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Cleanaway Material Recycling Facility, Rooty Hill

Air Quality Impact Assessment

Addressee(s):	Charter Hall Holdings Pty Limited
Report Reference:	21.1118.FR1V2
Date:	9 February 2022
Status:	Final

Quality Control

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

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21	1118	Final	R1	V2
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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   9th February 2021

Non-Technical Summary

Northstar Air Quality was engaged by Charter Hall Holdings Pty Limited to perform an air quality impact assessment for the proposed operation of a materials recycling facility, to be located at 600 Woodstock Avenue, Rooty Hill, NSW.

A construction dust risk assessment has been performed to determine the potential air quality impacts on surrounding receptor locations, and mitigation measures required to manage that risk. Given the size of the Proposal site, the distance to sensitive receptors and the activities to be performed, residual impacts associated with fugitive dust emissions from the construction of the Proposal would be anticipated to be negligible, should the implementation of the mitigation measures be performed appropriately.

A dispersion modelling assessment conducted in accordance with the relevant NSW Environment Protection Authority guidance has been performed to determine the likely air quality impacts upon surrounding receptor locations. Activity rates associated with average operational conditions have been used to determine the potential impact and compared against annual average criteria. To determine the potential maximum 24-hour impact of the Proposal, the materials haulage, handling and processing rates have been assumed to be 1.4 times that of the daily average rates. This is considered to represent a conservative assumption.

The operation of the Proposal is not anticipated to result in any additional exceedances of the relevant air quality criteria. The best practice management measures proposed are shown to act to minimise impacts on surrounding receptor locations.

It is respectfully considered that the Proposal should not be rejected on the grounds of air quality.

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1. INTRODUCTION

Charter Hall Holdings Pty Limited has engaged Northstar Air Quality Pty Ltd (Northstar) to perform an air quality impact assessment (AQIA) for the proposed construction and operation of a materials recycling facility (the Proposal) located at 600 Woodstock Avenue, Rooty Hill, NSW – Lot 67 of Deposited Plan (DP) 804292 (the Proposal site).

This AQIA supports the State Significant Development (SSD) for the Proposal, provides an assessment of predicted off-site air quality impacts, and presents a range of mitigation measures to minimise air quality impacts, where required and relevant.

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

1.1 Purpose of the Report

The purpose of this report is to examine and identify whether the impacts of the construction and operation of the Proposal may adversely affect local air quality and provide recommendations to manage risks to acceptable levels.

This AQIA has been performed in accordance with, and with due reference to:

- *Environmental Planning and Assessment Act* 1979;
- *Protection of the Environment Operations Act* 1997;
- Protection of the Environment Operations (Clean Air) Regulation 2021; and
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA, 2016).

1.2 Secretary's Environmental Assessment Requirements

Planning Secretary's Environmental Assessment Requirements (SEARs) have been provided for the Proposal by the NSW Department of Planning, Industry & Environment (DPIE) on 22 November 2021 and included input from NSW Environment Protection Authority (EPA). Table 1 provides a summary of the SEARs relevant to this AQIA.

Table 1 Coverage of SEARs and other Government Agency requirements relevant to air quality

Authority	Requirement	Relevant section
DPIE (22 November 2021)	A quantitative assessment of the potential air quality, dust and odour impacts of the development (construction and operation) on surrounding landowners, businesses and sensitive receivers in accordance with the relevant Environment Protection Authority guidelines, including:	Sections 6 & 7
	Details of buildings and air handling systems and strong justification for any material handling, processing or stockpiling external to building	Section 5.2.3
	Details of proposed mitigation, management and monitoring measures	Sections 5.2.3, 6.5 & 8
NSW EPA (22 November 2021)	Management of odour • Municipal waste streams are subject to contamination from food and liquid containers increasing the potential of odour issues and leachate ponding and runoff at the Premises or from trucks on the adjacent roads. The Proponent must include detailed consideration of odour generation and mitigation measures to manage odour and leachate.	Sections 5.2.3 & 8
	Air Quality • Including proposed mitigation measures to minimise the generation and emission of dust during the construction phase and proposed mitigation measures to prevent the generation and emission of dust during the operational phase.	Sections 5.2.3, 6.5 & 8
	Air quality and odour impacts The assessment should include a detailed Air Quality Impact Assessment (AQIA) for construction and operation of the project in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW	Sections 6 & 7
	The AQIA should: • Demonstrate how the development will comply with the relevant regulatory framework, specifically the POEO Act and the POEO (Clean Air) Regulation (2010); and • Include a cumulative local and regional air quality impact assessment, including odour. Technical standards and guidelines include: - Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016) - Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DECC 2006) - Technical Framework – Assessment and Management of Odour from Stationary Sources in NSW (DEC, 2006) - Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for inclusions into the 'Approved	Sections 3.4, 3.5, 4.5, 6 & 7

Authority	Requirement	Relevant section
	Methods for the modelling and Assessments of Air Pollutants in NSW, Australia (OEH, 2011) - Ground level ozone impact assessment framework (EPA, 2015)	

2. THE PROPOSAL

The following provides a description of the context, location, and scale of the Proposal and identifies the potential for emissions to air associated with the operation of the Proposal.

2.1 Environmental Setting

The Proposal site is located at 600 Woodstock Avenue, Rooty Hill, NSW within the Local Government Area (LGA) of the City of Blacktown. A map showing the location of the Proposal site is presented in Figure 1.

The land use surrounding the Proposal site is zoned as IN1 (General Industrial). The closest identified residential location is approximately 325 meters (m) to the northeast of the Proposal site, on Station Street, Rooty Hill.

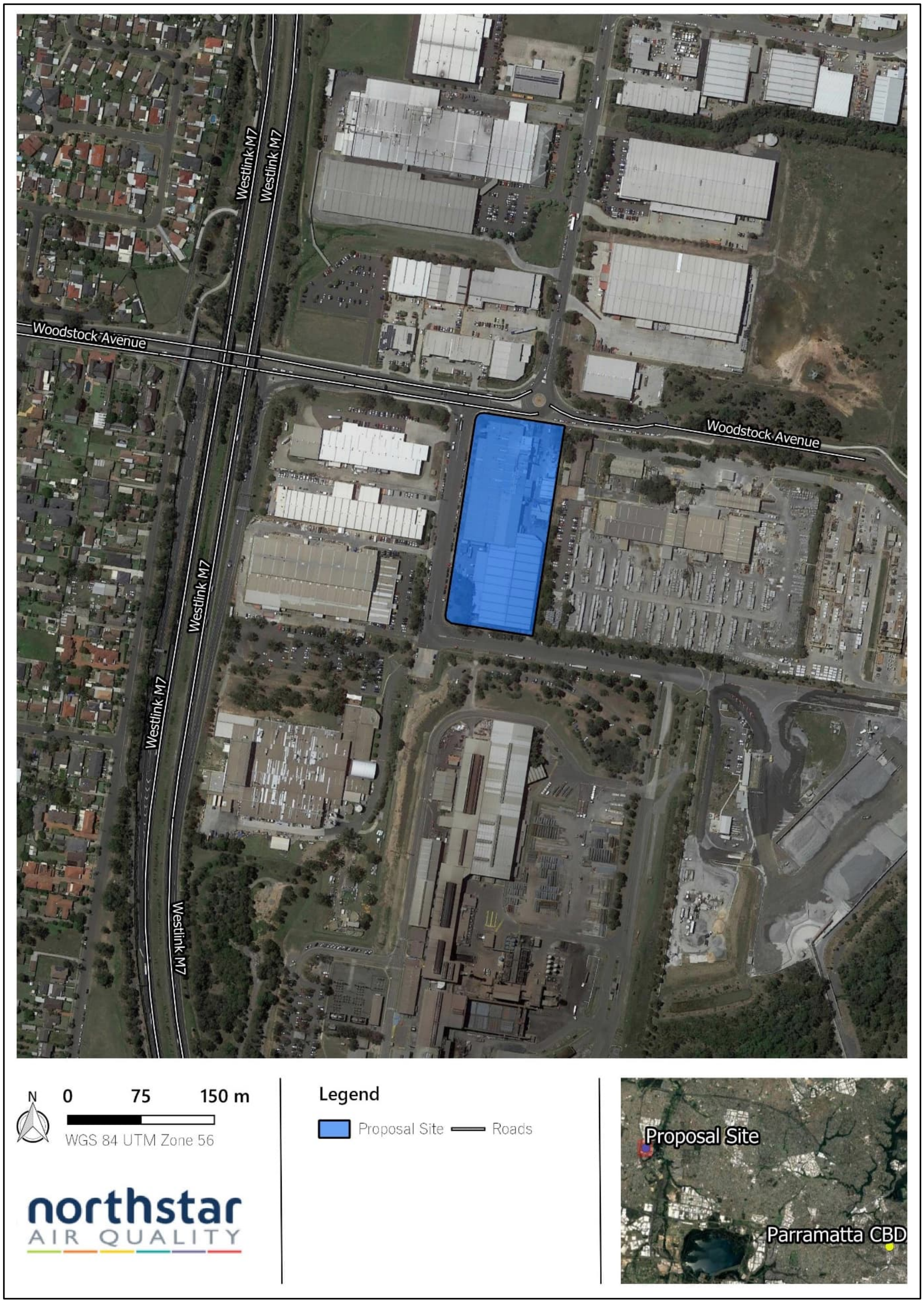
A full description of the sensitivity of the surrounding land, and the identification of discrete receptor locations used in the AQIA is provided in Section 4.1.

2.2 Overview and Purpose

The Proposal seeks to gain development approval for the operation of a materials recycling facility (MRF) on approximately 1.97 hectares (ha) of land zoned as IN1 (General Industrial) under the Blacktown Local Environmental Plan (LEP) 2015.

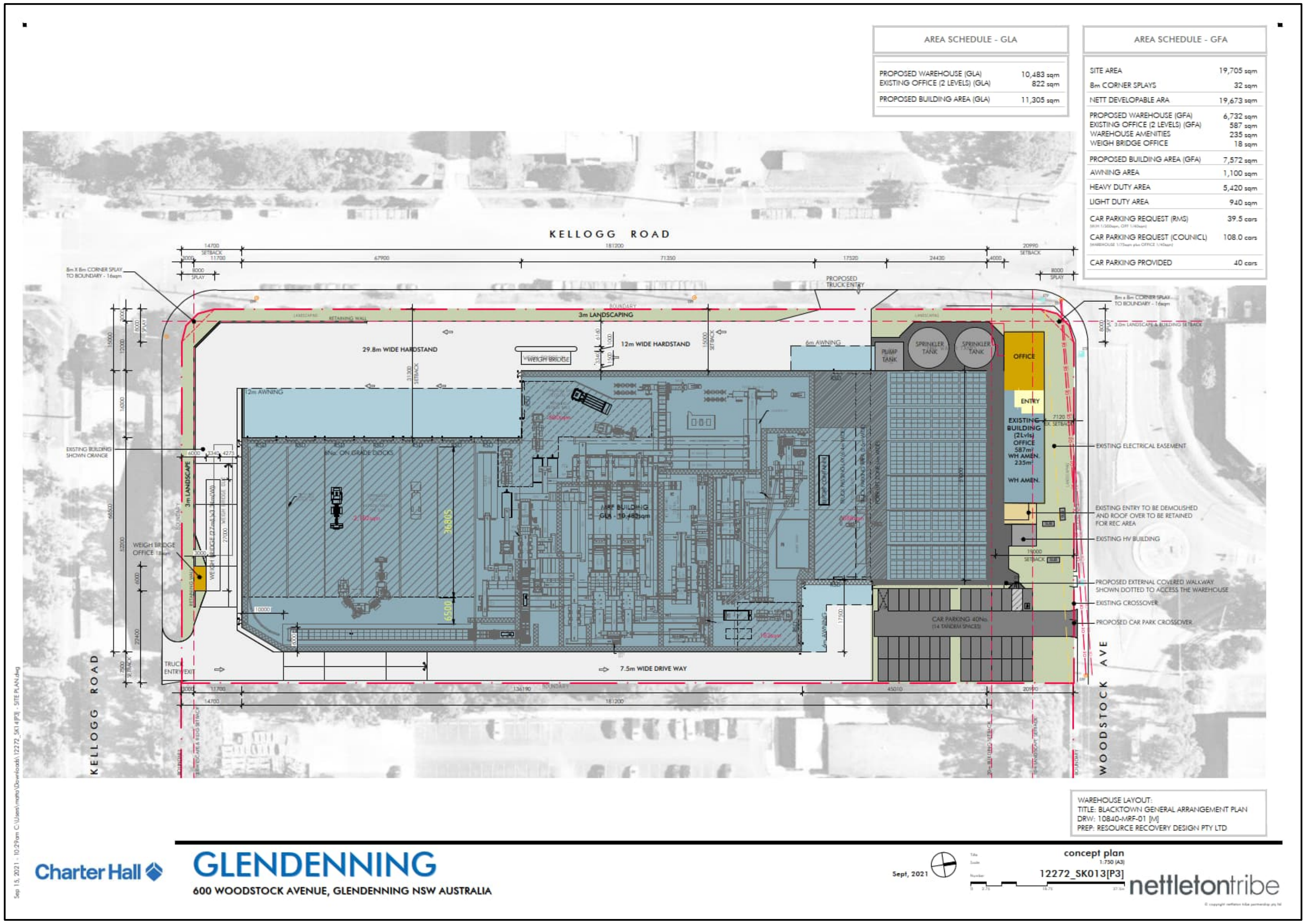
The Proposal would receive and process up to 120 000 tonnes per annum (tpa) of domestic kerbside co-mingled recycling (yellow bin lid). Activities such as delivery, materials handling, sorting, storage, and despatch of material would be performed at the Proposal site. A layout of the Proposal site is provided in Figure 2.

Figure 1 Proposal site location



Note: Image courtesy of Google Maps.

Figure 2 Proposed site layout



Source: nettletontribe

2.3 Process Description

The Proposal comprises the redevelopment of the site as summarised below:

- Demolition of existing structures
- Construction and operation of a purpose built Materials Recycling Facility (MRF) comprising a total of 7 572 square metres (m^2) gross floor area, including:
  - Maximum building height of RL 57.83 metres (m)
  - Warehouse space: 6 732 m^2
  - Office space (across two levels) and amenities: 840 m^2
  - Capacity to process up to 120 000 tpa
  - Car parking provided on-site: 40 car spaces
  - Hard and soft landscaping.

The Proposal site would operate 24 hours per day, seven days per week. Kerbside domestic co-mingled recycling would generally be received at the Proposal site between the hours of 0500 hrs (5:00 am) and 1300 hrs (1:00 pm) Monday to Sunday. Material processing would occur 24 hours per day, seven days per week, with material despatch generally occurring between the hours of 0500 hrs (5:00 am) and 1700 hrs (5:00 pm) Monday to Sunday. For the purposes of this assessment, the operational hours for materials receipt, processing and despatch have been assumed to be 24 hours per day, seven days per week.

Material will be delivered to the Proposal site from Kellogg Road via the weighbridge on the western side of the Proposal site and deposited inside the co-mingled receiving area. Vehicles will then exit via another weighbridge on the southern side of the Proposal site onto Kellogg Road as illustrated in Figure 2. The deposited materials will be visually inspected and pre-sorted within the receival area to remove larger items before processing through sorting equipment and plant.

Materials suitable for recycling are then transferred to an infeed conveyor using a front-end loader (FEL) or telehandler, where sorting equipment will then separate materials by size, weight and material type in accordance with the following categories:

- Ferrous metals;
- Non-ferrous metals;
- Glass;
- Plastics;
- Paper / cardboard; and
- Residual material.

All storage of sorted materials would occur within the building at the Proposal site prior to offtake in accordance with NSW Fire and Rescue guidance (Fire and Rescue, 2020). Paper / cardboard, plastics and appropriately sized ferrous and non-ferrous metals are expected to be baled and stored in bays in the northern end of the building (refer Figure 2). Glass will be stored in the southwest end of the building in a dedicated sealable glass silo.

