This document has been prepared on behalf of **Colas New South Wales Pty Ltd**:

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Asphalt Batching Plant, Tomago

Air Quality Impact Assessment

Addressee(s):	Colas New South Wales Pty Ltd
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Quality Control

Study	Status	Prepared by	Checked by	Authorised by
INTRODUCTION	Final	Northstar Air Quality	GCG	MD
THE PROPOSAL	Final	Northstar Air Quality	GCG	MD
LEGISLATION, REGULATION AND GUIDANCE	Final	Northstar Air Quality	GCG	MD
EXISTING CONDITIONS	Final	Northstar Air Quality	GCG	MD
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Report Status

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Year	Job Number	(Draft: Final)	(R*x*)	(V*x*)
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Final Authority

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

Martin Doyle **1st October 2021**

Non-Technical Summary

Colas New South Wales Pty Ltd has engaged Northstar Air Quality Pty Ltd to perform an Air Quality Impact Assessment to support a modification to State Significant Development MP07_0031 for a proposed increase in utilisation threshold for the Tomago Asphalt Batching Plant, located at 25-27 Kennington Drive, Tomago, NSW.

This Air Quality Impact Assessment forms part of the Modification Report prepared to accompany the modification application for the Proposal as requested by NSW Department of Planning, Industry & Environment.

The Air Quality Impact Assessment presents an assessment of the impacts of the operations at the Proposal site, taking into account the increased utilisation of the asphalt plant, associated with annual and maximum daily throughputs. The Air Quality Impact Assessment also includes the potential cumulative impacts associated with the storage yard operated by Colas NSW Pty Ltd at 31-33 Kennington Drive, Tomago.

The assessment has used a quantitative dispersion modelling approach performed in accordance with the relevant NSW Environment Protection Authority guidelines, and the assessment is presented as predicted incremental change and as a cumulative impact accounting for the prevailing background air quality conditions and the increments associated with the operation of the neighbouring storage yard.

Emissions of particulate matter from materials transport, unloading, handling, storage, and loading operations have been calculated using US Environmental Protection Agency AP42 emission factors relevant to those operations. Emissions of criteria air pollutants and air toxics associated with the operation of the dryer stack have also been calculated using US Environmental Protection Agency AP42 emission factors. Emissions of particulate matter and odour from the dryer stack have been based on site specific measurements.

The Air Quality Impact Assessment concludes that should emission controls as assumed in this report be implemented, all impact assessment criteria would achieved at all relevant sensitive receptor locations. No additional exceedances of the air quality criteria are predicted, and the emissions controls would act to minimise emissions of air pollutants, in accordance with best practice.

The results of the Air Quality Impact Assessment indicate that the granting of modification to the State Significant Development Consent for the Proposal should not be rejected on the grounds of air quality.

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1. INTRODUCTION

Colas New South Wales Pty Ltd (Colas) has engaged Northstar Air Quality Pty Ltd (Northstar) to provide an air quality impact assessment (AQIA) to support a modification to State Significant Development (SSD) MP07_0031 for a proposed increase in utilisation threshold for the Tomago Asphalt Batching Plant, located at 25-27 Kennington Drive, Tomago, NSW (the Proposal site).

The following section outlines the naming conventions adopted within this AQIA, and also includes reference to the storage yard, which is a separate approval sought by Colas, but is included within this AQIA to account for potential cumulative impacts (see further discussion in **Section 1.6**).

1.1. Adopted Naming Conventions

The following outlines the naming conventions adopted within this AQIA:

The Asphalt Batching Plant	the asphalt batching plant operated by Colas at 25-27 Kennington Drive, Tomago.
The Proposal	the proposed development at 25-27 Kennington Drive, Tomago, as described in **Section 1.3**.
The Proposal site	25-27 Kennington Drive, Tomago.
The storage yard	the proposed development at 31-33 Kennington Drive, Tomago, as described in **Section 1.6**.

The following sections describe the approved development (**Section 1.2**) and the proposed development (the Proposal, **Section 1.3**).

1.2. Approved Development

The Colas Asphalt Batching Plant and associated infrastructure was approved as a Major Project (07_0031) on 12 December 2007 under Part 3A of the *Environmental Planning and Assessment Act* 1979. The Project Approval conditions of relevance to this study include:

Schedule 2, Condition 5	The Proponent shall not produce more than 150 000 tonnes of asphalt a year.
Schedule 3, Condition 1	The Proponent shall not cause or permit the emission of offensive odours from the site, as defined under Section 129 of the *Protection of Environment Operations Act* 1997.

Schedule 3, Condition 2	The Proponent shall ensure that the stack emissions from the project comply with the relevant standards of concentrations under the *Protection of Environment Operations Act* 1997.
Schedule 3, Condition 3	The Proponent shall ensure that the dust emissions generated by the project do not cause additional exceedances of the air quality impact assessment criteria listed in Tables 1, 2 and 3 at any sensitive receivers (refer **Section 3**).
Schedule 3, Condition 4	The Proponent shall ensure that all road surfaces on site are paved and regularly cleaned.
Schedule 3, Condition 5	Trucks entering and leaving the site that are carrying loads of dust-generating materials must have their loads covered at all times.
Schedule 3, Condition 6	Within 6 months of the commencement of operations, during a period in which the project is operating at normal capacity, the Proponent shall conduct an air quality audit of the project to the satisfaction of the DECC and Director-General. This audit shall: a) be undertaken by a suitability qualified and experienced person; b) assess whether the project is complying with the relevant air quality assessment criteria in this approval; and c) provide details of any complaints received on the air quality impacts of the project, and any action taken to respond to these complaints.
Schedule 3, Condition 8	Operating days and hours – All days, any time

The approved development was supported by an AQIA (Holmes Air Sciences, 2007) which assessed the impacts of emissions from the asphalt plant stack, and from materials handling activities within the Proposal site.

1.2.1. Air Quality Audit and Complaints

As required by the Project Approval conditions (MP07-0031, Schedule 3, Condition 6, refer **Section 1.2**), an air quality audit was required to be performed within 6 months of the commencement of operations.

The air quality audit was not completed until July 2019, with the DPIE (then, the NSW Department of Planning) providing correspondence to Colas acknowledging the audit date. RCA Australia provided the required audit report, which is referenced below (RCA Australia, 2019a).

In relation to complaints, (RCA Australia, 2019a) stated that:

> *..two (2) complaints have been received in the period between 2013 and 2018 relating to dust:*
>
> *• A "dust/fume" complaint on 29/10/14. This complaint was originally recorded by personnel as "dust/fume", but subsequently transferred to the formal register as an "odour" complaint and appropriate actions were taken to address odour issues (refer to the Attachment for further details). RCA have mentioned this complaint in this audit to demonstrate that Colas took appropriate action at the time, in case the source of the complaint was dust in origin, for example wetting down of stockpiles and the receival pit was cleaned out.*
>
> *• A dust complaint on 30/1/18. The complainant reported that dust was being visibly produced from the Tomago site. Colas took action by ceasing operations during high wind conditions and by using additional water carts and sprays (refer to the Attachment for further details).*

Northstar are aware of some additional complaints received by Colas relating to the operation of the asphalt batching plant and associated yard to July 2021. A summary of those complaints is provided in **Table 1**.

