



This document has been prepared for **Sydney Metal Traders (NSW) Pty Ltd** by:

Northstar Air Quality Pty Ltd,

Head Office: Suite 1504, 275 Alfred Street, North Sydney, NSW 2060

Riverina Office: PO Box 483, Albury, NSW 2640

northstar-env.com | Tel: 1300 708 590

Towrang Resource Recovery Facility

Air Quality Impact Assessment

Addressee(s): Sydney Metal Traders (NSW) Pty Ltd

Site Address: 88 Murrays Flat Road, Towrang NSW

Report Reference: 22.1098.FR1V1

Date: 10 May 2024

Status: Final

Quality Control

Report	Reference	Status	Prepared by	Checked by	Authorised by
Towrang Resource Recovery Facility – Air Quality Impact Assessment	22.1098.FR1V1	Final	Northstar	MD	MD

Report Status

Northstar References		Report Status	Report Reference	Version
Year	Job Number	(Draft: Final)	(R _x)	(V _x)
2022	1098	Final	R1	V1
Based upon the above, the specific reference for this version of the report is:				22.1098.FR1V1

Final Authority

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



Martin Doyle

10 May 2024

© Northstar Air Quality Pty Ltd 2024

Copyright in the drawings, information and data recorded in this document (the information) is the property of Northstar Air Quality Pty Ltd. This report has been prepared with the due care and attention of a suitably qualified consultant. Information is obtained from sources believed to be reliable but is in no way guaranteed. No guarantee of any kind is implied or possible where predictions of future conditions are attempted. This report (including any enclosures and attachments) has been prepared for the exclusive use and benefit of the addressee(s) and solely for the purpose for which it is provided. Unless we provide express prior written consent, no part of this report should be reproduced, distributed, or communicated to any third party. We do not accept any liability if this report is used for an alternative purpose from which it is intended, nor to any third party in respect of this report.

Non-Technical Summary

Northstar Air Quality Pty Ltd has been commissioned by Sincorp Properties Pty Ltd on behalf of Sydney Metal Traders (NSW) Pty Ltd to perform an air quality impact assessment to support a development application for a proposed resource recovery facility located on part of a subject property at 88 Murrays Flat Road, Towrang NSW.

The air quality impact assessment details the relevant legislation, assessment methodology, and characterises both existing air quality and meteorological conditions around the Proposal and its vicinity. It assesses the potential impacts during construction and operation, adhering to State Environmental Assessment Requirements for the Proposal and best practices for modelling and assessing emissions of air pollutants including odour in New South Wales.

Identified risks of impact associated with construction activities were assessed using published *Guidance on the Assessment of Dust from Demolition and Construction* published by the United Kingdom Institute of Air Quality Management and adapted for use by Northstar for use within development projects in Australia. This methodology has been used in a similar context in numerous other similar air quality impact assessment studies.

The construction phase assessment showed there to be a medium risk of adverse dust soiling impacts and a low risk of health impacts related to earthworks and construction activities. Trackout activities carry a low risk of adverse dust soiling impacts and a negligible risk of health impacts. Additionally, demolition and construction traffic movements pose a negligible risk of adverse dust soiling and health impacts, assuming no mitigation measures are applied to control emissions during construction-phase activities. Correspondingly, a range of standard mitigation measures have been proposed to ensure that short-term impacts associated with construction activities are minimised.

The prediction of potential impacts associated with operational activities has been performed in line with the requirements of the NSW Environment Protection Authority *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* and the *Technical Framework for the Management of Odour in Stationary Sources* using an approved and appropriate dispersion modelling technique.

The results of the air quality impact assessment indicate that the predicted short-term and annual TSP, PM₁₀ and PM_{2.5} concentrations are compliant with the respective criteria, with no additional exceedances of the 24-hour PM₁₀ and PM_{2.5} criteria. Furthermore, the addition of minor incremental impacts to background dust deposition and metal levels results in the achievement of the impact assessment criterion.

The results of the odour impact assessment indicate that there are no exceedances of the adopted impact assessment criterion of 6.0 odour units. The maximum concentration at any identified receptor location of 1.0 odour unit has been predicted which is at the limit of detection for any odour (1 odour unit by definition).

The Proposal incorporates a set of control measures aimed at minimising dust, particulate matter, and metals emissions during operation. These measures are recommended for implementation to efficiently manage and decrease air pollutant and odour emissions arising from the Proposal's operation.

Given the assumptions outlined in this air quality impact assessment and the adoption of recommended mitigation measures, the Proposal is deemed to be compliant with the respective criteria and as such is considered to be acceptable for development with regard to air quality and odour.

CONTENTS

1.	INTRODUCTION	8
1.1.	Purpose of the Report	8
1.2.	Assessment Requirements	9
2.	THE PROPOSAL	10
2.1.	Environmental Setting	10
2.2.	Proposal Overview	12
2.3.	Identification of Potential Emissions to Atmosphere	19
3.	LEGISLATION, REGULATION AND GUIDANCE	21
3.1.	NSW Government Air Quality Planning	21
3.2.	Environmental Planning and Assessment Act and Regulation	21
3.3.	Protection of the Environment Operations Act	22
3.4.	Protection of the Environment Operations (Clean Air) Regulation	22
3.5.	NSW EPA Approved Methods	23
4.	EXISTING CONDITIONS	28
4.1.	Surrounding Land Sensitivity	28
4.2.	Local Topography	32
4.3.	Meteorology	32
4.4.	Background Air Quality Conditions	33
4.5.	Potential for Cumulative Impacts	36
5.	APPROACH TO ASSESSMENT	37
5.1.	Construction Phase	37
5.2.	Operational Phase	37
6.	CONSTRUCTION AIR QUALITY RISK ASSESSMENT	43
6.1.	Risk (Pre-Mitigation)	43
6.2.	Risk (Post Mitigation)	44
7.	OPERATIONAL AIR QUALITY IMPACT ASSESSMENT	45
7.1.	Particulate Matter	45
7.2.	Nitrogen Dioxide	54
7.3.	Metals	56

7.4.	Odour	56
7.5.	Summary of Results	59
8.	MITIGATION AND MONITORING.....	60
8.1.	Construction Phase Mitigation	60
8.2.	Operational Phase Mitigation.....	60
8.3.	Monitoring.....	61
9.	CONCLUSION.....	62
10.	REFERENCES	64
APPENDIX A.....		66
APPENDIX B		71
APPENDIX C		86
APPENDIX D.....		94
APPENDIX E		100

FIGURES

Figure 1	Proposal site location.....	11
Figure 2	Proposal site layout	13
Figure 3	Population density and sensitive receptors surrounding the Proposal site.....	31
Figure 4	Local topography.....	32
Figure 5	Predicted incremental 24-hour PM ₁₀ impacts.....	52
Figure 6	Predicted incremental 24-hour PM _{2.5} impacts.....	53
Figure 7	Predicted incremental 1-hour NO _x (as NO ₂) impacts	55
Figure 8	Predicted incremental 99 th percentile odour impacts	58

TABLES

Table 1	Coverage of SEARs requirements relevant to the AQIA	9
Table 2	Proposal site activity rates	18
Table 3	POEO (Clean Air) Regulation – standards of concentrations	23
Table 4	NSW EPA impact assessment criteria - individual air pollutants.....	24
Table 5	NSW EPA impact assessment criteria for principal and individual toxic pollutants.....	25
Table 6	NSW EPA impact assessment criteria for odour.....	27
Table 7	Discrete sensitive receptor locations.....	30
Table 8	Details of BoM meteorological monitoring stations within 50 km of Proposal site	33
Table 9	Details of NSW DCCEE AQMS within 100 km of the Proposal site	34
Table 10	Summary of background air quality data used in the AQIA.....	35
Table 11	Metal speciation in hammermill extracts (by mass fraction (% w/w)).....	40
Table 12	Summary of emission reduction methods adopted at part of Proposal operation.....	41
Table 13	Risk of air quality impacts from construction activities	43
Table 14	Predicted annual average TSP, PM ₁₀ and PM _{2.5} concentrations.....	46
Table 15	Predicted annual average dust deposition rate.....	47
Table 16	Predicted maximum incremental 24-hour PM ₁₀ and PM _{2.5} concentrations.....	48
Table 17	Summary of contemporaneous impact and background – 24-hour PM ₁₀ concentrations.....	50
Table 18	Summary of contemporaneous impact and background – 24-hour PM _{2.5} concentrations.....	51
Table 19	Predicted 1-hour and annual average NO ₂ concentrations	54
Table 20	Predicted incremental 99 th percentile odour concentrations.....	57

1. INTRODUCTION

Northstar Air Quality Pty Ltd (Northstar) has been commissioned by Sincorp Properties Pty Ltd on behalf of Sydney Metal Traders (NSW) Pty Ltd (the Proponent), to perform an air quality impact assessment (AQIA) to support a development application (DA) for a proposed resource recovery facility (the Proposal) located on part of a subject property at 88 Murrays Flat Road, Towrang NSW (the Proposal site).

This AQIA identifies and examines potential air quality impacts associated with the operation of the Proposal and identifies mitigation and monitoring requirements commensurate with those anticipated impacts to ensure that air quality criteria are achieved at all surrounding sensitive receptor locations.

1.1. Purpose of the Report

The purpose of this report is to identify and assess the potential impact of air emissions resulting from the establishment and operation of the Proposal.

NSW Planning Secretary's Environmental Assessment Requirements (SEARs) have been provided for the Proposal by the NSW Department of Planning and Environment (NSW DPE) (now NSW Department of Planning, Housing, and Infrastructure (NSW DPHI)) on 18 October 2023. These are presented and discussed in Section 1.2.

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

- *Environmental Planning and Assessment Act 1979* (EP&A Act).
- *Protection of the Environment Operations Act 1997* (POEO Act).
- Environmental Planning and Assessment Regulation 2021 (EP&A Regulation).
- Protection of the Environment Operations (Clean Air) Regulation 2022 (POEO CAR).
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA, 2022a).
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (NSW EPA, 2022b).
- Technical Framework - Assessment and Management of Odour from Stationary Sources in NSW (NSW DECC, 2006a).
- Technical Notes - Assessment and Management of Odour from Stationary Sources in NSW (NSW DECC, 2006b).
- Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2024).

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

1.2. Assessment Requirements

The SEARs for the Proposal were published by NSW Department of Planning and Environment (DPE, now NSW Department of Planning, Housing and Infrastructure [DPHI]) on 18 October 2023. Table 1 provides a summary of the SEARs relevant to the AQIA.

Table 1 Coverage of SEARs requirements relevant to the AQIA

Authority	Requirement	Relevant section
SEARs 18 October 2023 SEAR 1819	A description of all potential sources of air and odour emissions during construction and operation.	Section 2.3
	An air quality impact assessment in accordance with relevant Environment Protection Authority guidelines.	Section 6 Section 7
	A description and appraisal of air quality impact mitigation and monitoring measures.	Section 8

2. THE PROPOSAL

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

2.1. Environmental Setting

The Proposal site is positioned in part of the property located at 88 Murrays Flat Road near Towrang, in the Local Government Area (LGA) of Goulburn Mulwaree, approximately 5 kilometres (km) to the north-east of the city of Goulburn and in the Southern Tablelands of NSW.

The Proposal site is to be contained within the western confines of Lot 3 of Deposited Plan (DP) 251779 which covers an area of 32.24 hectares (ha). The Proposal is anticipated to cover part of this area, over approximately 6.5 ha in total. Part of the Proposal site is currently occupied by a residential property, namely 88 Murrays Flat Road, with the remainder being vacant.

The surrounding area is predominately rural in nature with few residential dwellings situated along Murrays Flat Road. The Proposal site is approximately 465 metres (m) from the junction of Murrays Flat Road and M31 Hume Highway / Remembrance Driveway, a main arterial route through Goulburn Mulwaree LGA.

A map showing the location of the Proposal site is provided in Figure 1. A full description of the sensitivity and uses of the surrounding land, and the identification of discrete receptor locations used in the AQIA, is provided in Section 4.1.

Figure 1 Proposal site location



Source: Northstar

2.2. Proposal Overview

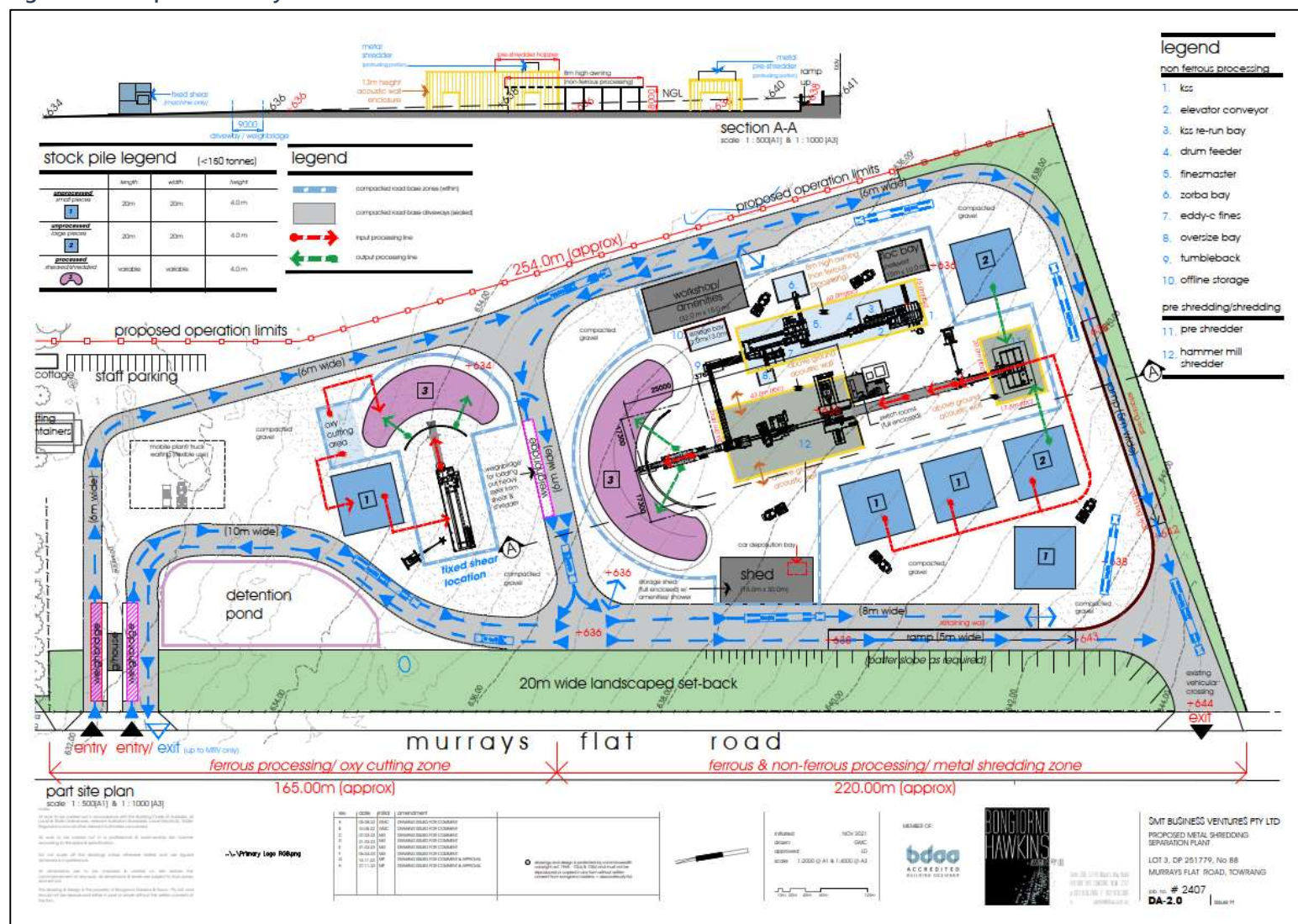
The Proposal is to construct and operate a metals recovery and recycling facility at the Proposal site for both ferrous and non-ferrous metals with a proposed throughput of up to 30 000 tonnes per year (t-yr⁻¹).

The Proposal comprises the following components:

- Use of the front (western) portion of the site for the purposes of a scrap metal yard, over an area of approximately 6.5 ha of a total site area of 32.24 ha.
- Establishment of ferrous (including oxycutting) and non-ferrous metal shredding processing areas to include:
 - Pre-shredder, hammermill, and downstream processing equipment.
 - Fixed inclined metal shearing plant.
- Conversion of the existing on-site residential property for staff administration and amenities.
- Utilisation of existing vehicular access points and proposed additional vehicular access points along Murrays Flat Road.
- Use of compacted road base for heavy vehicle ingress / egress, and movements around the Proposal site.
- Installation of a weighbridge for loading out heavy steel from the shear and shredder, and a dual lane weighbridge station located at the northern end of the of the Proposal site.
- Mobile materials handling machines and equipment, such as front-end loader (FEL).
- Non-ferrous pre-shredder and shredder equipment are to be surrounded by an above ground acoustic wall enclosure, with remaining non-ferrous processing equipment to be situated underneath an awning.
- Associated car parking for staff and visitors.

The Proposal site layout is illustrated in Figure 2.

Figure 2 Proposal site layout



2.2.1. Waste Streams

Materials that are to be received at the Proposal site for processing will comprise a variety of light gauge ferrous metals and non-ferrous metals. The types of waste to be received at the Proposal site comprise:

- Heavy gauge and structural steel.
- Heavy redundant equipment and machinery.
- Light gauge steel e.g. roofing iron / sheet metals.
- Non-ferrous metals including Al, Pb and Mg.
- Vehicle chassis frames.

Shredder floc would consist of residual materials following recovery of recyclable metals, and is typically composed of a mixture of plastics, rubber, textiles, metals, and inert materials such as dirt and glass. Shredder floc is generally contaminated with heavy metals, mineral oils, and hydrocarbons.

A report prepared for the Australian Government Department of Agriculture, Water and the Environment indicates that shredder floc from metals recycling facilities typically contains 10 %(w/w) metals, 45 %(w/w) mixed plastics, 25 %(w/w) textiles, rubber, and leather, with 20 %(w/w) of 'other' components (Blue Environment, 2021).

2.2.2. Operational Processes

A brief summary of the operational processes performed at the Proposal site is provided in the following sections.

2.2.2.1. Delivery

Waste materials would be delivered to the Proposal site either by heavy rigid vehicles or 26 m B-double heavy trucks, with delivery vehicles entering via the main access point off Murrays Flat Road and proceeding across the weighbridge past the Proposal site gatehouse. Trucks would then travel in a clockwise direction along the northern and eastern perimeter of the Proposal site, whereby heavy and light gauge scrap metals would be deposited to the respective feed stockpiles for ferrous and non-ferrous metals processing.

Trucks would then be scheduled to exit the Proposal site either through an existing vehicular crossing point located to the south of the Proposal site, or via the northern access point via the weighbridge and gatehouse before proceeding onto Murrays Flat Road. Vehicle traffic would be restricted to using the internal haul routes contained within the Proposal site.

2.2.2.2. Assessment and Preparation

Light and heavy gauge metals would be received at the Proposal site and placed into designated 'unprocessed' stockpile areas, which are anticipated to be 20 m by 20 m and 4 m in height, equating to a volume of 1 600 cubic meters (m^3) and containing around 150 t of scrap metal to be processed.

The respective materials would then be transferred to the initial processing stage via FEL, material handler or mobile scrap shear units.

An oxy-cutting area would be positioned to the north of the fixed metal shear for those heavy gauge ferrous metals that are required to be reduced in size prior to being fed through the inclined shearing plant. It is anticipated that this process would be carried out through use of oxy-acetylene equipment.

2.2.2.3. Processing

Scrap metal processing and shearing activities would be carried out on hardstand (concrete) areas and all operational equipment, processed sheared and shredded stockpiles contained on hardstand. The unprocessed sheared and shredded stockpiles would be situated atop a compacted gravel base.

Primary plant and equipment components to be operated at the Proposal site include:

- Vezzani heavy duty stationary inclined shear.
- Taurus Redline Bravo B16H pre-shredder.
- THOR 2121 mobile hammermill shredder, fitted with a 'Dust-Buster' dust control system.
- Steinert Finesmaster – required for downstream non-ferrous metals separation; and
- Steinert KSS multi sensor sorting system – for further separation and recovery of non-ferrous heavy metals concentrates in copper (Cu), brass, and grey metals.

The Proposal would include a heavy duty stationary inclined shear comprising a hopper and guillotine compartment. The shear is capable of handling both ferrous and non-ferrous metals, such as steel beams, plates, and fabrications, by cutting them into shorter lengths. The shear is capable of processing approximately 40 tonnes per hour ($\text{t}\cdot\text{hr}^{-1}$) and can operate for an average of 2.5 hours per day equating to an average production rate of $100 \text{ t}\cdot\text{day}^{-1}$ and an average annual production rate of $26\,000 \text{ t}\cdot\text{yr}^{-1}$, based on 260 working days.

The Taurus Redline Bravo B16H pre-shredder functions at reduced speed yet higher torque, specifically designed for overseeing material grading before entering the hammermill shredder.

The THOR 2121 mobile hammermill is a mill shredder that can process between $30 \text{ t}\cdot\text{hr}^{-1}$ and $40 \text{ t}\cdot\text{hr}^{-1}$ of scrap metal, depending on the nature and density of the input materials. When operated in conjunction with the

pre-shredder, the THOR 2121 hammermill is capable of processing up to $50 \text{ t}\cdot\text{hr}^{-1}$ of scrap metal, equating to an average production rate of $400 \text{ t}\cdot\text{day}^{-1}$.

The hammermill machine would be equipped with a rotor fitted with 14 hammers that swing on six hammer-hold shafts (hammer pins) allowing the hammers to pull back when they hit a non-crushable item. Materials would be fed via a tilting sliding gutter or conveyor system and can also separate metallic from non-metallic scrap metals and can deposit to separate stockpiles with use of a foldable conveyor belt.

The THOR 2121 hammermill would be fitted with a 'Dust-Buster' shredder dust control system to manage blue smoke emissions, dust, and shredder floc residuals when shredding metal materials. The Dust-Buster system is a control solution which injects foam and foaming chemical into the THOR hammermill to capture dust and floc before it is fugitively released into the atmosphere and does not release dust downstream at transfer points.

The 'Dust-Buster' emissions control system has the potential to control dust emissions by up to 85 % (refer Section 5.2.3) and can be operated on an operational basis of up to eight hours per day alongside the THOR 2121 hammermill.

The Steinert Finesmaster is used for non-ferrous metals separation and contains both a magnetic separator and an eddy current separator (ECS) for the recovery of fine non-ferrous metals. The magnetic separator recovers small iron and separates out ferrous grits as waste. The eddy currents selectively remove aluminium (Al), brass (as an alloy of Cu and zinc [Zn]), and Cu from the material flow, while leaving stainless steel and wire unaffected, resulting in the production of Zorba, which is the initial product stream from the plant.

Zorba refers to a composite category of shredded and pre-processed non-ferrous scrap metals, primarily consisting of Al. Additionally, Zorba may contain other non-ferrous metals such as Cu, lead (Pb), brass, magnesium (Mg), nickel (Ni), tin (Sn), and Zn in either their elemental or alloyed (solid) forms.

The Steinert KSS FLI is a combination sensor sorter which uses a series of detection techniques including colour detection and lasers to recover smaller fractions of non-ferrous metals from the residual wastes from the Steinert Finesmaster.

Heavy gauge scrap would be fed to and processed by the fixed inclined shearing plant whilst light gauge scrap metals would be processed within the pre-shredder to create a homogeneous feed for the hammermill. The shredded materials would be sorted automatically into ferrous and non-ferrous materials.

Each waste stream would be presented to a magnet to pull out ferrous dirt and grits, thus preparing the metal for the ECS. Non-ferrous metals and waste would then be sorted by the magnetic separator and ECS to produce a mixture of shredded non-ferrous metals predominately containing Zorba. The KSS would then be utilised to derive a combination of shredded non-ferrous metal containing primarily stainless steel and Cu. Once processed, sorted materials would be stockpiled in dedicated 'processed' areas at the end of the respective processing areas prior to those materials being loaded into trucks for off-site transport.

2.2.2.4. Transport

Traffic accessing the Proposal site will utilise Murrays Flat Road as the entry point, with all traffic directed through to Hume Highway. Proposed traffic movements for receiving and removing materials at the Proposal site were outlined by the appointed transportation consultant. The operation of the Proposal is expected to generate the following traffic:

- Six semi-trailer movements per day.
- Four heavy vehicle movements per day; and
- Up to two semi-trailer and one heavy vehicle movements in the peak traffic hour.

2.2.3. Operating Hours

The proposed opening hours of the Proposal site are summarised below:

- Opening hours (staffed) and truck deliveries.
 - Monday to Friday – 6:00 am to 6:00 pm.
 - Saturday – 7:00 am to 4:30 pm.
 - Closed on Sunday and Public Holidays.
- Metal processing activities (shearing, pre-shredding, shredding (hammermill)), screening sorting
 - Monday to Friday – 7:00 am to 6:00 pm.
 - Saturday - 7:00 am to 4:30 pm.
 - Closed on Sunday and Public Holidays.

2.2.4. Capacity and Throughput

The Proposal would facilitate an annual throughput of up to 30 000 t·yr⁻¹ of ferrous and non-ferrous metals delivered to site by a range of heavy-duty delivery vehicles. Depending on the grade of metal, these would be either treated by an oxy-acetylene cutting process and sheared, or processed through the pre-shredder, shredder and processing plant which includes a drum magnet to remove ferrous fragments and an ECS to separate non-ferrous material from the residual shredder floc.

It is assumed that approximately 3 840 t·yr⁻¹ of the 30 000 t·yr⁻¹ materials processed would be waste (floc), accounting for 16 %(w/w) of material received. Approximately 80 %(w/w) would be ferrous (equivalent to 19 200 t·yr⁻¹), and 4 %(w/w) (equivalent to 960 t·yr⁻¹) would be non-ferrous. The separated ferrous and non-ferrous products would be removed from the Proposal site by loading into appropriate vehicles and exported for recycling whilst residual shredder floc would be disposed at a licenced landfill facility.

The annual throughput of 30 000 t·yr⁻¹ equates to an average operating capacity of approximately 98.6 t·day⁻¹, based on 304 working days per year (refer Section 2.2.3).

To provide a conservative estimation of short-term emissions, the average operating capacity of 98.6 t·day⁻¹ has been factored by a ratio of 1.33 : 1 in consideration of other AQIA conducted for similar processes (refer (Northstar, 2021). As such, the calculated maximum daily operating capacity considered for this AQIA extrapolates *pro rata* as (98.6 t·day⁻¹ × 1.33) 130.7 t·day⁻¹, equating to approximately 39 773 t·yr⁻¹ based on 304 working days per year.

