in greater detail in **Appendix C**, and the assessment of risk is provided in **Section 5** and the identification of construction mitigation measures are identified in **Section 7.1**.

### 2.3.2. Operational Phase

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

- **Road traffic emissions**: Road traffic exhaust emissions from the movement of vehicles in and out of the Proposal site on paved road surfaces. These are associated with service vehicles, horse transports, and cars for workers in the office spaces;
- **Stables Complex (thoroughbred racing and training)**: Odour emissions from waste materials such as horse manure, washdown water, and particulate emissions from paved and unpaved surfaces.

*Road Traffic Emissions*

With regard to emissions from road traffic, the assessment should consider the potential impact of emissions associated with the operational phase. Construction phase traffic emissions are discussed in **Section 2.3.1**. Where changes to traffic flow is determined to be significant a quantitative assessment is typically performed.

Dust may be generated from unsealed surfaces due to wind and vehicle movements.

To evaluate the significance of the predicted changes in operational traffic flows, reference has been made to the Environmental Protection UK (EPUK) document "*Development Control: Planning for Air Quality (2010 Update)*" (EPUK, 2010) which has been referenced in lieu of any identified NSW or Australian guidance. The guidance provides threshold criteria for evaluating the significance of changes in traffic, as a traffic flow change of more than 5 % to 10 % on roads with AADT of >10 000 vehicles required to be assessed through quantitative methods (i.e. dispersion modelling).

The criteria outlined in EPUK (2010) provide a screening (i.e. qualitative) level of assessment which considers the potential for adverse air quality impacts based on traffic flows.

The traffic assessment for the Proposal (SECA, 2021) indicates that the overall impact of the Proposal on daily traffic flows in the locality will be low, with the majority of additional movements occurring outside of the peak periods, and before 5 am. The additional vehicle movements associated with the operation of the site (e.g. vets, farriers etc.) are also likely to be experienced outside of the peak periods.

In relation to operational traffic, the qualitative assessment presented above suggests that any impacts are not likely to be significant. Impacts would be managed through the Operational Environment Management Plan, including a Traffic Management Plan. Impacts associated with traffic serving the Proposal are not considered further in this report.

*Stables complex (thoroughbred racing and training)*

Emissions from a stabling facility will vary according with the quantities of horse manure and stable bedding waste generated from the stabling area each week. It will include the transportation and treatment of horse manure and horse bedding on site. From an environmental perspective, emissions to atmosphere from horse racing and training are typically associated with odour and particulates (i.e. dust).

Potential dust generation activities from the Development site include the cleaning of the stables, the training and the movement of horses over unsealed areas (training track).

In general terms, the most significant source of odour associated with a horse stable is associated with the management of liquid and solid wastes, including urine, faecal matter, and stable bedding waste (comprising straw, wood shavings and horse wastes).

NSW Department of Primary Industries (DPI) (2009) Primefact 932: *Planning for horse establishments* estimates that an average horse will generate approximately 22 kg of manure per day. Based upon an assumed density[1] of 725 – 960 kg·m3, this would equate to around 22.9 – 30 L per horse per day.

For the purposes of this AQRA, waste estimates have been taken from the *Management Plan NJC Stable Development* (Newcastle Jockey Club, 2022)for 480 adult horses.

As stated in (Newcastle Jockey Club, 2022) it is estimated that an average fully grown horse would generate 0.91 cubic feet (approx. 25.8 L) of manure wastes per day and 6.71 cubic feet (190.2 L) of bedding waste per day, based on 25 % of a 780 L mega bin per horse per day being removed.

Based upon these data, the volume of waste generated by the stable is estimated to be as follows:

**Table 2 Horse Stable Waste Estimations**

| Number | Waste | Generation Rate |
|---|---|---|
| 480 | Manure | 25.8 L·horse·day$^{-1}$ |
| | Bedding | 190.2L·horse·day$^{-1}$ |
| | Total | 216 L·horse·day$^{-1}$ |
| 40 horses | Total | 8640 L·- 40 horse level day$^{-1}$ |

[1] https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex8875

Given that the Proposal would have the capacity for 40 horses per level , that would equate to a daily aggregated waste generation rate of approximately 8.64 $m^3$ per 40-horse level per day (8 640 per 40-horse level per day). The facility will use 780 L solid mega bins (Newcastle Jockey Club, 2022) which indicates that the volume of waste would equate to the generation of up to 12 bins of waste material per 40 horse level per day. Assuming full stable capacity, 144 bins of waste material per day would be required to store the wastes described.

Wastes would be stored in lidded, non vented "mega bins" and with tight lids that completely seals all odours and prevents access to either the bedding or waste by rodents or insects.. For general waste produced by daytime employees and visitors, a number of general waste and recycling bins will be placed within and around the site.

Effective odour control therefore must provide adequate control of waste on site. Other sources of odour from the Proposal may be associated with the storage of horse foodstuffs, and from animal sweat within the stable. Animal feed stuffs would be storage in two dedicated stalls within the stable building.

## 2.4. Methodology

### 2.4.1. 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 minor scale of the proposed works, fugitive dust emissions would have the greatest potential to give rise to downwind air quality impacts.

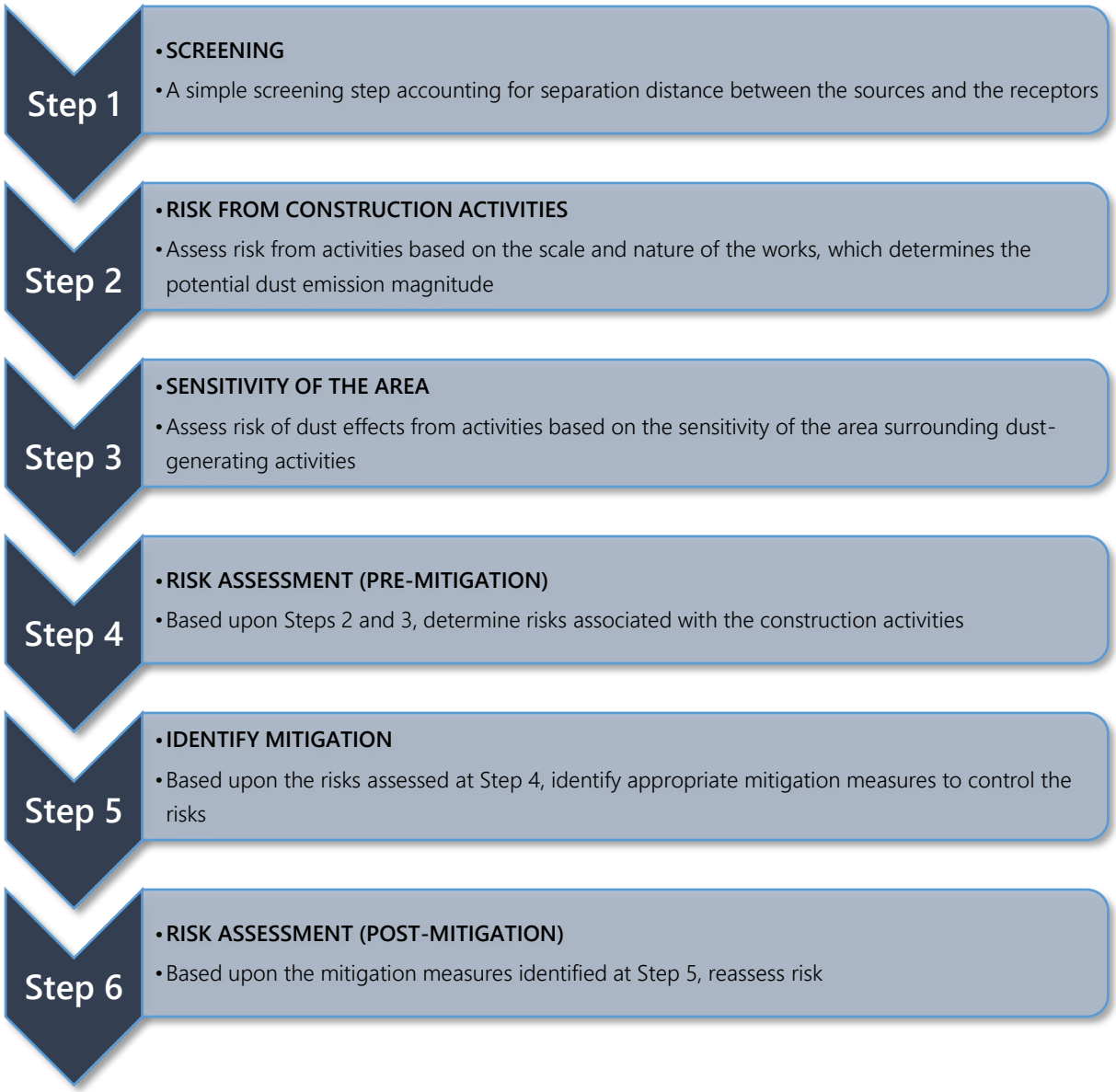
Modelling of dust from construction Proposals is generally not considered appropriate, as there is a lack of reliable emission factors from construction activities upon which to make predictive assessments, and the rates would vary significantly, depending upon local conditions. In lieu of a modelling 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, 2014). 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 6**.

Grouting of mine voids is acknowledged not to be a 'usual' construction activity. However, the composite parts of that activity (i.e. drilling, batching of cement, material handling, haulage, storage of material) would be anticipated during most construction projects. The IAQM construction dust risk assessment process is therefore considered to appropriately represent the risks associated with that specific phase of construction activities, occurring as part of the Proposal.