Table 1 Summary of complaints 2014 to 2021

Date of complaint	Summary of issue	Summary of response	Preventive action
29 October 2014	Concern regarding dust/fumes in immediate area	• Increased wetting down of stockpiles and yard • Increased sweeping of yard • Exhaust system of asphalt plant checked – Partial blockage detected at pugmill • Receival pit checked and cleaned out	Keep chute clean
21 June 2017	Material on roadway Dust leaving site	• Shovel out gutters, sweep up and wet down • Run vacuum trucks over roadway	N/A
29 November 2019	Smoke from stack causing sore throats	• Stack test performed, no issue detected	N/A
16 December 2020	Excessive dust coming from asphalt plant tower	• Replace bearings and seals of dust elevator • Replace dust sock and rotary feeder on weigh scale	Have spare socks Change bearings and inspect regularly

The last complaint relating to odour was received in 2014, with the last complaint relating to dust was received in 2020.

The air quality audit report concluded that:

"RCA's found that Colas have complied with most aspects of the approval conditions, namely:

• whether the project is complying with the relevant air quality assessment criteria in this approval*: The results of the stack testing for dust emissions complied with the concentrations under Protection of the Environment Operations (Clean Air) Regulation 2010. The results of the ambient testing for air emissions at the site boundaries exceed the impact assessment criteria; however, in RCA's opinion and experience, the relevant impact assessment criteria for dust are unlikely to be exceeded at the nearest sensitive receptors (houses and caravan park). The absence of dust complaints (except for one received in January 2018) is considered to support this finding. Air dispersion modelling and/ dust monitoring at the nearest houses would need to be carried out to confirm this.*

• provide details of any complaints received on the air quality impacts of the project, and any action taken to respond to these complaints*: Both of these details regarding Air Quality complaints and for dust emissions were provided and outlined in this audit.*

1.3. Proposed Development

Colas intends to increase the utilisation threshold of the asphalt batching plant from 150 000 tonnes per annum (tpa) to 250 000 tpa. No additional equipment is required to affect this change, and the increased production would be achieved through increased use of the plant's existing capacity, within the already approved days and times. No construction is proposed as part of this Proposal.

Colas has engaged Northstar to assess the air quality impacts associated with the proposed increased utilisation at the asphalt batching plant.

The *Environmental Planning and Assessment Act* 1979 (EP&A Act) forms the statutory framework for planning approval and environmental assessment in NSW. The development qualifies as a modification to an SSD consent. As such, a Statement of Environmental Effects / Modification report is required to support the Proposal.

1.4. Assessment Requirements

NSW Department of Planning, Industry & Environment (DPIE), issued requirements associated with the required Modification report to Colas on 19 November 2020. **Table 2** below identifies the requirements relevant to this study, and the section of this report in which they have been addressed.

Table 2 Assessment Requirements

Issue	Requirement	Addressed
Assessment of the modification	• a detailed assessment of the key environmental issues associated with the proposal, which includes: • an assessment of the relevant impacts associated with the increased utilisation of the approved asphalt plant from 150,000 tonnes per year to 250,000 tonnes per year	Section 2.3 Section 6 Section 7

Issue	Requirement	Addressed
	• an assessment of the potential impacts of all stages of the development, including any cumulative impacts of the proposal with the existing operations on site and nearby ancillary facilities	

1.5. Purpose of the Report

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

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

- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA, 2016);
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC, 2006);
- Technical Framework and Notes - Assessment and Management of Odour from Stationary Sources in NSW (NSW DEC, 2006);
- *Protection of the Environment Operations Act* 1997; and
- Protection of the Environment Operations (Clean Air) Regulation 2010.

1.6. Potential for Cumulative Impacts

As previously identified, Colas operates a Materials Storage and Processing Yard on land adjacent to the storage yard, at 31-33 Kennington Drive. A Designated Development Application is currently being prepared to seek approval to increase a number of materials processing and storage thresholds at the approved storage yard.

It is recognised that cumulative air quality impacts may be experienced at surrounding sensitive receptor locations as a result of the increased throughput of both the asphalt plant and storage yard. To ensure that those impacts have been appropriately quantified and assessed, a quantitative (dispersion modelling) assessment has been performed for both operations, and reported separately to support the two applications

Further discussion is provided in **Section 4.5**.

2. THE PROPOSAL

The following provides a description of the Proposal and the potential emissions to air which would be anticipated to be associated with the increase in material throughput at the storage yard.

2.1. Environmental Setting

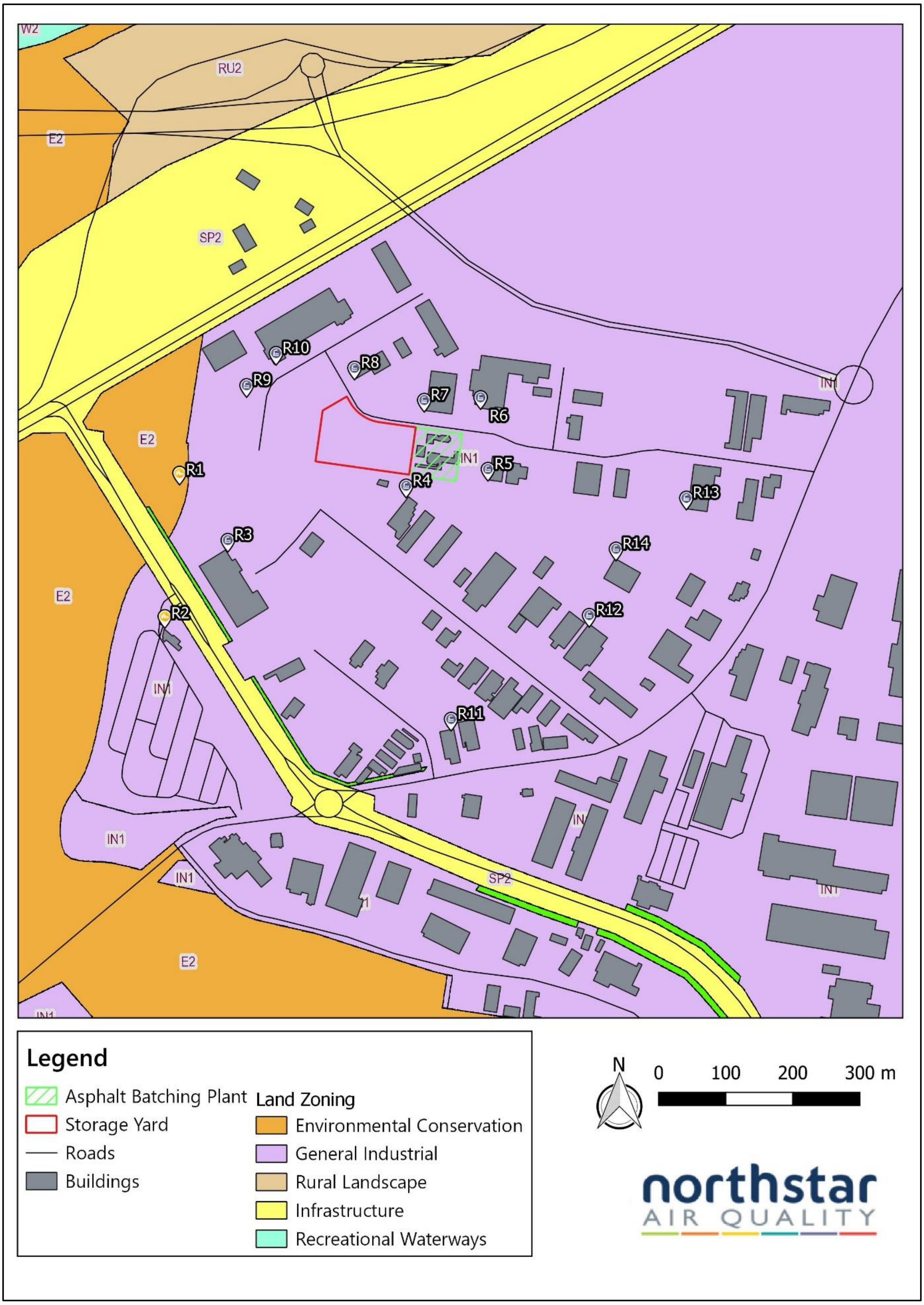
The Proposal site is located at 25 and 27 Kennington Drive, Tomago NSW which is in the local government area (LGA) of Port Stephens. A map illustrating the location of the Proposal site is presented in **Figure 1**. Also noted in **Figure 1** is the location of the neighbouring storage yard.