The comparison above has been provided to demonstrate that the potential for short-term emissions has been adequately and conservatively considered in this AQIA. It is important to note that this should not be interpreted as a potential to exceed the annual processing capacity of 30 000 t·yr⁻¹.

As referred to earlier in this section, the hammermill shredder and associated Dust-Buster control system has an average operating capacity of up to 50 t·hr⁻¹ and a permissible daily operating period of eight hours, generating a throughput capacity of 400 t·day⁻¹.

Table 2 provides the associated activity rates derived for this AQIA.

Table 2 Proposal site activity rates

Operational activity	Activity rate	
	Annual	Peak 24-hour
Materials haulage		
Materials haulage	2 995 VKT·yr ⁻¹	13.0 VKT·day ⁻¹
Number of vehicle movements	3 043 trips·yr ⁻¹	10 trips·day ⁻¹
Assessment and Preparation		
Transfer of materials to unprocessed stockpiles	30 000 t·yr ⁻¹	130.7 t·day ⁻¹
Front-end loader movements	1 718 VKT·yr ⁻¹	9.9 VKT·day ⁻¹
Processing		
Sheared materials to be processed	6 000 t·yr ⁻¹	26.1 t·day ⁻¹
Shredded materials to be processed	24 000 t·yr ⁻¹	104.6 t·day ⁻¹
- Ferrous	19 200 t·yr ⁻¹	83.7 t·day ⁻¹
- Non-ferrous	960 t·yr ⁻¹	4.2 t·day ⁻¹
- Waste floc generated	3 840 t·yr ⁻¹	16.7 t·day ⁻¹
Total materials processed	30 000 t·yr ⁻¹	130.7 t·day ⁻¹
Stockpile areas		
Unprocessed (small pieces)	4 x 1 600 m ³ (6 400 m ³)	
Unprocessed (large pieces)	2 x 1 600 m ³ (3 200 m ³)	
Processed (sheared / shredded)	2 x variable size x 4 m in height	
Waste floc bay	1 x 600 m ³	
Zorba bay	1 x 340 m ³	

Note: VKT – Vehicle kilometers travelled

2.3. Identification of Potential Emissions to Atmosphere

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

2.3.1. Construction Phase

The Proposal includes several construction activities: converting the existing residential dwelling into a staff administrative and amenity building, constructing a staff car parking area, additional vehicular entry/exit points and internal haul routes, a compacted road base for heavy vehicles, a weighbridge, and the construction of the Proposal site, including installation of a hammermill, preshredder, metal shear, oxycutting station, and various conveyors and sorting lines.

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

- Dozers;
- Excavators;
- Front end loaders;
- Graders and rollers;
- Light- and heavy vehicles; and
- Pneumatic and or power tools.

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

2.3.2. Operational Phase

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

- Deliveries of waste and separated metals materials to and from the Proposal site.
- Movement of heavy-duty trucks around the Proposal site on compacted road base surfaces.
- Processing, handling, storage, transportation and unloading of waste materials around site using non-road mobile machinery (NRMM) such as FEL and material handlers.
- Combustion emissions from construction equipment, metal shearing and shredding infrastructure during processing and from heavy-duty vehicles; and
- Wind erosion of any exposed materials stockpiles and processing areas.

The specific pollutants of interest associated with those activities are:

- Total suspended particulates (TSP);
- Particulates with a mean aerodynamic diameter of 10 microns or less (PM_{10});
- Particulates with a mean aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$); and
- Deposited dust.

Exhaust emissions of oxides of nitrogen (NO_x), carbon monoxide (CO) and sulphur dioxide (SO_2) related to diesel consumption in plant (including pre-shredder and shredder) and non-road mobile machinery (comprising of FEL and materials handling equipment) would also be experienced (in addition to particulates considered above). Given the quantity of equipment operating on site it is not anticipated that emissions associated with diesel combustion (other than particulate matter which have been assessed) would be a significant contributor to total site emissions.

The Proposal includes recycling of light and heavy gauge metals, whereby small quantities of other ferrous and non-ferrous metals such as Al and Cu may be recovered from the associated scrap metal processing activities and that several metals including iron (Fe), Pb, chromium (Cr), Zn and manganese (Mn) may be emitted in the pre-shredder and hammermill during the shredding process.

Regarding odour, it is acknowledged that potential odorous emissions are primarily associated with the operating zones of the oxycutter and hammermill shredder. Specific materials arriving at the Proposal site, such as End of Life Vehicles (EOLVs), undergo screening to detect the presence of unacceptable materials and are subsequently processed using specialised equipment such as oxy-acetylene cutters prior to shearing. The oxy-acetylene cutters employ oxygen (O_2) and acetylene gas as a fuel source to generate a high-temperature flame for metal cutting. It is noted that commercial-grade acetylene gas is infused with a distinctive odorant like methyl mercaptan and moreover, additional odorous compounds may potentially be derived as a result from oxy-cutting and grinding activities, including the burning or vaporisation of metals.

Odours may arise from the pre-shredder and hammermill due to the mechanical shredding process which involves high-speed impact and grinding. These processes generate heat and friction which then can potentially release volatile organic compounds (VOCs) from the metal, coatings, or surface contaminants during shredding. If the shredded metal contains coatings, paints, or oils, these substances can also be released and vaporised during the shredding process which may contain odorous compounds.

The potential impacts of the Proposal associated with odour have been specifically addressed in this AQIA.

3. LEGISLATION, REGULATION AND GUIDANCE

This section outlines the relevant legislative requirements for the Proposal under applicable State, Federal and Commonwealth legislation and planning instruments.

The Proposal will necessitate statutory approvals, such as compliance with regulations under the POEO Act and obtaining respective planning approvals in accordance with the EP&A Act. These approvals aim to regulate and mitigate the environmental impact of the Proposal.

3.1. NSW Government Air Quality Planning

NSW Environment Protection Authority (NSW EPA) has formulated 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*, which is supported by the Protection of the Environment Operations (Clean Air) Regulations 2022. The overall objective of this legislative instruments is to achieve the requirements of the National Environment Protection (Ambient Air Quality) Measure;
- **Clean Air for NSW:** The 10-year plan for the improvement in air quality;
- **Inter-agency Taskforce on Air Quality in NSW:** a vehicle to co-ordinate cross-government incentives and action on air quality;
- **Managing particles and improving air quality in NSW;** and
- **Diesel and marine emission management strategy.**

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

3.2. Environmental Planning and Assessment Act and Regulation

The *Environmental Planning and Assessment Act* (1979) (EP&A Act) and the Environmental Planning and Assessment Regulation (2021) (EP&A Regulation) set the framework for planning and environmental assessment in NSW.

The Proposal is classified as a designated development under Part 4 of the EP&A Act and will therefore require an approval under the POEO Act.

3.3. Protection of the Environment Operations Act

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

Schedule 1, Part 1 Clause 26 of the POEO Act sets threshold activity rates for metallurgical activities such as metal processing, metal waste generation and scrap metal processing. The Proposal would be broadly considered as a scrap metal processing facility given that crushing, shredding, and sorting (but not smelting) of both ferrous and non-ferrous scrap metal activities would be carried out.

The Proposal site would be declared to be a scheduled activity if it meets the following criteria:

- Capacity to process more than 150 t of scrap metal per day; or
- Capacity to process more than 30 000 t·yr⁻¹ (if not carried out wholly indoors); or
- Capacity to process more than 50 000 t·yr⁻¹ (if carried out wholly indoors).

Section 2.2.4 reflects that the Proposal would facilitate an annual throughput of up to 30 000 t·yr⁻¹ of ferrous and non-ferrous metals, with an average throughput of 98.6 t·day⁻¹ based on 304 working days (refer Section 2.2.3). Therefore, it is envisaged that the Proposal site may not be encompassed within the NSW environmental regulatory framework as a scheduled premises.

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

Plant and machinery operating at the Proposal site would be maintained regularly. Handling of materials at the Proposal site would be performed with the inclusion of control measures as described in Section 5.2.3. As such, the requirements of the POEO Act would be met.

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

The Protection of the Environment Operations (POEO) (Clean Air) Regulation 2022 (POEO CAR) sets requirements and standards of concentration for emissions to air for both scheduled and non-scheduled activities.

Under the POEO CAR, specific concentration standards are outlined in Schedule 2. For scheduled premises, Part 2, Division 3 details these standards concerning general activities and plant. Non-scheduled premises activities associated with the Proposal site are covered in Part 3 of Schedule 2.

Table 3 presents the relevant standards of concentrations (i.e. emissions limits) that are referenced in consideration of the Proposal site, dependent upon whether the Proposal site is categorised as a scheduled or non-scheduled premises.

Table 3 POEO (Clean Air) Regulation – standards of concentrations

Air impurity	Activity	Standard of concentration
Scheduled activities - Part 2, Division 3		
Solid particles (total)	A crushing, grinding, separating, or materials handling activity	20 mg·m ⁻³
Type 1 and Type 2 substances in aggregate ^(A)	An activity or plant	1 mg·m ⁻³
Nitrogen dioxide (NO ₂) or nitric oxide (NO) or both, as NO ₂ equivalent	Any activity or plant (except boilers, gas turbines and stationary reciprocating internal combustion engines)	350 mg·m ⁻³
Non-scheduled activities – Part 3		
Solid particles (total)	An activity or plant (except as listed)	100 mg·m ⁻³
Smoke	Any activity of plant in which liquid or gaseous fuel is burnt	Ringelmann 1 or 20 % opacity

Note: (A) Type 1 substance means the elements antimony (Sb), arsenic (As), cadmium (Cd), lead (Pb) or mercury (Hg), or a compound containing 1 or more of those elements. Type 2 substance means the elements beryllium (Be), chromium (Cr), cobalt (Co), manganese (Mn), nickel (Ni), selenium (Se), tin (Sn) or vanadium (V), or a compound containing 1 or more of those elements

Further to the requirements in Table 3, Part 4 Clause 15 of the POEO CAR requires that motor vehicles do not emit excessive air impurities which may be visible for a period of no more than 10 seconds when determined in accordance with the relevant standard.

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

3.5. NSW EPA Approved Methods

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, 2022a)) and the '*Technical Framework for the Assessment and Management of Odour from Stationary Sources in NSW*' (the Odour Technical Framework (NSW DECC, 2006a)), which have been consulted during the preparation of this AQIA.

3.5.1. Ambient Air Quality Criteria

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 and Section 7.2 of the Approved Methods clearly outlines the impact assessment criteria for those key pollutants of interest and both individual and principal toxic air pollutants. Principal toxic air pollutants are defined in the Approved Methods (NSW EPA, 2022a) on the basis that they are carcinogenic, mutagenic, highly persistent, or highly toxic in the environment.

The criteria listed in the Approved Methods (NSW EPA, 2022a) are derived from a range of sources (including National Health and Medical Research Council [NHMRC], National Environment Protection Council [NEPC], and World Health Organisation [WHO]).

The criteria specified in the Approved Methods (NSW EPA, 2022a) are the defining ambient air quality criteria for NSW. The impact assessment criteria adopted to protect members of the community from health impacts in NSW for relevant individual air pollutants are presented in Table 4.

Table 4 NSW EPA impact assessment criteria - individual air pollutants

Pollutant	Averaging period	Criterion ^(E)	Notes
		$\mu\text{g}\cdot\text{m}^{-3}$ (A)	
Particulates (as TSP)	Annual	90	Numerically equivalent to the AAQ NEPM ^(B) standards and goals.
Particulates (as PM ₁₀)	24 hours	50	
	Annual	25	
Particulates (as PM _{2.5})	24 hours	25	
	Annual	8	
Nitrogen dioxide (NO ₂)	1 hour	164	
	Annual	31	
Lead (Pb)	Annual	0.5	
Pollutant	Averaging period	Criterion	Notes
		$\text{g}\cdot\text{m}^{-2}\cdot\text{month}^{-1}$	
Particulates (as dust deposition)	Annual ^(C)	2	Assessed as insoluble solids as defined by AS 3580.10.1
	Annual ^(D)	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)

Table 5 below provides a summary of impact assessment criteria for principal and individual toxic pollutants that are referenced within this AQIA, as outlined in Section 7.2 of (NSW EPA, 2022a)

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

Pollutant	Averaging period	Units ^(A)	Criterion
Copper (Cu) dusts and mists	1 hour	mg·m ⁻³	0.018
Iron oxide fumes	1 hour	mg·m ⁻³	0.09
Manganese (Mn) and compounds	1 hour	mg·m ⁻³	0.018
Chromium (Cr VI) compounds	1 hour	mg·m ⁻³	0.00009
Nickel and nickel compounds	1 hour	mg·m ⁻³	0.00018

Note: (A): Gas volumes are expressed at 25°C and at an absolute pressure of 1 atmosphere (101.325 kPa)

3.5.2. Odour Criteria

The Odour Technical Framework (NSW DECC, 2006a) establishes the legal framework for odour control and offers guidelines for odour assessment criteria. It outlines a structure for various levels of odour assessment, strategies to address odours, and provides direction for monitoring, regulatory compliance, and enforcement actions.

The perception of odour impact is a subjective experience influenced by numerous factors, with the most significant ones being related to:

- Frequency of the exposure.
- Intensity of the odour.
- Duration of the odour episodes.
- Offensiveness of the odour.
- Location of the source.

These factors are often referred to as the 'FIDOL' factors which aide to assess and quantify the impact of odours on the surrounding environment and community.

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 detection threshold (ODT) and defines one odour unit (OU). An odour goal of less than 1 OU would (by definition) result in no odour impact being detectable in laboratory conditions. In practice, the character of an 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 (or greater) 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 odour units (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 (NSW DECC, 2006a) recommends that, as a design goal, no individual be exposed to ambient odour levels of greater than 7 OU. In modelling and assessment terms, this is expressed as the 99th percentile of 1-hour concentrations, adjusted to represent a nose response time average of approximately one second.

Odour assessment criteria need to consider the range in sensitivities to odours within the community to provide additional protection for individuals with a heightened response to odours. This is addressed in the Odour Technical Framework (NSW DECC, 2006a) by setting a population dependant odour assessment criterion, and in this way, the odour assessment criterion allows for population size, cumulative impacts, and anticipated odour levels during adverse meteorological conditions and community expectations of amenity.

A summary of odour performance goals for various population sizes, as referenced in the Odour Technical Framework (NSW DECC, 2006a) is reproduced in Table 6. This table shows that in situations where the aggregated population of the affected community lies between 125 and 500 people (for example), an odour assessment criterion of 4 OU is considered to represent an acceptable odour risk, and for single residences, an odour assessment criterion of 7 OU is considered to be appropriate.

Table 6 NSW EPA impact assessment criteria for odour

Population of affected community	Impact assessment criteria for complex mixture of odours (99 th percentile (OU))
Urban area (≥ 2000) and/or schools and hospitals	2.0
500 – 2000	3.0
125 – 500	4.0
30 – 125	5.0
10 – 30	6.0
Rural single residence (≤ 2)	7.0

Source: Odour Technical Framework (NSW DECC, 2006a)

For the purposes of this AQIA, the applicable odour criterion of 6.0 OU has been considered given that the surrounding area is predominantly rural in nature and that the corresponding population density surrounding the Proposal site (refer Section 4.1.2) is less than 10 persons·km⁻².

It is noted that the odour assessment criteria outlined in Table 6 are a design tool rather than a regulatory tool. The benchmark for operational facilities is not the odour assessment criteria outlined above but whether the emission of odour is '*offensive*' or being prevented or minimised using best management practices.

The POEO Act is applicable to scheduled activities in NSW and emphasises the importance of preventing 'offensive odour'.

For reference, 'offensive odour' is defined within the POEO Act as:

an odour:

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

The definition of offensive odour provided by the POEO Act references the FIDOL factors discussed above.

4. EXISTING CONDITIONS

4.1. Surrounding Land Sensitivity

4.1.1. Land Use Zoning

The Proposal site is situated within land zoned under the Goulburn Mulwaree Local Environmental Plan (LEP) 2009 as IN1 – General Industrial.

The State Environmental Planning Policy (SEPP) Amendment (Land Use Zones) (No 4) 2022, published in December 2022 provides specific amendments to the Goulburn Mulwaree LEP 2009. The SEPP Amendment (Land Use Zones) (No 4) refers to E4 – General Industrial, which is a combination of the former IN1 – General Industrial and IN2 – Light Industrial land use zones.

Other land use zones with the immediate locality include RU6 – Transition to the north, and SP2 – Infrastructure to the north-west.

4.1.2. Sensitive Receptor Locations

Air quality assessments include a desktop mapping exercise to identify ‘discrete receptor locations’, which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed.

The Approved Methods (NSW EPA, 2022a) denotes a sensitive receptor location to be:

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

Sensitive locations may also encompass ecological habitats whereby changes in air quality conditions may cause harm and stress to native flora species and vegetation from gaseous pollutants such as oxides of nitrogen (NO_x) produced from combustion sources and ammonia (NH₃) which can be predominant from agricultural activities.

The focus of the AQIA has been on discrete receptor locations, which are specified in consideration of the Approved Methods (NSW EPA, 2022a) and are broadly representative of those areas or sites that may experience the greatest or most likely levels of exposure on account of the Proposal.

In addition to the identified ‘discrete’ receptor locations, the entire modelling area is gridded with ‘uniform’ receptor locations that are used to plot out the predicted impacts, and as such the accidental non-inclusion

of a location sensitive to changes in air quality does not render the AQIA invalid, or otherwise incapable of assessing those potential risks.

To ensure that the selection of discrete receptors for the AQIA are reflective of the locations in which the population of the area surrounding the Proposal site reside, population density data has been examined. Population density data based on the 2021 census have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre (km²) grid, covering mainland Australia (ABS, 2022).

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

For clarity, the ABS use the following categories to analyse population density (persons·km⁻²):

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

Using ABS data in a GIS, the population density of the area surrounding the Proposal site and locality is in an area of very low population (less than 500 persons·km⁻²) which would be expected given the rural nature of the surrounding area. The corresponding ABS 1 km² squares covering the Proposal site indicates 2.75 persons·km⁻² and 5.5 persons·km⁻² respectively.

The population density of the area surrounding the Proposal site are presented in Figure 3.

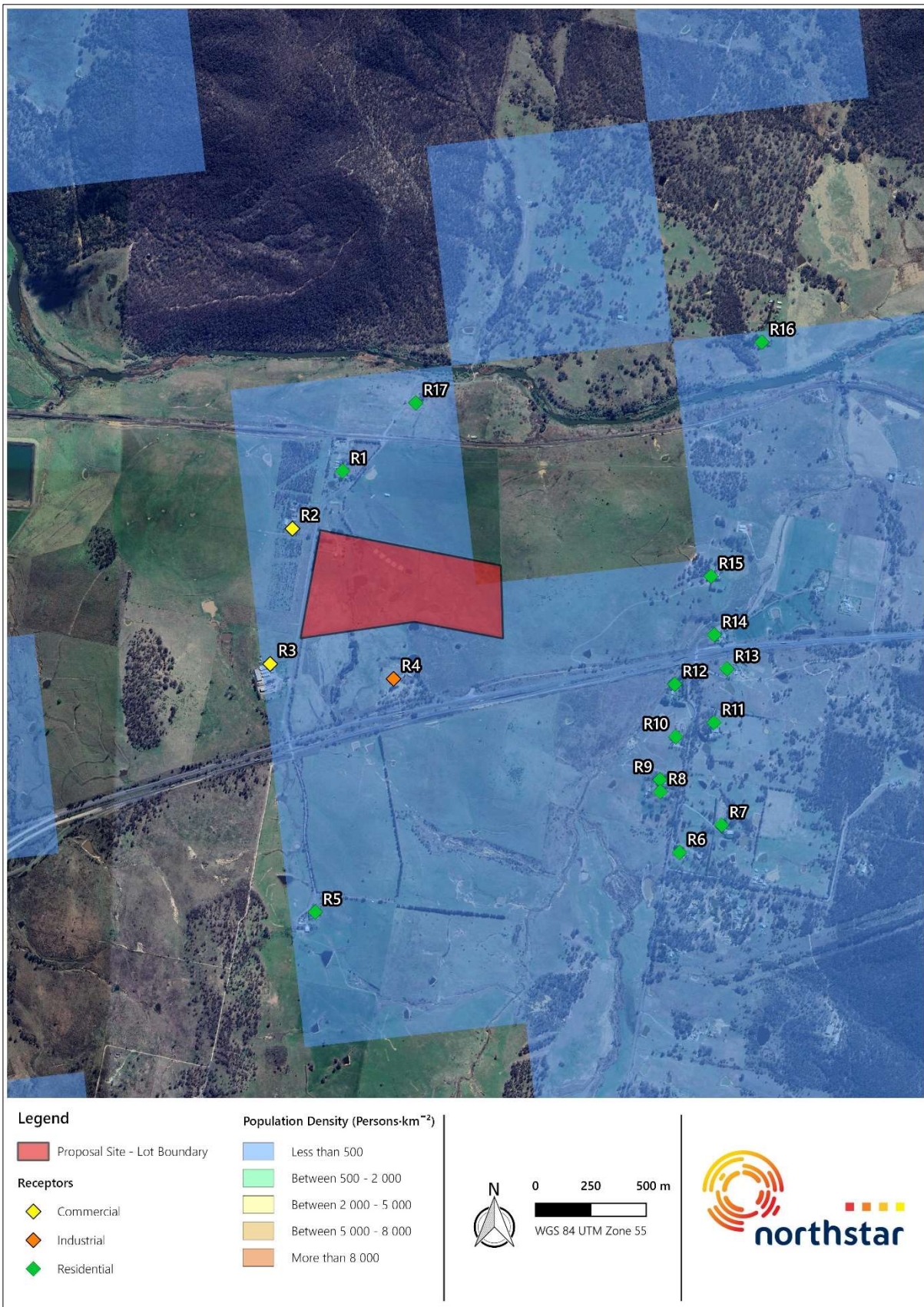
In accordance with NSW EPA requirements, sensitive receptors have been identified and the receptors adopted for use within this AQIA are presented in Table 7, and illustrated in Figure 3. Note that the nomenclature has been adopted to be consistent with that adopted for the assessment of noise impacts.

Table 7 Discrete sensitive receptor locations

Receptor ID	Address	Land use	Coordinates (UTM 55S)	
			mE	mS
R1	Murrays Flat Road, Towrang	Residential	755 438	6 153 870
R2	Murrays Flat Road, Towrang	Commercial	755 211	6 153 609
R3	Murrays Flat Road, Towrang	Commercial	755 111	6 152 998
R4	Hume Highway, Towrang	Industrial	755 668	6 152 930
R5	Hume Highway, Boxers Creek	Residential	755 314	6 151 873
R6	Boxers Creek Road, Boxers Creek	Residential	756 959	6 152 145
R7	Boxers Creek Road, Boxers Creek	Residential	757 150	6 152 269
R8	Boxers Creek Road, Boxers Creek	Residential	756 873	6 152 420
R9	Boxers Creek Road, Boxers Creek	Residential	756 871	6 152 475
R10	Boxers Creek Road, Boxers Creek	Residential	756 942	6 152 668
R11	Boxers Creek Road, Boxers Creek	Residential	757 115	6 152 733
R12	Boxers Creek Road, Boxers Creek	Residential	756 938	6 152 906
R13	Boxers Creek Road, Boxers Creek	Residential	757 174	6 152 976
R14	Hume Highway, Towrang	Residential	757 116	6 153 130
R15	Hume Highway, Towrang	Residential	757 101	6 153 394
R16	Murrays Flat Road, Towrang	Residential	757 331	6 154 452
R17	Murrays Flat Road, Towrang	Residential	755 768	6 154 178

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 3 Population density and sensitive receptors surrounding the Proposal site



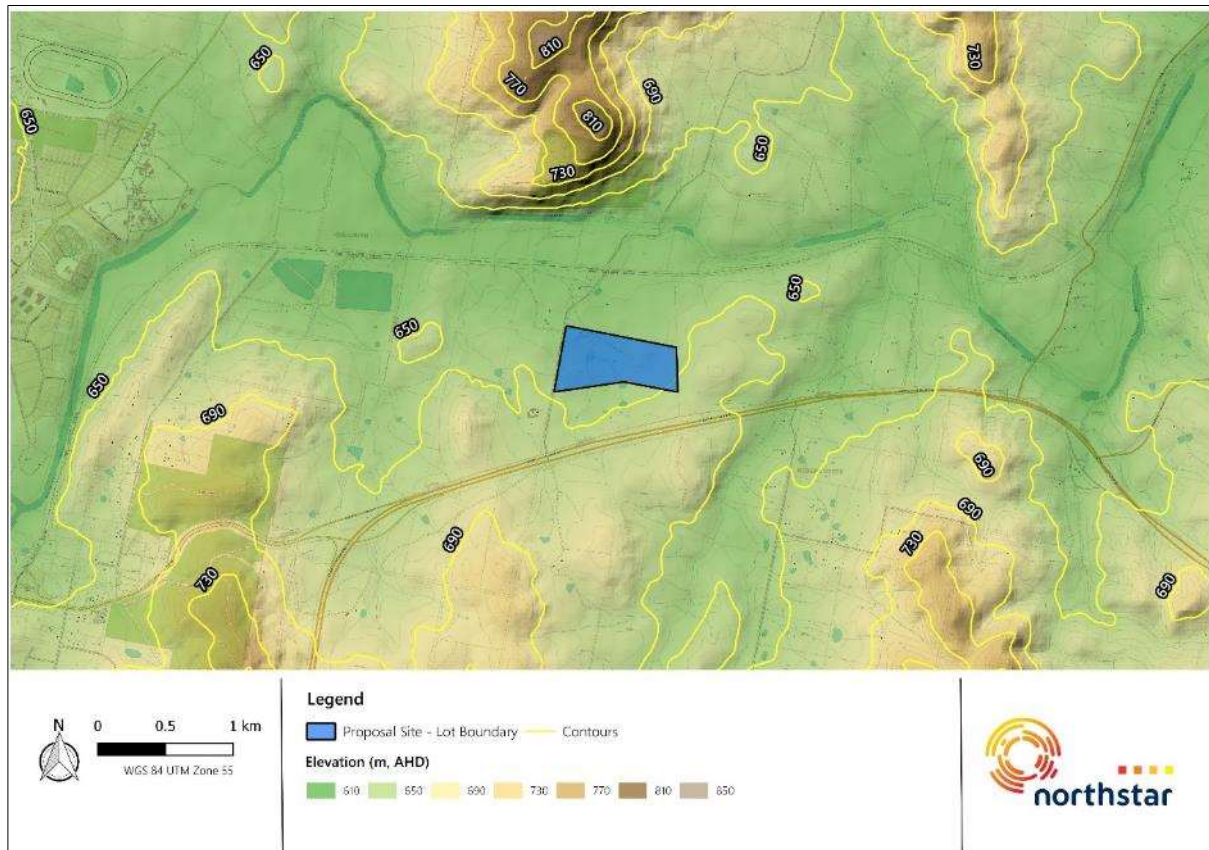
Source: Northstar

4.2. Local Topography

The elevation of the Proposal site ranges between approximately 630 m and 650 m Australian Height Datum (AHD). The topography between the Proposal site and nearest sensitive receptor locations is uncomplicated.