Residual materials are considered to be materials that are too damaged for reprocessing. These materials are expected to be baled and stored in a bay prior to despatch to an appropriate facility for disposal. Oversized residual items will be separated upon receival and stored prior to collection.

During material offtake/despatch, empty vehicles would enter the building via Kellogg Road to the south, via the weighbridge to the east of the Proposal site. Baled materials would be loaded and vehicles would exit through the western side of the building, turn south and exit onto Kellogg Road via a weighbridge located at the southwestern corner of the Proposal site. Glass would be taken from site in the full, sealed glass silo, with an empty silo being replaced.

2.4 Identification of Potential Emissions to Atmosphere

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

2.4.1 Construction Phase

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

The total volume of the construction required for the Proposal is anticipated to be approximately 103 736 cubic metres (m^3), assuming a footprint of the warehouse and office areas of 7 572 m^2 and an average building height of 13.7 m.

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

- Excavators;
- Front End Loaders;
- Graders;
- Light vehicles;
- Heavy vehicles;
- Drills;
- Pneumatic hand or power tools;
- Cranes;
- Commercial vans; and

- Cherry pickers.

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

2.4.2 Operational Phase

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

- Wheel-generated particulate emissions from the operation of trucks and other site vehicles on paved road surfaces;
- Particulate emissions from the unloading and loading of materials from trucks;
- Particulate emissions from materials handling (sorting) and processing; and
- Odour from a minor quantity of contaminated materials.

The Proposal is expected to result in a maximum of approximately 110 heavy vehicle movements per day, including unloading / loading recyclable materials to / from the Proposal site. Correspondingly, over a 24-hour operational day, the hourly average traffic is expected to be approximately 5 vehicles per hour, or 1 vehicle every 12 minutes, on average. These numbers might be anticipated to increase given that peak delivery hours are between 5 am and 1 pm. Even taking that into account, average vehicle numbers would increase to approximately 14 per hour.

Estimating the contribution of the Proposal site to existing annual average daily traffic (AADT) flows on the local road network has been performed based on measured 2018 traffic flows on Power Street, Doonside (RMS traffic counter 71172) which is approximately 600 m away from the Proposal site. The calculated AADT flows on surrounding roads during operation, including the addition of the flows associated with the Proposal are anticipated to be approximately 25 215 vehicles.

To evaluate the significance of the estimated 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 anticipated changes in traffic (i.e. a maximum of 110 trucks per day) account for approximately 0.5 % of existing traffic flow, and are therefore far below that threshold. Based on this screening approach it is not considered likely that the impacts associated with the Proposal would lead to significant changes in the existing traffic flow or adverse impacts during the operational phase. In accordance with the adopted guidance, the qualitative assessment screens that potential risk and a quantitative assessment is not considered to be warranted.

It is noted however that particulate potentially generated through the action of vehicles on hardstand at the Proposal site has been included as part of this AQIA.

The incoming waste received at the Proposal site is not anticipated to be highly odorous and would not typically contain putrescible waste. However, it is reasonable to assume that a fraction of incoming waste may be odorous by nature of residual materials left on recyclable material, such as residues of food present in recyclable food containers. A conservative assessment has therefore been conducted that assesses potential odour impacts that could occur should 5 % of waste from the co-mingled recyclables stream be contaminated by putrescible residues.

Given the nature of the material to be accepted at the Proposal site, and the fact that the unloading, sorting and storage areas are all enclosed and on hardstand, leachate is not anticipated to be generated in any significant quantities, or which cannot be contained by the drainage system. Significant spillages of leachate presented in waste material would be cleaned immediately through the use of spill kits.

An odour complaints procedure would also be implemented as part of the Air Quality Management Plan (AQMP) and the complaint log would form part of the ongoing environmental management of the site.

In light of the above, a quantitative assessment of the potential odour impacts identified above has been performed.

2.5 Environmental Controls

A number of air quality management measures are to be employed as part of the construction and operation of the Proposal to minimise the generation and off-site transport of particulate matter and odour. A discussion of these adopted measures is presented in Section 6.5 (construction) and Section 5.2.3 (operation).

2.6 Operational Activity Rates

The AQIA requires a range of activity data that describes the activity rates performed on site, such as vehicle movements, processing rates etcetera.

As the AQIA is required to assess impacts over both shorter-term and longer-term periods, the activity data presented in Table 2 are assumed to be representative of the proposed activity over the relevant assessment periods.

Table 2 Adopted operational activity rates

Parameter	Units	Annual	Daily maximum
Operating hours	hours	8 760	24
Operating days	days	365	-
Waste receival	-	24 hours, 7 days Peak times from 5 am to 1 pm	
Material despatch	-	24 hours, 7 days Peak times from 5 am to 5 pm	
Material delivery, handling and processing rates			
Residential and commercial recycling material (total) (100 %)	tonnes	120 000	461.6
Paper and cardboard (50 %)	tonnes	60 000	230.8
Glass (26 %)	tonnes	31 200	120.0
Plastic (9 %)	tonnes	10 800	41.5
Metals (5 %)	tonnes	6 000	23.1
Residual (10 %)	tonnes	12 000	46.2
External haulage routes			
Distance travelled by each delivery vehicle from entrance to exit	metres	240	
Average delivery vehicle weight	tonnes	11.5	
Distance travelled by each empty despatch vehicle from entrance to building entrance	metres	188	
Empty despatch vehicle weight	tonnes	21.0	
Distance travelled by each loaded despatch vehicle from building exit to site exit	metres	240	
Full despatch vehicle weight	tonnes	56.0	
Internal haulage routes			
Distance travelled by each despatch vehicle within building	metres	50	
Average despatch vehicle weight	tonnes	38.5	
Vehicle movements			
Heavy vehicle movements (material delivery)	number	30 000	110
Heavy vehicle movements (material despatch)	number	7 800	30

Note: The assumed distribution of waste materials has been adopted following review of typical composition of kerbside recycling bins from the National Waste Report 2020[1]. These data are used in the emissions estimation outlined in Section 5.2.2.

[1] http://www.environment.gov.au/system/files/pages/5a160ae2-d3a9-480e-9344-4eac42ef9001/files/national-waste-report-2020.pdf

It is noted that the maximum daily rate of material handling and processing has been assumed to be 1.4 times that of the average daily rate. This is likely to be a conservative assumption although has been adopted to ensure that the predicted short-term impacts are not underestimated. The likelihood of the maximum daily handling and processing rate being coincidental with the meteorological conditions which may give rise to the worst-case impacts is low but is required to be assessed in this manner.

A peak to average activity factor of ×1.4 provides an equivalent *pro-rata* annual waste activity rate of 168 000 tpa of co-mingled recyclables would be received at the Proposal site each year (120 000 t × 1.4). That assumption equates to a peak daily activity rate of 461.6 tonnes per day ($t \cdot day^{-1}$) (as presented in Table 2).

For clarity, that assumption is not the proposed annual waste acceptance capacity, but the equivalence of applying the above peak to average activity factor to the annual throughput for the purposes of the AQIA only.

This assumption is consistent with recently performed AQIA for similar facilities in Sydney (e.g. Chullora MRF (Katestone, 2020) assumed a peak to average activity factor of ×1.3). The reality of waste collection contracts would mean that the potential for peak rates to exceed that assumption are low, and it is considered to represent a suitable worst-case assumption.

3. LEGISLATION, REGULATION AND GUIDANCE

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

3.1 Ambient Air Quality Standards

The Approved Methods lists the statutory methods that are to be used to model and assess emissions of criteria air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria for the Proposal. The criteria listed in the Approved Methods are derived from a range of sources (including NHMRC, NEPC, DoE, WHO and ANZECC). Where relevant to this AQIA (coincident with the potential emissions identified in Section 2.4), the criteria have been adopted as set out in Section 7.1 of NSW EPA (2016) which are presented in Table 3.

Table 3 NSW EPA air quality standards and goals

Pollutant	Averaging period	Units(E)	Criterion	Notes
Particulates (as PM_{10})	24 hours	$\mu g{\cdot}m^{-3}$ (A)	50	Numerically equivalent to the AAQ NEPM(B) standards and goals.
	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)

3.2 NSW Government Air Quality Planning

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

- Legislation: formed principally through the implementation of the *Protection of the Environment Operations Act* 1997 and the Protection of the Environment Operations (Clean Air) Regulations 2010. The overall objective of this legislative instruments is to achieve the requirements of the National Environment Protection (Ambient Air Quality) Measure;
- Clean Air for NSW: The 10-year plan for the improvement in air quality;
- Interagency Taskforce on Air Quality in NSW: a vehicle to co-ordinate cross-government incentives and action on air quality;

- Managing particles and improving air quality in NSW; and
- Diesel and marine emission management strategy.

In regard to the relevance of the NSW Government's drive to improve air quality across the State and this AQIA, it is imperative that it is demonstrated that the Proposal would lead to the development of the NSW economy (in terms of activity and employment) and not cause an unacceptable environmental detriment to achieve its objective.

3.3 Odour Assessment Criteria

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".

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the odour threshold and defines one odour unit (OU). An odour goal of less than 1 OU would theoretically result in no odour impact being experienced. In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions.

Based on the literature available, the level at which an odour is perceived to be a nuisance can range from 2 OU to 10 OU depending on a combination of the following factors:

- Odour Quality: whether an odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold (lower offensiveness) than a mixture of compounds.
- Population sensitivity: any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it contains.
- Background level: whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely located sources it may be necessary to apply a lower threshold to prevent offensive odour.
- Public expectation: whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive until a higher threshold is reached than for odours from a landfill facility.
- Source characteristics: whether the odour is emitted from a stack (point source) or from an area (diffuse source). Generally, the components of point source emissions can be identified and treated more easily using control equipment than diffuse sources. Point sources tend to be located in urban areas, while diffuse sources are more prevalent in rural locations.

- Health Effects: whether a particular odour is likely to be associated with adverse health effects. In general, odours from agricultural activities are less likely to present a health risk than emissions from industrial facilities.

Experience gained through odour assessments from proposed and existing facilities in NSW indicates that an odour performance goal of 7 OU is likely to represent the level below which "offensive" odours should not occur (for an individual with a 'standard sensitivity' to odours). Therefore, the Odour Technical Framework (DECC, 2006a) recommends that, as a design goal, no individual be exposed to ambient odour levels of greater than 7 OU. This is expressed as the 99th percentile value, as a nose response time average (approximately one second).

Odour assessment criteria need to take into account the range in sensitivities to odours within the community in order to provide additional protection for individuals with a heightened response to odours. This is addressed in the Technical Framework (DECC, 2006a) by setting a population dependant odour assessment criterion. In this way the odour assessment criterion allows for population size, cumulative impacts, anticipated odour levels during adverse meteorological conditions and community expectations of amenity. A summary of odour performance goals for various population densities, as referenced in the Odour Technical Notes is shown in Table 4. This table shows that in situations where the population of the affected community lies between 125 and 500 people, an odour assessment criterion of 4 OU at the nearest residence (existing or any likely future residences) is to be used. For isolated residences, an odour assessment criterion of 7 OU is appropriate.

Table 4 NSW EPA Technical Framework odour criteria

Population of Affected Community	Impact Assessment Criteria for Complex Mixture of Odours (OU)
Urban area (≥2000)	2.0
500 – 2000	3.0
125 – 500	4.0
30 – 125	5.0
10 – 30	6.0
Single residence (≤2)	7.0

Source: The Odour Technical Notes, DEC 2006

The NSW EPA generally determines that in the Sydney Metropolitan region, an odour performance goal of 2 OU should be applied. The 2 OU goal has therefore been adopted for the purposes of this assessment.

3.4 Protection of the Environment Operations Act 1997

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

Clause 129 is associated with emissions of odours from premises licensed for scheduled activities, and is relevant to the Proposal site:

> *(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.*
>
> *(2) It is a defence in proceedings against a person for an offence against this section if the person establishes that—*
>
> > *(a) the emission is identified in the relevant environment protection licence as a potentially offensive odour and the odour was emitted in accordance with the conditions of the licence directed at minimising the odour, or*
> >
> > *(b) the only persons affected by the odour were persons engaged in the management or operation of the premises.*
>
> *(3) A person who contravenes this section is guilty of an offence.*

The POEO Act 1997 defines offensive odour 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.*

Mitigation measures would be in place at the Proposal site to ensure that no offensive odour would be emitted from the Premises. The efficacy of those controls is subject to quantitative assessment within this AQIA.

3.5 Protection of the Environment (Clean Air) Regulation 2021

The Protection of the Environment Operations (POEO) (Clean Air) Regulation (2021) sets requirements and standards of concentration relevant to the Proposal.

The Proposal would be operated, and equipment maintained in an appropriate manner, to ensure that general standards of concentration, and requirements associated with emissions from motor vehicles are achieved.

4. EXISTING CONDITIONS

4.1 Surrounding Land Sensitivity

4.1.1 Land Use Zoning

Land use zoning as a mechanism to provide planning and environmental control to achieve the objectives of the *Environmental Planning and Assessment Act* (1979).

The land use surrounding the Proposal site is zoned by Blacktown City Council in the Blacktown Local Environmental Plan (2015) and is illustrated in Figure 3. The land surrounding the Proposal site is zoned as IN1 (General Industrial).

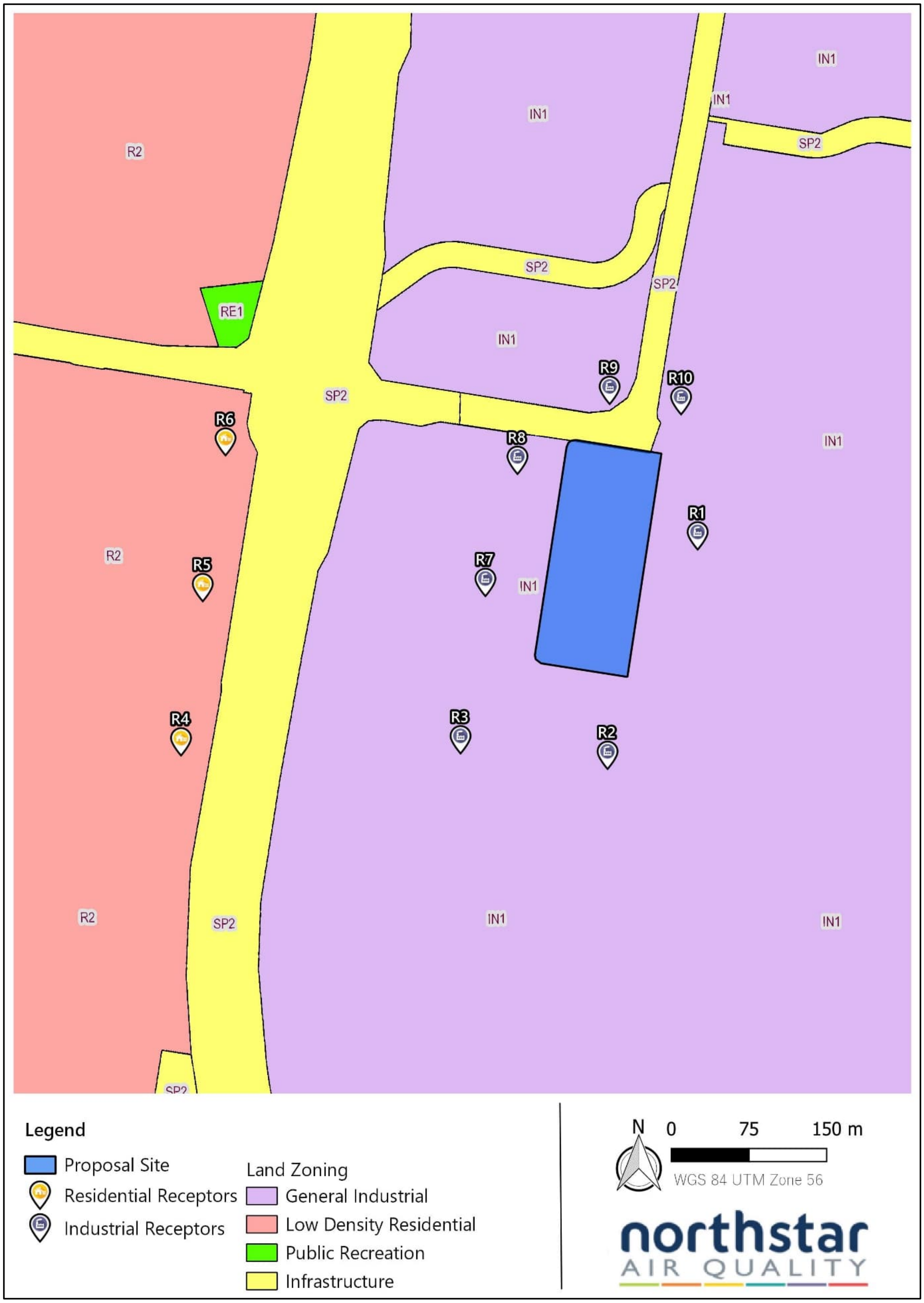
4.1.2 Discrete Receptor Locations

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed. Typically, these locations are identified as residential properties although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

It is noted that one of the assessment criteria applied to particulates (see Section 3.1) is over a 24-hour averaging period, and as such the predicted impacts need to be interpreted at commercial and industrial receptor locations with care. It is considered to be atypical for a person to be at those locations for a complete 24-hour period and as such the exposure risks at those locations would be over-estimated by the modelling assessment. Correspondingly, pollutant averaging periods of 8-hours or less (representative of a working shift) are assessed at all receptor locations and 24-hour impacts are assessed at residential locations.