The Proposal site is situated in an area of significant industrial activity with land immediately surrounding the site being zoned as E2 (General Industrial). The closest residential land uses are approximately 3 kilometres (km) to the northeast of the Proposal site, a caravan park is located approximately 250 m southwest and an individual residence approximately 380 m to the south southwest of the Proposal site (refer **Figure 2**).

Figure 1 Proposal site location

Source: Northstar Air Quality

Figure 2 Land use surrounding the Proposal site



Source: Northstar Air Quality

Note: Numbers (e.g. R1) relate to sensitive receptors surrounding the Proposal site which are discussed further in **Section 4.1**

2.2. Specific Operational Details

The Proposal seeks to increase the annual throughput of the asphalt batching plant through the increased utilisation of existing plant as outlined in **Section 1.3**. No construction works or changes are sought as part of this Proposal.

A batch mixing process is performed at the Proposal site. Aggregate is dribble fed from the delivery trucks into a receival hopper within a 3-sided and roofed enclosure with water sprays, and transported by an enclosed conveyor to the appropriate cold storage bin where it is metered onto a conveyer and transferred to a rotary dryer. There is no external stockpiling of aggregate. As the heated aggregate leaves the dryer, it drops into a bucket elevator, is screened and dropped into different "hot" aggregate bins according to aggregate size. The aggregate size distribution is controlled by mixing and weighing components from various bins. Reclaimed asphalt paving (RAP), hydrated lime and reclaimed dust may be added at this point. Meanwhile, liquid bitumen is pumped from heated storage tanks to a bucket and weighed for the desired mix. The dried and weighed aggregate is then dropped into the mixer (pug-mill), followed by the liquid bitumen where it is mixed until homogeneous. The resulting hot-mix is then either transported by skips to the hot storage bins or transferred directly to a delivery truck.

Bitumen is delivered to the Proposal site in sealed tankers and pumped into enclosed storage tanks which are fitted with carbon filters to capture volatile organic compounds (VOCs) and their odours as the tank is being filled and the internal air and vapour is displaced.

The conveyor covers are hemispherical in shape and cover the conveyor on three sides, with a gap of approximately 300 mm between the conveyor and the cover. A baghouse is used to capture particulate matter in the dryer stack emission and water sprays are used to control dust emissions at required points, for example, the truck unload area.

RAP is delivered by truck to a separate area of the plant and stored in a shed. The enclosure and coarse nature of the material would mean that emissions from unloading of RAP or wind erosion would not be significant.

It is proposed that the plant would have the capacity to produce an annual throughput of 250 000 t. The typical daily output would be between 400 t and 1 000 t of asphalt, with a maximum daily output of 3 000 t (24-hour day).

The activity rates associated with the Proposal are presented in **Table 3**. Activity rates are presented as 'Annual' and 'Maximum 24-hour', which describe the average and peak daily activity rates, respectively. These two activity rates are applied to determine the potential impact of the Proposal on longer term and shorter-term air quality criteria (see **Section 3**).