A graphical representation of the local topography is presented in Figure 4.

Figure 4 Local topography



Source: Northstar

4.3. Meteorology

In accordance with the Approved Methods (NSW EPA, 2022a), the AQIA is required to describe and account for the influence of the prevailing meteorological conditions.

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

Two meteorological stations operated by BoM were identified within a 50 km radius of the Proposal site. A summary of the relevant AWS is provided in Table 8 (listed by proximity).

Table 8 Details of BoM meteorological monitoring stations within 50 km of Proposal site

Site name	Station #	Approximate location		Approximate distance (km)
		mE	mS	
Goulburn Airport	070330	780 960	6 110 375	9.2
Nerriga	069128	749 829	6 144 792	49.8

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

The majority of wind speeds experienced at the Goulburn Airport AWS between 2018 and 2022 are generally in the range 1.5 meters per second ($\text{m}\cdot\text{s}^{-1}$) to $8 \text{ m}\cdot\text{s}^{-1}$ with the highest wind speeds (greater than $8 \text{ m}\cdot\text{s}^{-1}$) occurring from mostly west north-westerly directions. Winds of this speed occur during 11.7 % of the observed hours during the years while calm winds (less than $0.5 \text{ m}\cdot\text{s}^{-1}$) occur during 6.4 % of hours on average across the years between 2018 and 2022.

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

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

4.4. Background Air Quality Conditions

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

Air quality monitoring is not performed by the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) within 20 km of the Proposal site. There are four air quality monitoring station (AQMS) within a 100 km radius of the Proposal site. These locations (listed by proximity) are briefly summarised in Table 9.

Table 9 Details of NSW DCCEEW AQMS within 100 km of the Proposal site

AQMS location	Distance to site (km)	2020 data	Measurements					
			PM ₁₀	PM _{2.5}	TSP	CO	O ₃	NO ₂
Bargo	85.7	✓	✓	✓	✗	✗	✓	✓
Albion Park South	91.8	✓	✓	✓	✗	✗	✓	✓
Kembla Grange	97.7	✓	✓	✓	✗	✗	✓	✓
Oakdale	98.8	✓	✓	✓	✗	✗	✓	✓

The nearest representative AQMS with data accessible for the year 2020, consistent with the meteorological modelling, is identified as being situated at Bargo. Accordingly, data related to particulate matter (PM₁₀ and PM_{2.5}) and NO₂, for the year 2020 from Bargo AQMS has been adopted for this AQIA.

Appendix D provides a detailed assessment of the background air quality monitoring data collected at the Bargo AQMS. Data for the year 2020 has been adopted, consistent with the correlation coefficient analysis provided in Appendix C.

It is noted that none of the identified AQMS measure Total Suspended Particulate (TSP) which is of relevance to the expected emissions from the Proposal site. Based upon long-term historic monitoring data, a numerical relationship between TSP and PM₁₀ has been established for the NSW region. Based upon these data, a relationship between ambient concentrations of TSP: PM₁₀ of 2.2434 : 1 is used to approximate background annual average TSP concentrations. This relationship is established and is used frequently to approximate background annual average TSP concentrations in similar locations (see Appendix D).

The impact assessment criteria used for deposited dust (see Table 4) are presented as (i) a cumulative deposition rate of 4 g·m⁻²·month⁻¹ and (ii) a discrete deposition rate of 2 g·m⁻²·month⁻¹. In lieu of a background deposition rate to derive a cumulative rate, the incremental impact assessment criterion (2 g·m⁻²·month⁻¹) has been applied. This is a commonly adopted approach when background deposition rates are not available.

A summary of the air quality monitoring data and assumptions adopted to produce this AQIA are presented in Table 10.

Table 10 Summary of background air quality data used in the AQIA

Pollutant	Averaging period	Units	Measured value	Notes
Particles (as TSP) (derived from PM ₁₀)	Annual	µg·m ⁻³	35.8	Estimated on a TSP:PM ₁₀ ratio of 2.2434 : 1
Particles (as PM ₁₀)	24-hour	µg·m ⁻³	Daily varying	The 24-hour maximum PM ₁₀ concentration in 2020 was 265.7 µg·m ⁻³
	Annual	µg·m ⁻³	15.9	
Particles (as PM _{2.5})	24-hour	µg·m ⁻³	Daily varying	The 24-hour maximum PM _{2.5} concentration in 2020 was 121.9 µg·m ⁻³
	Annual	µg·m ⁻³	7.8	
Dust deposition	Annual	g·m ⁻² ·month ⁻¹	2.0	Difference in NSW EPA maximum allowable and incremental impact criterion
Nitrogen dioxide (NO ₂)	1-hour	µg·m ⁻³	92.3	Hourly maximum 1-hour average in 2020
	Annual	µg·m ⁻³	9.5	Annual average in 2020
Photochemical oxidants as Ozone (O ₃)	1-hour	µg·m ⁻³	244.0	Hourly maximum 1-hour average in 2020
	Annual	µg·m ⁻³	44.4	Annual average in 2020

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

Background air quality monitoring of other pollutants assessed in this AQIA, including metals, are not routinely performed in NSW, or Australia, although specific pollutant monitoring campaigns may be performed to identify and quantify risks surrounding specific emission sources. It is noted that only the incremental impact of the pollutants identified in Table 5 (i.e. copper dusts and mists, iron oxide fumes, manganese, and Chromium VI) are required to be assessed, as per the Approved Methods (NSW EPA, 2022a). No background data to determine potential cumulative impacts is therefore required.

The AQIA has been performed to assess the contribution of the Proposal to the air quality of the surrounding area. Further discussions of how the Proposal impacts upon the air quality of the area during construction and operation are presented in Section 6 and Section 7 respectively.

4.5. Potential for Cumulative Impacts

The area surrounding the Proposal site is generally rural in nature. A desktop survey of the POEO Public Register¹ was performed to identify significant sources in the Goulburn Mulwaree LGA surrounding the Proposal site with a similar emissions profile that may potentially result in cumulative impacts at nearby sensitive receptor locations.

That survey identified 22 issued Environment Protection Licences (EPLs) within the Goulburn Mulwaree LGA, of which 9 facilities that are active in the Goulburn locality. Of those premises, none are identified to operate within the realms of metals resource recovery or scrap metal processing, however there is one facility that is involved in crushing, grinding, or separating activities which is attributable to Divall's Quarry, located approximately 4.1 km to the east of the Proposal site.

The Proposal is for a metals resource recovery facility and may be considered under the POEO Act as a facility that is geared towards the reclamation and recycling of applicable metals materials which requires a component of materials processing to be carried out at the Proposal site.

A search has also been performed on the National Pollutant Inventory (NPI) database² for NPI-reporting industries for the year 2021 / 2022 (the most recent completed record year). The database search identified three facilities within a 5 km radius however none of the recognised NPI industries relate to metal materials processing and transfer activities.

In relation to particulate matter, given the nature of the activities being performed at the Proposal site (i.e. a metals recovery and recycling facility with scrap metal sorting and processing) with pre-shredding and shredding activities to be carried out within a screened enclosure, the potential for cumulative impacts to occur is limited. The inclusion of background air quality data as described in Section 4.4 would appropriately account for any potential cumulative impacts associated with surrounding land uses.

¹ <https://apps.epa.nsw.gov.au/prpoeoapp/SearchResult.aspx?SearchTag=licence&searchrange=licence&range=licence>

² <http://www.npi.gov.au/npidata/action/load/summary-result/criteria/destination/ALL/lga/74/source-type/ALL/subthreshold-data/Yes/substance-name/All/year/2022>

5. APPROACH TO ASSESSMENT

5.1. Construction Phase

Construction phase activities have the potential to generate short-term emissions of particulates. Generally, these are associated with uncontrolled (or ‘fugitive’) emissions and are typically experienced by neighbours as amenity impacts, such as dust deposition and visible dust plumes, rather than associated with health-related impacts. Localised engine-exhaust emissions from construction machinery and vehicles may also be experienced, but given the 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 the methodology as outlined from the Guidance on the Assessment of Dust from Demolition and Construction, developed in the United Kingdom by the Institute of Air Quality Management (IAQM) (IAQM, 2024). Reference should be made to Appendix B for the methodology.

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

5.2. Operational Phase

5.2.1. Dispersion Modelling

An atmospheric dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling has been performed in CALPUFF 3-dimensional (3-D) mode, adopting a ‘No-Obs’ meteorological modelling simulation, in accordance with air quality modelling guidance (Barclay & Scire, 2011) (refer Appendix C for further information). This approach allows the inclusion of topographical features which are present in the area surrounding the Proposal, as discussed in Section 4.2.

The meteorological dataset has been developed using The Air Pollution Model (TAPM, v 4.0.5) in conjunction with CALMET (see Appendix C 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 of the Proposal, approximating average operational characteristics which are appropriate to assess against longer term (annual average) criteria for emissions to air. The likely peak activities at the Proposal have also been characterised to allow comparison of potential impacts against shorter term (24-hour and 1-hour) criteria.

The modelling scenarios provide 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 and Appendix C) 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.

5.2.2.1. Operational Processes

In this assessment emission factors from the US Environmental Protection Agency (US EPA) AP-42 emissions factor compendium (US EPA, various) have been adopted for the assessment of particulate matter emissions resulting from the following operational processes:

- AP-42, Section 13.2.4.3 – Batch drop to represent material handling activities, conveyor, and transfer points.
- AP-42, Section 11.19.2 – Primary crushing for shear and pre-shredder, and screening for activities associated with the non-ferrous processing / screening plant e.g., Finesmaster, KSS and Tumbleback.
- AP-42, Section 11.9-4 – Wind erosion of exposed areas to represent material stockpile locations at each processing area.
- AP-42, Section 13.2.1 – Paved roads to represent on-site vehicle movements around the Proposal site.
- AP-42, Section 13.2.2 – Unpaved roads to represent on-site vehicle movements to the and FEL movements at both the shearing and shredding zones.

These factors are appropriate for adoption in Australia and are routinely adopted in the assessment of operations of this nature.

Potential emissions of particulate matter during the performance of those activities have been quantified, with an emissions inventory associated with the average and peak operational characteristics calculated, based on the activity data presented in Section 2.2.4.

Reference should be made to Appendix E for further information on the emissions inventory for this AQIA.

5.2.2.2. Hammermill Emissions

Air emissions from the Proposal site would arise from the operation of the hammermill.

Stack parameters and associated emissions data have been based on a series of emissions testing reports (Ektimo, 2017), (Ektimo, 2018), (Ektimo, 2019a), (Ektimo, 2020) and (Ektimo, 2021) produced for a hammermill located at a similar development, as referenced in (Northstar, 2021).

The maximum emission rate ($\text{g}\cdot\text{s}^{-1}$) for each pollutant derived from the emission test reports (Ektimo, various) has been used as the emission rate in this AQIA. The maximum measured concentration of each metal species has also been adopted in this assessment and emission discharge conditions (velocity, temperature, etc) have been acquired from the most recent test report (Ektimo, 2021).

It is noted that the hammermill shredder and its associated Emission Collection System (ECS) considered within the emissions testing reports (Ektimo, various) has been designed to manage emissions at a capacity processing rate of $140 \text{ t}\cdot\text{hr}^{-1}$ which equates to a throughput capacity of $2\,100 \text{ t}\cdot\text{day}^{-1}$.

As stated in Section 2.2, the hammermill has a maximum hourly operating capacity of $50 \text{ t}\cdot\text{hr}^{-1}$ and a permissible daily operating period of eight hours, generating a throughput capacity of $400 \text{ t}\cdot\text{day}^{-1}$. Under this Proposal, it is anticipated that the hourly processing rate will be lower than the benchmark set by the sampled hammermill, leading to conservative emissions rates being applied in this AQIA.

The metals extracted from the Hammermill are characterised by their mass fractions in $\text{PM}_{2.5}$, aligning consistently with US EPA³ assessment, as presented in Table 11.

³ <https://www.epa.gov/air-emissions-modeling/speciate>

Table 11 Metal speciation in hammermill extracts (by mass fraction (% w/w))

Metal	Mass fraction (% w/w)
Chromium (Cr)	0.04
Copper (Cu)	0.1
Iron (Fe)	5.76
Lead (Pb)	0.49
Manganese (Mn)	0.088
Nickel (Ni)	0.031
Titanium (Ti)	0.025
Vanadium (V)	0.001
Zinc (Zn)	2.1

A summary of the hammermill emissions estimates is provided in Appendix E.

5.2.2.3. Oxycutting Emissions

For this AQIA, it is considered that all oxycutting activities are conducted using oxy-acetylene cutting equipment at a designated outdoors open area located in proximity to the fixed inclined shear (refer Figure 2). To characterise the emissions resulting from oxycutting operations, data on emission rates and associated discharge conditions have been gathered from two emissions testing reports performed on oxycutting equipment in a comparable context (EML AIR, 2014) (Ektimo, 2019a).

It is noted that the emissions test report and the corresponding inventory covers particulates, NO_x, odour, and various measured metals species including silver (Ag), aluminium (Al), arsenic (As), cadmium (Cd), Pb, Mg and Zn.

The emissions estimation for the Oxycutter is presented in Appendix E.

5.2.2.4. Odour Emissions

With regard to the Proposal site, the sources with the potential to emit odour are limited to the oxycutter and both the pre-shredding and hammermill shredding zones, which is consistent with other AQIA conducted for operations of a similar nature including (ERM, 2015) (Todoroski Air Sciences, 2019), and (Northstar, 2021).

In consideration of the hammermill, odour emission rates have been referenced from the measurements presented within National Association of Testing Authorities (NATA) endorsed emissions testing reports produced by (EML AIR, 2014). The maximum measured odour emission derived from the emissions testing (1 600 OU) has been applied to represent odour emissions from the hammermill, which is noted to be a

conservative assumption. The same discharge conditions (velocity, temperature, etc) as acquired from (Ektimo, 2021) have also been applied to provide a representation of emissions from the hammermill.

The odour emission rate associated with the Oxycutter is derived from a NATA endorsed emission testing report for odour emissions associated with a proxy Oxycutter presented in (Ektimo, 2019b) which presents a maximum concentration of 2 400 OU.

For both pieces of plant, a peak to mean ratio of 2.3 has been applied to the predicted 1-hour odour impacts, as required within the Approved Methods (NSW EPA, 2022a).

Further information associated with the odour emissions estimations are provided in Appendix E.

5.2.3. Emissions Controls

Emission controls will be employed at the Proposal site. The application of these controls results in quantifiable reductions in the quantity of particulate matter being emitted as part of those activities.

A summary of the emissions reductions measures that would be adopted as part of the Proposal operations is provided in Table 12. The emission control efficiencies are outlined in the National Pollutant Inventory Emissions Estimation Technique Manual (NPI EETM) for Mining (NPI, 2012), NPI EETM for Non-Ferrous Metal Manufacture (NPI, 2001), and relevant AP-42 documentation (US EPA, 1995).

Table 12 Summary of emission reduction methods adopted at part of Proposal operation

Emission control method	Control efficiency (%)
Materials handling and processing activities	
'Dust-Buster' dust control on shredder equipment with foam and foaming chemical	85
Water sprays during truck unloading activities	70
Water sprays on handling and transfer points	50
Above ground acoustic wall enclosure of pre-shredder and shredder equipment	70
Awning enclosure of non-ferrous processing equipment	70
Controlled crushing at pre-shredder and hammermill shredder	77.7
Controlled screening at non-ferrous sorting plant (Drumfeeder, Finesmaster, KSS)	91.2
Wind shielding for conveyors	70
Enclosure for transfers	70
Minimisation of material drop point heights on handling and transfer points	30
Paved haul routes	
All vehicle loads are covered for transporting material off-site.	Not quantified
Limit load sizes to ensure material is not above the level of truck sidewalls	Not quantified
Road flushing – water application on paved haulage routes	30 - 70
Reduction in vehicle speeds to 50 km·hr ⁻¹	40
Management of paved road haulage route through routine sweeping	50

Emission control method	Control efficiency (%)
Wind erosion sources	
Erect three-sided enclosures around storage piles	75
Material stockpile sizes to be maintained	30

An emission reduction of 30 % has been applied for the watering of paved roads as per (US EPA, 2011) which indicates that an hourly water flushing at a rate of $0.48 \text{ gal}\cdot\text{yd}^{-2}$ (equivalent to $2.2 \text{ L}\cdot\text{m}^{-2}\cdot\text{hr}^{-1}$) could result in emissions reductions of between 30 % and 70 %. For the purposes of the AQIA, the lower (conservative) reduction factor of 30 % has been adopted.

5.2.4. NO_x to NO_2 Conversion

Emissions of NO_x have been calculated, with subsequent ground-level concentrations predicted using dispersion modelling techniques. Given that NO_x is a mixture of NO_2 and nitric oxide (NO), conversion of NO_x predictions to NO_2 concentrations may be performed.

To perform this, various techniques are common, which are briefly outlined below:

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

For this AQIA, the conversion of NO_x to NO_2 has been conducted in accordance with Method 1 of the Approved Methods (see Section 8.1.1 of (NSW EPA, 2022a)), which presents the conservative assumption that all NO is converted to NO_2 has been adopted (i.e. 100 % of NO_x is emitted as NO_2).

6. CONSTRUCTION AIR QUALITY RISK ASSESSMENT

Northstar has adapted the assessment procedure guidance for dust from demolition and construction (IAQM, 2024) to evaluate construction phase risks. The methodology and the complete risk assessment are provided in Appendix B.

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

6.1. Risk (Pre-Mitigation)

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

Table 13 Risk of air quality impacts from construction activities

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

Note: NA. = Not applicable, Neg. Negligible, Med. = Medium

The risks outlined in Table 13 indicate a medium risk of adverse dust soiling impacts and a low risk of health impacts related to earthworks and construction activities. Trackout activities carry a low risk of adverse dust soiling impacts and a negligible risk of health impacts. Additionally, demolition and construction traffic movements pose a negligible risk of adverse dust soiling and health impacts, assuming no mitigation measures are applied to control emissions during construction-phase activities.

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

6.2. Risk (Post Mitigation)

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

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

It is noted that the mitigation measures outlined in Appendix B represent a broad range of potential options which could be used to manage the identified risk and may not be appropriate to all construction activities at all sites. Those measures to be implemented during the construction phase should be reviewed as part of the preparation of any Construction Environment Management Plan (CEMP) and Air Quality Management Plan (AQMP).

7. OPERATIONAL AIR QUALITY IMPACT ASSESSMENT

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

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

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

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

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

7.1. Particulate Matter

7.1.1. Annual Average TSP, PM₁₀ and PM_{2.5} Concentrations

The predicted annual average particulate matter concentrations (as TSP, PM₁₀ and PM_{2.5}) resulting from the operations at the Proposal site are presented in Table 14.

The results indicate that incremental concentrations of TSP at surrounding receptor locations are below the relevant air quality impact assessment criterion (refer Table 4).

The addition of background concentrations (refer Section 4.4) to those predicted incremental impacts associated with the Proposal results in cumulative concentrations of annual average TSP, PM₁₀ and PM_{2.5} below the relevant criteria at all identified receptors.

Annual average PM_{2.5} concentrations are shown to be within 99.5 % of the criterion at receptor R2 with the corresponding contribution from the Proposal predicted to be 2 % of the criterion. No contour plots of annual average TSP, PM₁₀ or PM_{2.5} concentrations are presented, given the limited contributions to be experienced at the Proposal site.

Table 14 Predicted annual average TSP, PM₁₀ and PM_{2.5} concentrations

Receptor	Annual average concentration (µg·m ⁻³)								
	TSP			PM ₁₀			PM _{2.5}		
	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.
Criterion	90			25			8		
Max. % criterion	4.6	39.8	44.4	5.6	63.6	69.2	2.0	97.5	99.5
R1	0.8	35.8	36.6	0.3	15.9	16.2	<0.1	7.8	7.9
R2	4.2	35.8	40.0	1.4	15.9	17.3	0.2	7.8	8.0^(A)
R3	1.8	35.8	37.6	0.6	15.9	16.5	0.1	7.8	7.9
R4	1.8	35.8	37.6	0.7	15.9	16.6	0.1	7.8	7.9
R5	0.1	35.8	35.9	< 0.1	15.9	16.0	<0.1	7.8	7.9
R6	0.2	35.8	36.0	< 0.1	15.9	16.0	<0.1	7.8	7.9
R7	0.2	35.8	36.0	< 0.1	15.9	16.0	<0.1	7.8	7.9
R8	0.3	35.8	36.1	0.1	15.9	16.0	<0.1	7.8	7.9
R9	0.3	35.8	36.1	0.1	15.9	16.0	<0.1	7.8	7.9
R10	0.4	35.8	36.2	0.1	15.9	16.0	<0.1	7.8	7.9
R11	0.4	35.8	36.2	0.1	15.9	16.0	<0.1	7.8	7.9
R12	0.5	35.8	36.3	0.2	15.9	16.1	<0.1	7.8	7.9
R13	0.5	35.8	36.3	0.2	15.9	16.1	<0.1	7.8	7.9
R14	0.5	35.8	36.3	0.2	15.9	16.1	<0.1	7.8	7.9
R15	0.5	35.8	36.3	0.2	15.9	16.1	<0.1	7.8	7.9
R16	< 0.1	35.8	35.9	< 0.1	15.9	16.0	<0.1	7.8	7.9
R17	0.2	35.8	36.0	< 0.1	15.9	16.0	<0.1	7.8	7.9

Notes: Maximum predicted concentration in **Bold**

Incr. – incremental impact, Bkg. – background, Cumul. – cumulative impact.

(A) Actual cumulative impact is 7.96 µg·m⁻³ and rounded for clarity.

7.1.2. Annual Average Dust Deposition Rates

Table 15 presents the annual average dust deposition predicted as a result of the Proposal operation.

The results indicate minor incremental impacts at all surrounding receptor locations and as such, the criteria for dust deposition are anticipated to be achieved.

Table 15 Predicted annual average dust deposition rate

Receptor	Annual average dust deposition rate (g·m ⁻² ·month ⁻¹)		
	Incr.	Bkg.	Cumul.
Criterion	2	-	4
Max. % of criterion	11.0	-	55.5
R1	< 0.1	2.0	2.1
R2	0.2	2.0	2.2
R3	0.1	2.0	2.1
R4	0.1	2.0	2.1
R5	< 0.1	2.0	2.1
R6	< 0.1	2.0	2.1
R7	< 0.1	2.0	2.1
R8	< 0.1	2.0	2.1
R9	< 0.1	2.0	2.1
R10	< 0.1	2.0	2.1
R11	< 0.1	2.0	2.1
R12	< 0.1	2.0	2.1
R13	< 0.1	2.0	2.1
R14	< 0.1	2.0	2.1
R15	< 0.1	2.0	2.1
R16	< 0.1	2.0	2.1
R17	< 0.1	2.0	2.1

Notes: Maximum predicted concentration in **Bold**

Incr. – incremental impact, Bkg. – background concentration, Cumul. – cumulative impact

7.1.3. Maximum 24-hour PM₁₀ and PM_{2.5} Concentrations

Presented in Table 16 are the maximum 24-hour average PM₁₀ and PM_{2.5} concentrations predicted to occur at the nearest sensitive receptors due to the operation of the Proposal. No background concentrations are included within this table.

The highest incremental 24-hour impacts are predicted at receptor R3 for both PM₁₀ and PM_{2.5}.

Table 16 Predicted maximum incremental 24-hour PM₁₀ and PM_{2.5} concentrations

Receptor	Maximum 24-hour average concentration (µg·m ⁻³)	
	PM ₁₀	PM _{2.5}
Criterion	50	25
Max. % of criterion	9.2	5.3
R1	1.9	0.4
R2	4.3	0.8
R3	4.6	1.3
R4	4.2	1.0
R5	0.6	0.2
R6	0.4	0.1
R7	0.4	< 0.1
R8	0.5	0.1
R9	0.5	0.1
R10	0.6	0.2
R11	0.5	0.1
R12	0.5	0.2
R13	0.4	0.2
R14	0.5	0.1
R15	0.5	0.1
R16	0.2	< 0.1
R17	0.9	0.2

Note: Maximum predicted concentration in **Bold**

A contemporaneous analysis of the 24-hour PM₁₀ and PM_{2.5} data has been performed where each predicted incremental concentration is added to the corresponding measured background concentration, in accordance with Section 11.2.3(b) of the Approved Methods (NSW EPA, 2022a).

Table 17 and Table 18 present the predicted maximum 24-hour average PM₁₀ and PM_{2.5} concentrations at the Proposal site, resulting from the operation of the Proposal, with the corresponding background included for each day.

Results are presented for the receptor at which the highest incremental PM₁₀ and PM_{2.5} impacts have been predicted, and for the receptors at which the highest cumulative impacts (increment plus background) have been predicted. These may be different receptors than those at which the highest incremental impacts are predicted.

The left side of Table 17 and Table 18 indicates the predicted concentration on days with the highest cumulative impact (principally driven by the highest measured background concentrations), and the right side of the respective tables shows the total predicted concentration on days with the highest predicted

incremental concentrations and the contemporaneous background values to derive the corresponding cumulative predictions.

For PM_{10} , the maximum cumulative impact (the left-hand side of Table 17), and the maximum incremental impact (the right-hand side of Table 17) are predicted at receptor R4 and receptor R3 respectively.

For $PM_{2.5}$, the maximum cumulative impact (the left-hand side of Table 18), and the maximum incremental impact (the right-hand side of Table 18) are predicted at receptor R2 and receptor R3 respectively.

It is noted that Table 17 and Table 18 includes columns headed by 'rank', referring to the ranking of cumulative impacts i.e. rank 1 being the highest cumulative impact. This has been included to highlight days when the background concentrations are not the driver of exceedances.

Specifically, Table 17 indicates that there were six days on which the 24-hour PM_{10} criterion was exceeded in 2020 although importantly, the operation of the Proposal is not predicted to result in any additional exceedances of the criterion.

For clarity the background daily PM_{10} concentration on 13 January 2020 is $47.6 \mu\text{g}\cdot\text{m}^{-3}$ whilst the Proposal increment of less than $0.1 \mu\text{g}\cdot\text{m}^{-3}$ equates to a predicted cumulative impact of $47.7 \mu\text{g}\cdot\text{m}^{-3}$, representing 95.3 % of the respective air quality criterion.