**Figure 6 Construction phase impact risk assessment methodology**




Steps 1-4 (up to the "risk assessment (pre-mitigation)" are addressed in **Section 5**. Step 5 "identify mitigation" and Step 6 "risk assessment (post mitigation)" are discussed in **Section 7**.

### 2.4.2. Operational Phase

It is noted that standard assessment techniques including dispersion modelling studies are not necessarily the most appropriate assessment methodologies for evaluating the potential of smaller scale processes to give rise to air quality impacts. In relation to this AQRA, this is related to emissions from the thoroughbred racing and training activities. This limitation is due to a number of factors including:

- A lack of reliable and scalable emission factors to quantify emissions (i.e. a lack of published emission rates);
- A potential high degree of short-term variability in emissions from such processes;
- A potential high degree of control that may be applied through effective controls.

Due to the above well-documented technical constraints associated with modelling emissions from smaller scale processes, Northstar has performed this assessment in using a risk-assessment approach adopted from ISO 31000:2018 *Risk management — Guidelines* (International Organization for Standardization, 2018) and IEC 31010:2019 *Risk management — Risk assessment technique* (International Electrotechnical Commission, 2018).

The use of a risk assessment methodology allows the risk of off-site air quality impacts to be identified, ranked, and evaluated against the requirements of achieving Best Available Techniques (BAT) for emissions control. Where the risk assessment identifies processes as requiring additional emissions control(s), the benchmarking of those processes allows the selection of controls specifically designed to manage those specific process risks, which provides a means to evaluate and identify effective and practical emissions control.

The risk assessment approach is detailed in **Appendix D** and essentially evaluates risk as a function (product) of receptor sensitivity and potential impact magnitude:

$$risk = sensitivity \times magnitude$$

To evaluate the assessment categories of sensitivity and magnitude, reference is made to the description of 'offensive odour' provided in the POEO Act (see **Section 3**) may be summarised as a function of five broad factors, called the FIDOL factors, namely:

- **Frequency:** indicates how often an odour is experienced. Exposure to relatively pleasant odours (such as a bakery, for example) may be perceived to be a nuisance (or 'offensive odour') if it is experienced too frequently, and conversely, a more unpleasant odour may be tolerated if it is experienced hardly ever.
- **Intensity:** indicates the relative strength of the odour;
- **Duration:** in parallel to frequency, duration is an important factor representing the length of time of which an odour exposure is observed;
- **Offensiveness:** indicates how pleasant / unpleasant an odour is to the population. Whilst individuals may express a personal opinion of acceptance to specific odours, it is generally accepted that some odours are more unpleasant than others due to their chemical composition and also a hazard

identification function. The relative scale of typical pleasantness / unpleasantness is described as the odour's hedonic tone.

- **Location:** indicates the relationship between the odour experienced and the general perception of amenity that would be expected at that location. An odour that may be tolerated at an industrial site may be less tolerated at a healthcare centre, for example.

The first four factors (frequency, intensity, duration and offensiveness) are used to evaluate the magnitude of odour. The fifth factor (location) is used to evaluate the sensitivity component.

# 3. LEGISLATION, REGULATION AND GUIDANCE

Reference has been made to the following guidance, as specified in the SEARs (see **Section 1**):

- Protection of the Environment Operations (Clean Air) Regulation 2010
- Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales (DEC, 2007)
- Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (EPA, 2016)

The following specific guidance is noted as part of this study.

## 3.1. Protection of the Environment Operations Act

The *Protection of the Environment (Operations) Act* 1997 (POEO) is applicable to scheduled activities in NSW. Chapter 5, Part 5.4, Section 128 relates to the control of air emissions (emphasis added).

***128 Standards of air impurities not to be exceeded***

*(1) The occupier of any premises must not carry on any activity, or operate any plant, in or on the premises in such a manner as to cause or permit the emission at any point specified in or determined in accordance with the regulations of air impurities in excess of—*

*(a) the standard of concentration and the rate, or*

*(b) the standard of concentration or the rate,*

*prescribed by the regulations in respect of any such activity or any such plant.*

*(1A) Subsection (1) applies only to emissions (point source emissions) released from a chimney, stack, pipe, vent or other similar kind of opening or release point.*

*(2) The occupier of any premises must carry on any activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution if—*

*(a) in the case of point source emissions—neither a standard of concentration nor a rate has been prescribed for the emissions for the purposes of subsection (1), or*

*(b) the emissions are not point source emissions…*

Section 129 provides the requirements for the control of emissions of odour from licenced activities.

***129 Emission of odours from premises licensed for scheduled activities***

*(1) The occupier of any premises at which scheduled activities are carried on under the authority conferred by a licence must not cause or permit the emission of any offensive odour from the premises to which the licence applies…*

It is noted that the Proposal does not include any activities defined as a scheduled activity under the POEO Act, although the general principals of air pollution minimisation also apply to non-scheduled activities.

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management but are generally not intended to achieve "no odour", but manage odour impacts to an acceptable level.

The term 'offensive odour' is defined within the POEO Act as:

> *an odour:*
>
> *(a) that, by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances:*
>
> *(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*
>
> *(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
>
> *(b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations.*

As discussed in **Section 2.4.2**, the definitions provided in the POEO Act to define odour (strength, nature, duration, character or quality) have been used to determine the risk, through the FIDOL factors, which essentially are the same metrics.

## 3.2. Local Government Act

Section 125 of the *Local Government Act* (1993) provides Council with authority to manage nuisance, including emissions to air from unscheduled activities.

> ***125 Abatement of public nuisances***
>
> *A council may abate a public nuisance or order a person responsible for a public nuisance to abate it.*
>
> *Note :*
> *"Abatement" means the summary removal or remedying of a nuisance (the physical removal or suppression of a nuisance) by an injured party without having recourse to legal proceedings.*
>
> *"Nuisance" consists of interference with the enjoyment of public or private rights in a variety of ways. A nuisance is "public" if it materially affects the reasonable comfort and convenience of a sufficient class of people to constitute the public or a section of the public. For example, any wrongful or negligent act or omission in a public road that interferes with the full, safe and convenient use by the public of their right of passage is a public nuisance.*

It is noted that the definition of nuisance under the *Local Government Act* (1993) (which includes odour) is very similar in intent to the definition of 'offensive odour' provided under the *POEO Act* (1997).

## 3.3. 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 AQRA, 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.

## 3.4. Ambient Air Quality Standards

State air quality guidelines adopted by the NSW EPA, are published in the *'Approved Methods for the Modelling and Assessment of Air Pollutants in NSW'* (the Approved Methods (NSW EPA, 2016)), which has been consulted during the preparation of this AQRA.

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. It is noted that this information is provided for context only, and is not used in this AQRA.

Table 3 NSW EPA air quality standards and goals

| Pollutant | Averaging period | Units[e] | Criterion | Notes |
|---|---|---|---|---|
| Nitrogen dioxide ($NO_2$) | 1 hour | $\mu g \cdot m^{-3}$ [a] | 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
**(e)** Gas volumes are expressed at 25°C (298 K) and at an absolute pressure of 1 atmosphere (101.325 kPa)

# 4. EXISTING CONDITIONS

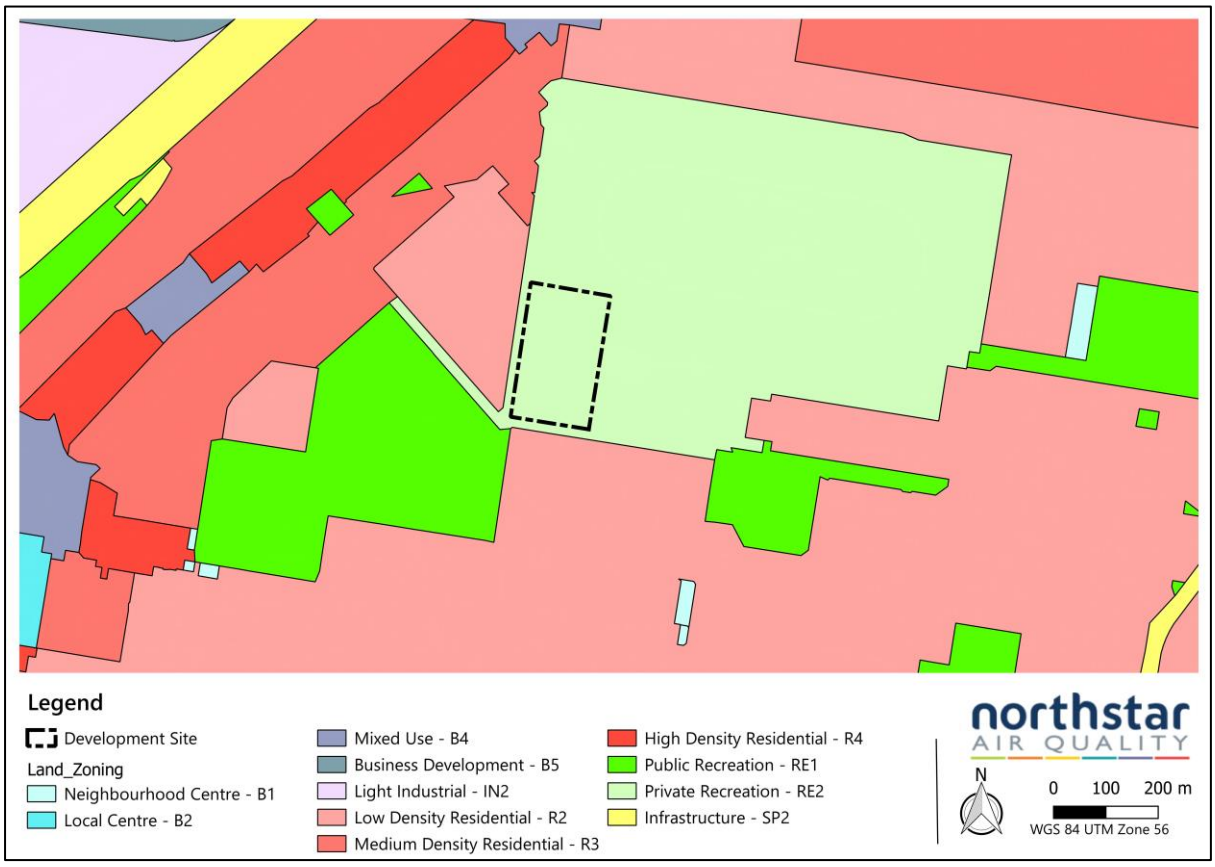
## 4.1. Surrounding Land Sensitivity

### 4.1.1. Land Use Zoning

The land use surrounding the Proposal site is zoned within the Newcastle LGA. The current land use zoning is illustrated in **Figure 7** below.