Figure 3 Proposal site layout

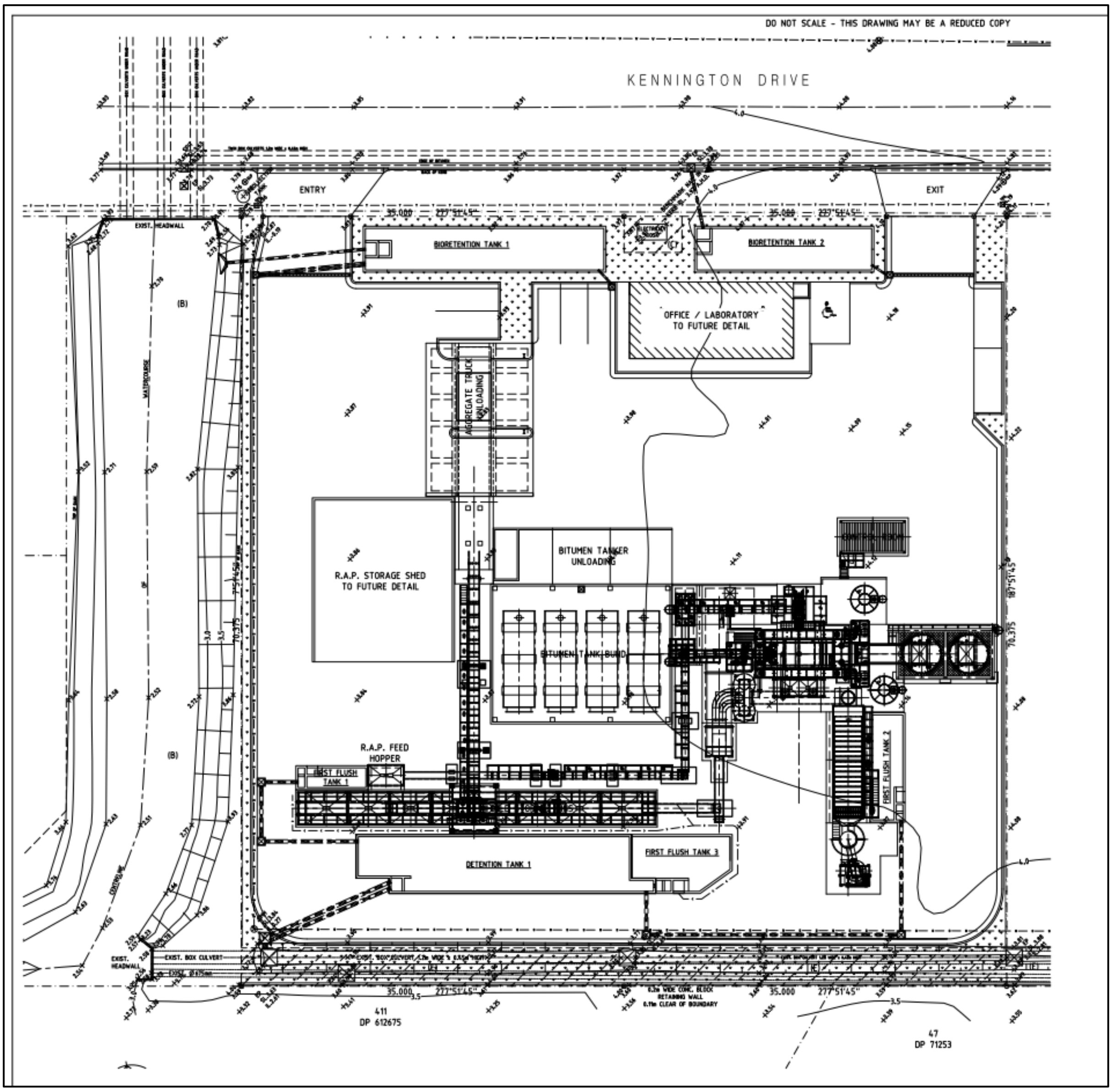


Table 3 Proposed operational details

Operation	Units	Annual	Maximum 24-hour
Distance of road loop	metres (m)	194	194
Delivery of RAP	tonnes (t)	57 500	690
Delivery of aggregates	tonnes (t)	192 500	1 950
Loading asphalt to trucks	tonnes (t)	250 000	3 000
Operational hours	hours	24 hours, 7 days	24 hours

The maximum 24-hour material delivery, processing and export rates have been calculated based on the following assumptions:

- During days of peak deliveries, up to 4.4 times the average material receival rate for RAP, and up to 3.7 times the average material rate for aggregates, may be experienced; and
- Asphalt loading to trucks may occur at up to 3 000 $t \cdot day^{-1}$, which represents 4.4 times the average rate.

These assumptions provide confidence that the predicted maximum short term (1-hour and 24-hour) impacts are appropriately conservative, given that the conservative assumptions are assumed to occur simultaneously, and on every day of the year.

2.3. Identified Potential for Emissions to Air

The processes which may result in the emission of pollutants to air include:

- Movement of vehicles around the Proposal site on paved road surfaces;
- Loading and unloading of materials to storage areas and hoppers;
- Handling of materials by wheeled loader;
- Operation of the asphalt batching plant; and
- Loading of asphalt to trucks.

The specific pollutants of interest associated with those activities are generally particulate matter (PM). Emissions of combustion related pollutants (PM, oxides of nitrogen (NO_X), including nitrogen dioxide (NO_2), carbon monoxide (CO), and sulphur dioxide (SO_2), and emissions of odour, organic pollutants, metals, and polycyclic aromatic hydrocarbons (PAH)) might also be reasonably anticipated to occur from the asphalt plant dryer stack.

With regard to the potential for emissions from diesel combustion in vehicles, these would include particulate matter (as PM_{10} and $PM_{2.5}$) and NO_X, including NO_2. There would additionally be some more minor emissions of CO, SO_2 and air toxics (including benzene and 1,3-butadiene). Given the scale of the operations proposed, impacts associated with vehicle exhaust emissions have not been considered in this report.

3. LEGISLATION, REGULATION AND GUIDANCE

3.1. NSW Air Quality Standards

3.1.1. Criteria and Principal Toxic Air Pollutants

State air quality guidelines adopted by the NSW EPA are published in the *'Approved Methods for the Modelling and Assessment of Air Quality in NSW'* (the Approved Methods (NSW EPA, 2017)) which has been consulted during the preparation of this assessment report.

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

The criteria listed in the Approved Methods are derived from a range of sources (including NHMRC, NEPC, DoE and WHO).

The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW. The standards adopted to protect members of the community from health impacts in NSW are presented in **Table 4**.

Table 4 NSW EPA criteria air pollutants

Pollutant	Averaging period	Units	Criterion	Notes
Particulates (as PM_{10})	24 hours	$\mu g \cdot m^{-3}$ [a]	50	Numerically equivalent to the AAQ NEPM[b] standards and goals
	1 year	$\mu g \cdot m^{-3}$	25	
Particulates (as $PM_{2.5}$)	24 hours	$\mu g \cdot m^{-3}$	25	
	1 year	$\mu g \cdot m^{-3}$	8	
Particulates (as Total Suspended Particulate [TSP])	1 year	$\mu g \cdot m^{-3}$	90	
Deposited dust	1 year	$g \cdot m^{-2} \cdot month^{-1}$ [c]	2	Assessed as insoluble solids as defined by AS 3580.10.1
		$g \cdot m^{-2} \cdot month^{-1}$ [d]	4	
Lead (Pb)	1 year	$\mu g \cdot m^{-3}$	0.5	
Nitrogen dioxide (NO_2)	1 hour	$\mu g \cdot m^{-3}$	246	Numerically equivalent to the AAQ NEPM[b] standards and goals
	1 year	$\mu g \cdot m^{-3}$	62	
Sulphur dioxide (SO_2)	1 hour	$\mu g \cdot m^{-3}$	570	
	24 hours	$\mu g \cdot m^{-3}$	228	
	1 year	$\mu g \cdot m^{-3}$	60	
Carbon monoxide	15 minutes	$\mu g \cdot m^{-3}$	100 000	
	1 hour	$\mu g \cdot m^{-3}$	30 000	

Pollutant	Averaging period	Units	Criterion	Notes
	8 hours	$\mu g \cdot m^{-3}$	10 000	

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

Given that industrial premises surrounding the Proposal site (refer **Section 4.1**) will not be occupied for periods of 24 hours, the application of criteria associated with that averaging period is not appropriate as it is not relevant to those potential impacts / risks. In the case of industrial receptor locations, impacts of nuisance dust (i.e. TSP and deposited dust) are more applicable.

Within this AQIA, impacts of annual average TSP, PM_{10}, $PM_{2.5}$, and deposited dust have been examined at all receptors, and impacts of 24-hour maximum PM_{10} and $PM_{2.5}$ examined at residential receptor locations only (i.e. where the risk to health is relevant over a 24-hour exposure period).

Additional air quality criteria are provided by NSW EPA for individual toxic air pollutants in section 7.2 of the Approved Methods (NSW EPA, 2017). The impact assessment criteria for the principal and individual toxic air pollutants of relevance to the Proposal are presented in **Table 5**. Pollutants of relevance have been identified through examination of National Pollution Inventory (NPI, 1999), and USEPA AP42 emission factors (USEPA, 2004)

Within the Approved Methods (NSW EPA, 2017), criteria for acetaldehyde, toluene and xylene are not included within the relevant tables for toxic air pollutants, but rather odorous air pollutants. The potential for impacts of these pollutants on the surrounding environment have been considered with respect to odour. In addition to the assessment criteria for individual odorous pollutants, the operation of the Proposal has also been assessed against complex mixtures of odorous pollutants and the applicable criteria are further explained in **Section 3.1.2**.