Table 18 similarly presents the predicted 24-hour average $PM_{2.5}$ concentrations at the Proposal site, whereby it is noted that there were 16 days which the 24-hour $PM_{2.5}$ criterion was exceeded. However, the modelled cumulative 24-hour $PM_{2.5}$ concentrations are not predicted to result in any additional exceedances of the relevant criterion at the Proposal site.

Contour plots of the incremental contribution of the proposed operations at the Proposal site to the 24-hour average PM_{10} and $PM_{2.5}$ concentrations are presented in Figure 5 and Figure 6.

Table 17 Summary of contemporaneous impact and background – 24-hour PM₁₀ concentrations

Rank	Date	24-hour average PM ₁₀ concentration (µg·m ⁻³)			Rank	Date	24-hour average PM ₁₀ concentration (µg·m ⁻³)		
		Receptor R4					Receptor R3		
		Incr.	Bkg.	Cumul.			Incr.	Bkg.	Cumul.
1	23/01/2020	0.6	265.7	266.3	1	18/06/2020	4.6	11.5	16.1
2	5/01/2020	< 0.1	164.2	164.3	2	5/03/2020	4.2	8.6	12.8
3	24/01/2020	0.2	139.6	139.8	3	19/09/2020	4.2	14.8	19.0
4	4/01/2020	0.8	134.7	135.5	4	16/05/2020	3.9	8.2	12.1
5	8/01/2020	< 0.1	93.6	93.7	5	9/06/2020	3.9	8.2	12.1
6	25/01/2020	< 0.1	58.5	58.6	6	8/07/2020	3.7	9.7	13.4
7	13/01/2020	< 0.1	47.6	47.7	7	1/04/2020	3.5	13.3	16.8
8	2/02/2020	0.2	47.0	47.2	8	20/10/2020	3.3	12.2	15.5
9	7/01/2020	0.5	45.3	45.8	9	18/05/2020	3.3	7.1	10.4
10	3/01/2020	0.4	45.3	45.7	10	6/09/2020	3.2	13.5	16.7
11	1/01/2020	0.2	45.3	45.5	11	7/04/2020	3.1	12.4	15.5
12	2/01/2020	< 0.1	45.3	45.4	12	24/03/2020	3.0	12.6	15.6
13	17/01/2020	< 0.1	40.7	40.8	13	12/03/2020	2.9	8.4	11.3
14	4/02/2020	< 0.1	38.2	38.3	14	26/12/2020	2.9	11.2	14.1
15	1/02/2020	1.2	36.5	37.7	15	25/01/2020	2.8	58.5	61.3
16	2/03/2020	0.2	34.7	34.9	16	28/03/2020	2.7	12.0	14.7
17	31/01/2020	1.3	33.5	34.8	17	27/04/2020	2.6	21.3	23.9
18	17/11/2020	0.5	31.6	32.1	18	17/03/2020	2.6	10.1	12.7
19	27/02/2020	0.4	31.5	31.9	19	18/11/2020	2.6	18.8	21.4
20	19/02/2020	< 0.1	31.6	31.7	20	15/12/2020	2.6	8.1	10.7
These data represent the highest Cumulative Impact 24-hour PM ₁₀ predictions (outlined in red) as a result of the operation of the Proposal.					These data represent the highest Incremental Impact 24-hour PM ₁₀ predictions (outlined in blue) as a result of the operation of the Proposal.				

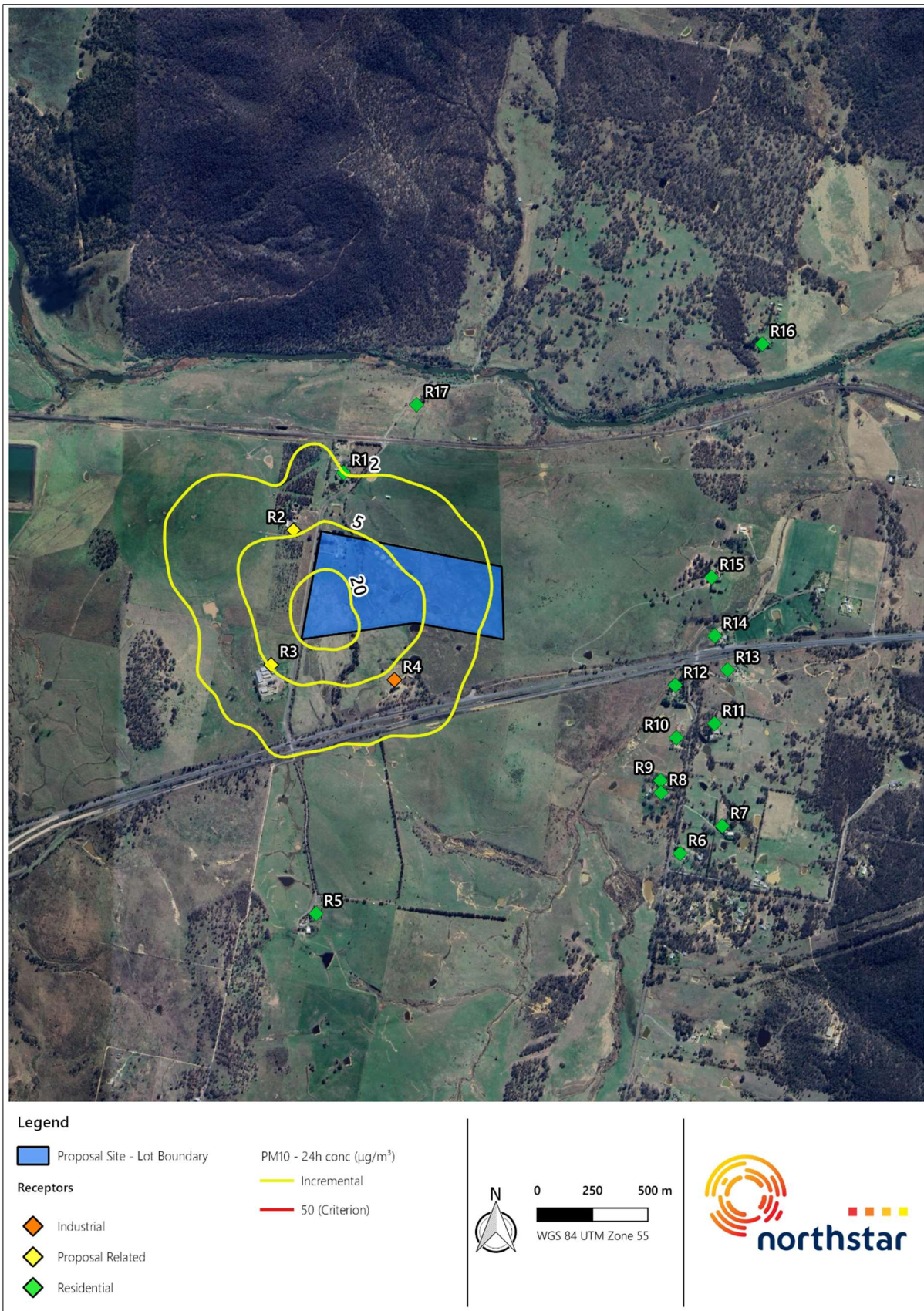
Note: Incr. – incremental impact, Bkg. – background concentration, Cumul. – cumulative impact

Table 18 Summary of contemporaneous impact and background – 24-hour PM_{2.5} concentrations

Rank	Date	24-hour average PM _{2.5} concentration (µg·m ⁻³)			Rank	Date	24-hour average PM _{2.5} concentration (µg·m ⁻³)		
		Receptor R2					Receptor R3		
		Incr.	Bkg.	Cumul.			Incr.	Bkg.	Cumul.
1	5/01/2020	< 0.1	121.9	122.0	1	19/09/2020	1.3	10.1	11.4
2	6/09/2020	< 0.1	104.6	104.7	2	5/03/2020	1.1	3.5	4.6
3	8/01/2020	0.4	76.5	76.9	3	1/04/2020	0.9	4.6	5.5
4	12/01/2020	< 0.1	66.0	66.1	4	26/12/2020	0.8	3.8	4.6
5	1/01/2020	< 0.1	64.4	64.5	5	20/10/2020	0.7	3.2	3.9
6	11/01/2020	< 0.1	62.7	62.8	6	18/06/2020	0.7	6.2	6.9
7	4/01/2020	< 0.1	56.2	56.3	7	9/06/2020	0.6	2.6	3.2
8	2/01/2020	< 0.1	49.8	49.9	8	16/05/2020	0.6	4.2	4.8
9	23/01/2020	< 0.1	40.5	40.6	9	18/05/2020	0.6	2.9	3.5
10	24/01/2020	< 0.1	37.6	37.7	10	25/01/2020	0.6	16.1	16.7
11	15/01/2020	< 0.1	35.1	35.2	11	24/03/2020	0.6	5.7	6.3
12	14/01/2020	< 0.1	35.1	35.2	12	12/03/2020	0.6	1.1	1.7
13	13/01/2020	< 0.1	35.1	35.2	13	8/07/2020	0.6	4.5	5.1
14	7/01/2020	< 0.1	30.6	30.7	14	4/03/2020	0.6	2.5	3.1
15	3/01/2020	< 0.1	28.6	28.7	15	28/03/2020	0.6	2.7	3.3
16	4/02/2020	< 0.1	25.8	25.9	16	21/12/2020	0.6	5.1	5.7
17	31/01/2020	< 0.1	21.0	21.1	17	6/09/2020	0.6	104.6	105.2
18	27/01/2020	< 0.1	19.9	20.0	18	15/12/2020	0.5	1.5	2.0
19	18/01/2020	0.2	19.2	19.4	19	13/01/2020	0.5	35.1	35.6
20	19/01/2020	< 0.1	19.2	19.3	20	18/11/2020	0.5	6.4	6.9
These data represent the highest Cumulative Impact 24-hour PM _{2.5} predictions (outlined in red) as a result of the operation of the Proposal.					These data represent the highest Incremental Impact 24-hour PM _{2.5} predictions (outlined in blue) as a result of the operation of the Proposal.				

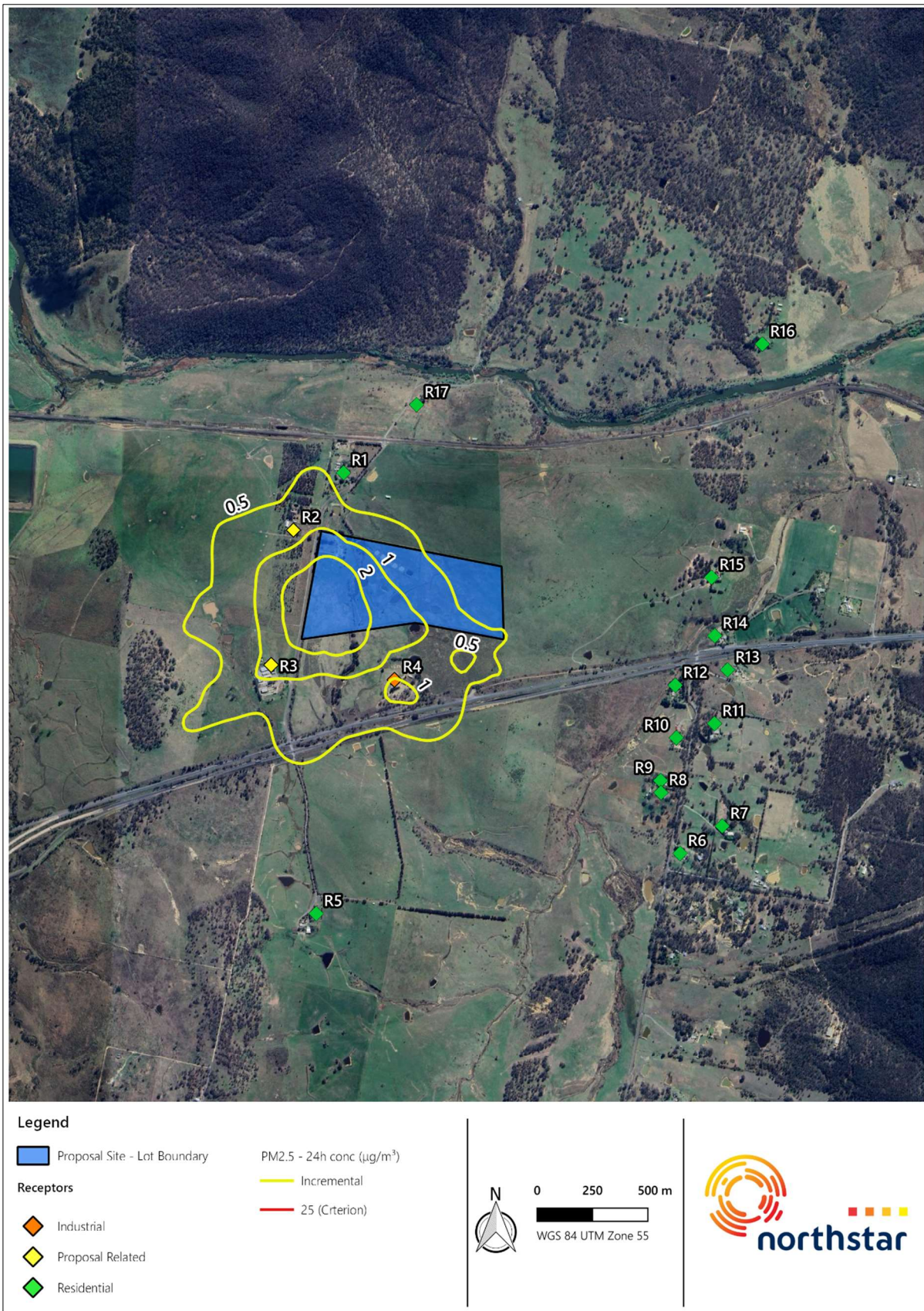
Note: Incr. – incremental impact, Bkg. – background concentration, Cumul. – cumulative impact

Figure 5 Predicted incremental 24-hour PM₁₀ impacts



Source: Northstar

Figure 6 Predicted incremental 24-hour $PM_{2.5}$ impacts



Source: Northstar

7.2. Nitrogen Dioxide

Predicted incremental and cumulative annual average and maximum 1-hour NO₂ concentrations resulting from the operation of the Proposal are presented in Table 19.

It is noted that the assessment assumes a 100 % conversion of NO_x to NO₂ (see Section 5.2.4) and adopts the highest 1-hour measured NO₂ concentration and the annual average NO₂ concentration as the respective background value.

The results indicate that predicted cumulative concentrations of NO₂ at all receptor locations are low and would comply with both the annual and maximum 1-hour average criteria.

Table 19 Predicted 1-hour and annual average NO₂ concentrations

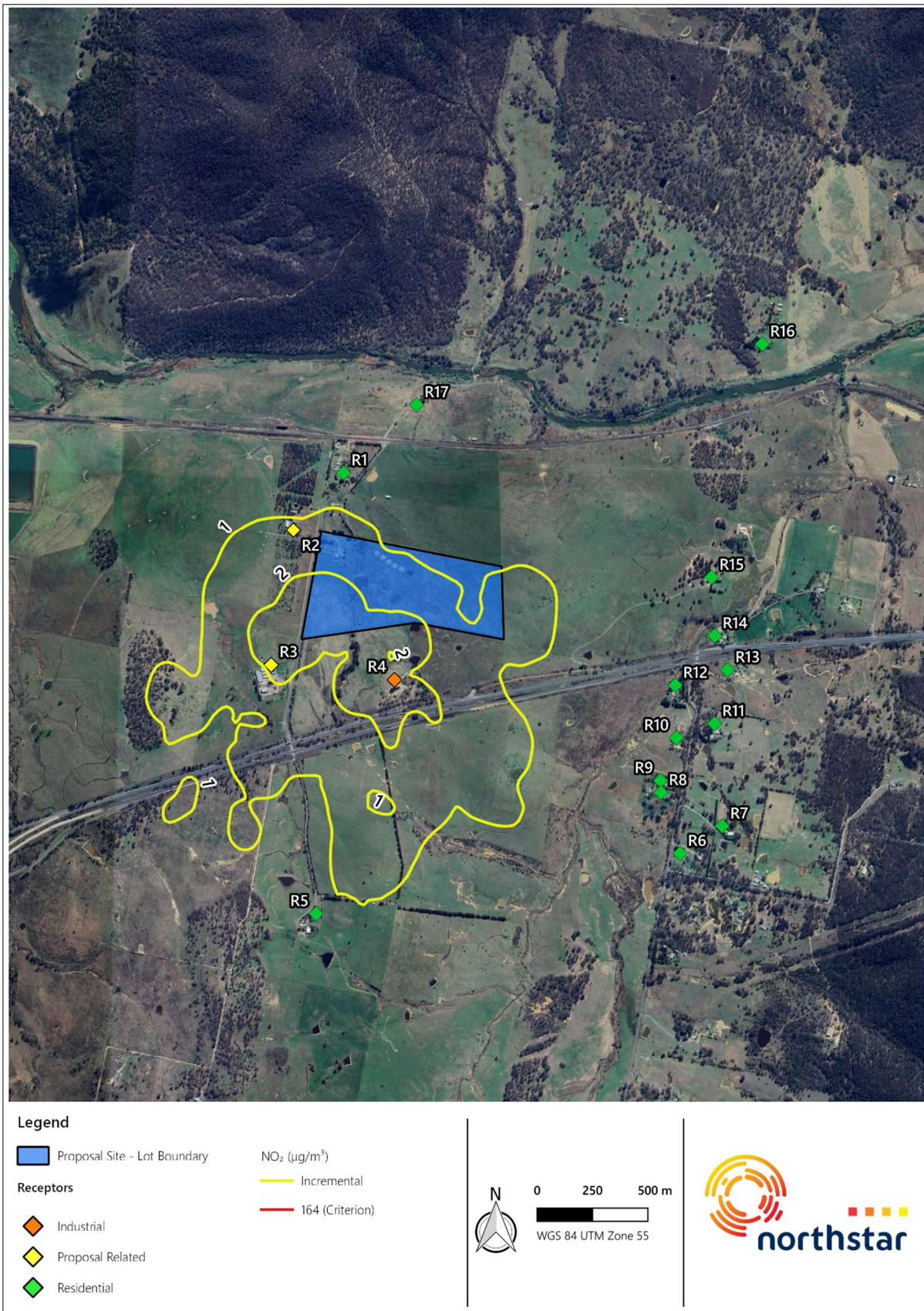
Receptor	Nitrogen dioxide (NO ₂) concentration (µg·m ⁻³)					
	1-hour average			Annual average		
	Incr.	Bkg.	Cumul.	Incr.	Bkg.	Cumul.
Criterion	164			31		
Max. % of criterion	1.3	56.3	57.6	< 0.1	30.6	30.8
R1	0.8	92.3	93.1	< 0.1	9.5	9.6
R2	1.2	92.3	93.5	< 0.1	9.5	9.6
R3	2.2	92.3	94.5	< 0.1	9.5	9.6
R4	2.1	92.3	94.4	< 0.1	9.5	9.6
R5	1.0	92.3	93.3	< 0.1	9.5	9.6
R6	0.5	92.3	92.8	< 0.1	9.5	9.6
R7	0.3	92.3	92.6	< 0.1	9.5	9.6
R8	0.6	92.3	92.9	< 0.1	9.5	9.6
R9	0.6	92.3	92.9	< 0.1	9.5	9.6
R10	0.4	92.3	92.7	< 0.1	9.5	9.6
R11	0.4	92.3	92.7	< 0.1	9.5	9.6
R12	0.3	92.3	92.6	< 0.1	9.5	9.6
R13	0.3	92.3	92.6	< 0.1	9.5	9.6
R14	0.3	92.3	92.6	< 0.1	9.5	9.6
R15	0.3	92.3	92.6	< 0.1	9.5	9.6
R16	0.2	92.3	92.5	< 0.1	9.5	9.6
R17	0.4	92.3	92.7	< 0.1	9.5	9.6

Note: Maximum predicted concentration in **Bold**

Incr. – incremental impact, Bkg. – background concentration, Cumul. – cumulative impact

A contour plot of the predicted maximum 1-hour incremental NO₂ impact is presented in Figure 7.

Figure 7 Predicted incremental 1-hour NO_x (as NO_2) impacts



Source: Northstar

7.3. Metals

Metals have been assessed as the respective fraction of $PM_{2.5}$ (refer Section 5.2.2)

The maximum incremental 1-hour $PM_{2.5}$ prediction is $7.6 \mu\text{g}\cdot\text{m}^{-3}$ at receptor location R3. Considering the potential for cumulative emissions of metals across the Proposal site, rather than the sole contribution from the hammermill, and referring to Table 11 for mass fraction speciation, the maximum 1-hour concentrations for specific components are as follows:

• Chromium (assessed as Cr(VI))	$0.003 \mu\text{g}\cdot\text{m}^{-3}$ (3.40 % of the criterion)
• Copper (Cu)	$0.008 \mu\text{g}\cdot\text{m}^{-3}$ (0.04 % of the criterion)
• Iron (Fe)	$0.440 \mu\text{g}\cdot\text{m}^{-3}$ (0.49 % of the criterion)
• Manganese (Mn)	$0.007 \mu\text{g}\cdot\text{m}^{-3}$ (0.04 % of the criterion)
• Nickel (Ni)	$0.002 \mu\text{g}\cdot\text{m}^{-3}$ (1.32 % of the criterion)

Lead (Pb) has an annual average criterion, as such the maximum predicted concentration has been applied for this AQIA. The maximum annual average $PM_{2.5}$ prediction of $0.2 \mu\text{g}\cdot\text{m}^{-3}$ (refer Table 14) and a Pb fraction of 0.49 % derives an annual average Pb concentration of $0.0008 \mu\text{g}\cdot\text{m}^{-3}$ or 0.2 % of the criterion.

Background concentrations of metals are assumed to be negligible (refer Section 4.4), and therefore the assessment considers incremental impacts only, or alternatively, the incremental impact is equal to the cumulative impact. The results do not predict any exceedances of the respective 1-hour metals criteria nor the annual average Pb criterion.

Correspondingly, no exceedances have been predicted with regard to the 1-hour metals impact assessment criterion (refer Table 5) nor the annual average Pb criterion (refer Table 4).

7.4. Odour

Incremental impacts of odour are presented in Table 20 for each identified sensitive receptor.

The predicted 99th percentile odour concentrations at each of the considered receptors are below the impact assessment criterion of 6.0 OU with the maximum odour concentration of 1.0 OU predicted at receptor R4.

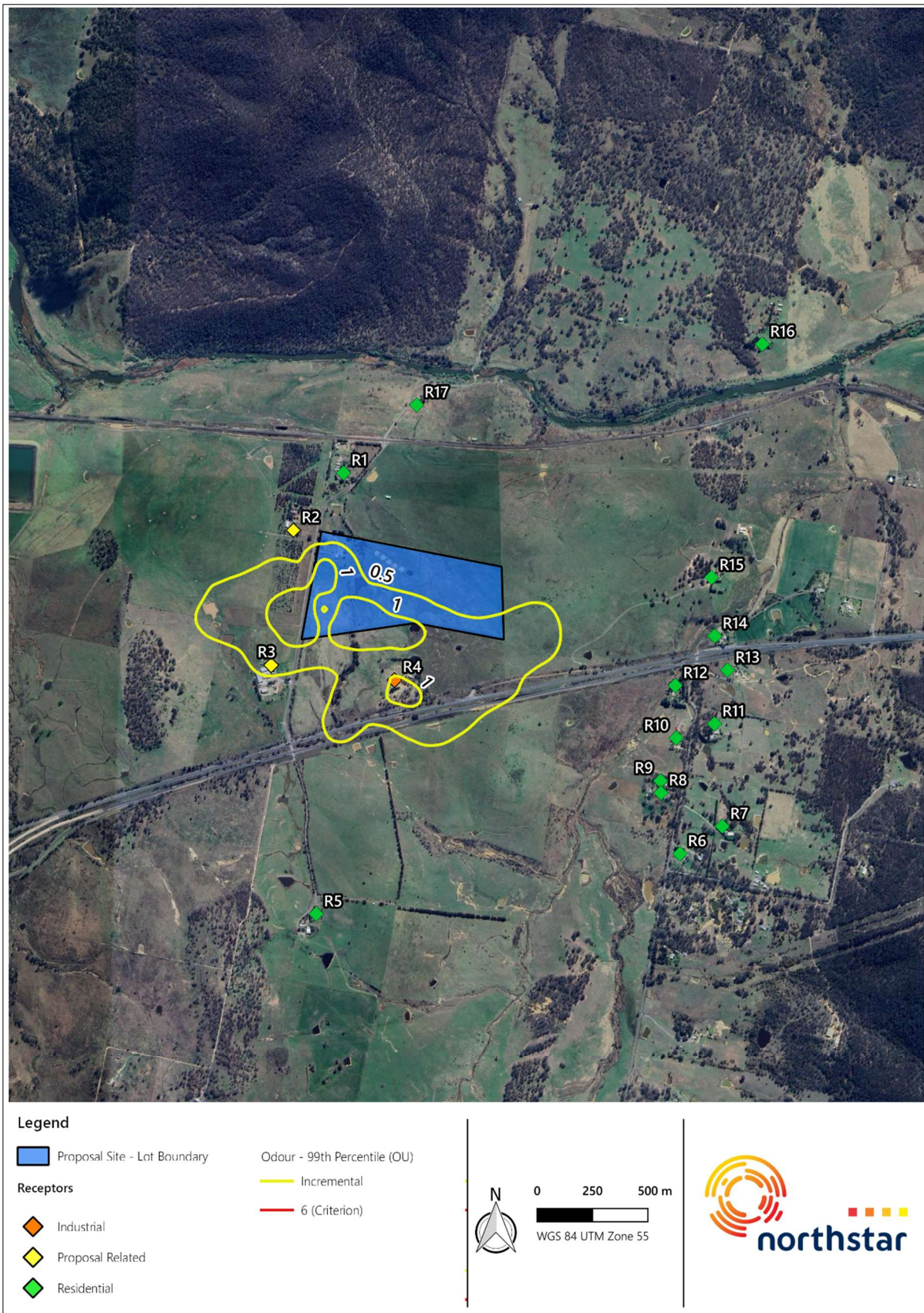
Table 20 Predicted incremental 99th percentile odour concentrations

Receptor	99 th percentile odour concentration (OU)
	Incr.
Criterion	6.0
Max % of criterion	17.3
R1	0.2
R2	0.3
R3	0.7
R4	1.0
R5	0.1
R6	0.1
R7	0.1
R8	0.2
R9	0.2
R10	0.2
R11	0.2
R12	0.2
R13	0.2
R14	0.2
R15	0.1
R16	< 0.1
R17	< 0.1

Note: Incr. – incremental impact

A contour plot illustrating the predicted incremental odour impacts associated with the Proposal are presented in Figure 8.