The land on which the Proposal site is situated on is currently zoned as RE2 (Private Recreation). Lands to the immediate north, south and west are zoned as R2 (Low Density Residential).

**Figure 7 Current land use zoning**




**Source**: Northstar Air Quality

### 4.1.2. Discrete Receptor Locations

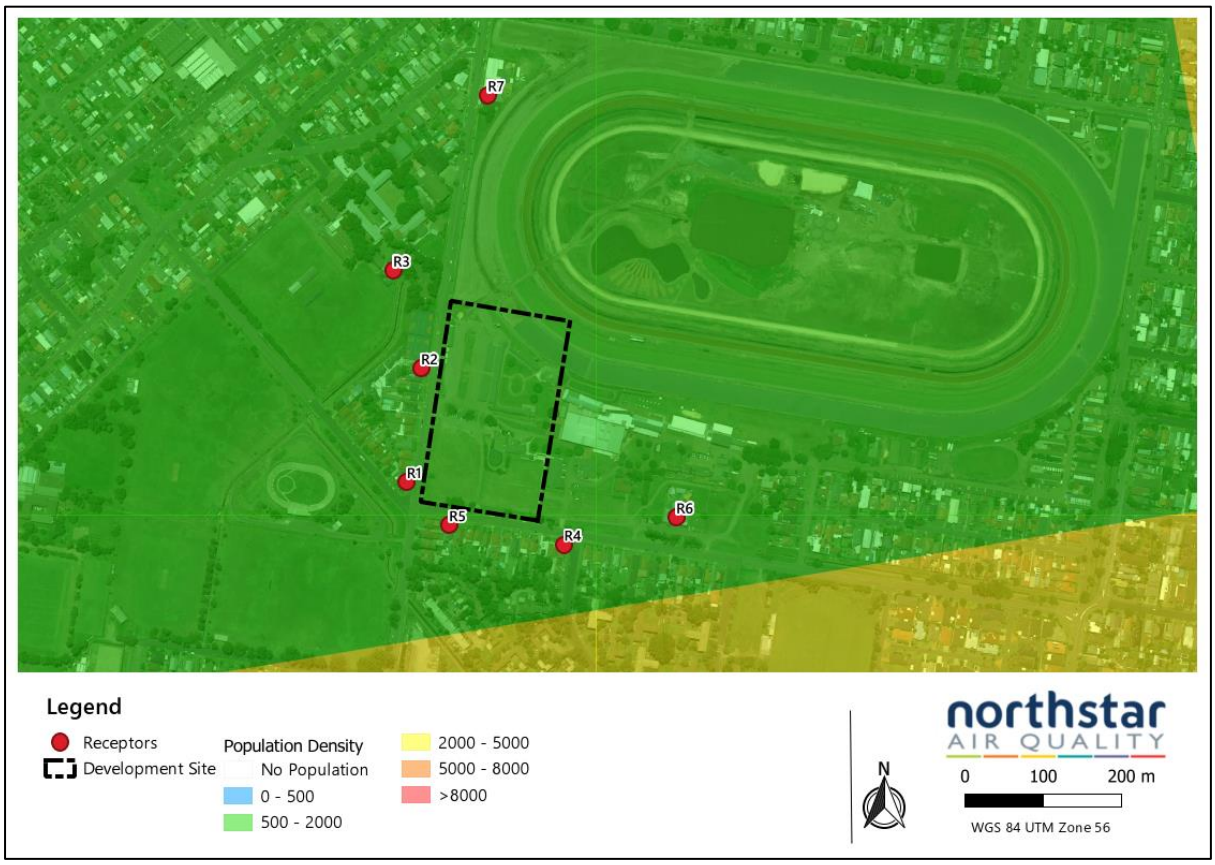
To ensure that the selection of discrete receptors for the AQRA are reflective of the locations in which the population of the area surrounding the Development site reside, population-density data has been examined. Population-density data based on the 2016 census, have been obtained from the Australian 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 Development site is presented in **Figure 8**.

**Figure 8 Population density and sensitive receptors surrounding the Development site**




**Source**: Image courtesy of Google Maps and data sourced from the ABS

The Development site and receptors are located in an area of 'low' population density (500 to 2 000 persons·$km^{-2}$).

In accordance with the requirements of the NSW EPA, several receptors have been identified and the receptors adopted for use within this AQRA are presented in **Table 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.

**Table 4 Receptor locations used in the study**

| Rec | Location | Land use | Location (UTM) | |
|---|---|---|---|---|
| | | | mE | mS |
| R1 | 160 Chatham Street Broadmeadow | Residential | 381 798 | 6 355 518 |
| R2 | 140 Chatham Street Broadmeadow | Residential | 381 817 | 6 355 652 |
| R3 | 130 Chatham Street Broadmeadow | School | 381 784 | 6 355 787 |
| R4 | 125 Darling Street Broadmeadow | Residential | 381 999 | 6 355 438 |
| R5 | 149 Darling Street Broadmeadow | Residential | 381 852 | 6 355 463 |
| R6 | 88 Darling Street Broadmeadow | Childcare | 382 142 | 6 355 473 |
| R7 | 125 Chatham Street Broadmeadow | Childcare | 381 901 | 6 356 012 |

**Note:** The requirements of this AQRA 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.

The closest residential properties are approximately 20 metres (m) from the Development site boundary to the west on Chatham Street, Broadmeadow (R1 and R2), and to the south on Darling Street, Broadmeadow (R4 and R5).

Two childcare centres are located on NJC's land. One is located approximately 300 m north of the Development site, on the eastern side of Chatham Street (R7) with a second located approximately 170 m south-east of the Development site, on the eastern side of Darling Street (R6)

Further to the north of the Development site is established low to medium density residential development. Immediately east of the Development site is the racetrack entrance, administration building, grandstands, betting ring and the new race day tie up stalls (currently under construction). Further east is the existing on-site stables complex and established medium and low-density residential development. West of the site is primarily low-density residential development comprising a mix of contemporary and older housing stock and a public recreation facility (tennis court). Low-density residential development characterises land use to the south.

Further north along the western side of Chatham Street is Merewether High School, community facilities and residential development.

## 4.2. Topography

The elevation of the Development site is between 5 m and 7 m Australian Height Datum (AHD). The topography between the Development site and nearest sensitive receptor locations is uncomplicated.

The site topography has been modified over time to facilitate the racetrack and other site improvements. The southern half of the Development site is generally flat, with the exception of a raised area surrounding the existing equine pool. The northern section is also generally flat with a gentle gradient from east to west which enables the site to drain via overland flow to Chatham Street.

## 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 Development 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 NSW Department of Planning, Industry & Environment (DPIE) at a number of Air Quality Monitoring Station (AQMS) surrounding the Development site (refer **Section 4.4**).

A summary of the relevant AWS operated by BoM and DPIE is provided in **Table 5** (listed by proximity) and also displayed in **Figure 9.**

**Table 5 Details of meteorological monitoring surrounding the Development site**

| Site Name | Source | Approximate Location (UTM) | | Approximate Distance |
|---|---|---|---|---|
| | | mE | mS | km |
| Newcastle AQMS | DPIE | 383 885 | 6 355 511 | 1.9 |
| Carrington AQMS | DPIE | 384 323 | 6 358 045 | 3.3 |
| Stockton | DPIE | 386 277 | 6 358 932 | 5.4 |
| Newcastle Nobbys Signal Station AWS | BoM | 387 649 | 6 357 518 | 5.7 |

A summary of the prevailing meteorological conditions at Newcastle AQMS is presented in **Appendix A**.