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

Figure 3 Land use zoning



Source: Image courtesy of NSW Department of Planning and Environment

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

To ensure that the selection of discrete receptors for the AQIA are reflective of the locations in which the population of the area surrounding the Proposal site reside, population density data has been examined. Population density data based on the 2016 census have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre (km^2) grid, covering mainland Australia (ABS, 2017). Using a Geographical Information System (GIS), the locations of sensitive receptor locations have been confirmed with reference to their population densities. Using ABS data in a GIS, the population density of the area surrounding the Proposal site are presented in Figure 4.

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
- None 0

The Proposal site is located in an area of very low / low population density which would be expected given the industrial nature of the surrounding area. Medium population densities are observed to the west and north-west of the Proposal site.

The receptors adopted for use within this AQIA are presented in Table 5. This selection is derived from the information presented in Figure 3 and Figure 4.

Table 5 Discrete sensitive receptor locations used in the study

Rec.	Land Use	Distance to Proposal site (m)	Location (UTM)	
			mE	mS
R1	Industrial	48	300 978	6 262 149
R2	Industrial	93	300 891	6 261 937
R3	Industrial	119	300 749	6 261 952
R4	Residential	356	300 479	6 261 950
R5	Residential	325	300 500	6 262 099
R6	Residential	325	300 522	6 262 240
R7	Industrial	56	300 773	6 262 104
R8	Industrial	43	300 804	6 262 222
R9	Industrial	38	300 893	6 262 290
R10	Industrial	40	300 962	6 262 280

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

Figure 4 Population density and sensitive receptors surrounding the Proposal site

Note: Image courtesy of Google Maps

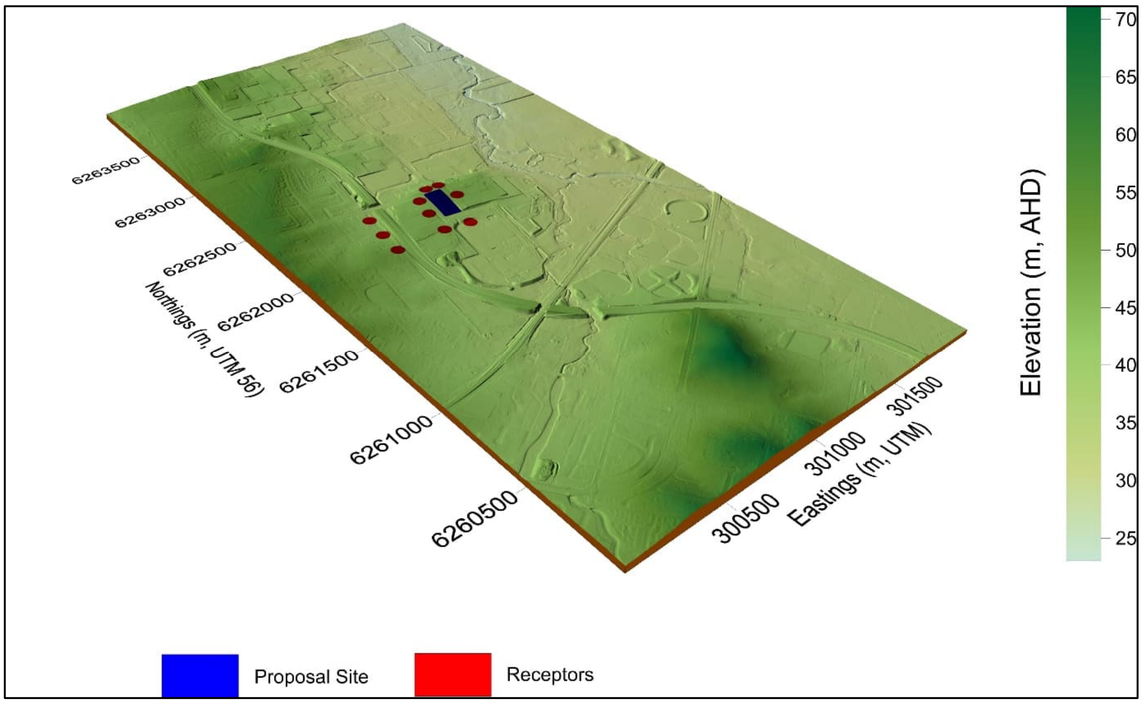
4.1.3 Uniform Receptor Locations

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

4.2 Topography

The elevation of the Proposal site is approximately 45 m Australian Height Datum (AHD). The topography between the Proposal site and nearest sensitive receptor locations is uncomplicated, from an air quality modelling perspective.

Figure 5 Local topography surrounding the Proposal site



4.3 Meteorology

The meteorology experienced within an area can govern the generation (in the case of wind-dependent emission sources), dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorological conditions surrounding the Proposal site have been characterised using data collected by the Australian Government Bureau of Meteorology (BoM) at a number of surrounding Automatic Weather Stations (AWS), and through a meteorological modelling exercise. A summary of the inputs and outputs of the meteorological modelling assessment, including validation of those outputs is presented in Appendix A.

A summary of the relevant AWS operated by BoM is provided in Table 6 (listed by proximity).

Table 6 Details of meteorological monitoring surrounding the Proposal site

Site Name	Approximate Location (UTM)		Approximate Distance
	mE	mS	km
Horsley Park Equestrian Centre AWS - Station # 67117	301 708	6 252 298	9.8
Penrith Lakes AWS – Station # 67113	284 871	6 266 524	16.5
Badgerys Creek AWS – Station # 677108	289 920	6 246 951	18.6

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

The majority of wind speeds experienced at Horsley Park Equestrian Centre AWS over the 5-year period 2016 to 2020 are generally in the range < 0.5 metres per second ($m \cdot s^{-1}$) to 5.5 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from a westerly and south-easterly direction. Winds of this speed are not frequent, occurring less than 1 % of the observed hours over the 5-year period. Calm winds prevail, occurring more than 17 % of observed hours.

Given the wind distributions across the years examined, data for the year 2018 has been selected as being appropriate for further assessment, as it best represents the general trend across the 5-year period studied. Reference should be made to Appendix A for further details.

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 will vary depending on the pollutants to be assessed and can often be characterised by using representative air quality monitoring data. For this study, the most recent five years of complete data (2016-2020) has been assessed to determine the background air quality environment surrounding the Proposal site.

The Proposal site is located proximate to a number of AQMS operated by NSW DPIE. These locations (listed by proximity) are summarised in Table 7.

Table 7 Closest DPIE AQMS to the Proposal site

AQMS Location	Data Availability	Distance to Site (km)	Measurements		
			PM_{10}	$PM_{2.5}$	TSP
Blacktown	Decommissioned	5.2	×	×	×
Prospect	2007 - present	6.7	✓	✓	×
St Marys	1992 - present	8.6	✓	✓	×
Parramatta North	2017 - present	14.2	✓	✓	×

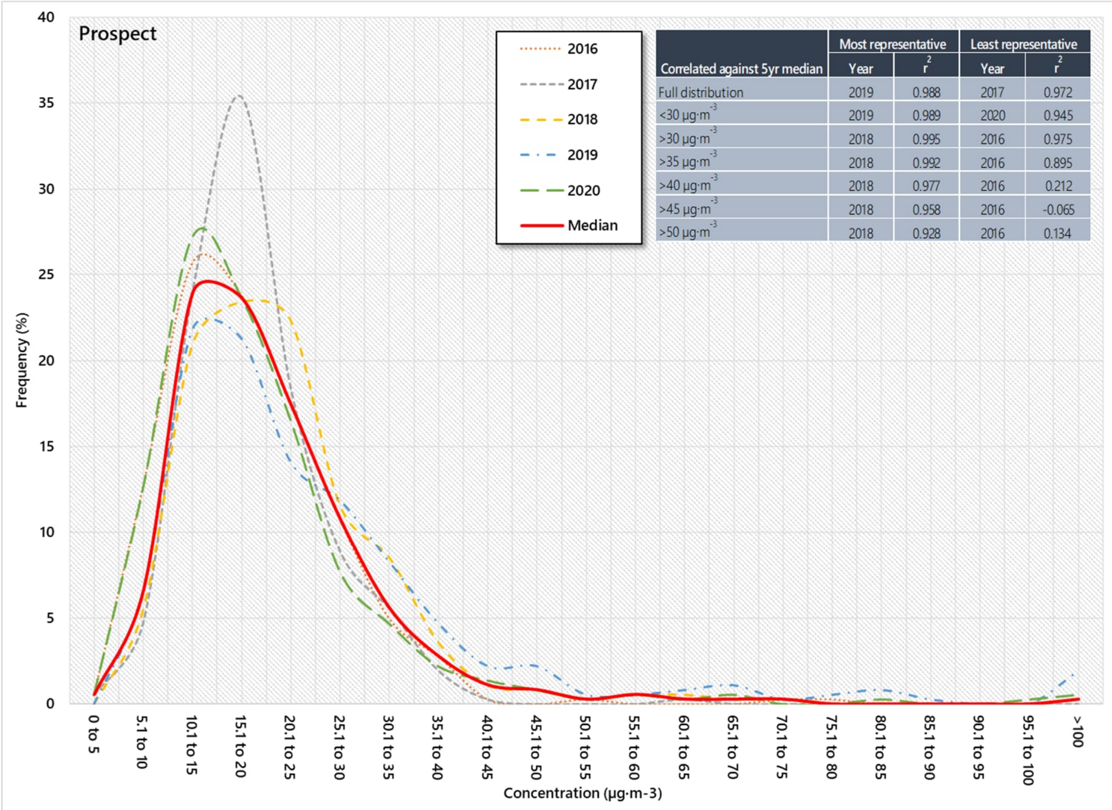
The closest active AQMS is noted to be located at Blacktown, however, this monitoring station has been decommissioned and therefore data from Prospect AQMS has been obtained for this assessment and is considered to be reflective of the conditions at the Proposal site, given its proximity and siting.

Data from the year 2018 have been selected for use in the AQIA to provide an approximation of 'representative' conditions surrounding the Proposal site. This year has been selected through examination of meteorology and air quality for the five-year period 2016 to 2020. In terms of background air quality, the year 2018 was selected as being most representative as PM_{10} data measured at the Prospect AQMS in 2018 were statistically shown to be most representative of the five-year median particulate distribution at that location, when considering the particulate distribution > 30 µg·m^{-3} (see Figure 6). Adoption of this background dataset ensures that the higher background concentrations (> 30 µg·m^{-3}) are appropriately assessed, when adding the predicted incremental particulate concentrations.

A full summary of air quality monitoring data measured at Prospect AQMS for the year 2018 (consistent with the selected meteorological period) is provided in Appendix B.

The background air quality data has been utilised in this AQIA to assess the contribution of the Proposal to the air quality of the surrounding area. A full discussion of how the Proposal impacts upon local air quality is presented in Section 6.

Figure 6 Statistical analysis of PM_{10} concentrations at Prospect, 2016 to 2020



Correlated against 5yr median	Most representative		Least representative	
	Year	r^2	Year	r^2
Full distribution	2019	0.988	2017	0.972
<30 µg·m^{-3}	2019	0.989	2020	0.945
>30 µg·m^{-3}	2018	0.995	2016	0.975
>35 µg·m^{-3}	2018	0.992	2016	0.895
>40 µg·m^{-3}	2018	0.977	2016	0.212
>45 µg·m^{-3}	2018	0.958	2016	-0.065
>50 µg·m^{-3}	2018	0.928	2016	0.134

4.5 Potential for Cumulative Odour Impacts

A desktop review of surrounding sources of potential odour was performed to determine the potential for cumulative odour impacts associated with the Proposal, using published separation distances as a screening approach to understand the potential for cumulative odour impacts. The identified surrounding sources of potential odour are presented in Table 8. These sources were identified through a review of the NSW major projects website[2] and Google Earth.

Table 8 Surrounding sources of potential odour

Source	Location	Activity	Distance and Direction from Site (km)
Cleanaway Glendenning ERS Liquid Waste Depot	6/8 Rayben Street, Glendenning	Liquid waste treatment	1.4 / N
Wanless Waste Management	120 Kurrajong Avenue, Mount Druitt	Materials recycling facility	4.4 / W

2 https://www.planningportal.nsw.gov.au/major-projects

Bingo Eastern Creek Recycling Ecology Park	1 Kangaroo Avenue, Eastern Creek	C & D Landfill, Recycling centre	4.4 / SW
Cleanaway Blacktown Municipal Collections Site	9 Bessemer Street, Blacktown	Solid waste collection	5.2 / NE

Separation distance guidelines provide recommended separation distances between various pollution emitters and sensitive land uses. They aim to ensure incompatible land uses are located in a way that minimise the impacts of odour and polluting air emissions.

The NSW EPA or DPIE do not publish separation distance guidelines. The ACT Environment, Planning and Sustainable Development Directorate have released a separation distance guideline for air emissions in November 2018, which consequently provides the most contemporary reference in regard to separation distances (ACT EPSDD, 2018).

The most appropriate recommended separation distance as published by ACT EPSDD relating to the identified surrounding activities are presented in Table 9. ACT EPSDD do not provide any detail as to the scale of activities which are associated with the recommended separation distances. It is noted that Cleanaway Glendenning Liquid Waste Depot and Cleanaway Municipal Collections Site (refer Table 8) do not fall within the category of either landfill or materials recovery facility. The larger separation distance of 500 m (refer Table 9) has been applied to these sources to adopt a more conservative approach.

Table 9 Recommended Separation Distance

Activity	Comments	Recommended separation distance (m)
Landfill	Municipal solid waste and commercial and industrial waste landfill activities	500
Materials Recovery Facility	Collecting, dismantling, treating, processing, storing or recycling used or surplus materials	300

The recommended separation distances for the identified facilities and the Proposal are presented in Figure 7 which indicates that the separation distances do not encroach on the Proposal site and correspondingly the risk for potential cumulative odour impacts is considered to be negligible.

It is understood that NSW EPA has received a significant number of complaints from residents in the Minchinbury area during the late autumn and winter 2021, describing an odour similar to rotten eggs. Odour of this character is generally associated with anaerobic digestion of waste materials, and has been attributed to the Bingo Eastern Creek Landfill. The character of any odour resulting from the activities to be performed at the Proposal site is likely to be significantly different, and the potential for cumulative impacts is anticipated to be minimal.