Figure 8 Predicted incremental 99th percentile odour impacts



Source: Northstar

7.5. Summary of Results

The assessment of potential impacts associated with operational activities has been performed in accordance with the requirements of the Approved Methods (NSW EPA, 2022a) and utilises an approved and appropriate dispersion modelling technique. The estimation of emissions has been performed using a combination of referenced emission factors and stack parameters and associated emissions data as based on emissions testing reports produced in support of a similar development (refer Section 5.2.2 and Appendix E).

Based on the assumptions presented in this AQIA, the results indicate the following:

- No exceedances are predicted with regard to annual average TSP, PM₁₀ or PM_{2.5} concentrations.
- The Proposal would result in a maximum incremental dust deposition impact of 0.2 g·m⁻²·month⁻¹ which is well below the criterion of 2.0 g·m⁻²·month⁻¹. As discussed in Section 4.4, background levels of dust deposition were calculated as 2.0 g·m⁻²·month⁻¹ at all receptors. When considered with incremental dust deposition rates, the cumulative impact at all receptors would be 2.2 g·m⁻²·month⁻¹ which is lower than the respective cumulative criteria of 4.0 g·m⁻²·month⁻¹.
- The Proposal is not predicted to result in any additional exceedances of the respective 24-hour PM₁₀ and PM_{2.5} criteria. Where exceedances have been identified (refer Table 17 and Table 18) these are caused by the background 24-hour PM₁₀ and PM_{2.5} concentrations already in exceedance of the criteria.
- Modelled incremental and cumulative 1-hour and annual average impacts for NO₂ are predicted to comply with the respective criteria at all considered receptors.
- Metals impacts have been assessed as a percentage of the total PM_{2.5} concentrations derived for the Proposal and according to their respective weight fraction as w/w% (refer Section 5.2.2). The maximum 1-hour PM_{2.5} prediction is 7.6 µg·m⁻³, which would correspond to the following metals concentrations:
 - Chromium – 0.003 µg·m⁻³
 - Copper (Cu) – 0.008 µg·m⁻³
 - Iron (Fe) – 0.440 µg·m⁻³
 - Manganese (Mn) – 0.007 µg·m⁻³
 - Lead (Pb) – 0.0008 µg·m⁻³
 - Nickel (Ni) – 0.002 µg·m⁻³

The results do not predict any exceedances of the respective 1-hour metals criteria nor the annual average lead (Pb) criterion.

- The assessment does not predict any exceedance of the 6.0 OU odour impact criterion at any receptors.

8. MITIGATION AND MONITORING

8.1. Construction Phase Mitigation

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

To offer a methodology to identify potential construction phase risks and where controls are required, a risk-based assessment procedure (IAQM, 2024) has been adopted. This methodology has been adapted for use in Australia by Northstar and used previously in NSW and Australia.

The published procedure assesses risk associated with various construction-phase activities, including demolition, earthworks, construction, and track-out. The identified risks are summarised in Section 6, and the mitigation measures identified to manage those risks are presented in Appendix B.

Additionally, the identified mitigation measures are anticipated to be reviewed and implemented in the Construction Environmental Management Plan (CEMP), as applicable.

8.2. Operational Phase Mitigation

The findings of the AQIA (refer Section 6) indicate that the operation of the Proposal meets the relevant criteria for all considered air pollutants, and acts to minimise emissions of pollutants, and subsequent impacts. As such, no additional mitigation measures are required to control emissions to meet the respective criteria considered in this AQIA (refer Table 4 to Table 6)

A range of emission control measures are proposed to be implemented as part of the Proposal operation. Where defensible quantification of the control efficiencies afforded by these measures can be determined, these have been applied within the AQIA (refer Section 5.2.3). The implemented emissions control measures are anticipated to effectively minimise the impacts associated with the operational phase of the Proposal site. It is envisaged that these measures will prevent any exceedances of the respective air quality and odour impact assessment criteria due to the proposed activities at the Proposal site.

The considered emissions control measures are reflective of best practice measures for this type of activity including the introduction of air pollution control technologies such as the operation of a 'Dust-Buster' dust control system to manage emissions from the hammermill in conjunction with the minimisation of drop

heights on all handling and transfer points, use of road sweepers to manage road silt content and use of targeted water sprays on all appropriate handling and transfers.

Good site management practices, including the observation of speed limits at the Proposal site, procedural visual materials check at the point of material reception and at all transfers, and all plant and equipment installed at the Proposal site or used in connection with the Proposal be maintained to a proper and efficient condition to ensure that off-site impacts are further minimised.

These range of measures would be detailed in an overarching Environmental Management Plan (EMP) for the Proposal site. The EMP would detail the implementation of monitoring and management controls to manage impacts associated with the Proposal to maintain compliance with air quality and odour criteria as required.

8.3. Monitoring

The results presented in this AQIA indicate that there would be no predicted additional exceedances of the adopted air quality criteria. As such, no ongoing air quality monitoring is recommended.

Should the Proposal site be categorised as a scheduled premises according to the NSW environmental regulatory framework, NSW EPA may mandate testing specifically related to emissions from the use of the hammermill shredder equipment at the Proposal site.

Notwithstanding the above, it is considered prudent to conduct routine monitoring of the emissions resulting from the operation of the hammermill to ensure they meet efficient emission specifications in terms of rates and concentrations. This review should align with manufacturer performance guarantees and to meet any emissions limit that may be outlined by NSW EPA (refer Table 3). The emissions testing frequency and pollutants speciation would be subject to review by NSW EPA.

It is recommended that regular audits are performed to ensure that the Proposal site is implementing the air quality control measures appropriately, as outlined within this AQIA.

9. CONCLUSION

Sincorp Properties Pty Ltd has engaged Northstar on behalf of Sydney Metal Traders (NSW) Pty Ltd to perform an AQIA to support a development application for the proposed metal resource recycling facility positioned on part of a subject property located at 88 Murrays Flat Road, Towrang NSW.

The AQIA has assessed the potential impacts of the Proposal through characterisation of existing air quality and meteorological conditions and a quantification of emissions relating to the development through an atmospheric dispersion modelling exercise to predict air pollutant concentrations and the subsequent impacts on air quality in the surrounding environment.

Construction phase activities will involve demolition, earthworks, construction works and associated vehicle traffic. The associated risks of impacts have been assessed using published guidance on the Assessment of dust from demolition and construction activities (IAQM, 2024), and adapted by Northstar for use in Australia. This methodology has been used in a similar context in numerous other similar AQIA studies.

The risk assessment indicated a 'medium' risk of dust soiling and a 'low' risk of health impacts associated with earthworks and construction activities if no mitigation measures are applied. Trackout activities are anticipated to have a 'low' risk of adverse dust soiling impacts and a 'negligible' risk of health impacts. For all other construction phase activities, including demolition and construction traffic movements, a 'negligible' risk of adverse dust soiling and health impacts is envisaged, assuming no mitigation measures are applied to control emissions during construction-phase activities. Correspondingly, a range of standard mitigation measures are proposed to ensure that short-term impacts associated with construction activities are minimised.

Regarding the operational phase, the AQIA has been performed in accordance with the requirements of the NSW Approved Methods document (NSW EPA, 2022a). Atmospheric dispersion modelling predictions for dust deposition and of NO₂, TSP, PM₁₀, PM_{2.5} and metals concentrations were made using the CALPUFF dispersion model in consideration of the operational profile of the Proposal site and compared with the respective annual and short-term air quality criteria at identified sensitive receptor locations in the surrounding area.

Modelled emissions sources from the Proposal site include:

- Point sources (i.e., oxycutting and hammermill).
- Materials conveyor, handling, and transfer points.
- Truck dumping material.
- Wind erosion from stockpiles.
- Movement of FEL at the sheared and shredding zones on unpaved road surfaces.
- Movement of vehicles through the Proposal site on paved and unpaved roads for materials drop off and pickup.

The results of the AQIA indicate that the predicted short-term and annual NO_2 , PM_{10} and $\text{PM}_{2.5}$ concentrations are compliant with the respective impact assessment criteria, with no additional exceedances of the 24-hour PM_{10} and $\text{PM}_{2.5}$ criteria. Odour concentrations are predicted to be below the applicable odour assessment criteria of 6.0 OU, and that the criteria for annual average dust deposition rates and metals are predicted to be achieved.

The Proposal includes a series of emission control measures to minimise dust, particulate and gaseous emissions during operation. These measures are recommended for implementation to effectively manage and reduce air quality emissions resulting from the Proposal operation.

Based upon the information presented in this AQIA, it is considered that the Proposal site is suitable for its proposed use, with no identified air quality constraints associated with emissions resulting from during construction and from operations conducted at the Proposal site with regard to metal resource recovery.

10. REFERENCES

- ABS. (2022). *Australian Bureau of Statistics*. Retrieved from Regional Population: <https://www.abs.gov.au/statistics/people/population/regional-population/2021#interactive-maps>
- Barclay & Scire. (2011). *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia', prepared for NSW OEH.*
- Blue Environment. (2021). *Australian standard for waste and resource recovery data and reporting. Prepared for Department of Agriculture, Water and the Environment. 24 August 2021.*
- DEWHA. (2008). *Emission Estimation Technique Manual for Combustion Engines Version 3.0.*
- Ektimo. (2017). *R003396 Emission Testing Report - Sell and Parker, Kings Park.*
- Ektimo. (2018). *R006468-1 Emission Testing - ERM Australia Pty Ltd, Docklands.*
- Ektimo. (2019a). *R008184 Annual Emission Testing - Sell and Parker, Kings Park.*
- Ektimo. (2019b). *R007718 Emissions Testing - ERM Australia Pty Ltd.*
- Ektimo. (2020). *R009653 Annual Emission Testing - Sell and Parker, Kings Park.*
- Ektimo. (2021). *R010794 Annual Emission Testing, Sell and Parker, Kings Park.*
- EML AIR. (2014). *Emissions Testing Report - ERM Australia Pty Ltd, Blacktown Plant - reference N92746.*
- ERM. (2015). *Waste Metal Recovery, Processing and Recycling Facility, 45 and 23-43 Tatterhall Road, Kings Park, Blacktown - Air Quality Assessment.*
- IAQM. (2024). *Guidance on the Assessment of Dust from Demolition and Construction - Version 2.2.*
- MRI. (2006). *Midwest Research Institute, Background Document for Revisions to Fine Fraction Ratios used for AP-42 Fugitive Dust Emission Factors.*
- Northstar. (2021). *Kings Park Metal Resource Facility - Revised Air Quality Assessment - reference 20.1074.FR4V1.*
- NPI. (2001). *Emission Estimation Technique Manual for Non-Ferrous Metals Manufacture, Version 1.1, October 2001.*
- NPI. (2012). *National Pollutant Inventory Emission Estimation Technique Manual for Mining, Version 3.1.*

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

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

NSW DPIE. (2021). *NSW Annual Compliance Report 2019*.

NSW EPA. (2022a). *Approved Methods for the Modelling and Assessment of Air Quality in NSW*.

NSW EPA. (2022b). *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*.

Todoroski Air Sciences. (2019). *Air Quality Impact Assessment, 57 Tattershall Road, Kings Park - reference 17030671*.

US EPA. (1995). *Compilation of Air Pollutant Emission Factors, January 1995*.

US EPA. (1998). *AP-42 Compilation of Air Pollutant Emission Factors, Section 11.9 Western Surface Coal Mining*.

US EPA. (2004). *AP-42 Compilation of Air Pollutant Emission Factors, Section 11.19.2 Crushed Stone Processing and Pulverised Mineral Processing*.

US EPA. (2006). *AP-42 Compilation of Air Pollutant Emission Factors, Chapter 13.2.4 Aggregate Handling and Storage Piles*.

US EPA. (2006). *AP-42 Compilation of Air Pollutant Emission Factors, Section 13.2.2 Unpaved Roads*.

US EPA. (2011). *AP-42 Compilation of Air Pollutant Emission Factors, Section 13.2.1 Paved Roads*.

APPENDIX A

Commonly used units and abbreviations

Units used in the Report

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

Commonly used SI units

The following units are commonly used in Northstar reports.

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

Multiples of SI and non-SI units

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

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

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

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

For example:

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

Commonly used SI-derived and non-SI units

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

Commonly used abbreviations

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

Abbreviation	Term
CEMP	construction environment management plan
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEM	digital elevation model
EETM	emission estimation technique manual
EPA VIC	Environmental Protection Authority Victoria
EPBC	Environment Protection and Biodiversity Conservation Act
FIBC	flexible intermediate bulk container
GIS	geographical information system
IAQM	UK Institute of Air Quality Management
IBC	intermediate bulk container
ID	internal diameter
LLV	low level waste
LoM	life of mine
MSDS	Material Safety Data Sheet
NCAA	National Clean Air Agreement
NEPM	National Environment Protection Measure
NH ₃	ammonia
NO	nitric oxide
NO _x	oxides of nitrogen
NO ₂	nitrogen dioxide
NORM	naturally occurring radioactive material
NSW	New South Wales
NSW DCCEEW	New South Wales Department of Climate Change, Energy, the Environment and Water
NSW DPE	New South Wales Department of Planning and Environment
NSW DPHI	New South Wales Department of Planning, Housing, and Infrastructure
NSW EPA	New South Wales Environment Protection Authority
NT	Northern Territory
OEMP	operational environmental management plan
O ₃	ozone
OU	odour unit
OU·m ³ ·s ⁻¹	odour units times metres cubed per second
OU·s ⁻¹	odour units per second
Pb	lead
PM	particulate matter
PM ₁₀	particulate matter with an aerodynamic diameter of 10 µm or less
PM _{2.5}	particulate matter with an aerodynamic diameter of 2.5 µm or less
ROM	run of mine
SA	South Australia

Abbreviation	Term
SEPP	State Environmental Protection Policy
SO _x	oxides of sulphur
SO ₂	sulphur dioxide
SRTM3	Shuttle Radar Topography Mission
SVOC	semi-volatile organic compound
TAPM	The Air Pollution Model
TAS	Tasmania
TEU	twenty-foot equivalent unit
TSP	total suspended particulates
TVOC	total volatile organic compounds
TWA	time weighted average
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VIC	Victoria
VLLW	very low-level waste
VOC	volatile organic compound

APPENDIX B

Construction Phase Air Quality Risk Assessment

Provided below is a summary of the methodology applied to inform the construction phase risk assessment. It is based upon IAQM (2024) Guidance on the assessment of dust from demolition and construction (version 2.2) and adapted by Northstar for use within AQIA within NSW development applications.

Adaptions to the Published Methodology Made by Northstar

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

- **PM₁₀ criterion:** an amended criterion representing the annual average PM₁₀ 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:

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

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

Table B1 overleaf presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria.

Table B1 Construction phase impact screening criteria distances

Receptor	Location	Land use	Screening distance (m)		
			Proposal site Boundary (250 m)	Proposal site entrance(s) (250 m)	Construction route(s) (50 m)
R1	Murrays Flat Road, Towrang	Residential	> 250	> 250	> 50
R2	Murrays Flat Road, Towrang	Commercial	125	162	> 50
R3	Murrays Flat Road, Towrang	Commercial	179	194	> 50
R4	Hume Highway, Towrang	Industrial	245	> 250	> 50
R5	Hume Highway, Boxers Creek	Residential	> 250	> 250	> 50
R6	Boxers Creek Road, Boxers Creek	Residential	> 250	> 250	> 50
R7	Boxers Creek Road, Boxers Creek	Residential	> 250	> 250	> 50
R8	Boxers Creek Road, Boxers Creek	Residential	> 250	> 250	> 50
R9	Boxers Creek Road, Boxers Creek	Residential	> 250	> 250	> 50
R10	Boxers Creek Road, Boxers Creek	Residential	> 250	> 250	> 50
R11	Boxers Creek Road, Boxers Creek	Residential	> 250	> 250	> 50
R12	Boxers Creek Road, Boxers Creek	Residential	> 250	> 250	> 50
R13	Boxers Creek Road, Boxers Creek	Residential	> 250	> 250	> 50
R14	Hume Highway, Towrang	Residential	> 250	> 250	> 50
R15	Hume Highway, Towrang	Residential	> 250	> 250	> 50
R16	Murrays Flat Road, Towrang	Residential	> 250	> 250	> 50
R17	Murrays Flat Road, Towrang	Residential	> 250	> 250	> 50
R18	Murrays Flat Road, Towrang	Residential	> 250	> 250	> 50
R19	Murrays Flat Road, Towrang	Commercial	> 250	> 250	> 50
R20	Murrays Flat Road, Towrang	Commercial	> 250	> 250	> 50

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

Table B2 Application of Step 1 screening

Construction impact	Screening criteria	Step 1 screening	Comments
Demolition	250 m from boundary 250 m from site entrance	Not screened	Receptors identified within the screening distance
Earthworks	250 m from boundary 250 m from site entrance	Not screened	Receptors identified within the screening distance
Construction	250 m from boundary 250 m from site entrance	Not screened	Receptors identified within the screening distance
Trackout	250 m from site entrance	Not screened	Receptors identified within the screening distance
Construction Traffic	50 m from roadside, up to 250 m from site entrance	Screened	Receptors identified outside of the screening distance

Step 2 – Risk from Construction Activities

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

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

Table B3 Dust emission magnitude activities

Activity	Small	Medium	Large
Demolition			
total building volume*	< 12 000 m ³	12 000 m ³ to 75 000 m ³	> 75 000 m ³
demolition height	< 6 m AGL	6 m and 12 m AGL	> 12 m AGL
onsite crushing	no	no	yes
onsite screening	no	no	yes
demolition of materials with high dust potential	no	yes	yes
demolition timing	wet months only	any time of the year	any time of the year
Earthworks			
total site area	< 18 000 m ²	18 000 m ² to 110 000 m ²	> 110 000 m ²
soil types	soil type with large grain size (e.g. sand)	moderately dusty soil type (e.g. silt)	potentially dusty soil type (e.g. clay which would be prone to suspension when dry due to small particle size)
heavy earth moving vehicles	< 5 heavy earth moving vehicles active at any one time	5 to 10 heavy earth moving vehicles active at any one time	> 10 heavy earth moving vehicles active at any time
formation of bunds	< 3 m AGL	3 m to 6 m AGL	> 6 m AGL
material moved	< 20 000 t	20 000 t to 100 000 t	> 100 000 t
earthworks timing	wet months only	any time of the year	any time of the year
Construction			
total building volume	< 12 000 m ³	12 000 m ³ to 75 000 m ³	75 000 m ³
piling	no	yes	yes
concrete batching	no	yes	yes
sandblasting	no	no	yes

Activity	Small	Medium	Large
materials	metal cladding or timber	concrete	concrete
Trackout (within 100 m of construction site entrance)			
outward heavy vehicles movements per day	< 20	20 to 50	> 50
surface materials	low potential	moderate potential	high potential
unpaved road length	< 50 m	50 m to 100 m	> 100 m
Construction Traffic (from construction site entrance to construction vehicle origin)			
Demolition traffic - total building volume	< 12 000 m ³	12 000 m ³ to 75 000 m ³	> 75 000 m ³
Earthworks traffic - total site area	< 18 000m ²	18 000 m ² to 110 000 m ²	> 110 000 m ²
Earthworks traffic – soil types	soil type with large grain size (e.g. sand)	moderately dusty soil type (e.g. silt)	potentially dusty soil type (e.g. clay which would be prone to suspension when dry due to small particle size)
Earthworks traffic – material moved	< 20 000 t	20 000 t to 100 000 t	> 100 000 t
Construction traffic – total building volume	< 12 000 m ³	12 000 m ³ to 75 000 m ³	75 000 m ³
Total traffic heavy vehicles movements per day when compared to existing heavy vehicle traffic	< 10 % of heavy vehicle movement contribution by Proposal	10 % to 50 % of heavy vehicle movement contribution by Proposal	> 50 % of heavy vehicle movement contribution by Proposal

The footprint of the Proposal site (the area affected) is anticipated to cover an area of approximately 6.5 hectare (ha) of a total site area of 32.24 ha.

The Proposal includes several construction activities: converting the existing residential dwelling into a staff administrative and amenity building, constructing a staff car parking area, additional vehicular entry/exit points and internal haul routes, a compacted road base for heavy vehicles, a weighbridge, and the construction of the Proposal site, including installation of a hammermill, preshredder, metal shear, oxycutting station, and various conveyors and sorting lines.

A desktop review of the existing structures at the Proposal site indicates that structures to be introduced are to be less than 75 000 m³ with materials to be moved on account of earthworks activities are less than 100 000 t. No explicit demolition activities are anticipated to occur at the Proposal site on account of the

conversion of the on-site residential property to form a staff administrative and amenities building. As such, no further considerations are given with regard to demolition activities.

It is anticipated that 4no B-double truck vehicles would be received at the Proposal site, equating to less than 10 vehicle movements per day associated with the construction phase. It is also envisaged that construction traffic would access the Proposal site from the Hume Highway and traverse along Murrays Flat Road to the site entrance. No sensitive receptors were identified within the screening distance for construction traffic (refer Table B1 and Figure B1) and are not further considered.

Based upon the above assumptions and the assessment criteria presented in Table B3, the dust emission magnitudes are as presented in Table B4.

Table B4 Construction phase impact categorisation of dust emission magnitude

Activity	Dust emission magnitude
Demolition	Not applicable
Earthworks and enabling works	Medium
Construction	Medium
Track-out	Small
Construction traffic routes	Not applicable

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 considers:

- 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 PM₁₀, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

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

Land Use Value

Individual receptor locations 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 methodology provides guidance on the land use value with regard to dust soiling and human health impacts and is shown in Table B5 below. It is noted that user expectations of amenity levels (dust soiling) are dependent on existing deposition levels.

Table B5 IAQM guidance for categorising land use value

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

Dust Soiling Impacts

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

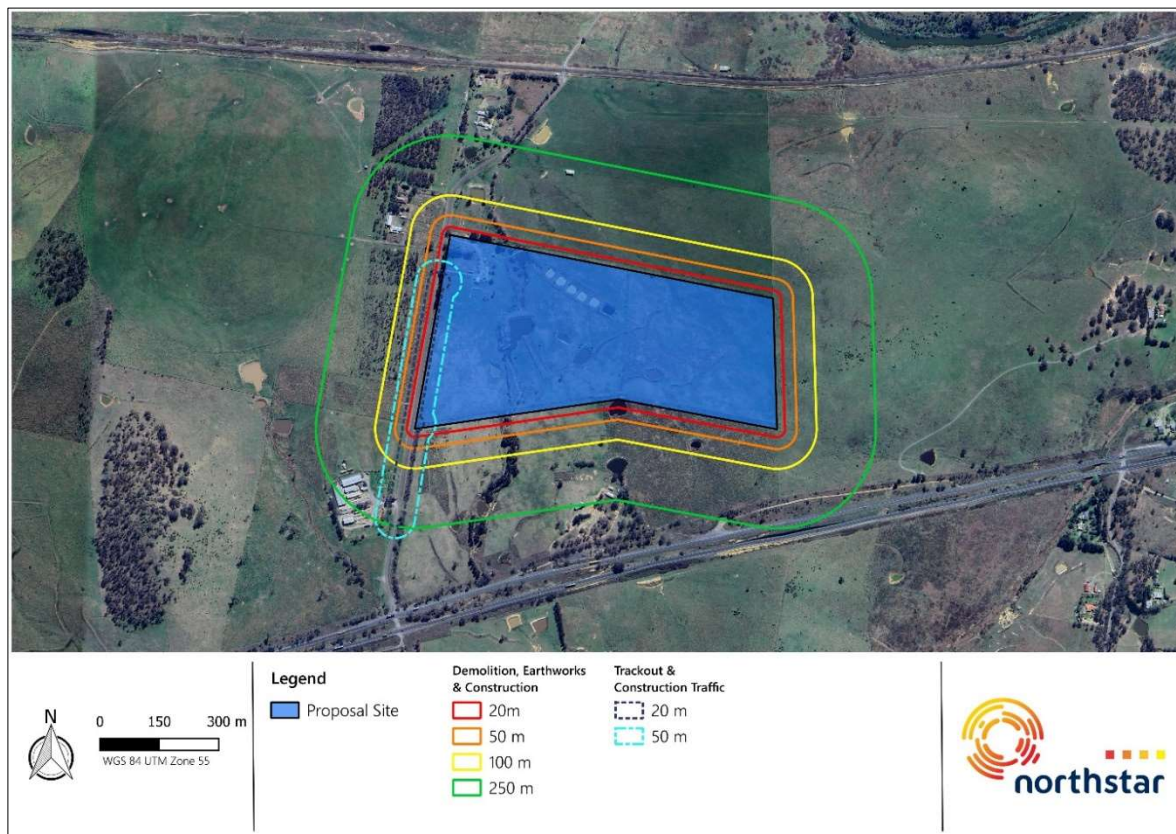
Table B6 IAQM guidance for categorising the sensitivity of an area to dust soiling impacts

Land use value	Number of receptors ^(a)	Distance from the source (m) ^(b)			
		< 20	< 50	< 100	< 250
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

In light of all construction-related activities, any residential receptors within 250 m of the construction footprint have been designated with a 'high' sensitivity rating whilst commercial and industrial properties are designated with a 'medium' sensitivity rating for dust soiling.

Figure B1 illustrates the extent of works considered for this AQIA, delineating the outer envelope boundary of the anticipated construction works, the IAQM distance bands and the positions of receptors.

Figure B1 Scope of construction activities, buffer distances and receptors



Source: Northstar

The IAQM guidance does not necessitate precise counting of human receptors. Instead, it advises using professional judgment to estimate the approximate number of buildings within each distance band and that only the highest level of area sensitivity from Table B6 needs to be considered.

No residential receptors are sited within 250 m of the Proposal site boundary with up to 10 commercial and industrial receptors contained up to 250 m from the Proposal site boundary. Considering both the sensitivity of receptors and their numbers within specified distances from the footprint, the sensitivity to dust soiling impacts is assessed as 'medium'.

Human Health Impacts

The assessed land use value (as described in Table B5) is then used to assess the sensitivity of the area surrounding the active construction area, considering the proximity and number of those receptors, and the local background PM₁₀ concentration (in the case of potential health impacts) and other site-specific factors.

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

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant, the season during which the works would take place;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which go beyond the classifications given in (IAQM, 2024).

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in Table B6.

The background annual average PM₁₀ concentration measured at Bargo AQMS in 2020 was 15.9 µg·m⁻³ (refer Table 10 and Appendix D). Together with the calculated land use value, this classifies the areas sensitivity as 'low' for dust health impacts.