**Figure 9 Monitoring stations surrounding the Development site**


Image courtesy of Google Earth

## 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. This '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 DPIE. These locations (listed by proximity) are briefly summarised in **Table 6** and presented in **Figure 9.**

**Table 6 Closest DPIE AQMS to the Development site**

| AQMS Location | Data Availability | Distance to Site (km) | Screening Parameters | | | |
|---|---|---|---|---|---|---|
| | | | Measurements | | | |
| | | | $PM_{10}$ | $PM_{2.5}$ | TSP | $NO_2$ |
| Newcastle | 1992-2021 | 1.9 | ✓ | ✓ | × | ✓ |
| Carrington | 2014-2021 | 3.3 | ✓ | ✓ | × | ✓ |
| Stockton | 2014-2021 | 5.4 | ✓ | ✓ | × | ✓ |

**Table 6** indicates that the closest active AQMS to the Development site is Newcastle AQMS. Concentrations of $PM_{10}$ have been measured at the Newcastle (AQMS) since 1992. Data collected at this AQMS has been adopted within this assessment. A review of $PM_{10}$ concentrations in the last five years (**Table 7**), indicates that the year 2019 is the most recent year more impacted by 'exceptional events' such as bush fires, dust storms and drought conditions and therefore data collected in 2019, specifically $PM_{10}$, has been used within this assessment. This provides a conservative level of assessment, and provides comfort that the most stringent level of controls required would be applied to the proposed construction activities at the Proposal site.

**Appendix B** provides a summary of the background air quality monitoring data collected at the Newcastle AQMS, and a summary of the air quality monitoring data and assumptions are presented in **Table 8**. This data is provided for context only. It is important to mention that annual average $PM_{10}$ is the only data used further in this assessment.

**Table 7 $PM_{10}$ Annual Average 2016-2020**

| Year | $PM_{10}$ Annual Average ($\mu g \cdot m^{-3}$) |
|---|---|
| 2016 | 21.6 |
| 2017 | 22.4 |
| 2018 | 24.5 |
| 2019 | 28.4 |
| 2020 | 22.4 |

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

| Pollutant | Ave Period | Measured Value | Notes |
|---|---|---|---|
| Particles (as TSP) (derived from $PM_{10}$) | Annual $\mu g \cdot m^{-3}$ | 66.4 | Estimated on a TSP:$PM_{10}$ ratio of 2.3404 : 1 |
| Particles (as $PM_{10}$) (Newcastle) | 24-hour $\mu g \cdot m^{-3}$ | Daily Varying | The 24-hour maximum for $PM_{10}$ in 2019 was 125.8 $\mu g.m^{-3}$ |
| | Annual $\mu g \cdot m^{-3}$ | 28.4 | |
| Particles (as $PM_{2.5}$) (Newcastle) | 24-hour $\mu g \cdot m^{-3}$ | Daily Varying | The 24-hour maximum for $PM_{2.5}$ in 2019 was 95.5 $\mu g.m^{-3}$ |
| | Annual $\mu g \cdot m^{-3}$ | 10.9 | |
| Dust deposition | Annual $g \cdot m^{-2} \cdot month^{-1}$ | 2.0 | Difference in NSW DPIE maximum allowable and incremental impact criterion |
| | 1-hour $\mu g \cdot m^{-3}$ | 90.2 | Hourly max 1-hr average in 2019 |

| Pollutant | Ave Period | Measured Value | Notes |
|---|---|---|---|
| Nitrogen dioxide ($NO_2$) (Newcastle) | Annual $\mu g \cdot m^{-3}$ | 17 | Annual average in 2019 |

**Note:** This data is provided for context only. Only Annual Average $PM_{10}$ will be use in further assessment.

Air quality in New South Wales (NSW) was greatly affected by the continuing intense drought conditions and unprecedented extensive bushfires during 2019. The bushfire emergency saw around 4 million hectares burnt in NSW from July to December 2019, resulting in widespread smoke impacts on many regions through spring and early summer. In addition, continuing intense drought has led to an increase in widespread dust events throughout the year. A further source of particles came from hazard reduction burns in and around Sydney in the cooler months (DPIE, 2019).

# 5. CONSTRUCTION PHASE RISK ASSESSMENT

The methodology used to assess construction phase risk is discussed in **Section 2.4.1** 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.**

## 5.1. 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 9** overleaf presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria.

**Table 9 Construction phase impact screening criteria distances**

| Rec | Location | Land Use | Screening Distance (m) | | |
|---|---|---|---|---|---|
| | | | Boundary (350m) | Site Entrance (500m) | Construction route (50m) |
| R1 | 160 Chatham Street Broadmeadow | Residential | 21 | 101 | 16 |
| R2 | 140 Chatham Street Broadmeadow | Residential | 23 | 43 | 43 |
| R3 | 130 Chatham Street Broadmeadow | Educational | 83 | 178 | 181 |
| R4 | 125 Darling Street Broadmeadow | Residential | 46 | 240 | 196 |
| R5 | 149 Darling Street Broadmeadow | Residential | 24 | 150 | 47 |
| R6 | 88 Darling Street Broadmeadow | Educational | 174 | 338 | 330 |
| R7 | 125 Chatham Street Broadmeadow | Educational | 267 | 406 | 406 |

With reference to **Table 9**, sensitive receptors are noted to be within the screening distance thresholds and therefore require further risk assessment as summarised in **Table 10**.

**Table 10 Application of Step 1 Screening**

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

## 5.2. Impact Magnitude

The footprint of the Development site (the area affected) is estimated as being approximately 25 500 $m^2$ (2.55 ha) in area.

The Proposal would involve demolition of the current buildings and structures on the Development site, earthworks for the Development site area and the construction of the structures as illustrated in **Figure 3** and **Figure 4**.

The estimated demolition building volume is approximately 8 157 $m^3$ (assuming seven buildings with an average height of 2.7 m, two sheds 4.5 m tall, and an equine pool with an estimated depth of 2 m). Based on review of plans, the estimated proposed building volume is approximately 89 630 $m^3$ (assuming an average height of 11 m for seven, two storey stable blocks and an average height of 5 m for a storage shed, a site office, and equipment shed and a maintenance area).

There will be a sporadic increase in traffic during construction. It is assumed that, approximately 10 – 20 construction vehicles may be required at peak hours during construction works. Construction vehicles will access the site from Chatham Street.

Based upon the above assumptions and the assessment criteria presented in **Appendix C**, the dust emission magnitudes are as presented in **Table 11**.

**Table 11 Construction phase impact categorisation of dust emission magnitude**

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

## 5.3. Sensitivity of an Area

### 5.3.1. 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 Development 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. For clarity, the maximum land use value across all receptors drives the requirement for the level of dust control during construction activities.

### 5.3.2. Sensitivity of an Area

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

The assumed existing background annual average $PM_{10}$ concentrations, as measured at Newcastle AQMS (see **Table 8**) in 2019 was 28.4 $\mu g \cdot m^{-3}$, which, along with the land use value calculated above, classifies the sensitivity of the area as *low* for dust health impacts and *medium* for dust soiling effects.

## 5.4. Risk (Pre-Mitigation)

Given the sensitivity of the identified receptors is classified as *low* for dust soiling, and *medium* for health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 11**, the resulting risk of air quality impacts (without mitigation) is as presented in **Table 12**.

**Table 12 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 | Med | Large | Large | Med | Large | Med | Med | Med | Low | Med |
| Human Health | Med | Med | Large | Large | Med | Large | Med | Med | Med | Low | Med |

**Note**: Med = medium

The risks summarised in **Table 12** show that there is a *low* risk of adverse dust soiling and human health impacts associated with vehicle track-out, and a *medium* risk of adverse dust soiling and human health associated with all the other activities, if no mitigation measures were to be applied to control emissions associated with construction-phase activities.

The risk assessment therefore provides recommendations for construction phase mitigation, commensurate with those identified risks, which are presented in **Section 7.1.2**.

# 6. OPERATIONAL PHASE RISK ASSESSMENT

It is anticipated that the main impacts associated with the Development during operation would be those related to odour. Impacts associated with particulate matter (dust) are not expected to be significant, but may include exhaust emissions from service vehicles and horse transports. Unpaved surfaces (training tracks, pathways and stabling areas) and the movement of horses over unpaved surfaces may generate dust impacts although these would be easily controlled through regular maintenance (sweeping, as required),watering, and the introduction of a dedicated horse tie-up area near the track access point, which would minimise the tracking of horses back and forth across the track area.

The following sections consider impacts associated with odour, although management and mitigation measures associated with particulate matter have been considered in **Section 7** to ensure that the requirements of the SEARs have been appropriately met.

## 6.1. Sensitivity of Receptors

To determine the sensitivity of receptors, reference is made to the receptors identified in **Section 4.1.2** and the methodology presented in **Appendix D**. The following sensitivities have been determined:

**Table 13 Sensitivity of receptors**

| Receptor ID | Property | Land use | Distance from site (m) | Sensitivity |
|---|---|---|---|---|
| R1 | 160 Chatham Street Broadmeadow | Residential | 21 | High |
| R2 | 140 Chatham Street Broadmeadow | Residential | 25 | High |
| R3 | 130 Chatham Street Broadmeadow | School | 83 | High |
| R4 | 125 Darling Street Broadmeadow | Residential | 46 | High |
| R5 | 149 Darling Street Broadmeadow | Residential | 24 | High |
| R6 | 88 Darling Street Broadmeadow | Childcare | 174 | Very High |
| R7 | 125 Chatham Street Broadmeadow | Childcare | 267 | Very High |

## 6.2. Impact Magnitude

In the context of the risk assessment methodology, impact magnitude relates to the definitions presented in **Appendix D** and is described on a scale from major to negligible.

As outlined in **Section 3**, the definition of 'offensive odour' under the POEO Act can be determined through various factors including the strength, nature, duration, character or quality of that odour.