Table 5 NSW EPA air quality standards and goals – principal & individual toxic and odorous air pollutants

Substance	Classification	Averaging period (99.9th percentile)	Impact assessment criteria ($mg \cdot m^{-3}$)(a)
Polycyclic aromatic hydrocarbons (PAH) (as benzo[a]pyrene)	Toxicity	1 hour	0.0004
Benzene	Toxicity	1 hour	0.029
Mercury (organic)	Toxicity	1 hour	0.00018
Arsenic & compounds	Toxicity	1 hour	0.00009
Beryllium & compounds	Toxicity	1 hour	0.000004
Barium (soluble compound)	Toxicity	1 hour	0.009
Cadmium & compounds	Toxicity	1 hour	0.000018
Chromium III & compounds	Toxicity	1 hour	0.009
Chromium VI & compounds	Toxicity	1 hour	0.00009
Copper & compounds (as copper fumes)	Toxicity	1 hour	0.0037
Ethylbenzene	Toxicity	1 hour	8.0
Formaldehyde	Toxicity	1 hour	0.02
Manganese & compounds	Toxicity	1 hour	0.018
Nickel & compounds	Toxicity	1 hour	0.00018
Zinc & compounds (zinc chloride fumes)	Toxicity	1 hour	0.018
Lead	Toxicity	1 year	0.5
Acetaldehyde	Odorous	1 hour	0.042
Toluene	Odorous	1 hour	0.36
Xylene	Odorous	1 hour	0.19

Notes: (a): Gas volumes are expressed at 25°C (298 K) and at an absolute pressure of 1 atmosphere (101.3 kPa).
(b): Acetaldehyde has been included within the assessment as a marker for odour rather than toxicity.

3.1.2. Odour

Experience gained through odour assessments from proposed and existing facilities in NSW indicates that an odour performance goal of 7 OU is likely to represent the level below which "offensive" odours should not occur (for an individual with a 'standard sensitivity' to odours). Therefore, the Odour Technical Framework (DECC, 2006) 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 value, as a nose response time average (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 Technical Framework (DECC, 2006) by setting a population dependant odour assessment criterion, and in this way, the odour assessment criterion allows for population size, cumulative impacts, anticipated odour levels during adverse meteorological conditions and community expectations of amenity. A summary of odour performance goals for various population sizes, as referenced in the Odour Technical Notes (DECC, 2006) is shown in **Table 6**. This table shows that in situations where the population of the affected community lies between 125 and 500 people, an odour assessment criterion of 4 OU at the nearest residence (existing or any likely future residences) is to be used. For isolated residences, an odour assessment criterion of 7 OU is appropriate.

Table 6 NSW EPA odour impact criterion

Population of affected community	Complex mixture of odours (OU)
Urban area (≥2000)	2.0
500 – 2000	3.0
125 – 500	4.0
30 – 125	5.0
10 – 30	6.0
Single residence (≤2)	7.0

Source: The Odour Technical Notes, DECC 2006

Given the population density in the environment surrounding the Project is < 500 persons·km^{-2}, an odour impact criterion of 4 OU has been adopted for this assessment.

It is noted that the previous air quality assessment for the Proposal (Holmes Air Sciences, 2007) did not specifically account for the potential impacts of complex mixtures of odour.

3.2. Protection of the Environment Operations Act 1997

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

It is understood that an Environment Protection Licence (EPL) is not required to be held for the activities performed at the Proposal site, as confirmed by NSW Department of Environment, Climate Change and Water (DECCW) on 24 April 2010. Changes to the Protection of the Environment Operations (General) Regulation 2009 meant that there is no requirement to hold a licence for bitumen works, although regulation of those operations will continue through existing environmental legislation provisions.

The activities being performed at the Proposal site would adhere to Part 5.4 of the POEO Act (1997), which outlines a number of 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.

Plant and machinery operating at the Proposal site will be maintained regularly.

Handling of materials at the Proposal site will be performed with the inclusion of control measures as described in this AQIA and as such, the requirements of the POEO Act (1997) would be met.

4. EXISTING CONDITIONS

4.1. Surrounding Land Sensitivity

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed (see **Section 3.1** and **Section 3.1.2**). Typically, these locations are identified as residential properties although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

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

A number of residential, commercial and industrial locations surrounding the Proposal site have been identified and these receptors have been adopted for use within this AQIA as presented in **Table 7** and **Figure 2**.

Table 7 is not intended to represent a definitive list of sensitive land uses, but a cross section of available locations that are used to characterise larger areas, or selected as they represent more sensitive locations which may represent people who are more susceptible to changes in air pollution than the general population.

Table 7 Discrete sensitive receptor locations used in the study

Rec. ID	Address	Land Use	Location (m, UTM 56)	
			Eastings	Northings
R1	838 Tomago Rd, Tomago	Residential	378 144	6 368 182
R2	Tomago Village Van Park	Residential	378 122	6 367 967
R3	21 Martin Dr, Tomago	Commercial	378 212	6 368 085
R4	24 Martin Dr, Tomago	Commercial	378 485	6 368 165
R5	21 Kennington Dr, Tomago (owned by Colas)	Commercial	378 606	6 368 190
R6	20 Kennington Dr, Tomago	Commercial	378 593	6 368 296
R7	24 Kennington Dr, Tomago	Commercial	378 510	6 368 292
R8	30 Kennington Dr, Tomago	Commercial	378 407	6 368 341
R9	7 Kilcoy Dr, Tomago	Commercial	378 241	6 368 314
R10	7 Kilcoy Dr, Tomago	Commercial	378 285	6 368 362
R11	2 Foresight Avenue, Tomago	Commercial	378 550	6 367 818
R12	6 Martin Drive, Tomago	Commercial	378 756	6 367 973
R13	5 Kennington Drive, Tomago	Commercial	378 901	6 368 148
R14	12 Old Punt Road, Tomago	Commercial	378 796	6 368 072

4.2. Topography

The elevation of the Proposal site is approximately 5 m Australian Height Datum (AHD). No significant topographical features are present between the Proposal site and the nearest sensitive receptor locations.

4.3. Meteorology

In accordance with the requirements of the NSW EPA Approved Methods, 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 a number of surrounding Automatic Weather Stations (AWS), including:

- **Newcastle Nobbys Signal Station AWS**: located at a coastal location approximately 13 km to the south-east of the Proposal site. The AWS has been recording observations since 1862.
- **Williamtown RAAF AWS**: located at the Williamtown RAAF airfield approximately 13 km to the north-northeast of the Proposal site. The AWS has been recording observations since 1942.

To provide a characterisation of the meteorology which would be expected at the Proposal site, a meteorological modelling exercise has been performed.

A summary of the inputs and outputs of the meteorological modelling assessment, including model validation, is presented in **Appendix B**. This analysis includes a discussion of data availability and variability. The Newcastle Nobbys Signal Station AWS and year 2015 have been adopted for use in this assessment. This is consistent with the AQIA performed for the development approval for the storage yard in 2020 (Northstar Air Quality, 2020).

4.4. Air Quality

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

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

The Proposal site is located proximate to a number of AQMS operated by NSW Department of Planning, Industry and Environment (DPIE). These locations (listed by proximity) are discussed in **Appendix C**.