Figure 7 Surrounding sources of potential odour and recommended separation distances

Note: Image courtesy of Google Maps

5. METHODOLOGY

5.1 Construction Phase

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

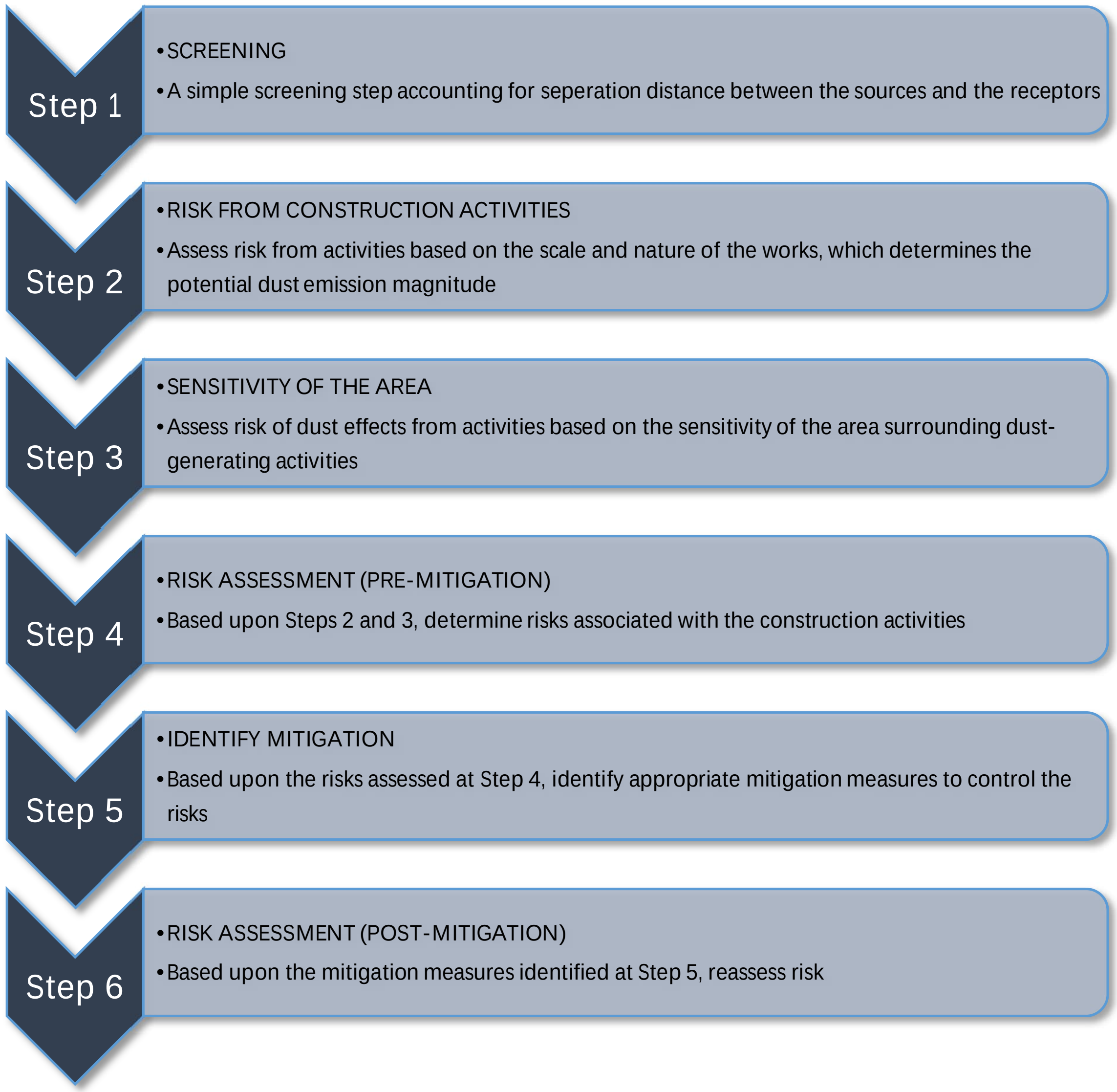
Modelling of dust from construction Proposals is generally not considered appropriate, as there is a lack of reliable emission factors from construction activities upon which to make predictive assessments, and the rates would vary significantly, depending upon local conditions. In lieu of a modelling 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)[3]. Reference should be made to Appendix D 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 8.

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

Figure 8 Construction phase impact risk assessment methodology



The assessment approach, as illustrated above in Figure 8, is detailed in Appendix D.

5.2 Operational Phase

5.2.1 Dispersion Modelling

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling has been performed in CALPUFF 2-dimensional (2-D) mode.

The meteorological dataset has been developed using The Air Pollution Model (TAPM, v 4.0.4) (see Appendix A for further information).

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

The modelling scenario used in this AQIA provides an indication of the air quality impacts of the operation of activities at the Proposal site. Added to these impacts are background air quality concentrations (where available and discussed in Section 4.4) which represent the air quality which may be expected within the area surrounding the Proposal site, without the impacts of the Proposal itself.

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

5.2.2 Emissions Estimation

The estimation of emissions from a process is typically performed using direct measurement or through the application of factors which appropriately represent the processes under assessment. This assessment has adopted emission factors for materials handling processes, and movement of trucks on paved site roads, as contained within the US EPA AP-42 emission factor compendium (USEPA, 2006) to represent the emission of particulate matter resulting from the operations occurring at the Proposal site as described in Section 2.4.

Emissions resulting from the loading of materials, and transfer of materials (except for road transport), have been estimated using the US EPA AP-42 emission factor for batch drop, or conveying processes. The emissions of particulate matter from these processes have been estimated using emission factors presented in Section 13.2.4.3 of AP-42 (Aggregate Handling and Storage Piles) (US EPA, 2006b).

This emission factor can result from several distinct source activities because the adding or removal of material from a storage pile or receiving surface results in batch drop operations and in other cases continuous drop operations. For either type of drop events, the emission factor can be estimated through:

$$EF\ (kg.tonne^{-1}) = k(0.0016)\frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}$$

where:

$EF_{(kg \cdot tonne^{-1})}$ = emission factor

k = particle size multiplier, where TSP = 0.74; PM_{15} = 0.48; PM_{10} = 0.35; PM_{5} = 0.20; $PM_{2.5}$ = 0.053

U = mean wind speed, meters per second ($m \cdot s^{-1}$) – taken to be 2.2 $m \cdot s^{-1}$, based on the wind speed modelled at the Proposal site in 2018

M = material moisture content (%) – taken to be 2 %

The quality rating for this application is rated A.

In relation to odour, emissions associated with the 5 % of contaminated material assumed to be present at the Proposal site have been calculated based on emission factors associated with municipal solid waste, in the absence of more specific data. It has been assumed that 57.7 t of material would be received at the Proposal site each hour during a peak busy day (461.6 t / 8 hours [peak hour of 5 am to 1 pm]), and of that, 5 %, or 2.9 t, may be contaminated. Applying an emission factor of 113.5 odour units per tonne of waste per second ($OU \cdot m^3 \cdot t^{-1} \cdot s^{-1}$) results in an emission rate of 327.5 $OU \cdot m^3 \cdot s^{-1}$. The emission factor has been sourced from monitoring data (TOU, 2018) and as applied in a recent co-mingled recycling SSD AQIA (Katestone, 2020).

The evaluation of odour impacts requires the estimation of short or peak concentrations on the time scale of less than one second. Dispersion model predictions are typically valid for averaging periods of one hour and longer. Dispersion models therefore need to be supplemented to accurately simulate atmospheric dispersion of odours and the instantaneous perception of odours by the human nose. The prediction of peak concentrations from estimates of ensemble means can be obtained from a ratio between extreme short-term concentration and longer-term averages. Properly defined peak-to-mean ratios depend upon the type of source, atmospheric stability and distance downwind. The NSW EPA recommended factor for estimating peak concentrations for volume source is 2.3, in all atmospheric conditions. This factor has been adopted within this assessment.

It is noted that emissions of odour and particulate matter are assumed to occur from the Proposal site over a period of 24 hours per day, and the basis for the calculation of emissions is conservative and predicted impacts will be correspondingly conservative. It is important to note that no reduction in odour has been assumed in the modelling assessment, although in reality, the containment of potentially odorous materials in either the glass silo, or other containment (including the building itself), would provide some level of emission reduction.

A full description of the emission sources included in the assessment for each scenario, and the emission factors and assumptions adopted are presented in Appendix C. The factors adopted are presented in Table 10.

Table 10 Adopted particulate matter emission factors

Emission source	Emission factor	Emission rate			Justification
		TSP	PM_{10}	$PM_{2.5}$	
Haulage	Paved roads (13.2.1 – AP-42)	0.072 $kg{\cdot}VKT^{-1}$	0.013 $kg{\cdot}VKT^{-1}$	0.0034 $kg{\cdot}VKT^{-1}$	Factor associated with paved roads (AP42) with a silt content of 2 $g{\cdot}m^{-2}$ adopted.
Loading and unloading material, Material flow through processing equipment	Batch drop (13.2.4.3 – AP-42)	0.0012 $kg{\cdot}t^{-1}$	0.0006 $kg{\cdot}t^{-1}$	0.00009 $kg{\cdot}t^{-1}$	AP-42 equation uses material and site-specific data and is used for the aggregate handling industry. Assumed material moisture content of 2 % for all materials and average wind speed of 2.2 $m{\cdot}s^{-1}$ (considered worst case given that the building will afford a significant amount of wind shielding)
Conveyor transfer points	Conveyor transfer point (11.9.2.1 - AP-42)	0.0015 $kg{\cdot}t^{-1}$	0.00055 $kg{\cdot}t^{-1}$	0.00015 $kg{\cdot}t^{-1}$	The AP-42 factor adopted is a constant factor for conveyor transfer points in the aggregate handling industry.

Wind erosion has not been considered within the dispersion modelling assessment. Given the nature of the materials received and activities to be performed at the Proposal site, a significant quantity of particulate matter is not anticipated to be present on the hardstand surfaces of either the internal or external hardstand areas. Furthermore, available emission factors which account for wind erosion are generally associated with the mining industry, and are relevant to areas which experience a constant replenishment of fine particulate material (e.g. coal dust). Given that the factors already applied to the materials receival, handling and processing activities at the Proposal site are already conservative, the inclusion of unrealistic emissions of particulate matter from clean hardstand areas is not considered to appropriately reflect actual site operations. The non-inclusion of wind erosion sources is consistent with a recent SSD AQIA for a similar co-mingled recycling facility in Sydney (Katestone, 2020).

5.2.3 Emissions Controls

This section discusses the control measures to be adopted as part of the operational phase of the Proposal.

All materials receival, handling, processing and loading activities will occur in an enclosed building, with fast acting roller doors operated. The use of an enclosed building will act to reduce wind shear, and wind speeds within that building, resulting in significantly lower generation of particulate matter, and reduce the potential for that material to be transported offsite. In accordance with (NPI, 2012), an emission control factor of 70 % has been applied to particulate emissions generation due to the operation of all activities within the enclosed building.

For the purposes of dispersion modelling, emissions of particulate matter (and odour) have been assumed to be released from each of the nine openable doors at the Proposal site. This is not anticipated to occur in reality, as the fast-acting roller doors would be closed, although the modelling has been performed in this manner to assess potential worst-case impacts on surrounding receptors.

For clarity, the fast-acting roller shutter doors will be closed at all times except to allow the ingress and egress of vehicles. The control factor applied to account for the effect of enclosure on the propagation of particulate emissions assumes that 70 % of particulates would be controlled and correspondingly, 30 % may be emitted (see Table 11). This control factor accounts for the potential emission during periodic door openings for vehicle access.

A range of dust collection equipment will be included on the materials sorting lines, and for the purposes of this assessment, that equipment is assumed to be included on all conveyor transfer points, the air separator, the glass breaker, ballistic separator, plastic separator, and metals magnet. Although a particulate control efficiency for such equipment is not provided in the literature, an efficiency of 50 % has been adopted and is considered to be reasonable. Air from these dust collection systems will be passed through filtration units which will be cleaned regularly, with any collected dust removed and sent to an appropriate facility for disposal. For the purposes of this assessment, filtered air is assumed to be exhausted within the building fabric and emitted through the doors as described above.

External roadways at the Proposal site would all be constructed of hardstand/paved surface which would be regularly swept to ensure that silt loadings are minimised. In addition, vehicle speeds within the Proposal site will be limited to 15 $km \cdot hr^{-1}$, which would also ensure that any resuspension of deposited material is reduced.

Table 11 provides the emission control efficiencies associated with each adopted management measure. Emissions controls which would be implemented continuously have been included in the dispersion modelling assessment. Those which would be applied on an as-required basis have not been included as they cannot be defensibly included to impact (for example) the maximum 24-hour particulate concentrations.

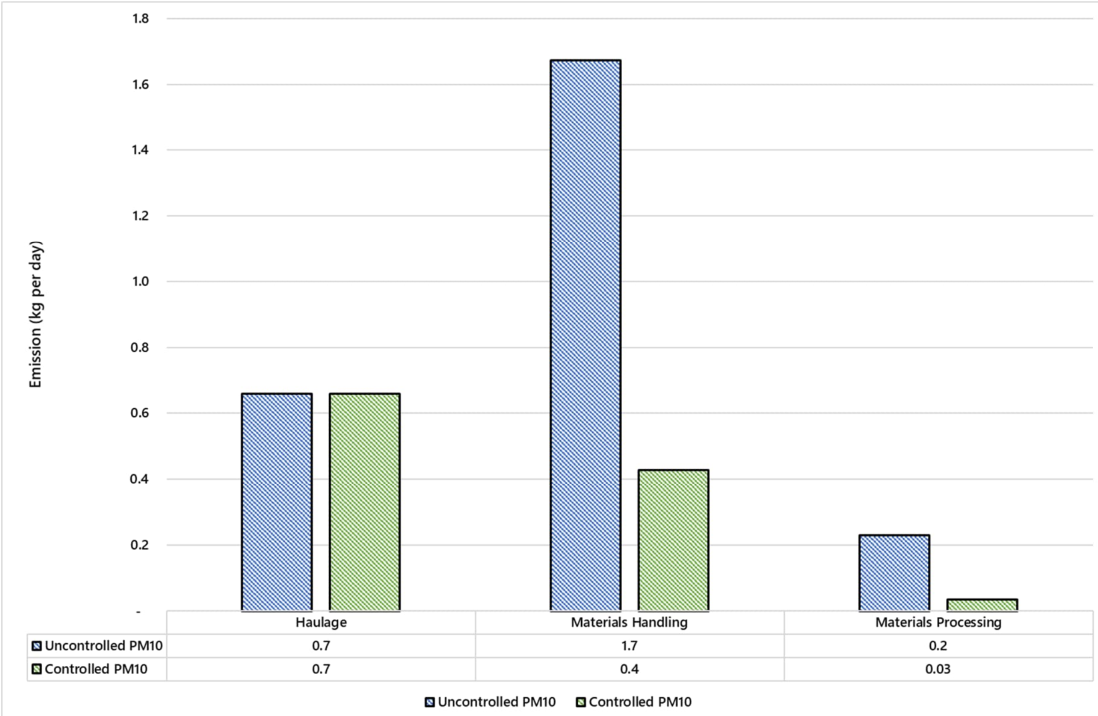
The Proposal would employ best practice emission controls on all activities
Applied conservatism The emission controls outlined in Table 11 are those which will be employed at the Proposal site during operation. Some applied emission control measures do not have an associated emission control efficiency, although their adoption would result in emissions from the Proposal, and subsequent impacts, being lower than those calculated, modelled, and assessed. All of the control measures outlined in Table 11 will be adopted, and their implementation will result in reductions in emissions from the Proposal. The results outlined in Section 6 should therefore be viewed with that conservatism in mind. It is noted that the Proposal does not rely on any unquantifiable emissions reductions to confirm compliance with the environmental objectives outlined in Section 3, rather these controls provide confidence that the results presented in Section 6 would be easily achievable.