In regulatory terms, the characteristics that may be controlled include the following (FIDOL factors, as discussed in **Section 2.4.2**):

- Frequency;
- Intensity;
- Duration;
- Offensiveness; and
- Location

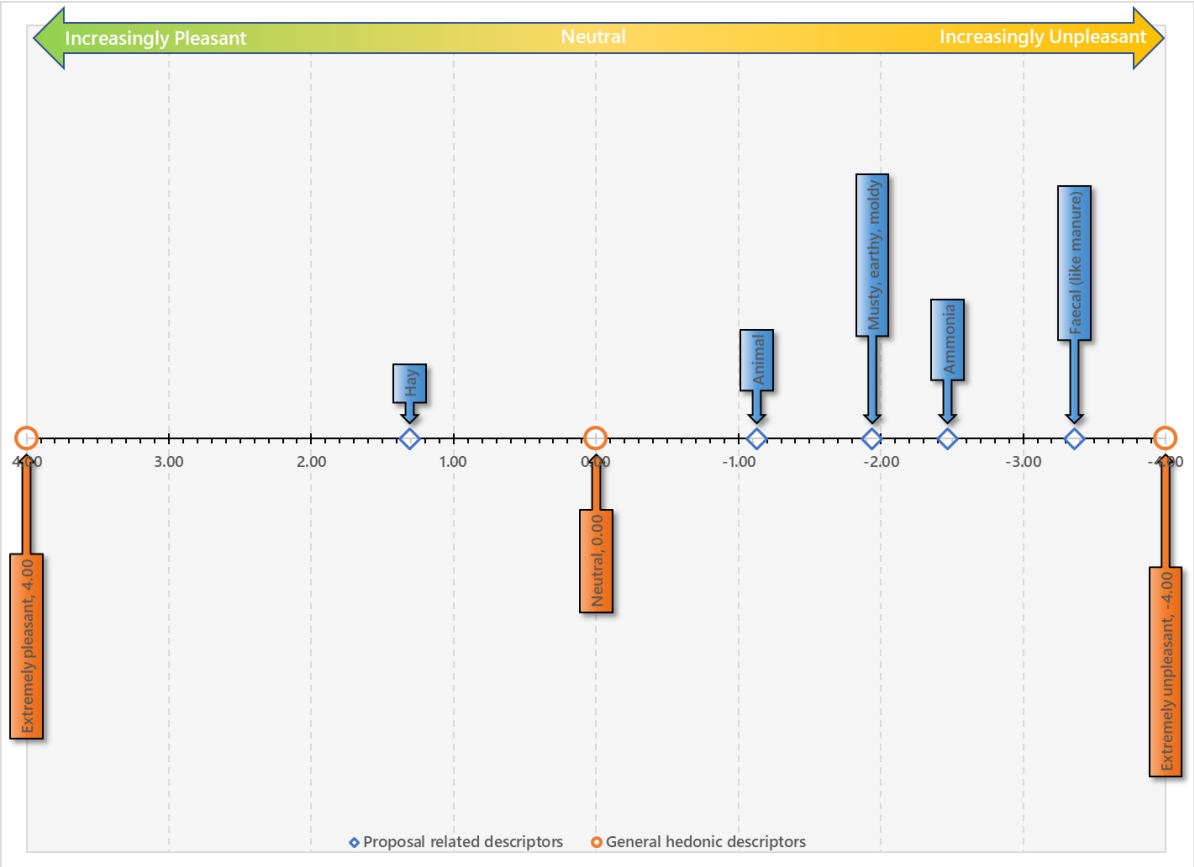
The following sections identify and discuss the magnitude in terms of those factors.

### 6.2.1. Horse Stabling

As discussed in **Section 2.3.2**, the significant sources of odour are solid and liquid stable wastes, horse foodstuff storage and animal sweat odour.

The character ('pleasantness') of horse stabling odour is highly variable, and may be experienced as a relatively pleasant odour (hay hedonic tone +1.31) to reasonably unpleasant (animal hedonic tone -1.13, musty, earthy, moldy hedonic tone -1.94, ammonia hedonic tone -2.47 and faecal (like manure) hedonic tone -3.36) depending upon the person experiencing the odour. How the hedonic tone of horse stabling sits on the Dravniek scale (see **Appendix D**) is illustrated in **Figure 10**.

Figure 10 Offensiveness (hedonic tone) of odour from horse stabling




Based upon the information presented in the report, the magnitude as outlined in **Table 14** is assessed with reference to the FIDOL factors.

**Table 14 Magnitude – odour from horse stabling**

| Odour Characteristic | Comments | Potential Impact Magnitude |
|---|---|---|
| Frequency (F) | Likely to be numerous times per day (constant throughout the year) | Moderate to major |
| Intensity (I) | Solid and liquid stable wastes | Major |
| | Horse foodstuffs | Negligible |
| | Animal sweat odour | Slight |
| Duration (D) | The source emissions are likely to be very low and constant all over the year | Moderate |
| Offensiveness (O) | Hedonic tone moderately pleasant +1.31 to moderately unpleasant -3.36 | Moderate |
| Location (L) | Not used – location is used to assess odour sensitivity | |

Given the characteristics of odour emissions from the horse stabling, the pre-mitigated magnitude of odour emissions is conservatively assessed as being *major*, as a consequence of the potential frequency and intensity. The magnitude is considered potentially likely to result in odour nuisance complaints if not controlled, and potentially resulting in regulatory action. In this instance, that is considered likely to include Council odour enforcement action.

## 6.3. Pre-Mitigated Risk

Based upon the foregoing information, the pre-mitigated risk is assessed as presented in **Table 15**.

**Table 15 Pre-mitigated risk - odour from horse stabling**

| Sensitivity of Receptors | | Impact Magnitude | | Pre-mitigated risk | Outcome |
|---|---|---|---|---|---|
| Location | Assessment | Process | Assessment | | |
| Various locations | Very High | Solid and liquid stable wastes | Major | High | Requires mitigation |
| | | Horse foodstuffs | Negligible | Medium | Manage Risk |
| | | Animal sweat odour | Slight | Medium | Manage Risk |

# 7. MITIGATION, MONITORING AND RESIDUAL RISK

## 7.1. Construction Phase

### 7.1.1. Assessed Risk (Pre-Mitigation)

The potential impacts associated with construction phase activities has been performed using a risk-based assessment procedure.

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 5.4**, and the mitigation measures identified to manage that risk are presented in **Section 7.1.2**.

### 7.1.2. Identified Mitigation

To manage the risks, the identified mitigation measures presented in **Table 16** are anticipated to be implemented in the Construction Environmental Management Plan (CEMP)[2].

The following represents a selection of recommended mitigation measures recommended by the IAQM methodology for a *medium* risk site for construction and construction traffic, given the findings of the construction phase assessment as outlined in **Section 5.4**. A detailed review of the recommendations would be performed once details of the construction phase are available.

**Table 16** 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).

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

Table 16 Site-specific management measures

| Identified Mitigation | | Unmitigated Risk |
|---|---|---|
| 1 | Communications | Medium |
| 1.1 | Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. | H |
| 1.1 | 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. | H |
| 2 | Site Management | Medium |
| 2.1 | Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. | H |
| 2.2 | Make the complaints log available to the local authority when asked. | H |
| 2.3 | Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book. | H |
| 2.4 | Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes. | N |
| 3 | Monitoring | Medium |
| 3.1 | Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the 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 |

| Identified Mitigation | | Unmitigated Risk |
|---|---|---|
| 3.4 | Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. | H |
| **4** | **Preparing and Maintaining the Site** | **Medium** |
| 4.1 | Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible. | H |
| 4.2 | Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site. | H |
| 4.3 | Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period. | H |
| 4.4 | Avoid site runoff of water or mud. | H |
| 4.5 | Keep site fencing, barriers and scaffolding clean using wet methods. | H |
| 4.6 | Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below | H |
| 4.7 | Cover, seed or fence stockpiles to prevent wind erosion | H |
| **5** | **Operating Vehicle/Machinery and Sustainable Travel** | **Medium** |
| 5.1 | Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable | H |
| 5.2 | Ensure all vehicles switch off engines when stationary - no idling vehicles | H |
| 5.3 | Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable | H |
| 5.4 | Impose and signpost a maximum-speed-limit of 25 $km \cdot h^{-1}$ on surfaced and 15 $km \cdot h^{-1}$ 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 |
| 5.5 | Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials. | H |
| 5.6 | Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing) | D |
| **6** | **Operations** | **Medium** |
| 6.1 | Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems | H |

| Identified Mitigation | | Unmitigated Risk |
|---|---|---|
| 6.2 | Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate | H |
| 6.3 | Use enclosed chutes and conveyors and covered skips | H |
| 6.4 | Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate | H |
| 6.5 | Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods. | H |
| **7** | **Waste Management** | **Medium** |
| 7.1 | Avoid bonfires and burning of waste materials. | H |
| **8** | **Measures Specific to Demolition** | **Medium** |
| 8.1 | Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust). | D |
| 8.2 | Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively 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. | D |
| 8.6 | Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable. | D |
| 8.7 | Only remove the cover in small areas during work and not all at once | D |
| **9** | **Measures Specific to Construction** | **Medium** |
| 9.1 | Avoid scabbling (roughening of concrete surfaces) if possible | D |
| 9.2 | Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place | H |
| 9.3 | Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery. | D |

| Identified Mitigation | | Unmitigated Risk |
|---|---|---|
| 9.4 | For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust | D |
| **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)** | **Medium** |
| 11.1 | Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable | H |
| 11.2 | Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery. | D |
| 11.3 | Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. | H |
| 11.4 | Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. | H |
| 11.5 | Record all inspections of haul routes and any subsequent action in a site log book. | H |

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

### 7.1.3. Residual 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 Development site, the distance to sensitive receptors and of the activities to be performed, residual impacts associated with fugitive dust emissions from the Development would be anticipated to be '*negligible*' for all activities.