The closest active AQMS is noted to be located at Beresfield which is considered to be the monitoring location most reflective of the conditions at the Proposal site, with the exception of sulphur dioxide, discussed further below. The Beresfield AQMS is considered to be most reflective of the Proposal site when compared to other AQMS as it is significantly closer than all others. The next closest AQMS at Mayfield is likely to be impacted by emissions associated with industrial activity near to Kooragang Island, which would be expected to be much lower at the Proposal site.

Appendix C provides a detailed assessment of the background air quality monitoring data collected at the Beresfield AQMS.

It is noted that none of the proximate AQMS measure total suspended particulate (TSP) which is of relevance to the expected emissions from the Proposal site. Based upon long-term historic monitoring data, a numerical relationship between TSP and PM_{10} has been established for the Lower Hunter region. Based upon these data a relationship between ambient concentrations of TSP : PM_{10} of 2.3404 : 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 (see **Appendix C**).

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

Carbon monoxide is not measured at any of the closest AQMS. Given that concentrations of CO are generally low away from main roads, for the purposes of this assessment, the concentration of CO has been assumed to be negligible.

Sulphur dioxide is measured at the Beresfield AQMS, although the concentrations of SO_2 near to the Proposal site are likely to be impacted by emissions from the Tomago Aluminium Smelter, located 1.1 km to the east of the Proposal site (see **Section 4.5**). To approximate background conditions of SO_2 for the purposes of this AQIA, SO_2 concentrations measured by Tomago Aluminium at Laverton Avenue (refer **Appendix C**) have been adopted. As presented in **Table 8**, these data present a conservative approximation of SO_2 concentrations surrounding the Proposal site. Note that data from the year 2020 have been adopted from the Laverton Avenue monitoring site, as these data represent impacts associated with current smelter operations.

Table 8 Comparison of Beresfield AQMS and Laverton Avenue SO_2 measurements

Pollutant	Ave Period	Units	Beresfield AQMS 2015	Laverton Avenue 2020
Sulphur dioxide	1-hour	$\mu g \cdot m^{-3}$	234.5	500.5
	24-hour	$\mu g \cdot m^{-3}$	22.8	82.9
	Annual	$\mu g \cdot m^{-3}$	3	8.6

None of the proximate AQMS measure any of the pollutants listed in **Table 5**, and the concentrations of these pollutants have been assumed to be negligible.

A detailed summary of the background air quality is presented in **Appendix C**, and a summary of the air quality monitoring data used in this assessment is presented in **Table 9**.

Table 9 Summary of background air quality used in the AQIA

Pollutant	Ave Period	Units	Measured Value	Notes
Particles (as TSP) (derived from PM_{10})	Annual	$\mu g \cdot m^{-3}$	43.8	Estimated on a TSP:PM_{10} ratio of 2.3404 : 1 (see **Appendix C**)
Particles (as PM_{10})	24-hour	µg·m-3	Varying	The 24-hour maximum PM_{10} concentration in 2015 was 64.9 $\mu g \cdot m^{-3}$
	Annual	µg·m-3	18.7	
Particles (as $PM_{2.5}$)	24-hour	$\mu g \cdot m^{-3}$	Varying	The 24-hour maximum $PM_{2.5}$ concentration in 2015 was 25.9 $\mu g \cdot m^{-3}$
	Annual	$\mu g \cdot m^{-3}$	7.3	
Dust deposition	Annual	$g \cdot m^{-2} \cdot month^{-1}$	2	Difference in NSW OEH maximum allowable and incremental impact criterion (see **Appendix C**)

Pollutant	Ave Period	Units	Measured Value	Notes
Nitrogen dioxide	1-hour	µg·m^{-3}	Varying	Maximum 1-hour NO_2 concentration at Beresfield in 2015 was 100.5 µg·m^{-3}
	Annual	µg·m^{-3}	17.9	Annual average NO_2, Beresfield, 2015
Sulphur dioxide	1-hour[1]	µg·m^{-3}	Varying	Maximum 1-hour SO_2 concentration at Laverick Ave Monitor in 2020 was 500.5 µg·m^{-3}
	24-hour[2]	µg·m^{-3}	Varying	The 24-hour maximum SO_2 concentration at Laverick Ave Monitor in 2020 was 82.9 µg·m^{-3}
	Annual	µg·m^{-3}	8.6	Annual average SO_2, Laverick Ave Monitor, 2020

Note: Reference should be made to **Appendix C** for validation and identification of data

The AQIA has been performed to assess the contribution of the Proposal to the air quality of the surrounding area. A full discussion of how the Proposal impacts upon air quality is presented in **Section 6**.

4.5. Potential Cumulative Impacts

As required by NSW EPA, the contribution of all identified existing and recently approved developments should be accounted for in the cumulative assessment. A number of industrial facilities are located in the area immediately surrounding the Proposal site. A review of operations in the immediate area indicates that a number of industrial and materials fabrication operations are located close to the Proposal site. It is not anticipated that these would contribute in any significant manner to cumulative impacts of particulate matter or other pollutants of concern at the nearest sensitive receptors.

As previously identified, the Tomago Aluminium Smelter is located approximately 1.1 km to the east of the Proposal site. Emissions of SO_2 are acknowledged to be of concern as a result of the smelter operation in recent years, and a dedicated SO_2 monitoring station was installed in 2010 to assist in identifying potential management measures. Data from the Laverton Avenue monitoring station for the year 2020 has been adopted to approximate existing SO_2 concentrations in the area surrounding the Proposal site.

Tomago Aluminium do not, and are not required to, monitor particulate matter concentrations. The most recent approved modification report (MOD5) for the smelter has been reviewed, and impacts associated with particulate matter were not discussed, indicating that they are not an issue of significant concern for the operator or regulator and have therefore not been considered further within this report.

1 https://www.tomago.com.au/assets/TAC-2020-Annual-Environment-Report.pdf
2 https://www.tomago.com.au/assets/TAC-2020-Annual-Environment-Report.pdf

This AQIA has considered the discrete impacts associated with the adjacent Colas operated storage yard. A detailed emissions inventory for that operation is presented in the AQIA report associated with the Designated Development application for the storage yard (Northstar Air Quality, 2021). The storage yard is anticipated to result in emissions of particulate matter only and predicted impacts associated with the storage yard have been presented separately in **Section 6** and accounted within the cumulative impact assessment.

5. METHODOLOGY

5.1. Dispersion Modelling

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling has been performed in CALPUFF 2-dimensional (2-D) mode. Given the relatively small distances between the sources and nearest receptors, the uncomplicated terrain between the sources and receptors, a detailed assessment using a 3-dimensional (3-D) meteorological dataset is not warranted.

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

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 relevant and available as discussed in **Section 4.4** and **Appendix B**) which represent the air quality which may be expected within the area surrounding the Proposal site, without the impacts of the Proposal itself.

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

5.2. Emissions Estimation

The estimation of emissions from a process is typically performed using direct measurement or through the application of factors which appropriately represent the processes under assessment. This assessment has adopted emission factors from the US EPA AP-42 emission factor compendium (US EPA, various), and data as measured at the Proposal site (emissions from the dryer stack). A full description of the calculated emissions is provided in **Appendix D.**

5.3. Short Term Impacts

The time resolution of dispersion modelling is defined by the hourly limitation of the meteorology, which uses hourly averaged data.