Table 11 Emission reduction methods and particulate control efficiencies

Emission control method	Adoption	Control efficiency (%)	Adopted in dispersion modelling	Reference / Notes
Road haulage				
Vehicle restrictions that limit the speed of vehicles on the road	☑	-	☒	Not quantified
Materials handling				
Minimising the drop height from vehicles	☑	30	☒	Adopted as far as practicable. Reduction associated with a drop height reduction from 3 m to 1.5 m (Katestone Environmental Pty Ltd, 2011)
Covering loads with a tarpaulin	☑	-	-	Not quantified
Limit load sizes to ensure material is not above the level of truck sidewalls	☑	-	-	Not quantified
Enclosure	☑	70	☑	Table 4 of (NPI, 2012) (Katestone Environmental Pty Ltd, 2011)
Minimising travel speeds and distances	☑	-	-	Not quantified
Materials processing				
Enclosure	☑	70	☑	Table 4 of (NPI, 2012) (Katestone Environmental Pty Ltd, 2011)

Based on the foregoing, the distribution of calculated annual average uncontrolled and controlled particulate emissions across broad emissions categories is presented in Figure 9 for PM_{10}.

Figure 9 Calculated uncontrolled & controlled peak daily PM_{10} emissions



6. CONSTRUCTION AIR QUALITY IMPACT ASSESSMENT

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

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 D.

6.1 Screening Based on Separation Distance

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

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

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

Table 12 overleaf presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria.

Table 12 Construction phase impact screening criteria distances

Rec	Land Use	Screening Distance (m)		
		Boundary (350 m)	Site Entrance (500 m)	Construction route (50 m)
R1	Industrial	48	110	110
R2	Industrial	93	312	312
R3	Industrial	119	345	177
R4	Residential	357	538	87
R5	Residential	326	452	97
R6	Residential	325	405	104
R7	Industrial	56	210	170
R8	Industrial	44	126	57
R9	Industrial	38	55	24
R10	Industrial	40	48	38

With reference to Table 12, sensitive receptors are noted to be within the screening distance boundaries and therefore require further assessment as summarised in Table 13.

Table 13 Application of step 1 screening

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

6.2 Impact Magnitude

The footprint of the Proposal site (the area affected) is estimated as being approximately 19 948 m^2 (1.9 hectares [ha]) in area.

The Proposal would involve demolition of existing structures and earthworks for the Proposal site area and the construction of a materials recycling facility with an approximate (total) building volume of 103 736 m^3, assuming a footprint of the warehouse and office areas of 7 572 m^2 and an average building height of 13.7 m.

The assumed supply route around the Proposal site during construction works may be up to 100 m in two-way length. It is anticipated that the number of heavy vehicle movements per day required to service the Proposal site would not exceed 50 vehicles each day. For the purposes of the assessment, the route for construction traffic to / from the Proposal site is assumed to be along Woodstock Road towards the Westlink M7.

Based upon the above assumptions and the assessment criteria presented in Appendix D, the dust emission magnitudes are as presented in Table 14.

Table 14 Construction phase impact categorisation of dust emission magnitude

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

6.3 Sensitivity of an Area

6.3.1 Land Use Value

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

The maximum land use value across the identified receptors has been taken forward to be conservative. It is concluded to be *high* for health impacts and for dust soiling, given the distance between the receptors and the Proposal site and the nature of receptors surrounding the site and the PM_{10} annual average concentration of 21.9 $\mu g{\cdot}m^{-3}$ as reported in Appendix B.

6.3.2 Sensitivity of an Area

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

The sensitivity of the surrounding area to health effects is determined to be *medium* and to dust soiling may be identified as being *low*. The assumed existing background annual average PM_{10} concentrations (measured at Prospect in 2018) are reported in Appendix B.

6.4 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 14. The resulting risk of air quality impacts (without mitigation) is as presented in Table 15.

Table 15 Risk of air quality impacts from construction activities

Impact	Sensitivity of Area	Dust Emission Magnitude					Preliminary Risk				
		Demolition	Earthworks	Construction	Track-out	Const. Traffic	Demolition	Earthworks	Construction	Track-out	Const. Traffic
Dust Soiling	low	large	large	large	med	large	high	med	med	low	med
Human Health	med	large	large	large	med	large	high	med	med	low	med

The risks summarised in Table 15 show that there is a *high* risk of adverse dust soiling and *high* risk of human health impacts at sensitive receptors, if no mitigation measures were to be applied to control emissions associated with demolition. Earthworks, construction and construction traffic activities are associated with a *medium* risk of dust soiling impacts and human health impacts while track-out activities correspondingly have a *low* risk.

6.5 Identified Mitigation

The following represents a selection of recommended mitigation measures recommended by the IAQM methodology for a *high* risk site for demolition. 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).

Table 16 Site-specific management measures

Identified Mitigation		Unmitigated Risk
1	Communications	High
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	H
1.2	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H
1.3	Display the head or regional office contact information.	H
1.4	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	H
2	Site Management	High
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H
2.2	Make the complaints log available to the local authority when asked.	H
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	H
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	H
3	Monitoring	High
3.1	Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary.	H
3.2	Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to the local authority when asked.	H
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H
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	High
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H

Identified Mitigation		Unmitigated Risk
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	High
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	H
5.4	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	H
5.5	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	H
6	Operations	High
6.1	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems	H
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H
6.3	Use enclosed chutes and conveyors and covered skips	H
6.4	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H
6.5	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	H
7	Waste Management	High
7.1	Avoid bonfires and burning of waste materials.	H

Identified Mitigation		Unmitigated Risk
8	Measures Specific to Demolition	High
8.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	H
8.2	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	H
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H
8.4	Bag and remove any biological debris or damp down such material before demolition.	H
8.5	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	H
8.6	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	H
8.7	Only remove the cover in small areas during work and not all at once	H
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
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

Identified Mitigation		Unmitigated Risk
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 (voluntary)

6.6 Risk (Post-Mitigation)

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

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

7. OPERATIONAL AIR QUALITY IMPACT ASSESSMENT

The methodology used to assess operational phase impacts is discussed in Section 5. This section presents the results of the dispersion modelling assessment and uses the following terminology:

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

The results are presented in this manner to allow examination of the likely impact of the Proposal in isolation and the contribution to air quality impacts in a broader sense.

In the presentation of results, the tables included shaded cells which represent the following:

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

Results are presented in this section for the predictions of particulate matter (TSP, PM_{10}, $PM_{2.5}$ and dust deposition) and odour. The averaging periods associated with the criteria for particulate matter is 24-hour and annual averages, as specified in Table 3. The emissions adopted for these scenarios reflect the operational profile of the Proposal over those averaging periods (refer Section 5.2.2).

7.1 Annual Average TSP, PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from the Proposal operations are presented in Table 17.

The results indicate that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at all receptor locations are low (< 2.6 % of the annual average TSP criterion, < 2.8 % of the annual average PM_{10} criterion and < 1.9 % of the $PM_{2.5}$ criterion).

The addition of existing background concentrations (refer Section 4.4), results in predicted concentrations of annual average TSP being < 53 % and annual average PM_{10} being ≤ 91 % of the relevant criteria at the nearest receptors.

The existing adopted annual average $PM_{2.5}$ background concentration is shown to be in exceedance of the relevant criterion (highlighted in Table 17), even without the operation of the Proposal added.

Examination of the predicted $PM_{2.5}$ impacts which would result from the operation of the Proposal indicates that these concentrations are predicted to be < 0.2 µg·m^{-3} at all surrounding receptors (essentially an immeasurable change to background).

The inclusion of the best practice management dust control measures is shown to minimise offsite annual average $PM_{2.5}$ impacts to the maximum extent possible.

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

Table 17 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations

Receptor	Annual Average Concentration (µg·m^{-3})								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Regional Background	Cumulative Impact	Incremental Impact	Regional Background	Cumulative Impact	Incremental Impact	Regional Background	Cumulative Impact
R1	1.8	45.0	46.8	0.5	21.9	22.4	0.1	8.5	8.6
R2	0.7	45.0	45.7	0.2	21.9	22.1	<0.1	8.5	8.6
R3	0.8	45.0	45.8	0.3	21.9	22.2	<0.1	8.5	8.6
R4	0.2	45.0	45.2	<0.1	21.9	22.0	<0.1	8.5	8.6
R5	0.2	45.0	45.2	<0.1	21.9	22.0	<0.1	8.5	8.6
R6	0.2	45.0	45.2	<0.1	21.9	22.0	<0.1	8.5	8.6
R7	2.4	45.0	47.4	0.7	21.9	22.6	0.2	8.5	8.7
R8	1.8	45.0	46.8	0.5	21.9	22.4	0.1	8.5	8.6
R9	1.3	45.0	46.3	0.4	21.9	22.3	<0.1	8.5	8.6
R10	1.3	45.0	46.3	0.4	21.9	22.3	<0.1	8.5	8.6
Criterion	-	90		-	25		-	8	

Predictions of incremental annual average PM_{10} and $PM_{2.5}$ concentrations are presented in Figure 10 and

Figure 11 to show the distribution of particulate matter around the Proposal site.

Figure 10 Predicted incremental annual average PM_{10} concentrations - operation

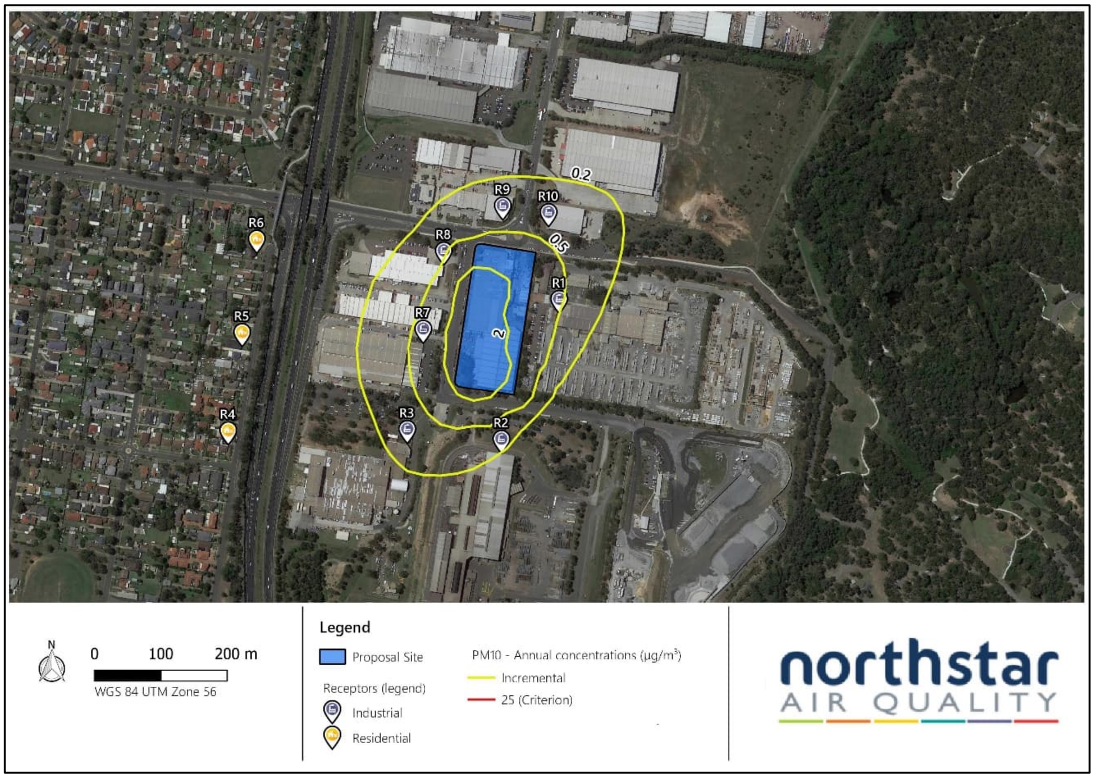


Figure 11 Predicted incremental annual average $PM_{2.5}$ concentrations - operation

7.2 Annual Average Dust Deposition Rates

Table 18 presents the annual average dust deposition predicted as a result of the operations at the Proposal site. An assumed background dust deposition of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ is presented in Table 18, although comparison of the incremental concentration with the incremental criterion of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ is also valid (as discussed within Section 4.4). In either case, the resulting conclusions drawn are identical. Annual average dust deposition is predicted to meet the criteria at all receptors surrounding the Proposal site where the predicted impacts are < 9 % of the incremental criterion at receptor locations.

No contour plot of annual average dust deposition is presented, given the minor contribution from the Proposal at the nearest sensitive receptors.

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

Table 18 Predicted annual average dust deposition

Receptor	Annual Average Dust Deposition ($g{\cdot}m^{-2}{\cdot}month^{-1}$)		
	Incremental Impact	Regional Background	Cumulative Impact
R1	0.1	2.0	2.1
R2	<0.1	2.0	2.1

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incremental Impact	Regional Background	Cumulative Impact
R3	<0.1	2.0	2.1
R4	<0.1	2.0	2.1
R5	<0.1	2.0	2.1
R6	<0.1	2.0	2.1
R7	0.2	2.0	2.2
R8	0.1	2.0	2.1
R9	<0.1	2.0	2.1
R10	<0.1	2.0	2.1
Criterion	2	-	4

7.3 Maximum 24-hour PM_{10} and $PM_{2.5}$

Table 19 presents the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest receptors as a result of the Proposal operations. No background concentrations are included within this table. The maximum predicted incremental impacts at residential receptors (R4-R6) are highlighted in bold text.

Table 19 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations

Receptor	Maximum incremental 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
R1	2.5	0.5
R2	2.1	0.5
R3	1.9	0.4
R4	0.4	<0.1
R5	0.5	0.1
R6	0.5	0.1
R7	3.5	0.7
R8	2.6	0.6
R9	2.6	0.5
R10	2.1	0.4
Criterion	50	25

The predicted maximum incremental concentrations at residential receptors are demonstrated to represent up to 1 % of the PM_{10} criterion, and up to 0.4 % of the $PM_{2.5}$ criterion at receptor R6.

The predicted cumulative maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the Proposal, with background included are presented in Table 20 and Table 21 respectively.

Results are presented in Table 20 and Table 21 for the residential receptor at which the greatest impacts have been predicted (refer to Table 19) for PM_{10} and $PM_{2.5}$.

The left side of Table 20 and Table 21 show the predicted concentration on days with the highest predicted cumulative impacts (generally driven by days of increased background contributions), and the right side shows the total predicted concentration on days with the highest predicted incremental concentrations, respectively.

The analysis indicates that no additional exceedances of the 24-hour average impact assessment criterion for PM_{10} or $PM_{2.5}$ are likely to occur as a result of the operation of the Proposal. Examination of the results for all receptors indicates that no additional exceedances of the PM_{10} and $PM_{2.5}$ criterion are predicted at any receptor location (including at all industrial receptors).

Table 20 Summary of contemporaneous impact and background – PM_{10}

Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) – Receptor 4			Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) – Receptor 6		
	Incr.	Bg	Cumul.		Incr.	Bg	Cumul.
22/11/2018	<0.1	113.3	113.4	26/01/2018	0.5	16.3	16.8
19/03/2018	<0.1	70.2	70.3	28/01/2018	0.4	16.1	16.5
28/05/2018	<0.1	65.8	65.9	28/06/2018	0.4	10.6	11.0
18/07/2018	<0.1	61.9	62.0	14/10/2018	0.4	12.0	12.4
15/02/2018	<0.1	61.6	61.7	6/09/2018	0.4	17.0	17.4
29/05/2018	<0.1	58.7	58.8	13/10/2018	0.4	10.5	10.9
21/11/2018	<0.1	55.7	55.8	17/03/2018	0.4	31.6	32.0
19/07/2018	<0.1	54.4	54.5	9/02/2018	0.4	37.6	38.0
18/03/2018	0.1	47.9	48.0	2/05/2018	0.4	28.3	28.7
14/04/2018	<0.1	47.8	47.9	27/06/2018	0.3	18.4	18.7
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.				These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.			