### 7.1.4. Monitoring

The site-specific management measures outlined in **Section 7.1.2** identify a number of monitoring methods to reduce air quality impacts experienced by proximate receptors. These methods are listed below:

- Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to visibly observe dust levels, record inspection results, and make the log available to the local authority upon request;
- Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to Council when requested;
- Increase the frequency of site inspections by the nominated accountable person when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions;
- Record all inspections of haul routes and any subsequent action in a site log book;
- 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;
- 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.

## 7.2. Operational Phase Mitigation

### 7.2.1. Assessed Risk (Pre-Mitigation)

As presented in **Section 6.3**, the pre-mitigated risk is assessed as being *high* for solid and liquid stable wastes odour emissions.

### 7.2.2. Identified Mitigation

The recommended measures will be implemented and managed by the Site Supervisor, or delegated to an appropriate person as required.

Based upon the assessment of the unmitigated and uncontrolled risk posed by the solid and liquid stable wastes generating an off-site odour impact, the control measures outlined in **Table 17** are recommended to be implemented.

**Table 17 Odour management plan recommendations (stable wastes)**

| Odour Control | Recommendation |
|---|---|
| Frequency of stable waste removal | The solid and liquid stable waste (stable bedding waste) will be removed on a daily basis |
| Temporary storage of stable waste | The removed solid and liquid waste material will be temporarily stored in appropriate and adequately-sized waste storage bins, fitted with close-fitting lids |
| | The removed stable wastes will be removed from site by an appropriate waste management company on a daily basis, for appropriate off-site treatment or disposal |
| | The storage bins will be periodically checked to ensure they are maintained and in a good working order. Any bins that cannot contain the waste material by way of breach, malfunction or damage will be removed from service and replaced as soon as practicable. Spare lids and bins will be kept on site for replacement purposes. |
| | Provision will be made for the use (when required) for an odour neutralising agent, that may be applied to the temporarily stored waste materials in event of prolonged storage, prolonged high temperatures or as a control measure in the event of an odour complaint |
| | The storage bins will be maintained in an adequately clean condition, so that they do not represent an odour source in themselves. The bins will be cleaned internally and externally as required |
| Stable wash down | The stables will be thoroughly washed down on a monthly basis |
| | Daily hose down of breezeways and corridors |
| | Periodic (six-monthly) cleaning using pressure washers of stable building and surrounds |
| | The wash down water will be drained to subsurface drains, and to the foul water drains |

NJC proposes that a private contractor will be appointed to manage the logistics of feed and bedding delivery, as well as horse waste removal using the following basic approach:

- All bedding and feed will be delivered to site in non vented lidded bins, which are then distributed by NJC staff to the individual stables via forklift (**Figure 11**).
- All waste is removed from the stables by NJC staff using the same lidded bins to the central waste collection point, where the private contractor will collect and remove the full bins from site.
- Horse waste can then be appropriately disposed, or treated and used / on-sold as an organic fertiliser.

- Bins are then cleaned by the private contractor before re-filling them with feed / bedding for delivery back to NJC.

**Figure 11 Lidded bins used for storing and transporting materials.**

**Source**: Proposed New Stables Complex-NJC Report (11/01/2021)

No additional controls are considered to be required for foodstuffs, other than maintaining the material with good housekeeping measures as presented in **Table 18**.

**Table 18 Odour management plan recommendations (horse foodstuffs)**

| Odour Control | Recommendation |
|---|---|
| Storage of foodstuffs | All foodstuffs will be stored in appropriate and suitable storage drums / containers, and spilled materials will be contained and cleaned up immediately |

The risk of animal sweat odour is considered to be *medium*. To manage this risk of generating off-site odour, the building needs to be maintained with adequate ventilation airflow (see **Table 19**)

**Table 19 Odour management plan recommendations (animal sweat odour)**

| Odour Control | Recommendation |
|---|---|
| Building ventilation | The stables will be operated with adequate natural ventilation |
| | The stabled horses will be adequately groomed to minimise the risk of animal odour |

To minimise emissions of particulate matter from the Development, the use of any unsealed areas of training facilities and tracks are to be minimised where possible during windy and dry conditions. In addition, the location of the stable buildings would act as a potential buffer for potential windblown dust towards the residential receptors resulting from any unsealed areas of the training facility. Any areas of the stabling yards which are observed to be causing visible dust emissions will be swept and/or watered as required. Any dirt tracked onto access routes is to be cleaned as soon as possible. Access roads and pathways must be kept clean.

Additionally, the windows and doors of the stabling building would be closed during periods of heavy wind in order to reduce any potential dust or odour impacts beyond the building.

### 7.2.3. Residual Risk (Post Mitigation)

Based upon the above mitigation, the magnitude of impacts would be reduced to a maximum of slight, which corresponds to "*potential impact may be tolerated*", and "*potential slight magnitude of impacts is not likely to generate nuisance complaints*".

It is noted that the post-mitigated risk is largely driven by the determined sensitivity of the surrounding receptors, rather than the likely (post-mitigated) magnitude of any impacts.

**Table 20 Post-mitigated risk - odour from stabling horses**

| Sensitivity of Receptors | | Impact Magnitude | | Post-mitigated risk | Outcome |
|---|---|---|---|---|---|
| Location | Assessment | Process | Assessment | | |
| Various locations | Very High | Solid and liquid stable wastes | Slight | Medium | Manage risk |
| | | Horse foodstuffs | Negligible | Medium | Manage risk |
| | | Animal sweat odour | Negligible | Medium | Manage risk |

### 7.2.4. Monitoring

The NJC will operate an odour complaints procedure which will, as a minimum, record the number and details of complaints received regarding the environmental impacts and any action taken in response to the complaint.

The odour complaint procedure and associated complaint forms will be maintained in a proper fashion by the NJC, and will be made available for inspection by Council upon request.

An example of a complaint record form is provided at **Appendix E**, which may be adapted for use if required.

# 8. CONCLUSION

Northstar Air Quality was engaged by Newcastle Jockey Club Ltd, to perform an Air Quality and Odour Risk Assessment (AQRA) for the construction and operation of a new stables complex.

Construction phase activities may involve grouting of mine voids, demolition works and earthworks, construction works and associated vehicle traffic. The associated risks of impacts from these activities 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 AQRA studies.

That assessment showed there to be a low to medium risk of dust soiling and health risk impacts during demolition and construction activity (including grouting of mine voids). Based upon that assessment, a range of mitigation measures are recommended to ensure that short-term impacts associated with construction activities are minimised.

The potential impacts associated with operational activities including the management of solid and liquid stable wastes, horse foodstuffs and animal sweat, the movement of horses from the stables to the track, training, thoroughbred racing and training have been assessed using a risk-assessment approach adopted from ISO 31000:2018 and IEC 31010:2019.

The risk assessment found there to be a high risk of potential odour emissions generated from solid and liquid stable wastes, and a number of required mitigation methods have been determined, including recommendations for air pollution control to manage emissions of dust and odour. A reduction in the capacity of the original number of horses to be stabled at the Proposal site when compared to a previous design will result in the generation of less waste, and the introduction of a dedicated tie-up area for horses near the track access point will help to minimise the back and forth movement of horses from the stabling buildings to the track during morning trackwork. These, along with the management measures outlined, will help to minimise potential odour and air quality impacts to nearby receptors. As the waste removal store shields the proximate residences from prevailing winds, and the waste will be contained in sealed, non-vented lidded bins, no offensive odour should be detectable should the management plan be implemented and carried out effectively.

As discussed within this report, the Proposal will manage dust and odour using lidded, non-vented "mega bins". In addition, the separation distance between residences and the source of any generated and stored waste will be far greater under the proposed development than it is currently, with the residences positioned on the opposite side of the road to the development, and the waste store and stables themselves will set well back from the boundary and protected by enclosed structures. These factors considered together would result in a far greater odour performance than is currently experienced.

Based upon the assumptions presented in the report and the implementation of the recommended mitigation methods, the site is assessed as being capable to not give rise to significant air quality and odour impacts during the construction and operational phases associated with the Development site.