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

Land use value	Annual mean PM ₁₀ concentration (µg·m ⁻³)	Number of receptors ^(a)	Distance from the source (m) ^(b)			
			< 20	< 50	< 100	< 250
High	> 30	> 100	High	High	High	Medium
		10 – 100	High	High	Medium	Low
		1 – 10	High	Medium	Low	Low
	26 – 30	> 100	High	High	Medium	Low
		10 – 100	High	Medium	Low	Low
		1 – 10	High	Medium	Low	Low
	22 – 26	> 100	High	Medium	Low	Low
		10 – 100	High	Medium	Low	Low
		1 – 10	Medium	Low	Low	Low
	≤ 22	> 100	Medium	Low	Low	Low
		10 – 100	Low	Low	Low	Low
		1 – 10	Low	Low	Low	Low
Medium	> 30	> 10	High	Medium	Low	Low
		1 – 10	Medium	Low	Low	Low
	26 – 30	> 10	Medium	Low	Low	Low
		1 – 10	Low	Low	Low	Low
	22 – 26	> 10	Low	Low	Low	Low
		1 – 10	Low	Low	Low	Low
	≤ 22	> 10	Low	Low	Low	Low
		1 – 10	Low	Low	Low	Low
Low	-	≤ 1	Low	Low	Low	Low

Note: (a) Estimate the total within the stated distance (e.g. the total within 250 m and not the number between 100 m and 250 m), noting that only the highest level of area sensitivity from the table needs to be considered. In the case of high sensitivity areas with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

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

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

Step 4 - Risk Assessment (Pre-Mitigation)

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

Table B8 Risk of dust impacts from construction related activities

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

Given the sensitivity of the identified receptors is classified as medium for dust soiling and low health effects, and the dust emission magnitudes for the various construction phase activities as shown in Table B4, the resulting risk of air quality impacts (without mitigation) is as presented in Table B9.

Table B9 Risk of air quality impacts from construction activities

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

Note: NA. = Not applicable, Neg. = Negligible, Med. = Medium

The risks outlined in Table B9 indicate a medium risk of adverse dust soiling impacts and a low risk of health impacts related to earthworks and construction activities. Trackout activities carry a low risk of adverse dust soiling impacts and a negligible risk of health impacts. Additionally, demolition and construction traffic movements pose a negligible risk of adverse dust soiling and health impacts, assuming no mitigation measures are applied to control emissions during construction-phase activities.

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

Step 5 – Identify Mitigation

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

The identified mitigation measures are presented as follows:

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

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

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

Table B10 represents a selection of recommended mitigation measures recommended by the IAQM methodology (IAQM, 2024) for construction activities commensurate with the risks identified in Table B9.

It is noted that the mitigation measures outlined below represent a broad range of potential options which could be used to manage the identified risk and may not be appropriate to all construction activities at all sites. Those measures to be implemented during the construction phase should be reviewed as part of the preparation of any Construction Environment Management Plan (CEMP) and Air Quality Management Plan (AQMP).

Step 6 – Risk Assessment (post-mitigation)

Following Step 5, the residual impact is then determined.

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

Given the size of the 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.

Table B10 Site-specific mitigation measures

Identified Mitigation		Unmitigated Risk
1	Communications	Medium
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	H
1.2	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H
1.3	Display the head or regional office contact information.	H
1.4	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	H
2	Site Management	Medium
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H
2.2	Make the complaints log available to Council and/or NSW EPA 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
3	Monitoring	Medium
3.1	Conduct 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 requested.	D
3.2	Carry out regular site inspections to monitor compliance with the DMP / CEMP, record inspection results, and maintain an inspection log available to Council and/or NSW EPA when requested.	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
4	Preparing and Maintaining the Site	Medium
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
4.2	Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site.	H
4.3	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	H
4.4	Avoid site runoff of water or mud.	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	H
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	H
4.7	Cover, seed or fence stockpiles to prevent wind erosion	H

Identified Mitigation		Unmitigated Risk
5	Operating Vehicle / Machinery and Sustainable Travel	Medium
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H
5.2	Ensure all vehicles switch off engines when stationary	H
5.3	Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment, where practicable	H
5.4	Impose and signpost a maximum-speed-limit of 25 km·h ⁻¹ on surfaced and 15 km·h ⁻¹ on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).	D
5.5	Implement a Travel Plan that supports and encourages sustainable travel	D
6	Operations	Medium
6.1	Only use cutting, grinding, or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems	H
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H
6.3	Use enclosed chutes and conveyors and covered skips	H
6.4	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H
6.5	Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	H
7	Waste Management	Medium
7.1	Avoid bonfires and burning of waste materials.	H
8	Measures Specific to Earthworks	Medium
8.1	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	D
8.2	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	D
8.3	Only remove the cover in small areas during work and not all at once	D
9	Measures Specific to Construction	Medium
9.1	Avoid scabbling (roughening of concrete surfaces) if possible	D
9.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place	H

Identified Mitigation		Unmitigated Risk
10.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	D
10.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	D
11	Measures Specific to Trackout	Low
11.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	D
11.2	Avoid dry sweeping of large areas.	D
11.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D
11.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	N
11.5	Record all inspections of haul routes and any subsequent action in a site log book.	D
11.6	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	N
11.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D
11.8	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permit.	N
11.9	Access gates to be located at least 10 m from receptors where possible.	N

APPENDIX C

Meteorology

Meteorological Stations

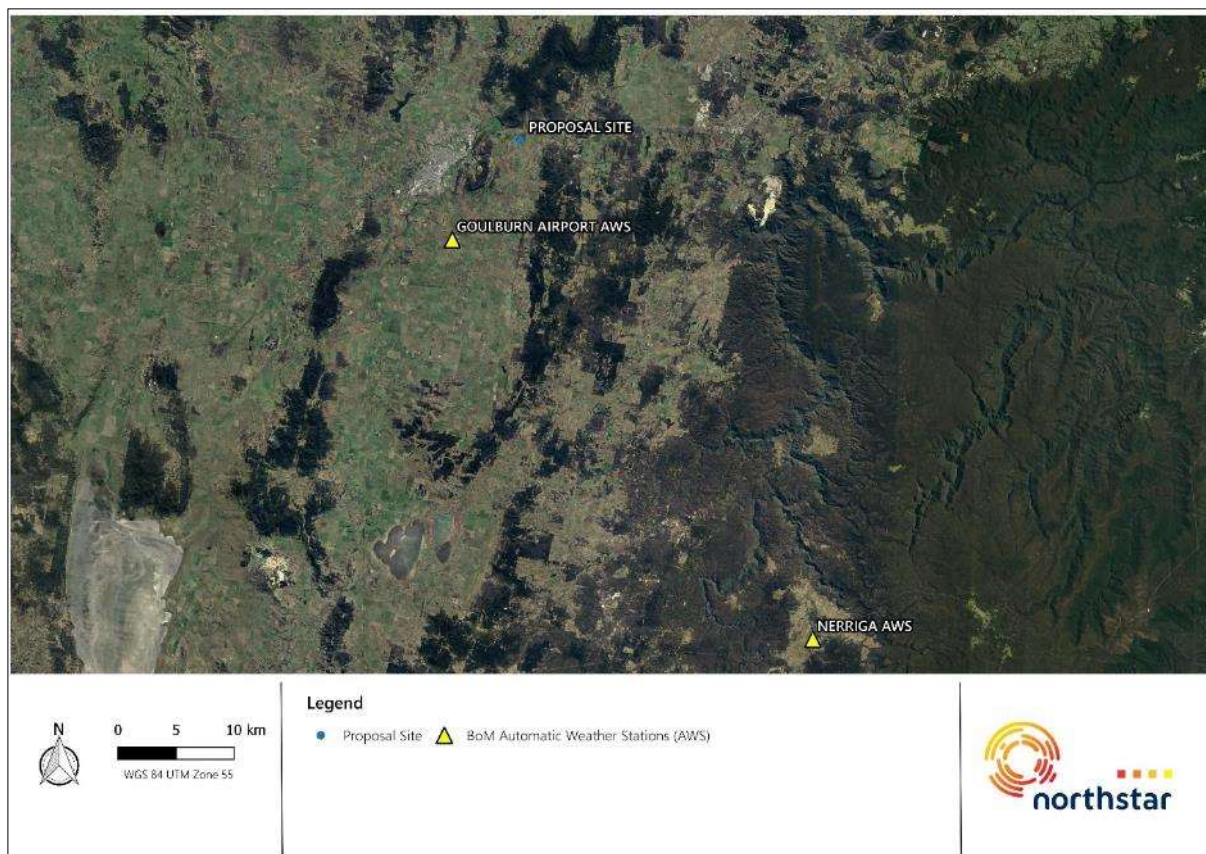
A meteorological modelling exercise has been performed to characterise the meteorology of the Proposal site in the absence of site-specific measurements. The meteorological monitoring has been based on measurements acquired from surrounding automatic weather stations (AWS) operated by the Australian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

A summary of the relevant monitoring sites is provided in Table C1 and illustrated in Figure C1.

Table C1 Details of BoM meteorological monitoring stations within 50 km of Proposal site

Site name	Station #	Approximate location		Approximate distance (km)
		mE	mS	
Goulburn Airport	070330	780 960	6 110 375	9.2
Nerriga	069128	749 829	6 144 792	49.8

Figure C1 BoM meteorological monitoring stations within 50 km of Proposal site



Source: Northstar

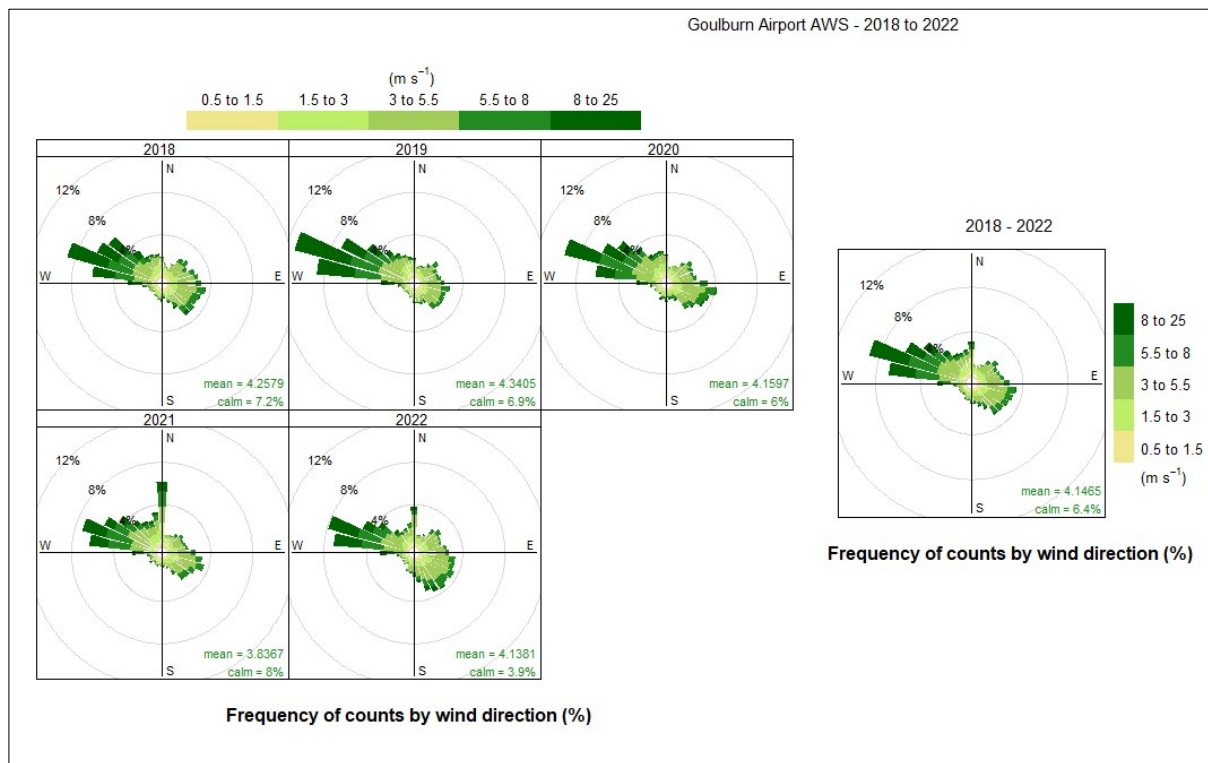
Meteorological conditions at Goulburn Airport AWS have been examined to determine a 'typical' or representative dataset for use in dispersion modelling. Annual wind roses for the most recent years of data (2018 to 2022) are presented in Figure C2. The annual wind speed frequency distribution for the five-year period is presented in Figure C3.

The correlation coefficients between each year and the five-year period for wind speed and wind direction at Goulburn Airport AWS are summarised in Table C2. Additionally, the correlation coefficients for PM₁₀ and PM_{2.5} concentrations measured at Bargo AQMS are considered (refer Appendix D). These coefficients were ranked and aggregated to select the representative year for meteorological modelling, as shown in Table C2.

The wind roses indicate that from 2018 to 2022, winds at the Goulburn Airport AWS show predominant west north-westerly directions.

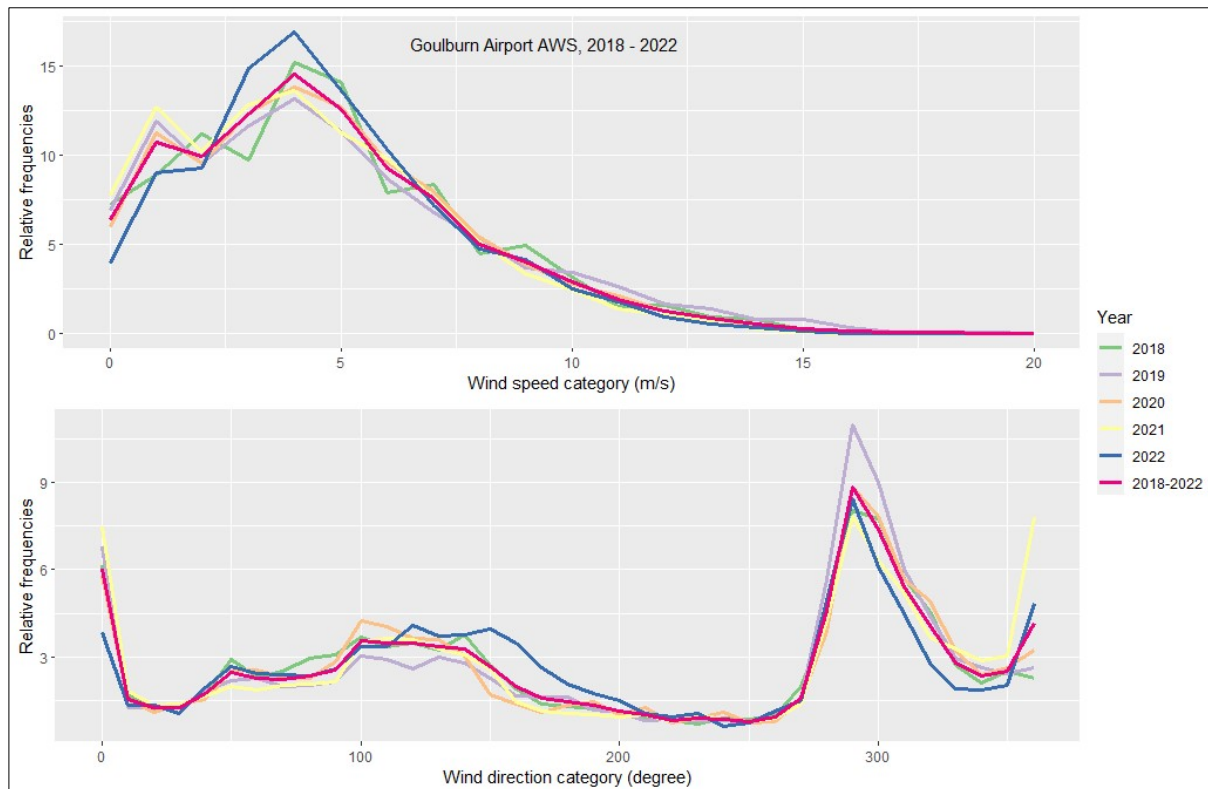
Wind speeds experienced at the Goulburn Airport AWS from 2018 to 2022 are generally in the range 1.5 meters per second ($\text{m}\cdot\text{s}^{-1}$) to $8\text{ m}\cdot\text{s}^{-1}$ with the highest wind speeds (greater than $8\text{ m}\cdot\text{s}^{-1}$) occurring from mostly west north-westerly directions. Winds of this speed are less common and occur during 11.7 % of the observed hours during the years while calm winds (less than $0.5\text{ m}\cdot\text{s}^{-1}$) occur during 6.4 % of hours on average across the years from 2018 to 2022.

Figure C2 Annual wind roses – Goulburn Airport AWS (2018 to 2022)



Source: Northstar

Figure C3 Annual wind direction and speed distributions - Goulburn Airport AWS (2018 to 2022)



Source: Northstar

Table C2 Correlation coefficient analysis - Goulburn Airport AWS and Bargo AQMS (2018 to 2022)

Parameter	Wind speed		Wind direction		PM ₁₀		PM _{2.5}		Aggregated rank
	Corr.	Rank	Corr.	Rank	Corr.	Rank	Corr.	Rank	
2018	0.981	5	0.974	2	0.942	5	0.942	4	4
2019	0.994	2	0.974	3	0.959	3	0.942	3	2.5
2020	0.998	1	0.980	1	0.996	1	0.996	1	1
2021	0.991	3	0.926	4	0.994	2	0.988	2	2.5
2022	0.982	4	0.926	5	0.948	4	0.919	5	5
2018-2022	1	-	1	-	1	-	1	-	-

Note: Corr. = Correlation

Wind speed observations for each year correlated well against the wind speed over the five-year period, with each year having a correlation coefficient greater than 0.98. The year 2020 is the highest ranked for correlation against the wind speed over the five-year period.

Wind direction observations for each year are reasonably well correlated against the wind direction over the five-year period, with each year having a correlation coefficient greater than of 0.92. The year 2020 is the highest ranked for correlation against the wind direction over the five-year period.

Particulate matter concentrations for each year are also well correlated against particulate matter concentrations over the five-year period. Each year resulted in having a correlation coefficient greater than 0.91. The year 2020 is the highest rank for both PM_{10} and $PM_{2.5}$ background concentrations.

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

Meteorological Processing

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

In absence of any measured onsite meteorological data, site representative meteorological data for this Proposal has been generated using the CALMET meteorological model in a format suitable for using in the CALPUFF dispersion model (refer Section 4.3).

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

In this AQIA, CALMET has been run in no-observations (no-obs) mode using gridded prognostic data generated by The Air Pollution Model (TAPM, v 4.0.5), developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

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

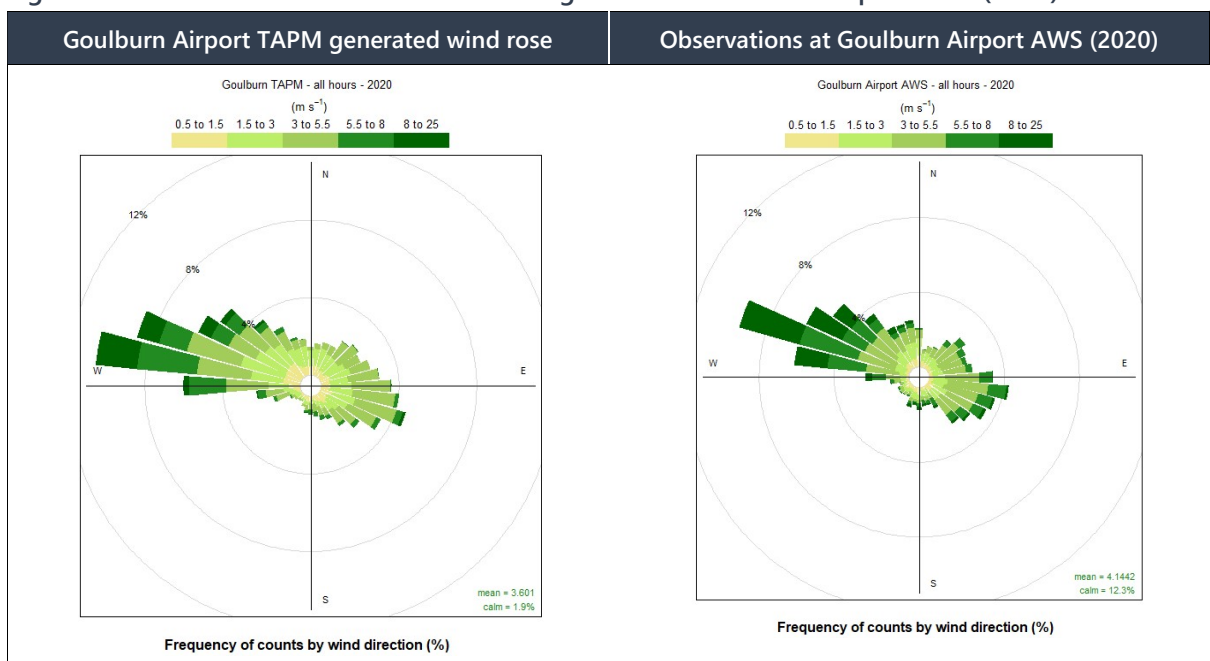
The parameters used in both the TAPM and CALMET meteorological modelling are presented in Table C3.

Table C3 CALMET and TAPM meteorological parameters

TAPM V 4.0.5	
Modelling period	1 January 2020 to 31 December 2020
Centre of analysis	755 604 mE, 6 152 979 mS (UTM Coordinates)
Number of grid points	25 x 25 x 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	Goulburn Airport AWS
CALMET	
Modelling period	1 January 2020 to 31 December 2020
South-West corner of analysis	752 000 mE, 6 149 400 mS (UTM Coordinates)
Meteorological grid domain (resolution)	8 km x 8 km (0.1 km)
Vertical resolution (cell heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1 200 m, 2 000 m, 3 000 m, 4 000 m)
Data assimilation	No-obs approach using TAPM – 3D.DAT file

A comparison of the TAPM generated meteorological data, and that observed at the Goulburn Airport AWS are presented in Figure C4. The Goulburn Airport AWS was not included within the CALMET model domain and as such an associated wind rose is unavailable for comparison, however the TAPM generated wind rose shows broad agreement with the observations recorded at the Goulburn Airport AWS in 2020.

Figure C4 Modelled and observed meteorological data - Goulburn Airport AWS (2020)



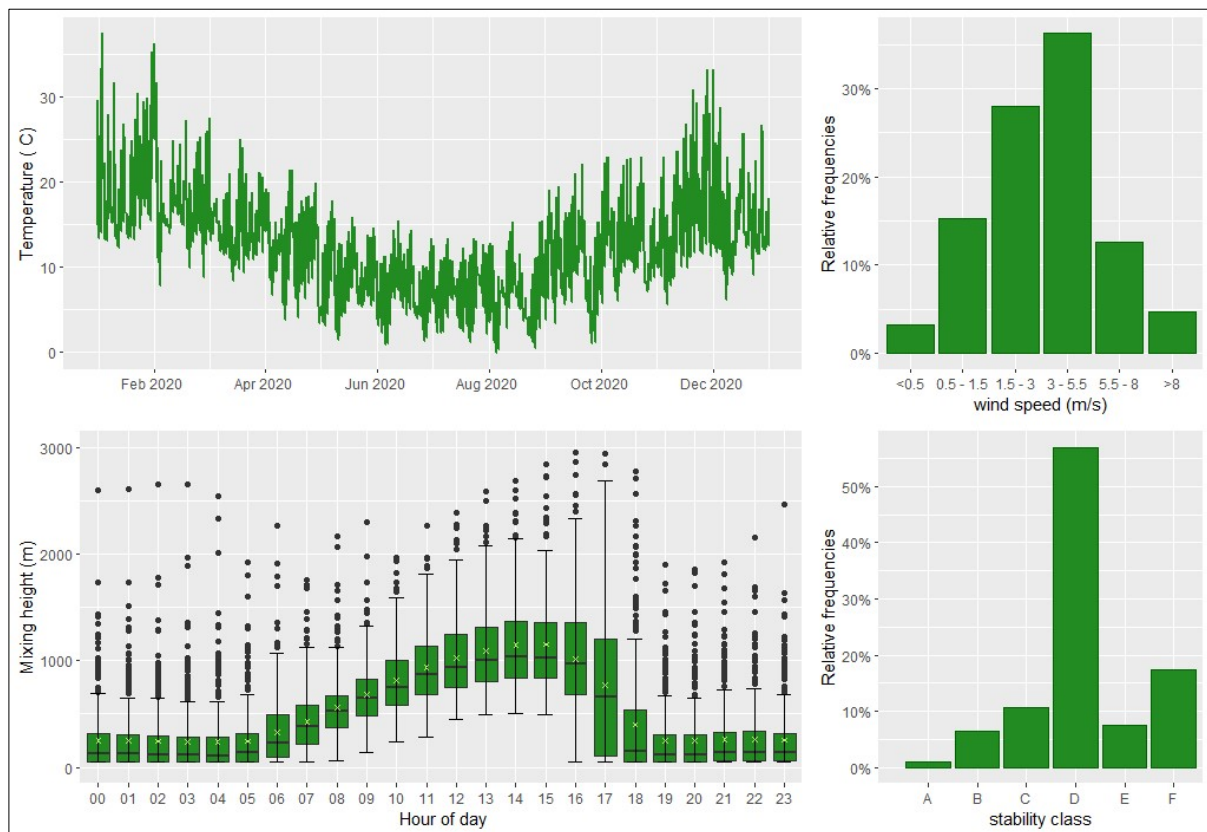
Source: Northstar

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

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Proposal site during 2020 are illustrated in Figure C5.

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

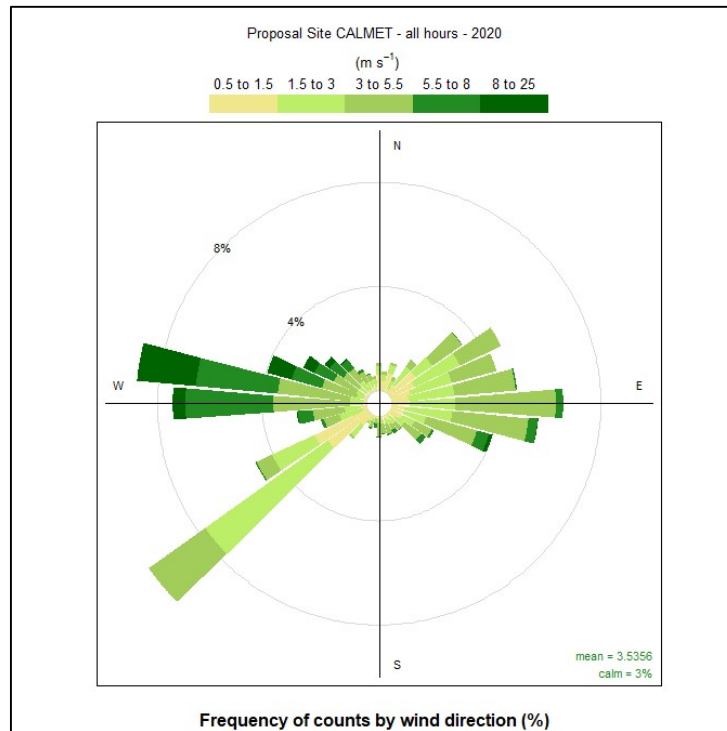
Figure C5 Predicted temperature, mixing height, stability class and wind characteristics – Proposal site (2020)



Source: Northstar

The modelled wind speed and direction at the Proposal site during 2020 are presented in Figure C6.