Note: Incr = Increment, Bg = Background, Cumul = Cumulative impact

Table 21 Summary of contemporaneous impact and background – $PM_{2.5}$

Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) – Receptor 4			Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) – Receptor 6		
	Incr.	Bg	Cumul.		Incr.	Bg	Cumul.
29/05/2018	<0.1	47.5	47.6	26/01/2018	0.1	5.5	5.6
28/05/2018	<0.1	42.5	42.6	28/01/2018	<0.1	4.2	4.3
6/05/2018	<0.1	27.1	27.2	28/06/2018	<0.1	9.6	9.7
27/05/2018	<0.1	27.0	27.1	6/09/2018	<0.1	9.3	9.4
15/07/2018	<0.1	23.1	23.2	14/10/2018	<0.1	4.0	4.1
9/05/2018	<0.1	21.7	21.8	13/10/2018	<0.1	4.6	4.7
25/04/2018	<0.1	20.6	20.7	9/02/2018	<0.1	11.7	11.8
8/05/2018	<0.1	19.9	20.0	17/03/2018	<0.1	11.7	11.8
27/07/2018	<0.1	19.5	19.6	2/05/2018	<0.1	13.3	13.4
26/08/2018	<0.1	18.4	18.5	27/06/2018	<0.1	13.0	13.1
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project.				These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project.			

Note: Incr = Increment, Bg = Background, Cumul = Cumulative impact

Predictions of incremental maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations are presented in Figure 12 and

Figure 13 to show the distribution of particulate matter around the Proposal site.

The performance of the Proposal does not in itself result in any exceedances of the maximum 24-hour average PM_{10} and $PM_{2.5}$ impact assessment criteria.

The implementation of best practice emission controls at the Proposal site results in the minimisation of particulate matter concentrations at surrounding receptors.

7.4 Odour

Presented in Table 22 are the 99th percentile 1-second average odour concentrations predicted at the surrounding receptor locations, as a result of the Proposal operation.

The results presented in Table 22 indicate that the operation of the Proposal would not likely result in any exceedance of the assessment criterion for odour at all receptor locations. Therefore, it would be anticipated that the odour environment currently experienced in the area would not significantly change as a result of the Proposal. As discussed in Section 4.4, the potential for cumulative odour impacts associated with the Proposal and other, similar activities in the area is considered to be low.

Table 22 Predicted 99th percentile odour concentrations

Receptor	99th percentile 1-second average odour (OU)
	Incremental Impact
R1	0.3
R2	0.3
R3	0.3
R4	<0.1
R5	<0.1
R6	<0.1
R7	0.6
R8	0.4
R9	0.3
R10	0.3
Criterion	2.0

The performance of the Proposal is not predicted to result in any exceedances of the odour assessment criteria.

Figure 12 Predicted incremental maximum 24-hour average PM_{10} concentrations - operation

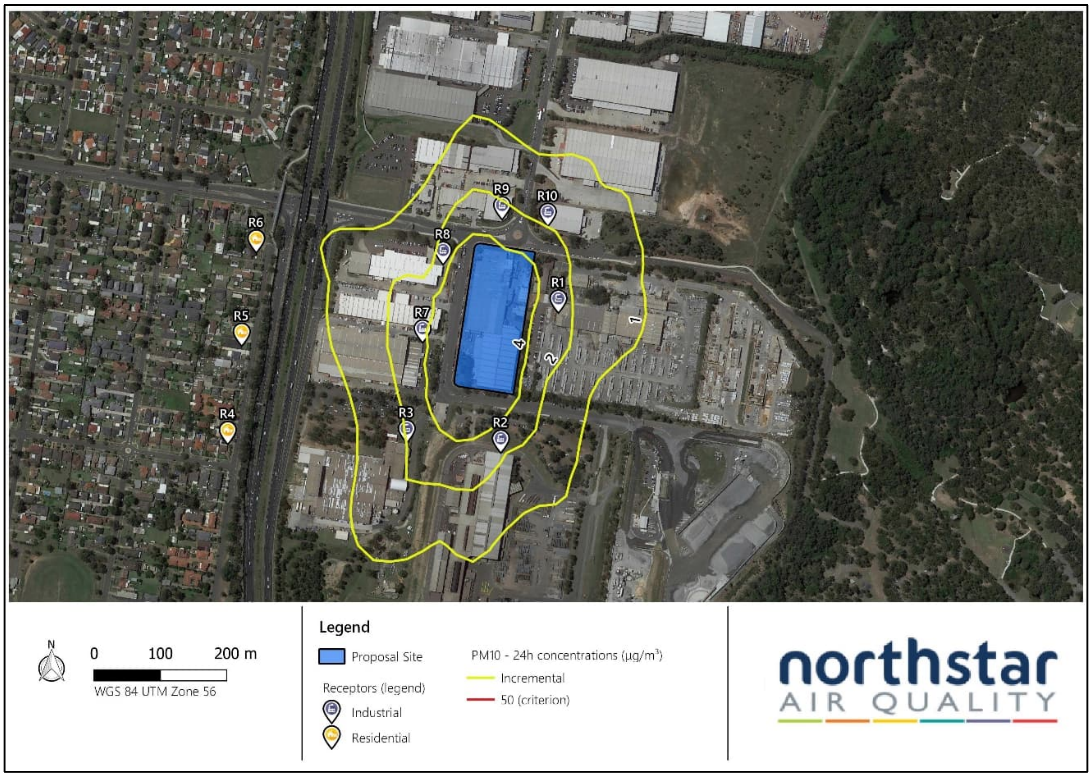
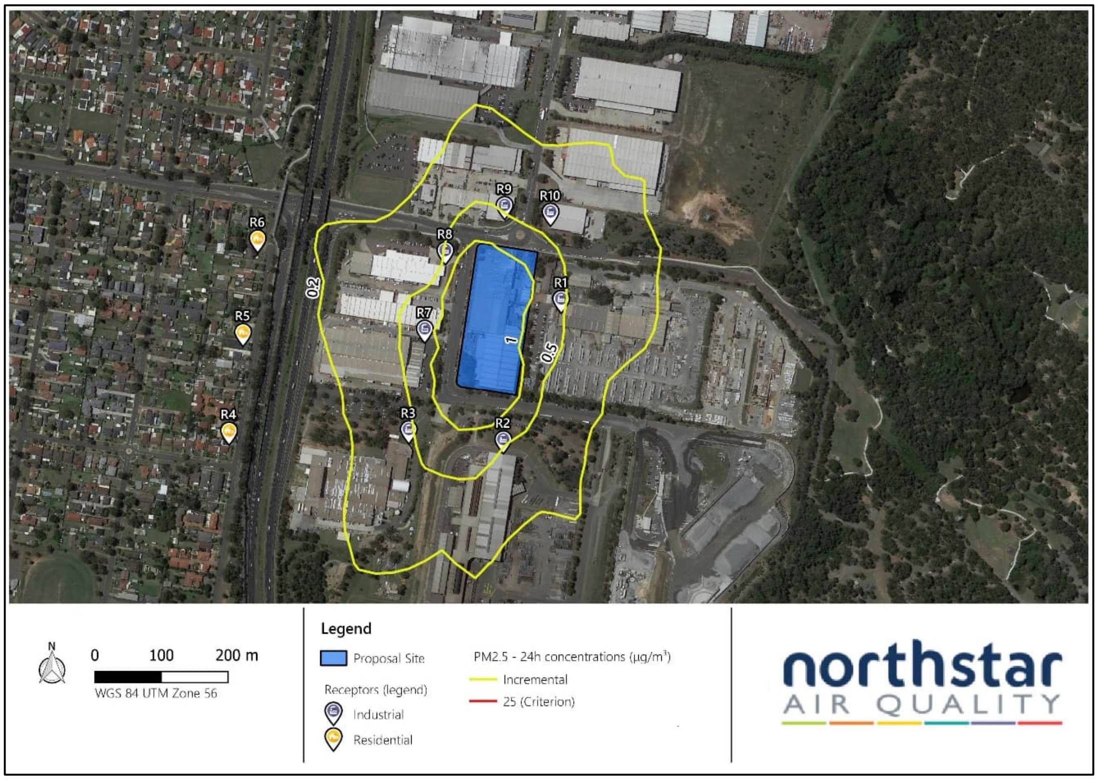


Figure 13 Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations - operation



8. MITIGATION AND MONITORING

Based on the findings of the air quality impact assessment, it is considered that the current Proposal layout and operation will be sufficiently controlled to ensure that exceedances (or additional exceedances in the case of 24-hour PM_{10} and $PM_{2.5}$) would not be experienced as a result of the Proposal operation.

The Proposal has been designed to incorporate best practice particulate matter and odour control, which includes the performance of all activities within an enclosed building on hardstand, as fully described in Section 5.2.3.

The mitigation measures proposed to be included as part of the Proposal operation and the control efficiencies afforded have been presented in Table 11.

In relation to the construction phase, the mitigation measures proposed, which represent the anticipated level of risk associated with that construction, are presented in Section 6.5.

8.1 Air Quality Management Plan

Further to the above mitigation, it is recommended that the proponent implements and maintains an Air Quality Management Plan (AQMP), including procedures for the recording, evaluation and actioning of complaints arising from the proposed activities.

The AQMP should also include some air quality monitoring to confirm the findings of this AQIA and demonstrate compliance with the air quality impact assessment criteria and any other conditions of consent.

9. CONCLUSION

Northstar Air Quality was engaged by Charter Hall Holdings Pty Limited to perform an AQIA for the proposed operation of a materials recycling facility, to be located at 600 Woodstock Avenue, Rooty Hill, NSW.

A construction dust risk assessment has been performed to determine the potential air quality impacts on surrounding receptor locations, and mitigation measures required to manage that risk. Given the size of the Proposal site, the distance to sensitive receptors and the activities to be performed, residual impacts associated with fugitive dust emissions from the construction of the Proposal would be anticipated to be negligible, should the implementation of the mitigation measures be performed appropriately.

A dispersion modelling assessment has been performed in accordance with the requirements of the NSW Approved Methods (NSW EPA, 2016) to determine the likely air quality impacts upon surrounding receptor locations. Activity rates associated with average operational conditions have been used to determine the potential impact and compared against annual average criteria. To determine the potential maximum 24-hour impact of the Proposal, the materials haulage, handling and processing rates have been assumed to be 1.4 times that of the average daily rate. This is considered to represent a conservative assumption and is consistent with previous study for similar processes.

The potential air quality impacts at all the identified receptor locations are presented in Section 6 which documents those predictions as:

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

The operation of the Proposal is not anticipated to result in any additional exceedances of the relevant air quality criteria. The best practice management measures proposed are shown to act to minimise impacts on surrounding receptor locations.

It is respectfully considered that the Proposal should not be rejected on the grounds of air quality.

10. REFERENCES

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APPENDIX A

Meteorology

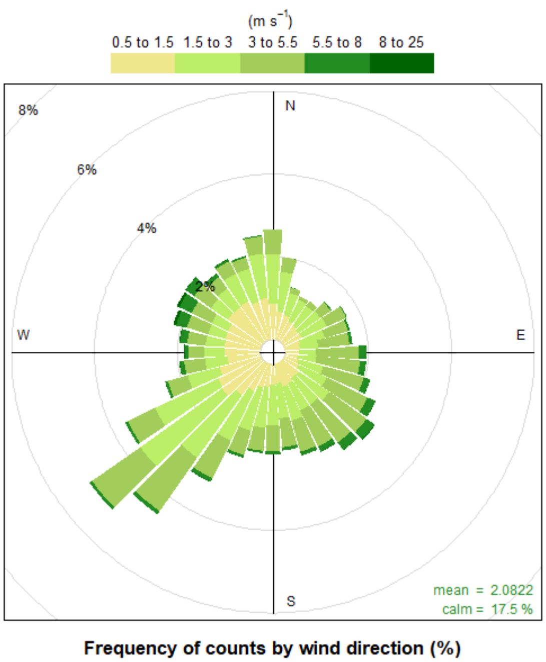
A summary of the relevant meteorological monitoring sites is provided in Table A1.

Table A1 Details of the meteorological monitoring surrounding the Proposal site

Site Name	Approximate Location (UTM)		Approximate Distance
	mE	mS	km
Horsley Park Equestrian Centre AWS - Station # 67117	301 708	6 252 298	9.8
Penrith Lakes AWS – Station # 67113	284 871	6 266 524	16.5
Badgerys Creek AWS – Station # 677108	289 920	6 246 951	18.6

Meteorological conditions at Horsley Park Equestrian Centre AWS have been examined to determine a 'typical' or representative dataset for use in dispersion modelling. Annual wind roses for the most recent years of data (2016 to 2020) are presented in Figure A1.

Figure A1 Annual wind roses 2016 to 2020, Horsley Park Equestrian Centre AWS



The wind roses indicate that from 2016 to 2020, winds at Horsley Park Equestrian Centre AWS show a predominant south-westerly wind direction.

The majority of wind speeds experienced at the Horsley Park Equestrian Centre AWS between 2016 and 2020 are generally in the range 1.5 metres per second (m·s^{-1}) to 5.5 m·s^{-1} with the highest wind speeds (greater than 8 m·s^{-1}) occurring from a north-westerly direction. Winds of this speed are rare and occur less than 1 % of the observed hours during the years. Calm winds (< 0.5 m·s^{-1}) occur for 17 % of hours across the years.

The distribution of winds in year 2018 was selected as the most representative year with a typical profile. Presented in Figure A2 are the annual wind rose for the 2016 to 2020 period and the year 2018, and in Figure A3 the annual wind speed distribution for Horsley Park Equestrian Centre AWS. These figures indicate that the distribution of wind speed and direction in 2018 is very similar to that experienced across the longer-term period.

It is concluded that conditions in 2018 may be considered to provide a suitably representative dataset for use in dispersion modelling.