# 9. REFERENCES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# Appendix A

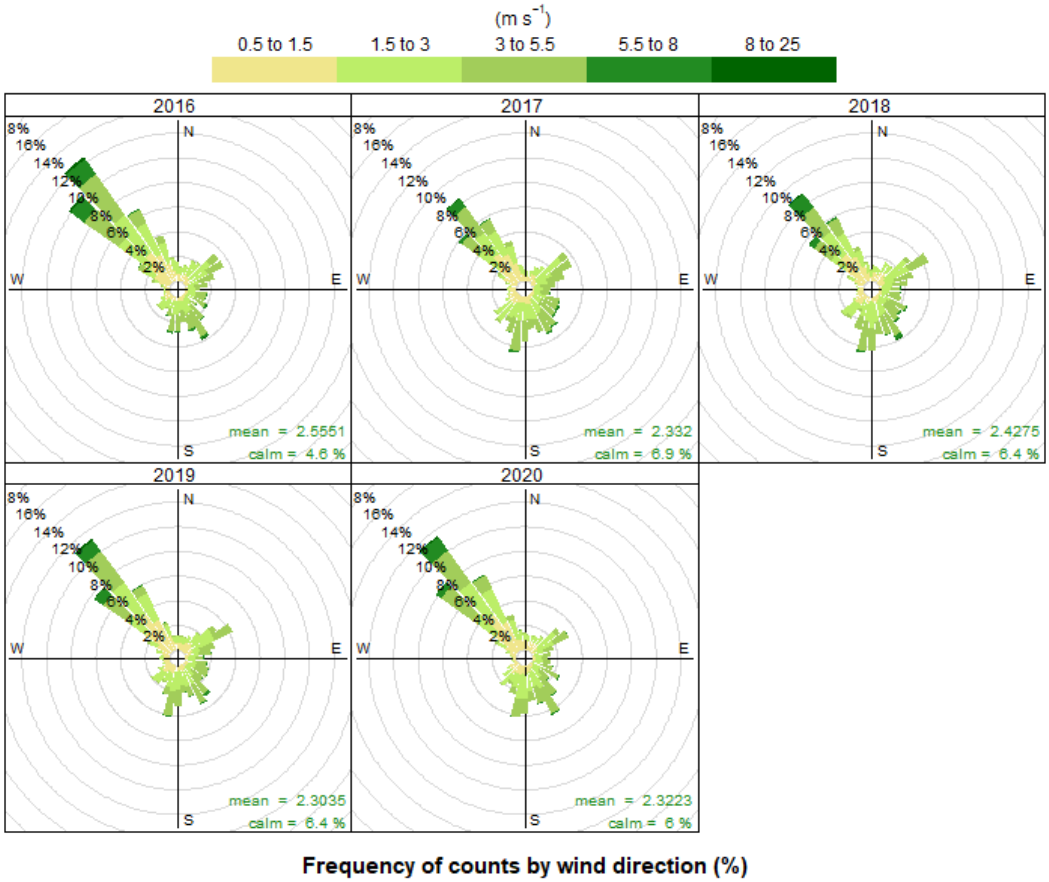
## Meteorology

As discussed in **Section 4.3** the meteorology surrounding the Proposal site has been observed to characterise the existing conditions of the area. 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). Meteorology is also measured by the NSW Department of Planning, Industry and Environment (DPIE) at a number of Air Quality Monitoring Station (AQMS) surrounding the Proposal site (refer **Section 4.4**).

A summary of the relevant monitoring sites is provided in **Section 4.4**

To adequately describe the prevailing meteorological conditions at the Newcastle AQMS, a 5-year (2016-2020) analysis of observed meteorology is provided as a series of wind roses in **Figure 1.**

**Figure A1 Annual wind roses 2016 to 2020, Newcastle AQMS**




The wind roses indicate that from 2016 to 2020, winds at Newcastle AQMS show similar patterns across the years, with predominant North-westerly wind direction.

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# Appendix B

## Background Air Quality Data

Air quality data presented in this appendix is not used in a quantitative manner in the AQRA, and is provided for context only.

Determination of data to be used as a location representative of the Development site and during a representative year can be complicated by factors which include:

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

As discussed in **Section 4.4** air quality monitoring is performed by the DPIE at a number of quality monitoring station (AQMS) proximate to the Proposal site.

Based on the sources of AQMS data available and their proximity to the Development site, Newcastle was selected as the source of AQMS data for use in this assessment.

Graphs presenting the daily varying $PM_{10}$ and $PM_{2.5}$ data recorded at Newcastle for the years 2016-2020 are presented in **Figure B1** and **Figure B2**, respectively.

Figure B1 $PM_{10}$ Measurements, Newcastle 2016-2020

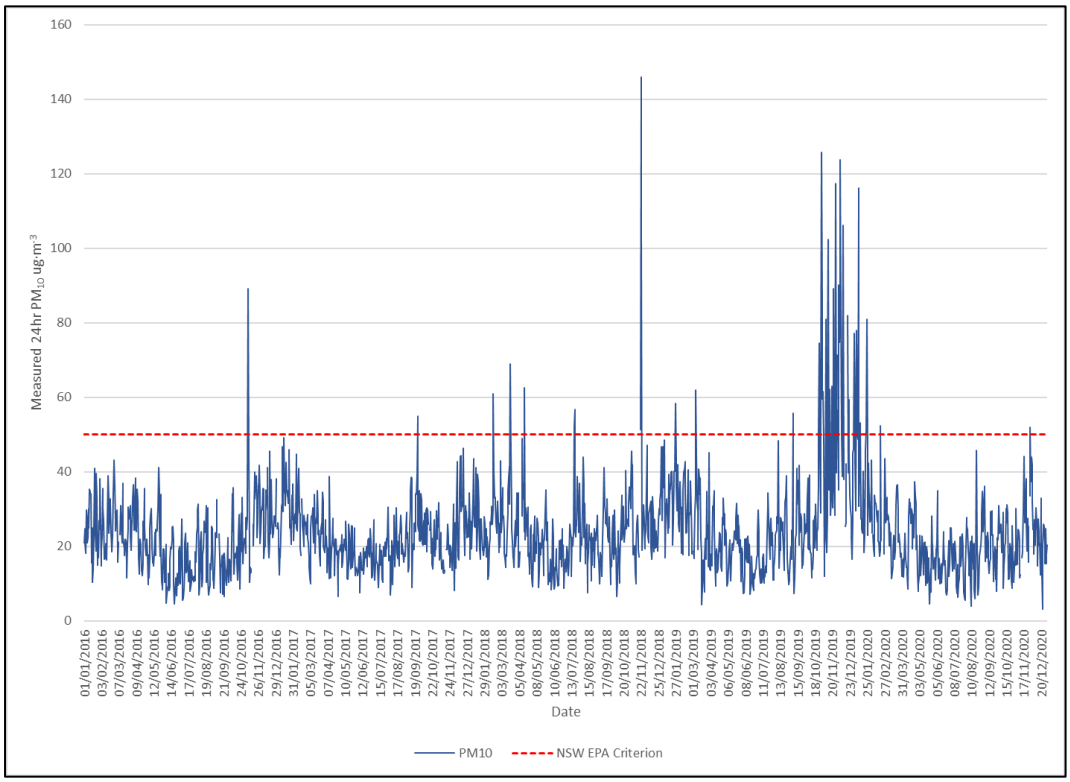
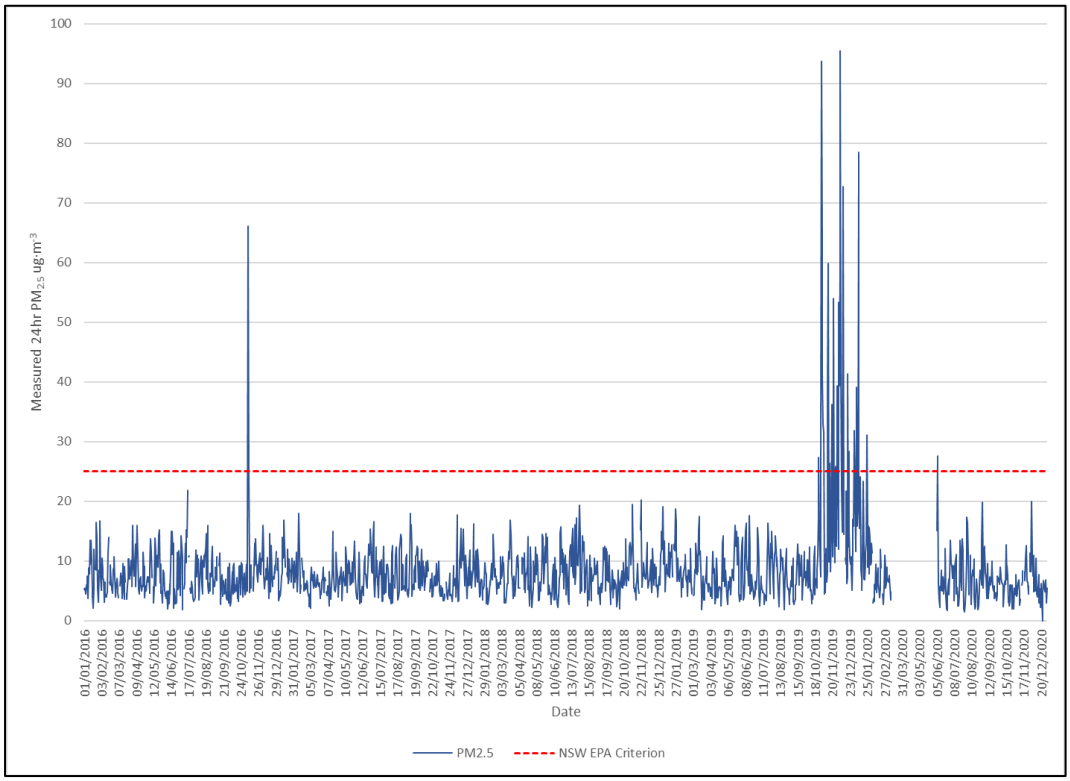



Figure B2 $PM_{2.5}$ Measurements, Newcastle 2016-2020



# 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<br>- total building volume | • >50 000 $m^3$ | • 20 000 $m^3$ to 50 000 $m^3$ | • <10 000 $m^3$ |
| Earthworks traffic<br>- total area | • >10 000 $m^2$ | • 2 500 $m^2$ to 10 000 $m^2$ | • <2 500 $m^2$ |
| Earthworks traffic<br>- 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<br>- material moved | • >100 000 t | • 20 000 t to 100 000 t | • <20 000 t |
| Construction traffic<br>- total building volume | • 100 000 $m^3$ | • 25 000 $m^3$ to 100 000 $m^3$ | • <25 000 $m^3$ |
| Total traffic<br>- 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).<br>*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).<br>*Examples: Office and shop workers, but would generally not include workers occupationally exposed to $PM_{10}$.* | • Locations where human exposure is transient.<br>*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<br>• 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.<br><br>*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<br>• The appearance, aesthetics or value of their property could be diminished by soiling; or<br>• 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.<br><br>*Examples: Parks and places of work.* | • The enjoyment of amenity would not reasonably be expected; or<br>• Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or<br>• 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.<br><br>*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 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 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 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 |
| 5.4 | Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials. | N | H | H |
| 5.5 | 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** | | | |
| 8.1 | Avoid scabbling (roughening of concrete surfaces) if possible | D | D | H |
| 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 | H | 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 | D | H |
| 8.4 | 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)

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# Appendix D

# Operational Phase Risk Assessment Methodology

Provided below is the summary for the risk assessment methodology used for the operational phase of this assessment. It is based upon the definitions provided under ISO 31000.