Figure C6 Predicted wind direction and speed – Proposal site (2020)



Source: Northstar

APPENDIX D

Background Air Quality Conditions

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:

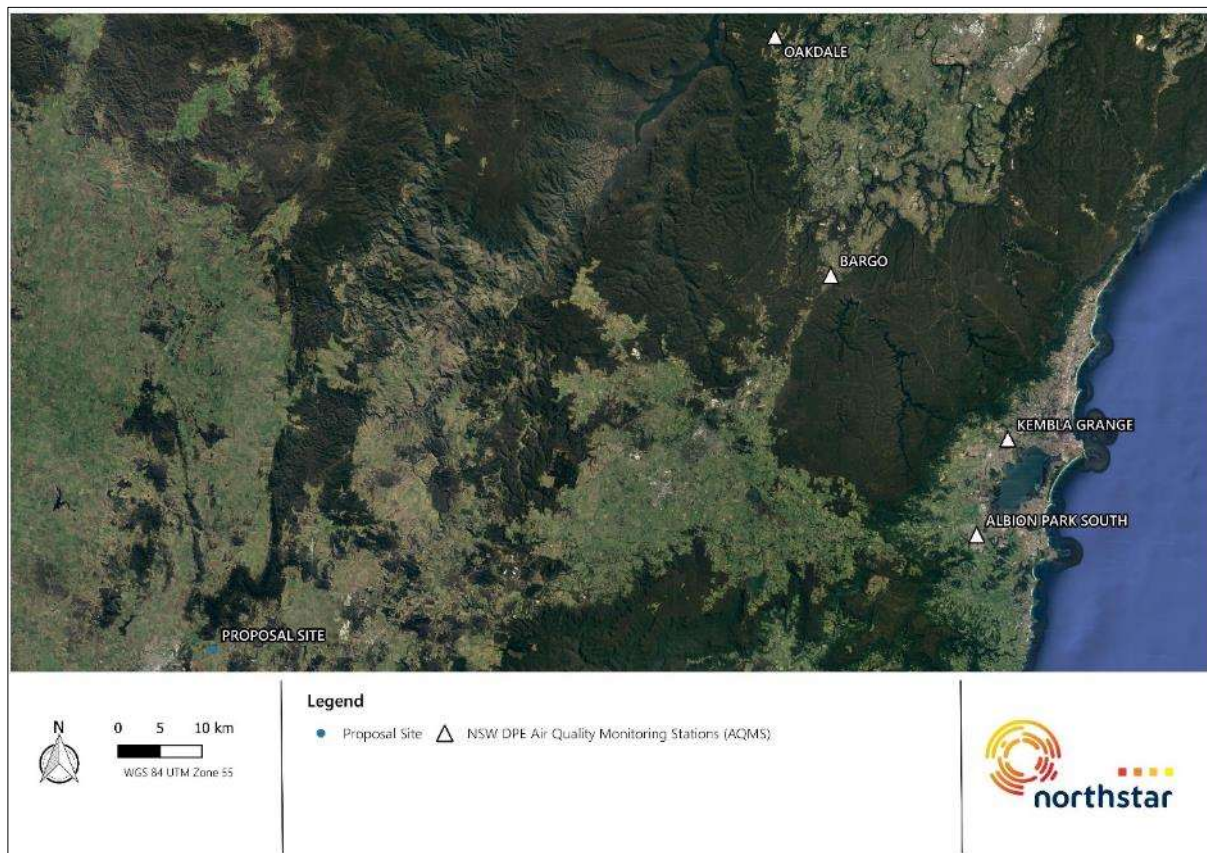
- The sources of air pollutant emissions around the Proposal site and representative AQMS; and
- The variability of particulate matter concentrations (often impacted by natural climate variability).

Air quality monitoring in NSW is conducted by NSW DCCEEW at various air quality monitoring stations (AQMS) across the State. Details of the monitoring conducted at AQMS within a 100 km radius of the Proposal site are presented in Table D1 and depicted in Figure D1.

Table D1 Details of NSW DCCEEW AQMS within 100 km of the Proposal site

AQMS location	Distance to site (km)	2020 data	Measurements					
			PM ₁₀	PM _{2.5}	TSP	CO	O ₃	NO ₂
Bargo	85.7	✓	✓	✓	✗	✗	✓	
Albion Park South	91.8	✓	✓	✓	✗	✗	✓	
Kembla Grange	97.7	✓	✓	✓	✗	✗	✓	
Oakdale	98.8	✓	✓	✓	✗	✗	✓	

Figure D1 NSW DCCEEW AQMS within 100 km of the Proposal site



Source: Northstar

The nearest representative AQMS with data accessible for the year 2020, consistent with the meteorological modelling, is identified as being situated in Bargo. Consequently, data related to NO₂, PM₁₀ and PM_{2.5} has been examined from this monitoring station and integrated into this AQIA. TSP data have been derived from PM₁₀ monitoring data, as described below.

A statistical summary of the measured concentrations of NO₂, PM₁₀ and PM_{2.5} at Bargo AQMS during 2020 is presented in Table D2.

Graphs presenting the daily varying PM₁₀ and PM_{2.5} data, and hourly varying NO₂ data recorded at Bargo AQMS for 2020 are presented in Figure D2, Figure D3 and Figure D4 respectively. Figure D5 illustrates the hourly varying O₃ background concentrations recorded at Bargo AQMS for 2020.

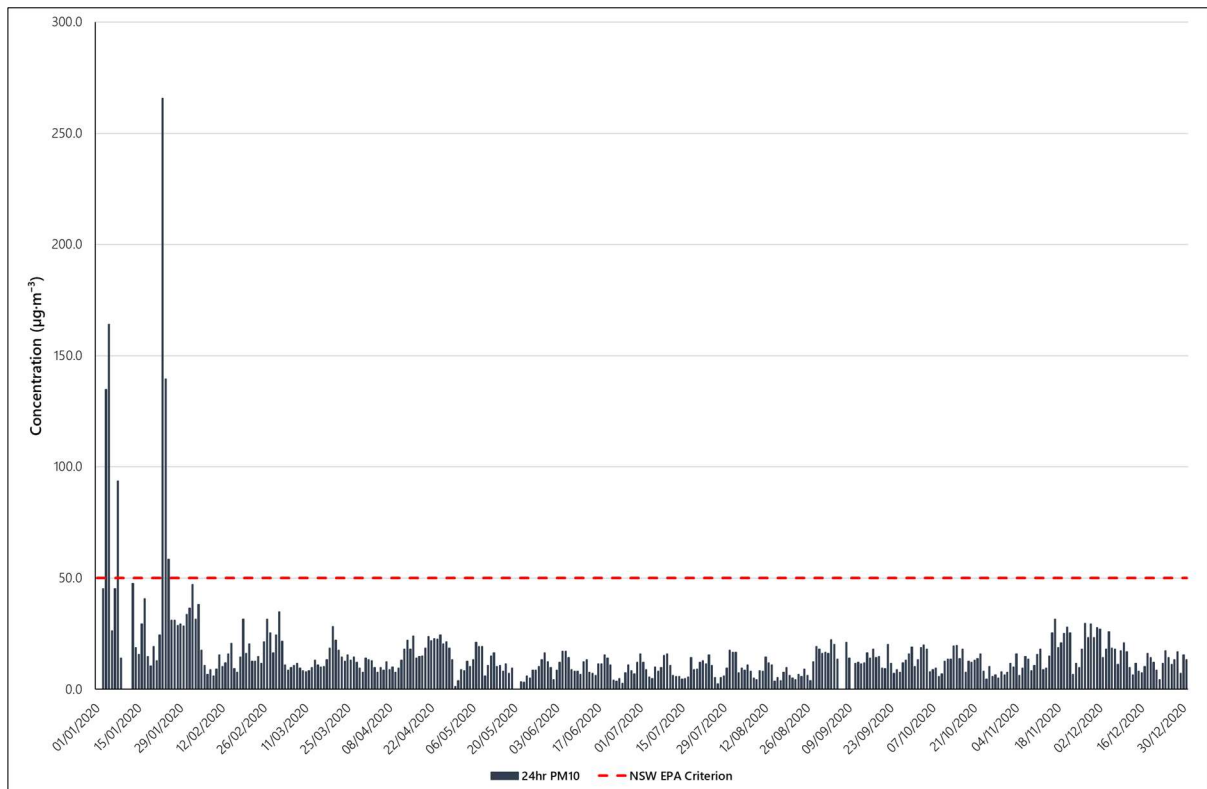
Table D2 Background air quality statistics for Bargo AQMS (2020)

Pollutant	Bargo AQMS				
	TSP	PM ₁₀	PM _{2.5}	NO ₂	O ₃
Averaging period	Annual	24-hour	24-hour	1-hour	1-hour
Units	µg·m ⁻³	µg·m ⁻³	µg·m ⁻³	µg·m ⁻³	µg·m ⁻³
Statistics					
Data points (No.)	356	356	347	8211	8228
Mean	35.8	15.9	7.8	9.5	44.4
Standard deviation	-	20.1	12.1	13.1	26.5
Skew	-	8.0	5.9	1.7	0.7
Kurtosis	-	81.4	41.6	3.1	2.5
Minimum	-	1.2	0.2	-6.2	-2.1
Percentiles					
25 th	-	8.6	3.2	0.0	27.8
50 th	-	12.3	5.0	4.1	47.1
75 th	-	17.5	8.0	14.4	59.9
90 th	-	25.2	11.1	28.7	71.3
95 th	-	31.4	18.5	36.9	85.6
97 th	-	39.1	33.4	43.1	98.4
98 th	-	46.8	50.3	47.2	107.0
99 th	-	112.1	65.3	53.3	124.1
Maximum	-	265.7	121.9	92.3	244.0
Data capture (%)	97.3	97.3	94.8	93.5	93.7

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

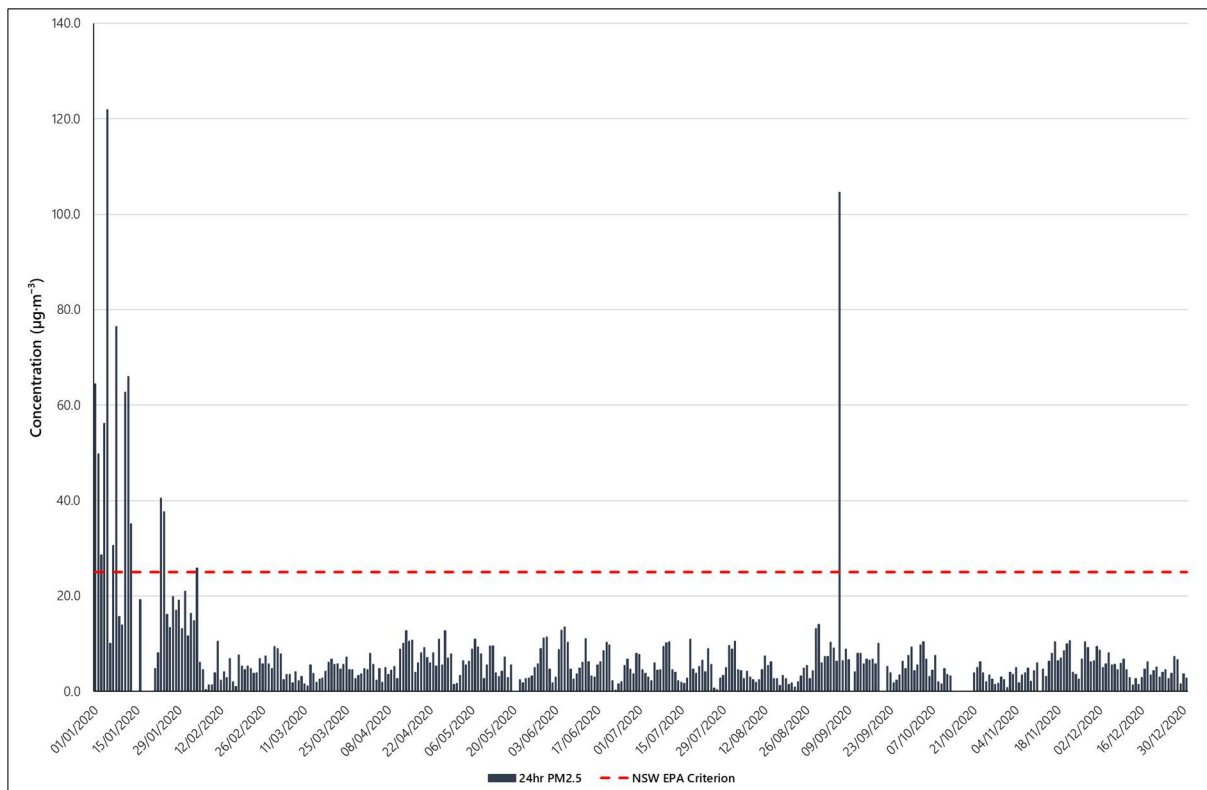
2: Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more peaked distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Figure D2 Daily varying PM₁₀ background concentrations – Bargo AQMS (2020)



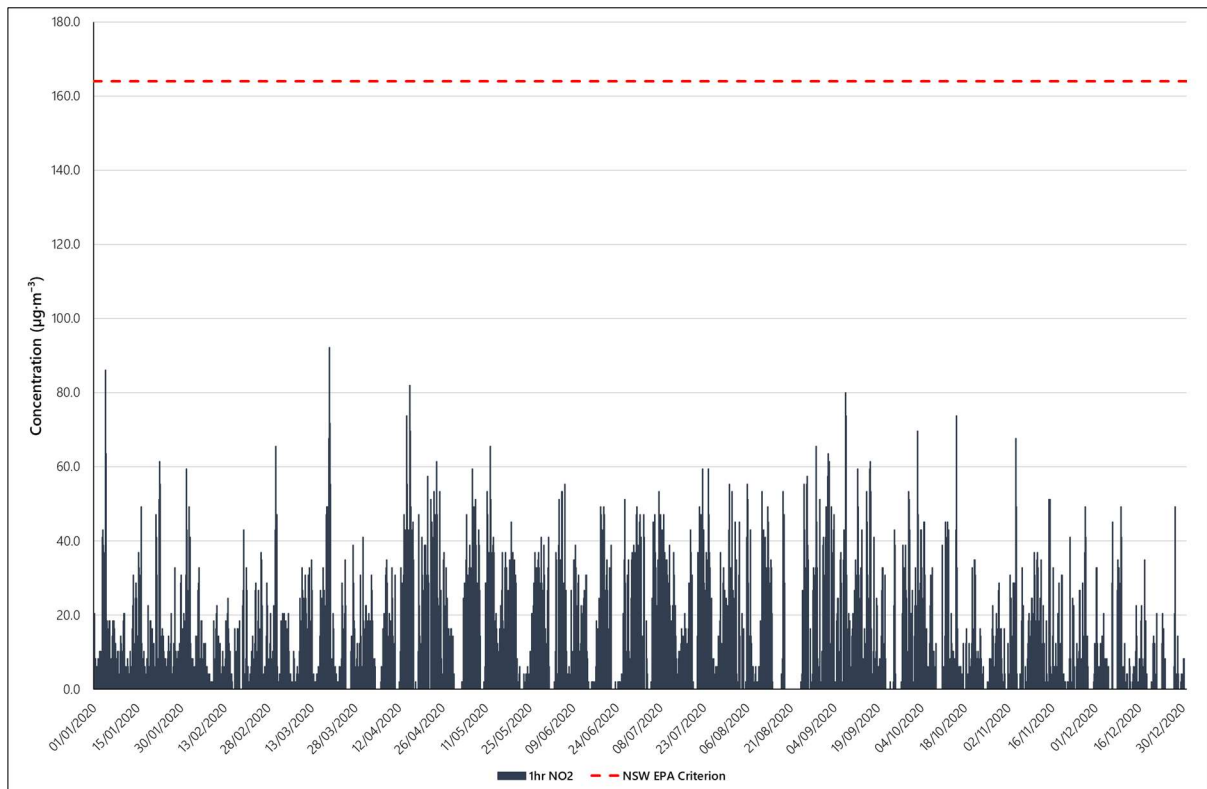
Source: Northstar

Figure D3 Daily varying PM_{2.5} background concentrations – Bargo AQMS (2020)



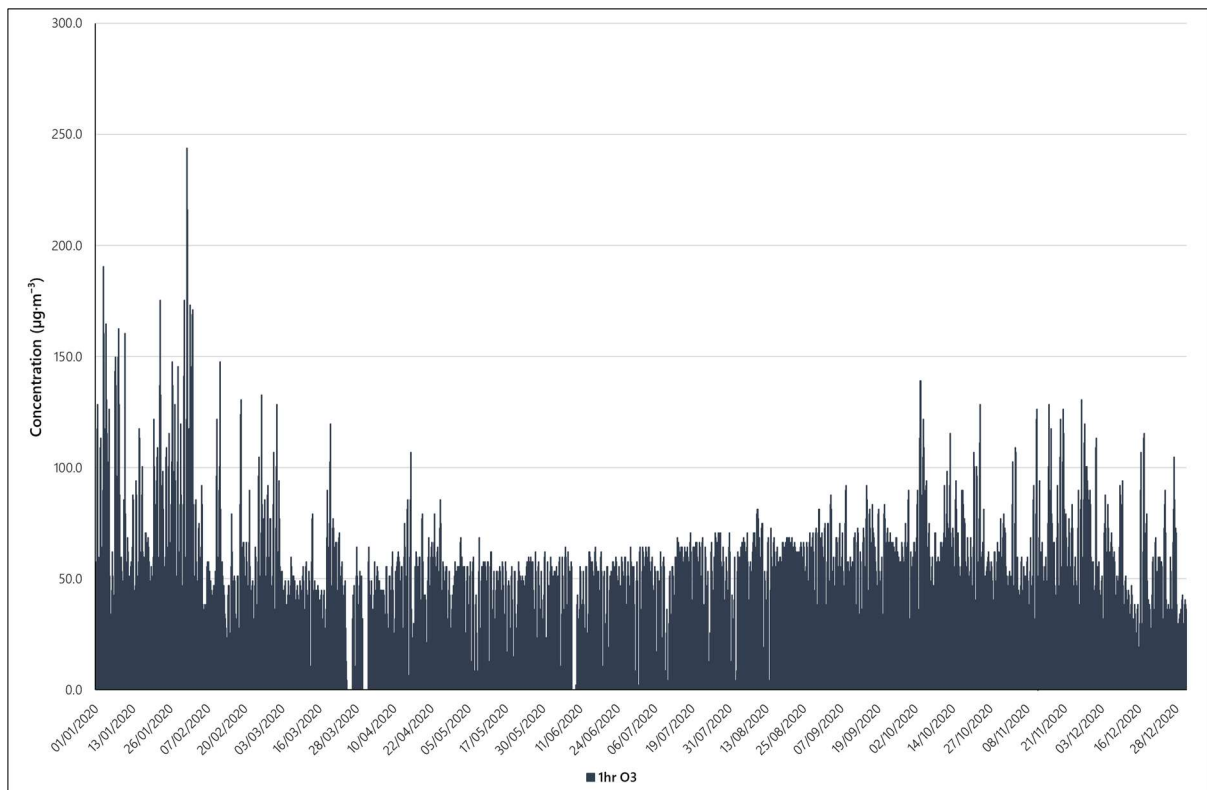
Source: Northstar

Figure D4 Hourly varying NO₂ background concentrations – Bargo AQMS (2020)



Source: Northstar

Figure D5 Hourly varying O₃ background concentrations – Bargo AQMS (2020)



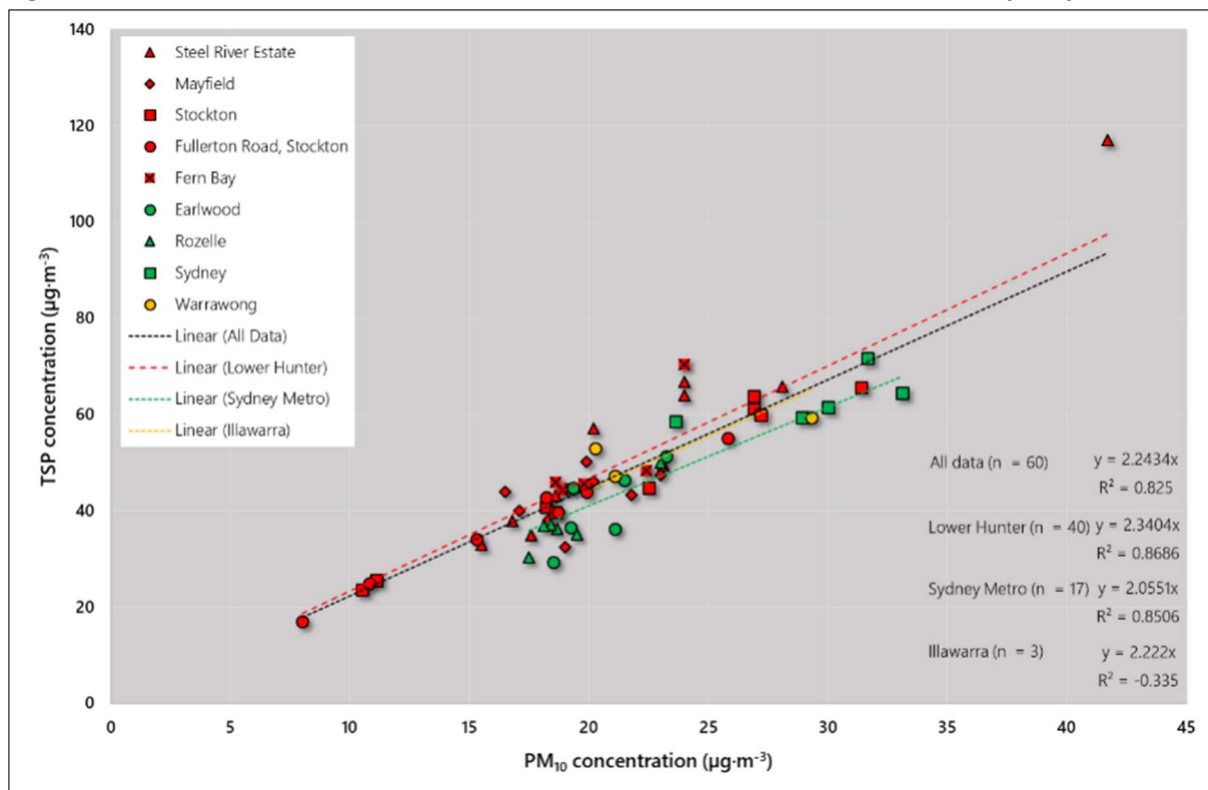
Source: Northstar

Concentrations of TSP are not measured at any AQMS surrounding the Proposal site. An analysis of co-located measurements of TSP and PM₁₀ in the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions is presented in Figure D6.

The analysis concludes that, based on the measurements collected across NSW between 1999 to 2011, the derivation of a broad TSP:PM₁₀ ratio of 2.2434: 1 (i.e., PM₁₀ represents ~44.6 % of TSP) is appropriate to be applied to measurements in the Sydney Metropolitan region.

In the absence of any more specific information, this ratio has been incorporated into this AQIA, leading to the adoption of a background annual average TSP concentration of 35.8 µg·m⁻³.

Figure D6 Co-located TSP and PM₁₀ measurements – Illawarra, Lower Hunter and Sydney Metro



Source: Northstar

APPENDIX E

Emissions Inventory

As outlined in Section 2.3, multiple operations integral to the Proposal have the potential to result in particulate matter emissions. To assess these, the AQIA has relied upon emission factors sourced from the US EPA AP-42 emissions factor compendium (US EPA, various).

This appendix provides a comprehensive overview of the adopted emission estimation techniques utilised to derive total emissions from the identified sources.

Materials Handling

Emissions for material handling, transfer points and conveyor movements have been characterised using the factor outlined in Section 13.2.4.3 of AP-42 for batch drop processes (US EPA, 2006).

The equation is:

$$EF (kg \cdot tonne^{-1}) = k(0.0016) \frac{\left(\frac{U (m \cdot s^{-1})}{2.2}\right)^{1.3}}{\left(\frac{M (\%)}{2}\right)^{1.4}}$$

where:

$EF_{TSP} (kg \cdot tonne^{-1})$ = emission factor for total suspended particles

$EF_{PM_{10}} (kg \cdot tonne^{-1})$ = emission factor for total suspended particles

k_{TSP} = 0.74 for particles less than 30 micrometres aerodynamic diameter

$k_{PM_{10}}$ = 0.35 for particles less than 10 micrometres aerodynamic diameter

$k_{PM_{2.5}}$ = 0.053 for particles less than 2.5 micrometres aerodynamic diameter

U = mean wind speed ($m \cdot s^{-1}$) (ave $3.5 m \cdot s^{-1}$ (refer Appendix C))

M = material moisture content (% by weight) (assumed 2 %)

The quality rating for this application is rated A.

Crushing

Emissions of particulate matter resulting from the processing of materials (shear and pre-shredder) have been estimated using the emission factors presented in Section 11.19.2 of AP-42 (US EPA, 2004), in the absence of industry specific emission factors.

No emission factors associated with primary or secondary crushing are available within AP-42 although emission factors for tertiary crushers can be used as an upper limit for primary or secondary crushing (US EPA, 2004).

PM_{2.5} emission factors are not available for uncontrolled crushing sources in AP-42 although have been taken to be 10% of PM₁₀ as per aggregate handling sources (MRI, 2006).

For uncontrolled tertiary crushing (and uncontrolled primary and secondary crushing):

$$EF_{TSP} (kg. tonne^{-1}) = 0.0027$$

$$EF_{PM_{10}} (kg. tonne^{-1}) = 0.0012$$

$$EF_{PM_{2.5}} (kg. tonne^{-1}) = 0.00012$$

The quality rating for these emission factors is: Tertiary Crushing (uncontrolled) = E & C (TSP & PM₁₀ respectively).

Screening

Emissions of particulate matter resulting from the screening of metal materials have been estimated using the emission factors presented in Section 11.19.2 of AP-42 (US EPA, 2004), again in the absence of industry specific factors.