Figure A2 Annual wind roses 2016 to 2020, and 2018 Horsley Park Equestrian Centre AWS

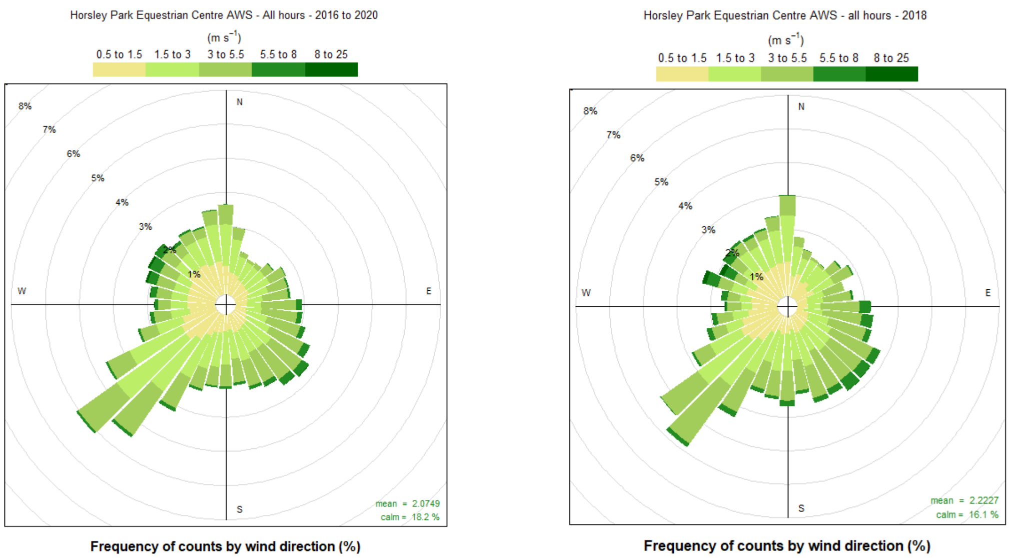
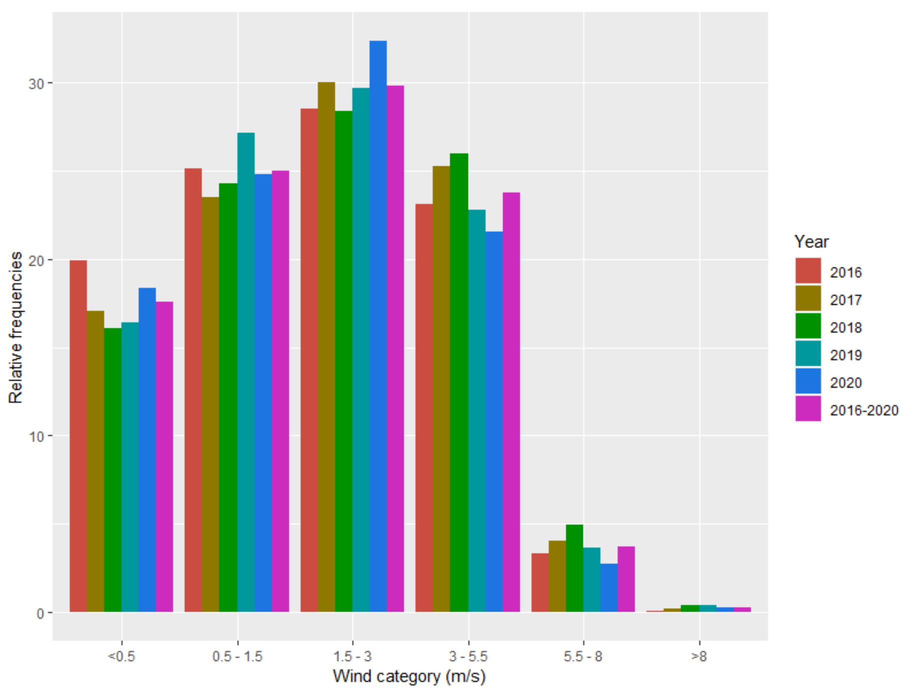


Figure A3 Annual wind speed distribution Horsley Park Equestrian Centre AWS



Meteorological Processing

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

In absence of any measured onsite meteorological data, site representative meteorological data for this project was generated using the TAPM meteorological model in a format suitable for using in the CALPUFF dispersion model (refer Section 5.1).

Meteorological modelling using The Air Pollution Model (TAPM, v 4.0.5) has been performed to predict the meteorological parameters required for CALPUFF. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, precipitation and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

The parameters used in TAPM modelling are presented in Table A1.

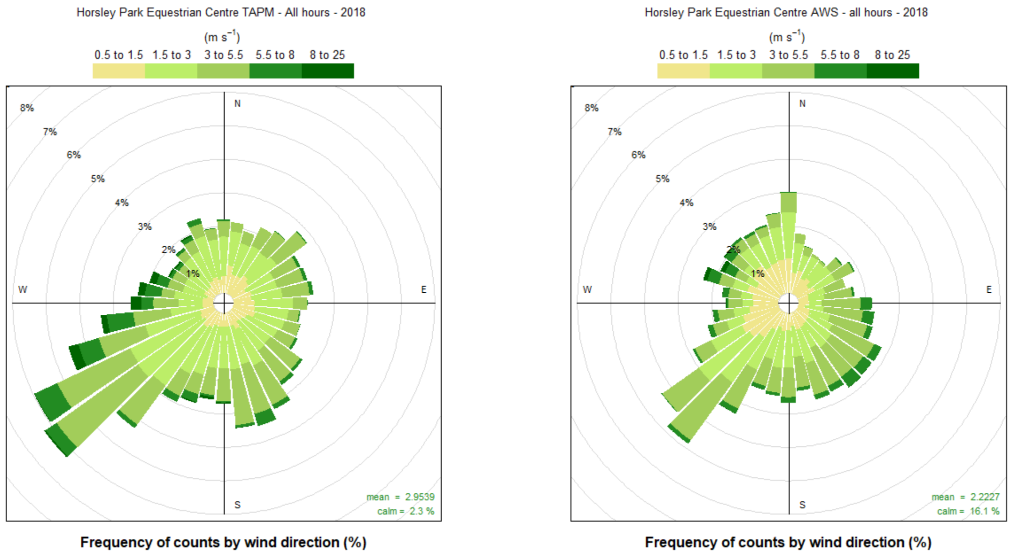
Table A1 Meteorological parameters used for this study

TAPM v 4.0.5	
Modelling period	1 January 2018 to 31 December 2018
Centre of analysis	306 484 mE, 6 252 507 mN (UTM Coordinates)
Number of grid points	25 × 25 × 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	-

A comparison of the TAPM generated meteorological data, and that observed at the Horsley Park Equestrian Centre AWS is presented in Figure A4.

Figure A4 Modelled and observed meteorological data – Horsley Park Equestrian Centre 2018

TAPM generated windrose	Observations at Horsley Park Equestrian Centre AWS

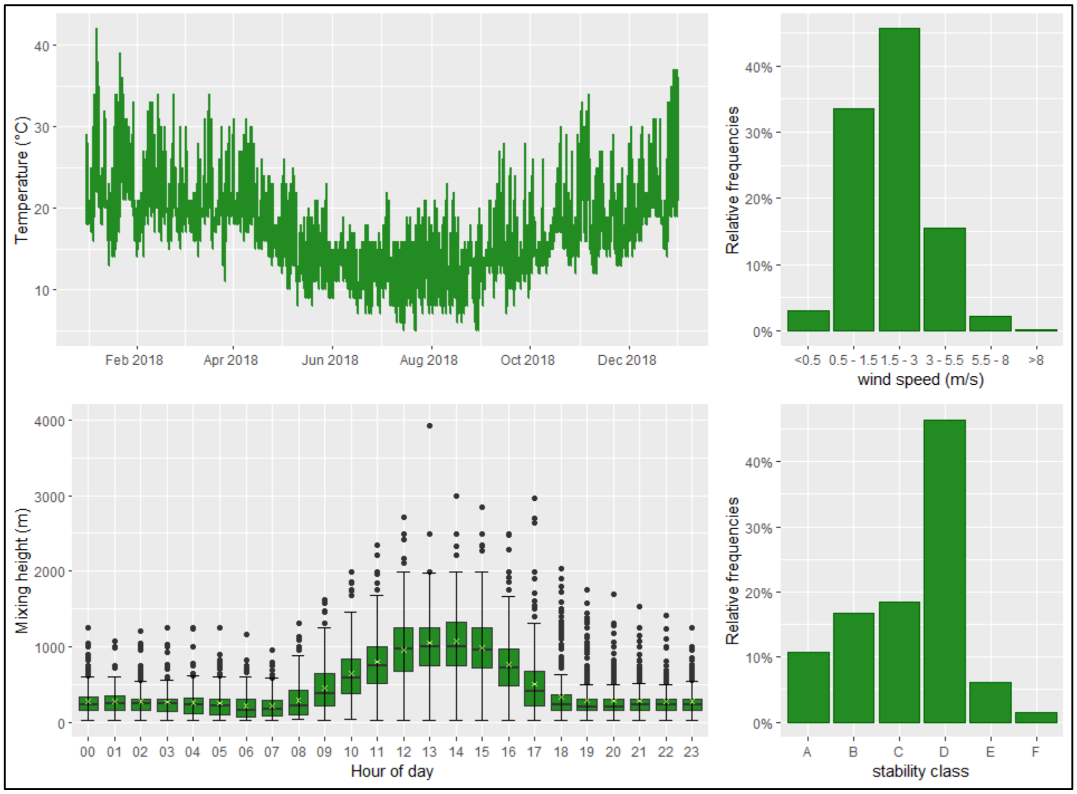


As generally required by the NSW EPA, the following provides a summary of the modelled meteorological dataset. Given the nature of the pollutant emission sources at the Proposal site, detailed discussion of the humidity, evaporation, cloud cover, katabatic air drainage and air recirculation potential of the Proposal site has not been provided. Details of the predictions of wind speed and direction, mixing height and temperature at the Proposal site are provided in Figure A5.

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

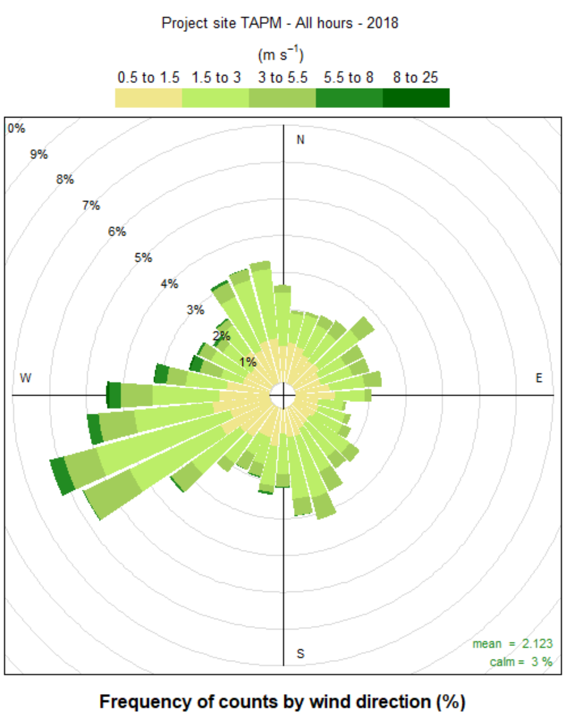
The modelled temperature variations predicted at the Proposal site during 2018 are presented in Figure A5. The maximum temperature of 42 °C was predicted on 7 January 2018 and the minimum temperature of 5 °C was predicted on 15 July 2018.

Figure A5 Predicted meteorological parameters – Proposal site 2018



The modelled wind speed and direction at the Proposal site during 2018 are presented in Figure A6.

Figure A6 Predicted wind speed and direction – Proposal site 2018



APPENDIX B

Background Air Quality Data

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

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

Air quality monitoring is performed by the NSW Department of Planning, Industry and Environment (DPIE) at four air quality monitoring station (AQMS) within a 15 km radius of the Proposal site. Details of the monitoring performed at these AQMS is presented in Table 7.

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

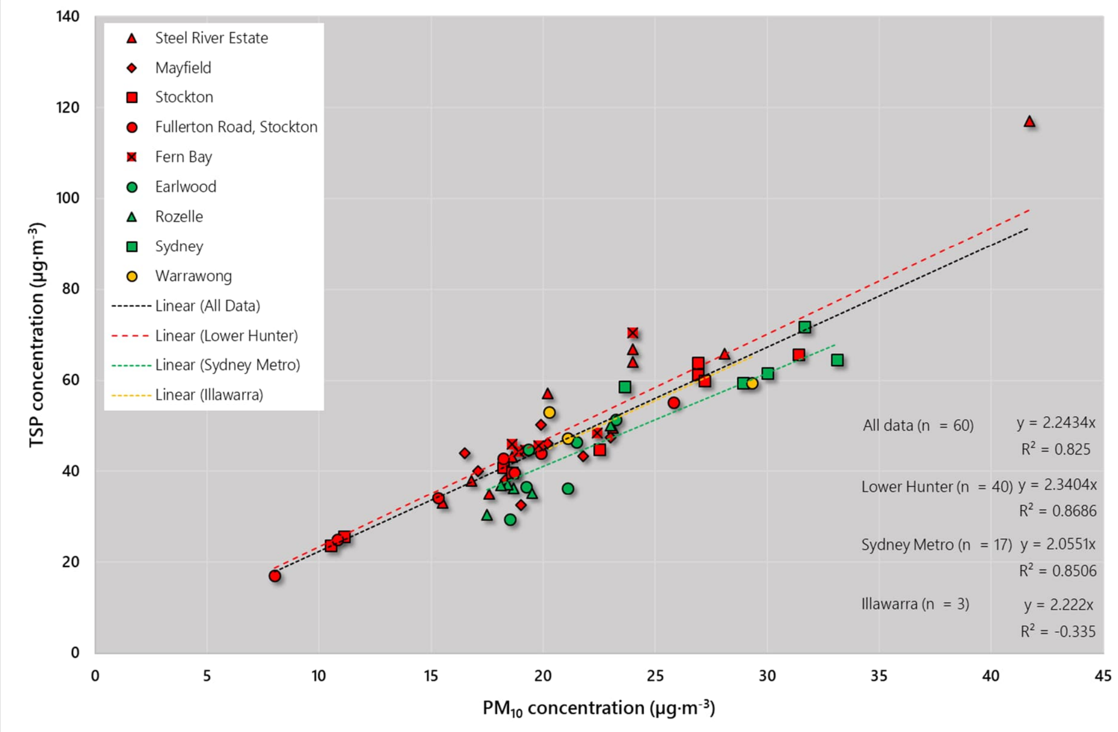
Summary statistics are for PM_{10} and $PM_{2.5}$ data are presented in Table B1.

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

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

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

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



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

A summary of background air quality data for the site for the year 2018 (consistent with the selected meteorological period) is presented in Table B1.

Graphs presenting the daily varying PM_{10} and $PM_{2.5}$ data recorded at Prospect in 2018 are presented in Figure B2 and Figure B3, respectively.

Table B1 Summary of background air quality data (Prospect 2018)

Pollutant	TSP (µg·m^{-3})	PM_{10} (µg·m^{-3})	$PM_{2.5}$ (µg·m^{-3})
Averaging Period	Annual	24-Hour	24-Hour
Data Points (number)	363	363	352
Mean	45.0	21.9	8.5
Standard Deviation	-	10.9	4.9
Skew[1]	-	2.7	3.0
Kurtosis[2]	-	15.6	17.7
Minimum		5.4	1.1
Percentiles (µg·m^{-3})			
1	-	7.1	2.0
5	-	9.9	3.2
10	-	11.2	4.1
25	-	14.8	5.3
50	-	20.2	7.4
75	-	25.8	10.4
90	-	33.3	13.8
95	-	37.4	16.1
97	-	42.9	17.8
98	-	52.8	19.9
99	-	61.7	25.0
Maximum	45.0	113.3	47.5
Data Capture (%)	99.5	99.5	96.4