With regard to predicting the potential impacts of CO (see **Section 3.1.1**) the predicted impact is required to be compared against the 15-minute average criterion. To derive this prediction from the maximum 1-hour average prediction, the following Power Law adjustment has been applied[3]:

$$C_{p,t} = C_{p,60}\left[\frac{60}{t}\right]^{0.2}$$

Where:

$C_{p,t}$ = concentration of pollutant (p) at averaging time (mins) (t) (15 mins)

$C_{p,60}$ = concentration of pollutant (p) at modelled averaging time (60 mins)

t = time (mins) (15 mins)

The evaluation of odour impacts requires the estimation of short or peak concentrations on the time scale of less than one hour, and as discussed above, dispersion model outputs are limited by the resolution of the input meteorological data (1-hour). Dispersion models therefore need to be supplemented to accurately simulate atmospheric dispersion of odours and the instantaneous perception of odours by the human nose. The prediction of peak concentrations from estimates of ensemble means can be obtained from a ratio between extreme short-term concentration and longer-term averages. Properly defined peak-to-mean ratios depend upon the type of source, atmospheric stability and distance downwind. The NSW EPA recommended factor for estimating peak concentrations for a wake-affected point source is 2.3, in all atmospheric conditions. This factor has been adopted within this assessment.

5.4. NO_X to NO_2 Reactions

The emission rates of oxides of nitrogen (NO_X) have been modelled as nitrogen dioxide (NO_2). Approximately 90 % - 95 % of NO_X from a combustion process will be emitted as NO, with the remaining 5 % - 10 % emitted directly as NO_2. Over time and after the point of discharge, NO in ambient air will be transformed by secondary atmospheric reactions to form NO_2, and this reaction often occurs at a considerable distance downwind from the point of emission, and by which time the plume will have dispersed and diluted significantly from the concentration at point of discharge.

Air quality impact assessments need to account for the conversion of NO to NO_2 to enable a comparison against the air quality criterion for NO_2. 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.

3 http://www.epa.vic.gov.au/~/media/Publications/1551.pdf

- **Ozone limiting method**: 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.

This AQIA assumes that 100% of the emitted NO_X is in the form of NO_2, which presents the most conservative approach.

5.5. Emissions Controls

A number of emissions controls are currently employed at the asphalt plant and will continue to be employed as part of the Proposal operation.

All roads travelled by heavy vehicles delivering and picking up goods are constructed of hardstand, which will ensure that emissions of particulate matter resulting from resuspension of road dust will be minimised. Visual inspections would be required to ensure that silt is not allowed to build up on the road surface and should this be the case then road sweepers or other measures to remove that surface silt loading will be implemented. Paving of road surfaces is best practice control for sources of this nature. A water truck operates on site to maintain all paved road surfaces in a damp condition when necessary.

Vehicles speeds are limited to 10 $km \cdot hr^{-1}$ which ensures that the resuspension of any silt on paved road surfaces will be minimised.

Unloading of aggregates at the Proposal site occurs in a 3-sided and roofed shed, with a water spraying system operating on the open side. Aggregates are directly unloaded into a 'cattle grid' and directly conveyed to the cold feed bins. RAP is also unloaded to 3-sided storage sheds.

Lime and bitumen are delivered to the Proposal site in sealed delivery vehicles. Bitumen is pumped into enclosed storage tanks which are fitted with carbon filters to capture volatile organic compounds (VOCs) and their odours as the tank is being filled and the internal air and vapour is displaced.

A baghouse is operated on the dryer stack to capture particulate matter.

Colas uses a 'dust-a-side' system on all conveyors at the asphalt plant to minimise dust emissions. Conveyors are also partially covered.

The emission controls included in the quantitative assessment are:

- watering of road surfaces (50 % particulate control efficiency);
- limiting of vehicle speeds to 10 $km \cdot hr^{-1}$ (85 % control efficiency);
- use of 3 sided and roofed structure for aggregate unloading (70 % control efficiency), with a water spray system (50 % control efficiency);
- use of 3 sided and roofed structure for RAP unloading (70 % control efficiency);
- partial covering of all material conveyors (70 % control efficiency);

- loading of lime and bitumen by sealed vehicles into sealed storage vessels (100 % control efficiency); and
- use of a baghouse on dryer stack (control efficiency considered through measured emission rate [refer **Appendix D**])

The implementation of the measures above is considered to represent best management practice.

6. ASSESSMENT

The following sections of the report present the results of the operational phase air quality assessment.

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

- **Incremental impact** – relates to the concentrations predicted as a result of the operation of the Proposal in isolation.
- **Storage yard** – relates to the concentrations predicted as a result of the operation of the adjacent storage yard as discussed in **Section 4.5**.
- **Cumulative impact** – relates to the concentrations predicted as a result of the operation of the Proposal PLUS the background air quality concentrations discussed in **Section 4.4**.

The results are presented in this manner to allow examination of the likely impact of the Proposal in isolation and the contribution to air quality impacts in a broader sense. In the presentation of results, the tables included shaded cells which represent the following:

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

The meteorological year adopted within dispersion modelling is 2015, as discussed in **Section 4.3** and **Appendix B**.

6.1. Criteria and Principal Toxic Air Pollutants

6.1.1. Particulate Matter - Annual Average Dust Deposition, TSP, PM_{10} and $PM_{2.5}$

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

The results indicate that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at sensitive receptor locations are low (< (less than) 16 % of the annual average TSP criterion, < 20 % of the annual average PM_{10} criterion, and < 9 % of the annual average $PM_{2.5}$ criterion).

The addition of existing background concentrations (refer **Section 4.4**) and the addition of the contribution from the storage (refer **Section 4.5**) does not result in any predicted exceedances of the annual average criteria for TSP or PM_{10}. One minor exceedance of the annual average $PM_{2.5}$ criterion is predicted at the industrial receptor R5 (noted to be owned by Colas, and therefore Proposal-related). However, given that this is an industrial receptor, exposure over the course of an entire year is not likely to occur, and given the minor exceedance (0.1 $\mu g \cdot m^{-3}$, or 1.3 % of the criterion), exposure over that averaging period is not likely to occur.

The performance of the Proposal does not result in any exceedances of the annual average TSP or PM_{10} impact assessment criteria.

One minor exceedance of the annual average $PM_{2.5}$ concentration is predicted, although given the industrial nature of the relevant receptor, exposure over that averaging period is not likely.