PM_{2.5} emission factors are not available for uncontrolled screening sources in AP-42 although have been taken to be 10 % of PM₁₀ as per aggregate handling sources (MRI, 2006). The control efficiency used for screening is 91.2 % as calculated in AP-42 (US EPA, 2004)

For uncontrolled screening:

$$EF_{TSP} (kg. tonne^{-1}) = 0.0125$$

$$EF_{PM_{10}} (kg. tonne^{-1}) = 0.0043$$

$$EF_{PM_{2.5}} (kg. tonne^{-1}) = 0.00043$$

The quality rating for these emission factors is screening (uncontrolled) = E & C (TSP & PM₁₀ respectively).

Wind Erosion (Stockpile Areas)

Emissions of particulate matter resulting from wind erosion sources (i.e., stockpiled materials) have been estimated using the emission factors presented in Section 11.9-4 of AP-42 (US EPA, 1998).

The emission factors within Table 11.9-4 have been adopted for each respective stockpile area at the Proposal site.

The emission factor calculation is:

$$EF_{TSP} (\text{tonne} \cdot (\text{hectare} \cdot \text{year})^{-1}) = 0.85$$

where:

$EF_{TSP} (\text{tonne} \cdot (\text{hectare} \cdot \text{year})^{-1})$ = emission factor for total suspended particulate matter

PM₁₀ and PM_{2.5} emission factors are not available in AP-42 although have been taken to be 50% of TSP for PM₁₀ and, 7.5% of TSP for PM_{2.5} as per AP-42 section (13.2.5) for industrial wind erosion.

The quality rating for this emission factors is C.

Paved Routes

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

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

where:

$EF_{(g \cdot VKT^{-1})}$ = 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, PM₁₀ 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 PM₁₀, D for PM_{2.5}.

The road surface silt loading of the paved road has been taken to be 9.7 g·m⁻² which is consistent with the iron and steel production industry (US EPA, 2011).

The calculated weighted average vehicle weight (t) for using paved routes at the Proposal site was calculated at 24.0 t. This figure represents the semi-trailer and heavy truck types intending to use the Proposal site, with Gross Vehicle Mass (GVM) spanning at 42.5 t.

Unpaved Routes

Emissions of particulate matter resulting from the movement of materials on unpaved roads have been estimated using the emission factors presented in Section 13.2.2 (Unpaved Roads) of AP-42 (US EPA, 2006). The emission factor in Section 13.2.2 of (US EPA, 2006) has been adopted for the operations of vehicles on unpaved roads.

The emission factor calculation is:

$$EF_{(kg.VKT^{-1})} = 0.2819 \times k \times \left(\frac{s}{12}\right)^a \times \left(\frac{W \times 0.907185}{3}\right)^b$$

where:

$EF_{(kg.VKT^{-1})}$ = emission factor (kg per vehicle kilometre travelled) multiplied by 0.2819 to convert from lb per vehicle mile travelled

k = particle size multiplier (dimensionless)

s = surface material silt content (%)

W = mean vehicle weight (tons) multiplied by 0.907185 to convert from metric tonnes

The particle size multipliers for TSP, PM₁₀ and PM_{2.5} (k) are provided in (US EPA, 2006) as 4.9, 1.5 and 0.15, respectively.

The quality rating for this application is rated B for TSP, B for PM₁₀ and B for PM_{2.5}.

The silt content of unpaved haul roads at the Proposal site has been taken to be 6 %, which is consistent with the iron and steel production industry (US EPA, 2006).

In relation to FEL movements at the Proposal site, the average weight was calculated at 14.8 t, derived from the technical specification of a comparable non-road mobile machinery unit.

Emissions Estimates

Table E1 to Table E3 outline emissions calculated for volume sources in the Proposal, while Table E4 to Table E6 detail emissions concerning wheel-generated dust. Additionally, Table E7 to Table E9 present emissions related to wind erosion (stockpile) areas. These tables cover both peak 24-hour and annual emissions, which were included in the AQIA using dispersion modelling.

Table E1 Emission estimates - volume sources - peak daily and annual activity rates

Source ID	Description	Emission factor	Activity rate	
			t·day ⁻¹	t·yr ⁻¹
DP1	Sheared - HDV Unload	AP-42 - Batch drop - Section 13.2.4.3	26.1	6 000
TRANS1	Sheared - Materials Transfer to Unprocessed Sheared Stockpile	AP-42 - Batch drop - Section 13.2.4.3	26.1	6 000
TRANS2	Sheared - Materials Transfer to Shear	AP-42 - Batch drop - Section 13.2.4.3	26.1	6 000
SHEAR	Sheared - Inclined Fixed Shear	AP-42 - Primary crushing - Table 11.19.2.1	26.1	6 000
CONV1	Sheared - Inclined Fixed Shear Conveyor to Processed Sheared Stockpile	AP-42 - Batch drop - Section 13.2.4.3	26.1	6 000
DP2	Sheared - Drop Point from Conveyor to Processed Sheared Stockpile	AP-42 - Batch drop - Section 13.2.4.3	26.1	6 000
TRANS3	Sheared - Transfer from Sheared Processed SP to HDV Export	AP-42 - Batch drop - Section 13.2.4.3	26.1	6 000
DP3	Shredded - HDV Unload	AP-42 - Batch drop - Section 13.2.4.3	104.6	24 000
TRANS4	Shredded - Materials Transfer from Unprocessed Shredded Stockpile (1-3) to Pre-Shredder	AP-42 - Batch drop - Section 13.2.4.3	62.7	14 400
TRANS5	Shredded - Materials Transfer from Unprocessed Shredded Stockpile Large (1) to Pre-Shredder	AP-42 - Batch drop - Section 13.2.4.3	20.9	4 800
TRANS6	Shredded - Materials Transfer from Unprocessed Shredded Stockpile Large (2) to Pre-Shredder	AP-42 - Batch drop - Section 13.2.4.3	20.9	4 800
DP4	Shredded - Batch Drop to Pre-Shredder	AP-42 - Batch drop - Section 13.2.4.3	104.6	24 000
PRESHRED	Shredded - Pre-Shredder	AP-42 - Primary crushing - Table 11.19.2.1	104.6	24 000
CONV2	Shredded - Conveyor from Pre-Shredder to Hammermill	AP-42 - Batch drop - Section 13.2.4.3	104.6	24 000
CONV3	Shredded - Conveyor Transfer from Hammermill to Sorter	AP-42 - Batch drop - Section 13.2.4.3	104.6	24 000
CONV4	Shredded (Ferrous) - Conveyor post Auto Sorting, Pre-Stockpile	AP-42 - Batch drop - Section 13.2.4.3	83.7	19 200
DP5	Shredded (Ferrous) - Drop Point from Auto Sorter to Processed Shredded Stockpile	AP-42 - Batch drop - Section 13.2.4.3	83.7	19 200
CONV5	Shredded (Non-Ferrous + Floc) - Conveyor to Tumbleback	AP-42 - Batch drop - Section 13.2.4.3	20.9	4 800
TUMBLE	Shredded (Non-Ferrous + Floc) - Tumbleback	AP-42 - Batch drop - Section 13.2.4.3	20.9	4 800
CONV6	Shredded (Non-Ferrous + Floc) - Conveyor into Eddy C-Fines	AP-42 - Batch drop - Section 13.2.4.3	20.9	4 800
EDDYC	Shredded (Non-Ferrous + Floc) - Eddy C-Fines	AP-42 - Screening - Table 11.19.2.1	20.9	4 800
CONV7	Shredded (Non-Ferrous + Floc) - Conveyor from Eddy C-Fines to Finesmaster	AP-42 - Batch drop - Section 13.2.4.3	20.9	4 800
FINES	Shredded (Non-Ferrous + Floc) - Finesmaster	AP-42 - Screening - Table 11.19.2.1	20.9	4 800
CONV8	Shredded (ZORBA) - Conveyor from Finesmaster to ZORBA Bay	AP-42 - Batch drop - Section 13.2.4.3	4.2	960

Source ID	Description	Emission factor	Activity rate	
			t·day ⁻¹	t·yr ⁻¹
DP6	Shredded (ZORBA) - Drop Point for ZORBA Bay	AP-42 - Batch drop - Section 13.2.4.3	4.2	960
CONV9	Shredded (Non-Ferrous + Floc) - Conveyor from Finesmaster to Drumfeeder	AP-42 - Batch drop - Section 13.2.4.3	16.7	3 840
DRUMFEED	Shredded (Non-Ferrous + Floc) – Drumfeeder	AP-42 - Screening - Table 11.19.2.1	16.7	3 840
CONV10	Shredded (Non-Ferrous + Floc) - Elevator Conveyor from Drumfeeder to KSS	AP-42 - Batch drop - Section 13.2.4.3	16.7	3 840
KSS	Shredded (Non-Ferrous + Floc) – KSS	AP-42 - Screening - Table 11.19.2.1	16.7	3 840
CONV11	Shredded (Floc) - Conveyor from KSS to Waste Floc Bay	AP-42 - Batch drop - Section 13.2.4.3	16.7	3 840
DP7	Shredded (Floc) - Drop Point from KSS to Waste Floc Bay	AP-42 - Batch drop - Section 13.2.4.3	16.7	3 840

Table E2 Emission estimates - volume sources – peak daily emission rates

Source ID	Emission factor				Emissions controls	Controlled emissions (kg·day ⁻¹)		
	TSP	PM ₁₀	PM _{2.5}	Units		TSP	PM ₁₀	PM _{2.5}
DP1	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %)	4.01E-02	1.90E-02	2.88E-03
TRANS1	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	1.72E-02	8.14E-03	1.23E-03
TRANS2	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	1.72E-02	8.14E-03	1.23E-03
SHEAR	2.7E-03	1.2E-03	2.2E-04	kg·t ⁻¹	Enclosed (70 %)	2.12E-02	9.41E-03	1.69E-03
CONV1	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (50 %), Enclosure (Transfers) (70 %)	8.60E-03	4.07E-03	6.16E-04
DP2	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (50 %), Minimise Drop Height (30 %)	2.01E-02	9.49E-03	1.44E-03
TRANS3	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	1.72E-02	8.14E-03	1.23E-03
DP3	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %)	1.61E-01	7.60E-02	1.15E-02
TRANS4	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	4.13E-02	1.95E-02	2.96E-03
TRANS5	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	1.38E-02	6.51E-03	9.86E-04
TRANS6	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	1.38E-02	6.51E-03	9.86E-04
DP4	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %), Acoustic Wall Enclosure (70 %)	4.82E-02	2.28E-02	3.45E-03
PRESHRED	2.7E-03	1.2E-03	2.2E-04	kg·t ⁻¹	Acoustic Wall Enclosure (70 %), Controlled Crushing (77.7 %)	1.89E-02	8.39E-03	1.51E-03
CONV2	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %)	6.88E-02	3.26E-02	4.93E-03

Source ID	Emission factor				Emissions controls	Controlled emissions (kg·day ⁻¹)		
	TSP	PM ₁₀	PM _{2.5}	Units		TSP	PM ₁₀	PM _{2.5}
CONV3	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Acoustic Wall Enclosure (70 %)	2.06E-02	9.77E-03	1.48E-03
CONV4	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (50 %), Enclosure (Transfers) (70 %)	2.75E-02	1.30E-02	1.97E-03
DP5	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (50 %), Minimise Drop Height (30 %)	6.42E-02	3.04E-02	4.60E-03
CONV5	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %)	1.38E-02	6.51E-03	9.86E-04
TUMBLE	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Controlled Screening (91.2 %)	4.04E-03	1.91E-03	2.89E-04
CONV6	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	4.13E-03	1.95E-03	2.96E-04
EDDYC	1.3E-02	4.3E-03	3.0E-04	kg·t ⁻¹	Controlled Screening (91.2 %), Awning Structure (70 %)	6.90E-03	2.37E-03	1.66E-04
CONV7	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	4.13E-03	1.95E-03	2.96E-04
FINES	1.3E-02	4.3E-03	3.0E-04	kg·t ⁻¹	Controlled Screening (91.2 %), Awning Structure (70 %)	6.90E-03	2.37E-03	1.66E-04
CONV8	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %)	2.75E-03	1.30E-03	1.97E-04
DP6	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %)	6.42E-03	3.04E-03	4.60E-04
CONV9	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	3.30E-03	1.56E-03	2.37E-04
DRUMFEED	1.3E-02	4.3E-03	3.0E-04	kg·t ⁻¹	Controlled Screening (91.2 %), Awning Structure (70 %)	1.84E-02	6.33E-03	4.43E-04
CONV10	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	1.10E-02	5.21E-03	7.89E-04
KSS	1.3E-02	4.3E-03	3.0E-04	kg·t ⁻¹	Controlled Screening (91.2 %), Awning Structure (70 %)	1.84E-02	6.33E-03	4.43E-04
CONV11	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	1.10E-02	5.21E-03	7.89E-04
DP7	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %)	2.57E-02	1.22E-02	1.84E-03

Table E3 Emission estimates – volume sources – annual emission rates

Source ID	Emission factor				Emissions controls	Controlled emissions (kg·yr ⁻¹)		
	TSP	PM ₁₀	PM _{2.5}	Units		TSP	PM ₁₀	PM _{2.5}
DP1	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %)	9.21E+00	4.36E+00	6.60E-01
TRANS1	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	3.95E+00	1.87E+00	2.83E-01
TRANS2	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	3.95E+00	1.87E+00	2.83E-01
SHEAR	2.7E-03	1.2E-03	2.2E-04	kg·t ⁻¹	Enclosed (70 %)	4.86E+00	2.16E+00	3.89E-01
CONV1	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (50 %), Enclosure (Transfers) (70 %)	1.97E+00	9.34E-01	1.41E-01
DP2	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (50 %), Minimise Drop Height (30 %)	4.61E+00	2.18E+00	3.30E-01
TRANS3	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	3.95E+00	1.87E+00	2.83E-01
DP3	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %)	3.69E+01	1.74E+01	2.64E+00
TRANS4	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	9.48E+00	4.48E+00	6.79E-01
TRANS5	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	3.16E+00	1.49E+00	2.26E-01
TRANS6	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (70 %)	3.16E+00	1.49E+00	2.26E-01
DP4	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %), Acoustic Wall Enclosure (70 %)	1.11E+01	5.23E+00	7.92E-01
PRESHRED	2.7E-03	1.2E-03	2.2E-04	kg·t ⁻¹	Acoustic Wall Enclosure (70 %), Controlled Crushing (77.7 %)	4.34E+00	1.93E+00	3.47E-01
CONV2	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %)	1.58E+01	7.47E+00	1.13E+00
CONV3	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Acoustic Wall Enclosure (70 %)	4.74E+00	2.24E+00	3.39E-01
CONV4	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (50 %), Enclosure (Transfers) (70 %)	6.32E+00	2.99E+00	4.53E-01
DP5	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Water Sprays (50 %), Minimise Drop Height (30 %)	1.47E+01	6.97E+00	1.06E+00
CONV5	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %)	3.16E+00	1.49E+00	2.26E-01
TUMBLE	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Controlled Screening (91.2 %)	9.27E-01	4.38E-01	6.64E-02
CONV6	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	9.48E-01	4.48E-01	6.79E-02
EDDYC	1.3E-02	4.3E-03	3.0E-04	kg·t ⁻¹	Controlled Screening (91.2 %), Awning Structure (70 %)	1.58E+00	5.45E-01	3.81E-02
CONV7	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	9.48E-01	4.48E-01	6.79E-02
FINES	1.3E-02	4.3E-03	3.0E-04	kg·t ⁻¹	Controlled Screening (91.2 %), Awning Structure (70 %)	1.58E+00	5.45E-01	3.81E-02
CONV8	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %)	6.32E-01	2.99E-01	4.53E-02

Source ID	Emission factor				Emissions controls	Controlled emissions (kg·yr ⁻¹)		
	TSP	PM ₁₀	PM _{2.5}	Units		TSP	PM ¹⁰	PM _{2.5}
DP6	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %)	1.47E+00	6.97E-01	1.06E-01
CONV9	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	7.58E-01	3.59E-01	5.43E-02
DRUMFEED	1.3E-02	4.3E-03	3.0E-04	kg·t ⁻¹	Controlled Screening (91.2 %), Awning Structure (70 %)	4.22E+00	1.45E+00	1.02E-01
CONV10	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	2.53E+00	1.20E+00	1.81E-01
KSS	1.3E-02	4.3E-03	3.0E-04	kg·t ⁻¹	Controlled Screening (91.2 %), Awning Structure (70 %)	4.22E+00	1.45E+00	1.02E-01
CONV11	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Enclosure (Transfers) (70 %), Awning Structure (70 %)	2.53E+00	1.20E+00	1.81E-01
DP7	2.2E-03	1.0E-03	1.6E-04	kg·t ⁻¹	Minimise Drop Height (30 %)	5.90E+00	2.79E+00	4.22E-01

Table E4 Emission estimates – wheel generated dust – peak daily and annual activity rates

Source ID	Description	Emission factor	Activity rate	
			VKT·day ⁻¹	VKT·yr ⁻¹
ROAD1	Entrance (N) to Shear Weighbridge	AP-42 Paved roads - Section 13.2.1	0.8	181
ROAD2	Entrance (N) to Shredding Area	AP-42 Paved roads - Section 13.2.1	3.8	878
ROAD3	T-Junction (1) to Exit (S)	AP-42 Paved roads - Section 13.2.1	1.0	226
ROAD4	Shredding Processed to T-Junction (2)	AP-42 Paved roads - Section 13.2.1	1.7	399
ROAD5	T-Junction (2) to Exit (N) - Sheared	AP-42 Paved roads - Section 13.2.1	0.6	139
ROAD6	T-Junction (2) to Exit (S) - Processed	AP-42 Paved roads - Section 13.2.1	2.5	572
ROAD7	Through Shredding Area (Unpaved)	AP-42 Unpaved roads - Section 13.2.2	2.6	600
ROAD8	FEL Movements (Sheared)	AP-42 Unpaved roads - Section 13.2.2	2.5	435
ROAD9	FEL Movements (Shredded)	AP-42 Unpaved roads - Section 13.2.2	7.4	1 283

Table E5 Emission estimates - wheel generated dust – peak daily emission rates

Source ID	Emission factor				Emissions controls	Controlled emissions (kg-day ⁻¹)		
	TSP	PM ₁₀	PM _{2.5}	Units		TSP	PM ₁₀	PM _{2.5}
ROAD1	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	1.08E-01	2.07E-02	5.01E-03
ROAD2	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	5.24E-01	1.01E-01	2.44E-02
ROAD3	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	1.35E-01	2.60E-02	6.28E-03
ROAD4	2.7E-03	1.2E-03	2.2E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	2.38E-01	4.58E-02	1.11E-02
ROAD5	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	8.33E-02	1.60E-02	3.87E-03
ROAD6	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	3.42E-01	6.56E-02	1.59E-02
ROAD7	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Level 1 Watering (50%), speed restriction (40%)	1.77E+00	4.73E-01	4.73E-02
ROAD8	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Level 1 Watering (50%), speed restriction (40%)	1.37E+00	3.66E-01	3.66E-02
ROAD9	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Level 1 Watering (50%), speed restriction (40%)	4.04E+00	1.08E+00	1.08E-01

Table E6 Emission estimates – wheel generated dust - annual emission rates

Source ID	Emission factor				Emissions controls	Controlled emissions (kg-yr ⁻¹)		
	TSP	PM ₁₀	PM _{2.5}	Units		TSP	PM ₁₀	PM _{2.5}
ROAD1	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	3.11E+01	5.97E+00	1.44E+00
ROAD2	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	1.51E+02	2.90E+01	7.02E+00
ROAD3	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	3.90E+01	7.48E+00	1.81E+00
ROAD4	2.7E-03	1.2E-03	2.2E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	6.87E+01	1.32E+01	3.19E+00
ROAD5	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	2.40E+01	4.61E+00	1.11E+00
ROAD6	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Road flushing (2.2 l.m ⁻² .hr ⁻¹), (30-70%), sweeping (50%), speed restriction (40%)	9.85E+01	1.89E+01	4.58E+00
ROAD7	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Level 1 Watering (50%), speed restriction (40%)	4.50E+02	1.20E+02	1.20E+01
ROAD8	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Level 1 Watering (50%), speed restriction (40%)	2.38E+02	6.33E+01	6.33E+00
ROAD9	2.2E-03	1.0E-03	1.6E-04	kg·VKT ⁻¹	Level 1 Watering (50%), speed restriction (40%)	7.00E+02	1.87E+02	1.87E+01

Table E7 Emission estimates – open area wind erosion sources – peak activity rate

Source ID	Description	Emission factor	Peak activity rate	
			Area (ha)	hr·day ⁻¹
WE1	Sheared Unprocessed Small (1)	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	4.00E-02	2.40E+01
WE2	Shredded Unprocessed Small (1)	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	4.00E-02	2.40E+01
WE3	Shredded Unprocessed Small (2)	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	4.00E-02	2.40E+01
WE4	Shredded Unprocessed Small (3)	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	4.00E-02	2.40E+01
WE5	Shredded Unprocessed Large (1)	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	4.00E-02	2.40E+01
WE6	Shredded Unprocessed Large (2)	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	4.00E-02	2.40E+01
WE7	Sheared Processed SP	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	6.30E-02	2.40E+01
WE8	Shredded Processed SP	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	1.18E-01	2.40E+01
WE9	Zorba Bay	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.50E-03	2.40E+01
WE10	Waste Floc Bay	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	1.50E-02	2.40E+01

Table E8 Emission estimates – open area wind erosion sources – peak daily emission rate

Source ID	Emission factor				Emissions controls	Controlled emissions (kg·day ⁻¹)		
	TSP	PM ₁₀	PM _{2.5}	Units		TSP	PM ₁₀	PM _{2.5}
WE1	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	9.32E-02	4.66E-02	6.99E-03
WE2	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	9.32E-02	4.66E-02	6.99E-03
WE3	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	9.32E-02	4.66E-02	6.99E-03
WE4	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	9.32E-02	4.66E-02	6.99E-03
WE5	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	9.32E-02	4.66E-02	6.99E-03
WE6	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	9.32E-02	4.66E-02	6.99E-03
WE7	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	1.47E-01	7.34E-02	1.10E-02
WE8	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	2.75E-01	1.37E-01	2.06E-02
WE9	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	Erect 3-sided Enclosure (75 %)	4.95E-03	2.47E-03	3.71E-04
WE10	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	Erect 3-sided Enclosure (75 %)	8.73E-03	4.37E-03	6.55E-04

Table E9 Emission estimates - open area wind erosion sources – peak daily emission rate

Source ID	Emission factor				Emissions controls	Controlled emissions (kg·yr ⁻¹)		
	TSP	PM ₁₀	PM _{2.5}	Units		TSP	PM ₁₀	PM _{2.5}
WE1	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	3.40E+01	1.70E+01	2.55E+00
WE2	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	3.40E+01	1.70E+01	2.55E+00
WE3	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	3.40E+01	1.70E+01	2.55E+00
WE4	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	3.40E+01	1.70E+01	2.55E+00
WE5	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	3.40E+01	1.70E+01	2.55E+00
WE6	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	3.40E+01	1.70E+01	2.55E+00
WE7	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	5.36E+01	2.68E+01	4.02E+00
WE8	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	-	1.00E+02	5.02E+01	7.52E+00
WE9	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	Erect 3-sided Enclosure (75 %)	1.81E+00	9.03E-01	1.35E-01
WE10	8.5E+02	4.3E+02	6.4E+01	kg·ha ⁻¹ ·yr ⁻¹	Erect 3-sided Enclosure (75 %)	3.19E+00	1.59E+00	2.39E-01

Point Source Emissions Estimates

Table E10 below represents a summary of the emissions estimation used for the assessment of both the oxycutter and hammermill.

The oxycutter source data and associated emission rates were acquired from Ektimo Emission Test Report (Ektimo, 2019b), involving duplicate tests, and utilising the maximum to quantify emissions. Regarding the hammermill, a series of emissions testing were carried out (Ektimo, various) and the maximum measured emission rate as acquired from these test reports has been adopted for use in this AQIA. Emission conditions, including flow rates, temperatures etc., were derived from (Ektimo, 2020).

The associated monitoring reports pertaining to both the oxycutter, and hammermill are presented in Appendix F of (Northstar, 2021).

Table E10 Emissions estimates - point source emissions

Source / parameter	Units	Oxycutter ⁽¹⁾	Hammermill ⁽²⁾
Point source parameters			
Source ID	value	OXY	HAMMER
Easting	m	755 389	755 373
Northing	m	6 153 396	6 153 234
Base elevation	m AHD	634.1	635.1
Stack height	m AGL	1	16.7
Diameter at point of discharge	m ID	0.05	0.440
Emission temperature	°C	31	39
Emission velocity (discharge)	m·s ⁻¹	14.0	50.0
Gas volumetric flow rate	Nm ⁻³ ·s ⁻¹	0.1	6.6
Emission rates			
Odour	OU·m ⁻³ ·s ⁻¹	2.50E+02	1.22E+04
TSP	g·s ⁻¹	2.17E-02	7.50E-02
PM ₁₀	g·s ⁻¹	-	5.33E-02
PM _{2.5}	g·s ⁻¹	-	3.33E-02
NO _x	g·s ⁻¹	5.50E-04	3.33E-02
Cr	g·s ⁻¹	1.27E-06	1.83E-05
Cu	g·s ⁻¹	5.17E-06	2.00E-05
Fe	g·s ⁻¹	5.50E-03	2.33E-04
Mn	g·s ⁻¹	9.17E-05	4.17E-05
Ni	g·s ⁻¹	1.57E-06	3.33E-05

Note: (1) Source data derived from Ektimo Emission Test Report (Ektimo, 2019b))

The tests were performed in duplicate, and the maximum value has been used to quantify the emission rates. Monitoring reports presented in Appendix F of (Northstar, 2021)

(2) Source data derived from Ektimo Emission Test Reports (Ektimo, various). The maximum measured emission rate from all test reports has been adopted in this AQIA. Emission conditions, including flow rates, temperatures etc., were derived from (Ektimo, 2020). Monitoring reports presented in Appendix F of (Northstar, 2021)

air quality | environment | sustainability

air quality	Northstar specialises in all aspects of air quality, dust, and odour management, covering monitoring, modelling and assessment, due diligence and process specification, licencing and regulatory advice, peer review and expert witness.
environment	Our team has extensive experience in environmental management, covering environmental policy and management plans, licencing, compliance reporting, auditing, data, and spatial analysis.
sustainability	We look beyond compliance to add value and identify opportunities. Our services range from sustainability strategies, ecologically sustainable development reporting and assessment, to bespoke greenhouse gas and energy estimation and reporting.

Head Office

Suite 1504, 275 Alfred Street,
North Sydney NSW 2060

Riverina Office

PO Box 483
Albury NSW 2640



northstar
■■■■■



Tel: 1300 708 590 | admin@northstar-env.com | northstar-env.com