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

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

Figure B2 PM_{10} Measurements, Prospect 2018

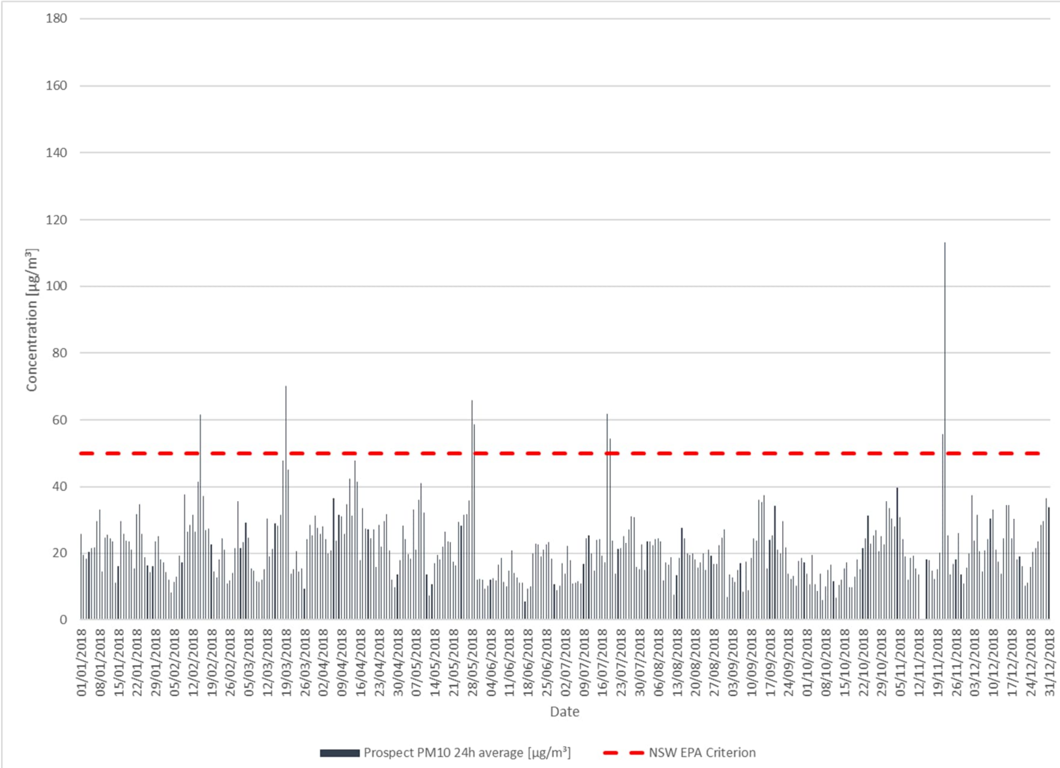
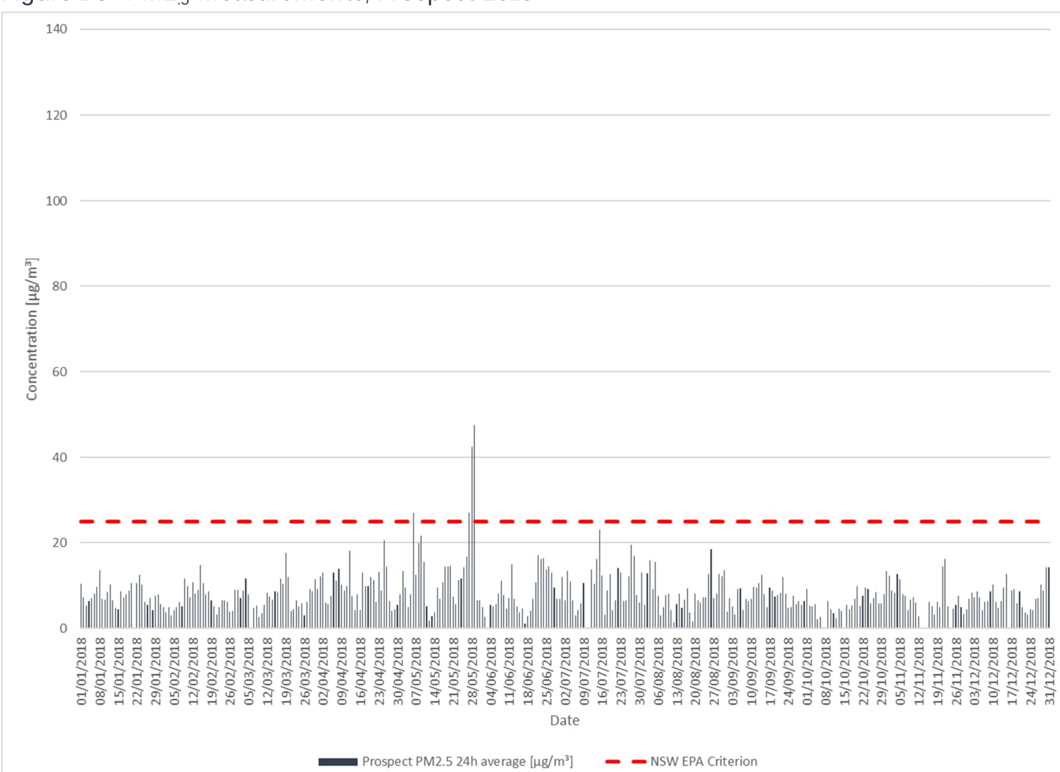


Figure B3 $PM2_{.5}$ Measurements, Prospect 2018



APPENDIX C

Emissions Estimation

The activity rates as presented in Table 2 have been used in the development of the particulate emissions inventory for the Proposal.

Emissions resulting from the loading of materials, transfer of materials (except for road transport) have been estimated using the US EPA AP-42 emission factor for batch drop. The emissions of particulate matter from these processes have been estimated using emission factors presented in Section 13.2.4.3 of AP-42 (Aggregate Handling and Storage Piles) (US EPA, 2006b).

This emission factor can result from several distinct source activities because the adding or removal of aggregate material from a storage pile or receiving surface results in batch drop operations and in other cases continuous drop operations. Either type of drop events emission factor can be estimated through:

$$EF\ (kg.tonne^{-1}) = k(0.0016)\frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}$$

where:

$EF_{(kg\cdot tonne^{-1})}$ = emission factor

k = particle size multiplier, where TSP = 0.74; PM_{15} = 0.48; PM_{10} = 0.35; PM_5 = 0.20; $PM_{2.5}$ = 0.053;

U = mean wind speed, meters per second ($m.s^{-1}$)

M = material moisture content (%)

The quality rating for this application is rated A.

Note: Silt content is not included in this equation. It is reasonable to expect that silt content and emission factors are interrelated however no significant correlation was found under the parameters conducted by the US EPA. Hence it is recommended that if the source parameters lie outside of the studied range, that the equations quality rating be reduced by 1 level. The parameters adopted for the purposes of this assessment are: Silt Content (%) = 2; Moisture Content (%) = 2; Wind Speed ($m\cdot s^{-1}$) = 2.1 .

Emissions of particulate matter resulting from the movement of materials on paved roads have been estimated using the emission factors presented in 13.2.1 (Paved Roads) of AP-42, (US EPA, 2011).

The emission factor on page 13.2.1.3 of (US EPA, 2011) has been adopted for the operations of vehicles on paved roads:

$$EF_{(g.VKT^{-1})} = k(sL)^{0.91}(W \times 0.907185)^{1.02}$$

where:

$EF_{(g.VKT^{-1})}$= emission factor (g per vehicle kilometre travelled)

k = particle size multiplier (dimensionless)

sL = road surface silt loading (g·m^{-2})

W = average weight (tons) of vehicles travelling the road multiplied by 0.907185 to convert to metric tonnes

The particle size multipliers for TSP, PM_{10} and $PM_{2.5}$ (k) are provided in (US EPA, 2011) as 3.23, 0.62 and 0.15, respectively.

The quality rating for this emission factors are A for TSP, A for PM_{10}, D for $PM_{2.5}$.

The emissions of particulate matter from materials processing activities including conveying and operating the air separator and metals magnet have been estimated using emission factors presented in Section 11.19.2-1 of AP-42 (Crushed Stone Processing and Pulverised Mineral Processing) (US EPA, 2004).

The emission factors within table 11.19.2-1 have been adopted for the operations outlined above. PM2.5 emission factors are not available for conveyor transfer point sources in AP-42 although have been taken to be 10% of PM_{10} as per aggregate handling sources (MRI, 2006). The control efficiency used for conveyor transfer points is 95.3% as calculated in AP-42 (US EPA, 2004).

For uncontrolled fines screening:

$$EF_{TSP}\ (kg.tonne^{-1}) = 0.0015$$

$$EF_{PM_{10}}\ (kg.tonne^{-1}) = 0.00055$$

$$EF_{PM_{2.5}}\ (kg.tonne^{-1}) = 0.000055$$

Emissions controls will be employed at the Proposal site as discussed in Section 5.2.3. The application of these controls results in quantifiable reductions in the quantity of particulate matter being emitted as part of the Proposal operation. A description of each emission reduction method to be employed as part of the Proposal is presented in Section 5.2.3.

Particulate emissions have been modelled based on the groupings outlined in Table C1 below:

Table C1 Modelled particulate fractions

Fraction	Representing	Geometric mass mean diameter (microns)	Geometric standard deviation (microns)
Coarse	TSP minus PM_{10} fraction	20	1.24
Intermediate	PM_{10} minus $PM_{2.5}$ fraction	5	1.24
Fine	$PM_{2.5}$ fraction	1.25	1.24

Source: (Government of Newfoundland and Labrador, 2012)

By adopting this approach, the dispersion model separates out the larger particulates which are more rapidly deposited from the atmosphere, closer to the site. This is a more realistic approach than the default adopted in CALPUFF (geometric mass mean diameter of 0.48 microns for all particulate size fractions) and results in the predicted off-site suspended and deposited particulate levels decreasing more rapidly with increasing distance from the source.

Table C3 Maximum 24hr activity rates and emissions (refer Table 2)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls (% efficiency)	Controlled Emissions (kg·day^{-1})		
		TSP	PM_{10}	$PM_{2.5}$					TSP	PM_{10}	$PM_{2.5}$
Unloading material in receiving area	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	462	tonnes	Enclosure (70 %)	0.162	0.077	0.012
FEL pick up	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	462	tonnes	Enclosure (70 %)	0.162	0.077	0.012
FEL loading conveyor	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	462	tonnes	Enclosure (70 %)	0.162	0.077	0.012
Paper and Carboard - conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	231	tonnes	Enclosure (70 %), dust collector (50 %)	0.052	0.019	0.005
Paper and cardboard - air separator	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	231	tonnes	Enclosure (70 %), dust collector (50 %)	0.052	0.019	0.005
Paper and cardboard - conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	231	tonnes	Enclosure (70 %), dust collector (50 %)	0.052	0.019	0.005
Paper and cardboard - baler	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	231	tonnes	Enclosure (70 %)	0.081	0.038	0.006
Glass - conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	120	tonnes	Enclosure (70 %), dust collector (50 %)	0.027	0.010	0.003
Glass - breaker	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	120	tonnes	Enclosure (70 %), dust collector (50 %)	0.021	0.010	0.002
Glass - balistic separator	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	120	tonnes	Enclosure (70 %), dust collector (50 %)	0.021	0.010	0.002
Glass - loading bunker	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	120	tonnes	Enclosure (70 %)	0.042	0.020	0.003
Glass - FEL on glass	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	120	tonnes	Enclosure (70 %)	0.042	0.020	0.003
Glass - FEL loading glass silo	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	120	tonnes	Enclosure (70 %)	0.042	0.020	0.003
Plastic - conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	42	tonnes	Enclosure (70 %), dust collector (50 %)	0.009	0.003	0.001
Plastic - separator	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	42	tonnes	Enclosure (70 %), dust collector (50 %)	0.007	0.003	0.001
Plastic - conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	42	tonnes	Enclosure (70 %), dust collector (50 %)	0.009	0.003	0.001
Plastic - load bin	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	42	tonnes	Enclosure (70 %), dust collector (50 %)	0.007	0.003	0.001
Plastic - baler	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	42	tonnes	Enclosure (70 %)	0.015	0.007	0.001
Metals - conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	23	tonnes	Enclosure (70 %), dust collector (50 %)	0.005	0.002	0.001
Metals - magnet	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	23	tonnes	Enclosure (70 %), dust collector (50 %)	0.005	0.002	0.001
Metals conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	23	tonnes	Enclosure (70 %), dust collector (50 %)	0.005	0.002	0.001
Metals - load to bin	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	23	tonnes	Enclosure (70 %), dust collector (50 %)	0.004	0.002	0.000
Metals - baler	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	23	tonnes	Enclosure (70 %)	0.008	0.004	0.001
Residual - conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.002	0.001	0.000	kg·t-1	46	tonnes	Enclosure (70 %)	0.021	0.008	0.002
Residual - baler	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.001	0.000	kg·t-1	46	tonnes	Enclosure (70 %)	0.016	0.008	0.001
Materials receival IN and OUT	AP-42 Paved roads - Section 13.2.1	0.073	0.014	0.003	kg·VKT-1	19	VKT		1.4	0.3	0.1
Offtake empty in	AP-42 Paved roads - Section 13.2.1	0.135	0.026	0.006	kg·VKT-1	6	VKT		0.8	0.1	0.04
Offtake in shed	AP-42 Paved roads - Section 13.2.1	0.251	0.048	0.012	kg·VKT-1	2	VKT		0.4	0.1	0.02
Offtake full out	AP-42 Paved roads - Section 13.2.1	0.368	0.071	0.017	kg·VKT-1	2	VKT		0.9	0.2	0.04
								Total	4.5	1.1	0.2

APPENDIX D

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 m³	• 20 000 m³ to 50 000 m³	• <20 000 m³
- 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 m²	• 2 500 m² to 10 000 m²	• <2 500 m²
- 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 m³	• 25 000 m³ to 100 000 m³	• <25 000 m³
- piling	• yes	• yes	• no
- concrete batching	• yes	• yes	• no
- sandblasting	• yes	• no	• no
- materials	• concrete	• concrete	• metal cladding or timber
Trackout (within 100 m of construction site entrance)			
- outward heavy vehicles movements per day	• >50	• 10 to 50	• <10
- surface materials	• high potential	• moderate potential	• low potential
- unpaved road length	• >100m	• 50m to 100m	• <50m

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

Step 3 – Sensitivity of the Area

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

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

Land Use Value

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

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

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

IAQM Guidance for Categorising Land Use Value

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

Value	High Land Use Value	Medium Land Use Value	Low Land Use Value
Dust soiling	• Users can reasonably expect a high level of amenity; or • The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land. *Examples: Dwellings, museums, medium and long term car parks and car showrooms.*	• Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or • The appearance, aesthetics or value of their property could be diminished by soiling; or • The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. *Examples: Parks and places of work.*	• The enjoyment of amenity would not reasonably be expected; or • Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or • There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. *Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*

Sensitivity of the Area

The assessed land use value (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors.

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

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

Sensitivity of the Area - Health Impacts

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

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

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

Land Use Value	Annual Mean PM_{10} Concentration ($\mu g \cdot m^{-3}$)	Number of Receptors[a]	Distance from the Source (m)[b]				
			<20	<50	<100	<200	<350
High	>30	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	26 – 30	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	22 – 26	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	≤22	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Note: (a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m), noting that only the highest level of area sensitivity from the table needs to be considered. In the case of high sensitivity areas with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

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

Sensitivity of the Area - Dust Soiling

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in the table below

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

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

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

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

Step 4 - Risk Assessment (Pre-Mitigation)

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

Risk of dust impacts from earthworks

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

Risk of dust impacts from construction activities

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

Risk of dust impacts from demolition activities

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

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

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

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

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

Step 5 – Identify Mitigation

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

The identified mitigation measures are presented as follows:

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

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

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
1	Communications			
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	N	H	H
1.1	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H	H	H
1.2	Display the head or regional office contact information.	H	H	H
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	D	H	H
2	Site Management			
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H	H	H
2.2	Make the complaints log available to the local authority when asked.	H	H	H
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	H	H	H
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	N	N	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
3	Monitoring			
3.1	Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary.	D	D	H
3.2	Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to the local authority when asked.	H	H	H
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H	H	H
3.4	Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	N	H	H
4	Preparing and Maintaining the Site			
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H	H	H
4.2	Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site.	H	H	H
4.3	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	D	H	H
4.4	Avoid site runoff of water or mud.	H	H	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	D	H	H
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	D	H	H
4.7	Cover, seed or fence stockpiles to prevent wind erosion	D	H	H
5	Operating Vehicle/Machinery and Sustainable Travel			
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H	H	H
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	H	H	H
5.3	Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable	H	H	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
5.4	Impose and signpost a maximum-speed-limit of 25 km·h^{-1} on surfaced and 15 km·h^{-1} on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate	D	D	H
5.5	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	N	H	H
5.6	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	N	D	H
6	Operations			
6.1	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems	H	H	H
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H	H	H
6.3	Use enclosed chutes and conveyors and covered skips	H	H	H
6.4	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H	H	H
6.5	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	D	H	H
7	Waste Management			
7.1	Avoid bonfires and burning of waste materials.	H	H	H
8	Measures Specific to Demolition			
8.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D	D	H
8.2	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	H	H	H
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H	H	H
8.4	Bag and remove any biological debris or damp down such material before demolition.	H	H	H

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

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
8.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	N	D	H
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D	H	H
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H	H	H
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	D	H	H

Step 6 – Risk Assessment (post-mitigation)

Following Step 5, the residual impact is then determined.

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