The risk assessment presented in this report is performed in two stages:

- **Step 1: Pre-mitigated risk:** This is used to identify any significant risks and identify the need to control;
- **Step 2: Control and mitigation:** An examination of what constitutes best available technology (BAT) for emissions control for that process.

The risk assessment procedure adopted in this instance uses the determinations of:

- sensitivity of receptors; and
- impact magnitude; to derive
- risk.

These terms are defined and discussed in the following subsections.

## Sensitivity of Receptors

Sensitivity terminology may vary depending upon the environmental effect, but generally this may be described in accordance with a scale from 'very high' to 'low', as defined below.

With regard to odour impacts, sensitivity relates to the Location factor (F I D O **L**).

### Methodology - sensitivity of receptors

| Sensitivity | | Descriptions |
|---|---|---|
| 4 | Very high | • Receptors are highly sensitive to changes in the air quality / odour environment.<br>• Areas may be typified by extended (day-long) exposure times and/or an expectation of high amenity values.<br>• Typical examples may include residential areas, health care facilities, retirement homes |
| 3 | High | • Receptors have a high sensitivity to changes in the air quality / odour environment.<br>• Areas may be typified by working-day exposure times and/or an expectation of high amenity values.<br>• Typical examples may include commercial zones, recreation facilities, schools, high-end office space (banking etc). |

| Sensitivity | | Descriptions |
|---|---|---|
| 2 | Medium | • Receptors have a medium sensitivity to changes in the air quality / odour environment.<br>• Areas may be typified by up to working-day exposure times and an expectation of reasonable amenity values commensurate with the land-uses.<br>• Typical examples may include agricultural and environmental conservation spaces, industrial zones. |
| 1 | Low | • Receptors have a low sensitivity to changes in the air quality / odour environment.<br>• Areas may be typified by short-term exposure times and a low expectation of amenity values.<br>• Typical examples may include infrastructure land uses, open and undeveloped land. |

## Impact Magnitude

Impact magnitude is a descriptor for the predicted scale of change to the odour environment that may be attributed to the operation of the Proposal, and is evaluated on a scale from 'major' to 'negligible' as defined below.

With regard to odour impacts, magnitude relates to the Frequency, Intensity, Duration and Offensiveness factors (**F I D O** L).

### Methodology - impact magnitude

| Magnitude | | Descriptions |
|---|---|---|
| 4 | Major | Potential impact magnitude may cause statutory objectives / standards to be exceeded.<br>Potential major magnitude of impacts may generate nuisance complaints, resulting in regulatory action. |
| 3 | Moderate | Potential impact may give rise to a perceivable health and/or amenity impact.<br>Potential moderate magnitude of impacts may generate nuisance complaints, likely to require management but not result in regulatory action. |
| 2 | Slight | Potential impact may be tolerated.<br>Potential slight magnitude of impacts is not likely to generate nuisance complaints. |
| 1 | Negligible | Potential impact magnitude is unlikely to cause significant consequences.<br>Potential negligible magnitude of impacts is unlikely to generate nuisance complaints and is likely to only be perceptible within the site boundary. |

The assessment of magnitude with regard to offensiveness references the Dravniek index from -4 (unpleasant) through 0 (neutral) to +4 (pleasant) (Andrew Dravnieks, 1984). The Dravniek index is commonly used to evaluate the hedonic tone (offensiveness) of odour.

## Risk

The risk matrix provided illustrates how the definition of the impact magnitude and sensitivity of receptors interact to produce impact risk (composite risk index). For example, an odour impact of slight magnitude at a medium sensitive receptor location would be determined to be of medium risk (significance).

### Methodology – odour risk matrix

| Magnitude / Sensitivity | Negligible (1) | Slight (2) | Moderate (3) | Major (4) |
|---|---|---|---|---|
| **Very High (4)** | Medium (4) | Medium (8) | High (12) | High (16) |
| **High (3)** | Medium (3) | Medium (6) | Medium (9) | High (12) |
| **Medium (2)** | Low (2) | Medium (4) | Medium (6) | Medium (8) |
| **Low (1)** | Low (1) | Low (2) | Medium (3) | Medium (4) |

The 'risk' derived through this methodology is presented on a simplified three-point scale:

| | |
|---|---|
| High | A high risk that requires management, through changes to impact magnitude and/or sensitivity |
| Medium | An intermediate risk, and recommendations are to reduce risk as low as practicable through changes to impact magnitude and/or sensitivity |
| Low | No further management required, although risks should be managed |

The relative risk is provided as a dimensionless product of the defined values attributed to receptor sensitivity and impact magnitude.

The determined risk (significance) may be used to highlight the relative environmental risk and to highlight the general requirement for the application of controls and mitigation. It is noted that the above approach is designed to provide an overall impact risk and is not intended to represent the defining determination for the requirement for mitigation and control. The determined risk methodology is not designed to exclude impacts with a lower determined significance from receiving mitigation and control treatments, in accordance with the principle of reducing environmental impacts to maximum extent practicable.

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# Appendix E

## Example Odour Complaint Record

| Complainant Contact Details | | | |
|---|---|---|---|
| Date and time complaint received | | | |
| Contact details for complainant | | | |
| **Complaint Details** | | | |
| Date and time start | / / : am\|pm | | |
| Date and time stop | / / : am\|pm | | |
| Location(s) of the odour | | | |
| Description of the odour | | | |
| Persistence *see note 1* | ☐ Constant ☐ Intermittent | | |
| Intensity (odour) *see note 2* | ☐ 6 extremely strong | ☐ 4 strong | ☐ 2 weak |
| ☐ generally ☐ at its worst | ☐ 5 very strong | ☐ 3 distinct | ☐ 1 very weak |
| **Prevailing weather conditions at the time of the complaint** | | | |
| General description (dry, rain, windy, still etc) | | | |
| Temperature | | | |
| General wind direction *see note 3* | | | |
| General wind strength *see note 4* | | | |
| **Operational details, actions, resolution** | | | |
| Operations during complaint | | | |
| Identified causes | | | |
| Actions taken | | | |
| Cause resolved | ☐ Yes ☐ No | | |
| Follow up required | ☐ Yes ☐ No | | |
| Complainant informed of outcome | ☐ Yes ☐ No | | |
| Signed | | | |
| Date | / / | | |

# Notes

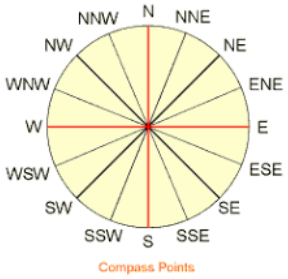
**1. Persistence**. Please record the descriptor that best describes the extent of the observation:

- Constantly: air quality impact was observed virtually constantly between the stated start and stop times
- Intermittently: odour was observed intermittently between the stated start and stop times

**2. Odour Intensity**. Using the scale below, estimate how intense the odour was generally or at its worst (as appropriate)

| | | | |
|---|---|---|---|
| 6 | **Extremely strong:** Overpowering odour triggering a physical reaction (i.e. gaging, eyes watering etc.) or an involuntary action (i.e. turning away from odour, covering nose etc.). | 3 | **Distinct:** Mid way between a weak and strong odour, this is a clearly defined odour, immediately recognisable and tolerable. |
| 5 | **Very strong:** A strong odour that may initiate an involuntary action that you subsequently control. Odour is barely tolerable and exposure is uncomfortable | 2 | **Weak:** This is a clearly defined odour (i.e. without uncertainty/guessing), immediately recognisable but not yet strong enough to be considered distinct and readily tolerable. |
| 4 | **Strong:** A clearly defined odour that is immediately recognisable and is tolerable but mildly uncomfortable. | 1 | **Very weak:** A very faint odour. The VDI definition of a very weak odour requires the odour to be clearly defined without uncertainty or guessing involved. |

**3. Wind Direction**.




**4. Wind Strength**

| | | |
|---|---|---|
| 0 | Calm | Calm. Smoke rises vertically |
| 1 | Light air | Wind motion visible on smoke |
| 2 | Light breeze | Wind felt on exposed skin. Leaves rustle. |
| 3 | Gentle breeze | Leaves and smaller twigs in constant motion |
| 4 | Moderate breeze | Dust and loose paper raised. Small branches move |
| 5 | Fresh breeze | Moderate branches move. Small trees begin to sway. |
| 6 | Strong breeze | Large branches in motion. Overhead wires whistle. Umbrella use is difficult. Empty rubbish bins tip. |
| 7+ | Near gale | Wind effects greater than above |