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

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

Receptor	Annual Average Concentration ($\mu g \cdot m^{-3}$)											
	TSP				PM_{10}				$PM_{2.5}$			
	Incremental Impact	Storage yard	Background	Cumulative Impact	Incremental Impact	Storage yard	Background	Cumulative Impact	Incremental Impact	Storage yard	Background	Cumulative Impact
R1	0.7	0.3	33.0	34.0	0.3	0.1	18.7	19.1	<0.1	<0.1	7.3	7.5
R2	0.6	0.1	33.0	33.8	0.2	<0.1	18.7	19.0	<0.1	<0.1	7.3	7.5
R3	1.0	0.3	33.0	34.2	0.4	<0.1	18.7	19.1	<0.1	<0.1	7.3	7.5
R4	7.0	1.8	33.0	41.8	2.3	0.6	18.7	21.6	0.4	0.1	7.3	7.8
R5	14.2	0.6	33.0	47.8	4.9	0.2	18.7	23.8	0.7	<0.1	7.3	8.1
R6	5.8	0.4	33.0	39.3	1.9	0.1	18.7	20.7	0.3	<0.1	7.3	7.7
R7	9.7	1.4	33.0	44.0	2.9	0.4	18.7	22.0	0.5	<0.1	7.3	7.8
R8	2.1	2.0	33.0	37.1	0.7	0.6	18.7	20.1	0.1	0.1	7.3	7.5
R9	0.9	0.6	33.0	34.5	0.3	0.2	18.7	19.3	<0.1	<0.1	7.3	7.5
R10	1.0	0.6	33.0	34.6	0.4	0.2	18.7	19.3	<0.1	<0.1	7.3	7.5
R11	0.4	0.1	33.0	33.5	0.1	<0.1	18.7	18.9	<0.1	<0.1	7.3	7.5
R12	1.4	0.2	33.0	34.6	0.5	<0.1	18.7	19.3	<0.1	<0.1	7.3	7.5
R13	0.9	0.1	33.0	34.1	0.4	<0.1	18.7	19.1	<0.1	<0.1	7.3	7.5
R14	2.0	0.2	33.0	35.2	0.7	<0.1	18.7	19.5	<0.1	<0.1	7.3	7.5
Criterion		-	90			-	25			-	8	

Note: Where values are less than the limit of reporting (LOR) (<0.1 $\mu g \cdot m^{-3}$) the corresponding value used in the calculation of the cumulative impact has been assumed to be 50 % of the LOR.
The value representing the calculated cumulative impact may be marginally different to the aggregate of the reported incremental values due to rounding.

Table 11 presents the annual average dust deposition predicted as a result of the operations at the Proposal site.

Table 11 Predicted annual average dust deposition

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)			
	Incremental Impact	Storage yard	Background	Cumulative Impact
R1	<0.1	<0.1	2.0	2.2
R2	<0.1	<0.1	2.0	2.2
R3	<0.1	<0.1	2.0	2.2
R4	0.4	<0.1	2.0	2.5
R5	1.2	<0.1	2.0	3.2
R6	0.3	<0.1	2.0	2.4
R7	0.8	<0.1	2.0	2.8
R8	0.2	0.1	2.0	2.3
R9	<0.1	<0.1	2.0	2.2
R10	<0.1	<0.1	2.0	2.2
R11	<0.1	<0.1	2.0	2.2
R12	<0.1	<0.1	2.0	2.2
R13	<0.1	<0.1	2.0	2.2
R14	0.2	<0.1	2.0	2.2
Criterion	2.0	2.0	-	4.0

An assumed background dust deposition of 2 $g \cdot m^{-2} \cdot month^{-1}$ is presented in **Table 11**, although comparison of the incremental concentration with the incremental criterion of 2 $g \cdot m^{-2} \cdot month^{-1}$ is also valid (as discussed within **Section 4.4**). In either case, the resulting conclusions drawn are identical. Annual average dust deposition is predicted to meet the criteria at all receptors where the predicted impacts are < 60 % (1.2/2.0) of the incremental criterion and <80 % (3.2/4.0) of the cumulative criterion at all receptor locations

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

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

6.1.2. Particulate Matter - Maximum 24-hour Average

Presented in **Table 12** are the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest sensitive residential receptors as a result of the operations at the Proposal site only. No background concentrations, or impacts associated with the storage yard are included within this table.

Table 12 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations

Receptor	Maximum incremental 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	**50**	**25**
R1	8.0	1.5
R2	5.9	1.0

The predicted incremental concentration of PM_{10} and $PM_{2.5}$ at surrounding sensitive receptors are demonstrated to be < 16 % and < 6 % of the respective criteria. The maximum increment predicted is at Receptor R1 for PM_{10} and $PM_{2.5}$.

The predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the Proposal, with impacts associated with the storage yard and background included are presented in **Table 13** and **Table 14** respectively.

The left side of the tables show the predicted concentration on days with the highest predicted cumulative impacts (typically driven by the highest regional background concentrations), and the right side shows the highest predicted cumulative concentration on days with the highest predicted incremental concentrations respectively. The results are presented in this way to demonstrate the maximum cumulative impacts (increment plus background) and the likely cumulative impacts on the day of the maximum increment. The table is presented as per section 11.2 of the Approved Methods (NSW EPA, 2017).

The analysis identifies two days that are predicted to exceed the 24-hour PM_{10} criterion, but these are driven by background concentrations already exceeding the criterion.

The analysis indicates that no additional exceedances of the 24-hour average impact assessment criteria for PM_{10} are likely to occur as a result of the operation of the Proposal at either residential receptor.

The performance of the Proposal does not result in any additional exceedances of the maximum 24-hour average PM_{10} impact assessment criteria at the identified sensitive receptor locations.

The analysis identifies one day that is predicted to exceed the 24-hour $PM_{2.5}$ criterion, but this is also driven by the background concentration already exceeding the criterion.

The analysis indicates that no additional exceedances of the 24-hour average impact assessment criteria for $PM_{2.5}$ are likely to occur as a result of the operation of the Proposal at the nearest sensitive receptor locations.

The performance of the Proposal does not result in any additional exceedances of the maximum 24-hour average $PM_{2.5}$ impact assessment criteria at the identified sensitive receptor locations.

Contour plots of the predicted incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations associated with the Proposal, are presented in **Figure 6** and **Figure 7**.

Table 13 Summary of contemporaneous impact and background – PM_{10}

Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) – Receptor 2				Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) – Receptor 1			
	Incremental Impact	Storage yard	Background	Cumulative Impact		Incremental Impact	Storage yard	Background	Cumulative Impact
6/05/2015	0.3	<0.1	64.9	65.2	11/02/2015	8.0	8.1	21.7	37.8
26/11/2015	<0.1	<0.1	57.5	57.6	19/02/2015	7.1	5.1	21.0	33.1
19/11/2015	4.7	1.5	43.3	49.5	31/10/2015	5.0	2.6	12.3	19.9
6/10/2015	0.7	0.1	42.0	42.8	15/04/2015	4.8	2.7	19.4	26.9
20/11/2015	<0.1	<0.1	39.4	39.5	22/11/2015	4.8	3.0	22.8	30.6
7/10/2015	<0.1	<0.1	39.4	39.5	10/02/2015	4.0	2.4	13.5	19.9
9/03/2015	1.3	0.5	36.9	38.7	14/02/2015	4.0	2.8	14.1	20.9
11/08/2015	0.9	1.0	35.8	37.7	17/03/2015	3.9	3.9	18.7	26.5
21/08/2015	0.7	0.8	35.8	37.2	24/10/2015	3.7	1.9	13.0	18.5
5/10/2015	1.1	0.3	35.8	37.2	18/02/2015	3.4	4.1	17.8	25.3
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.				

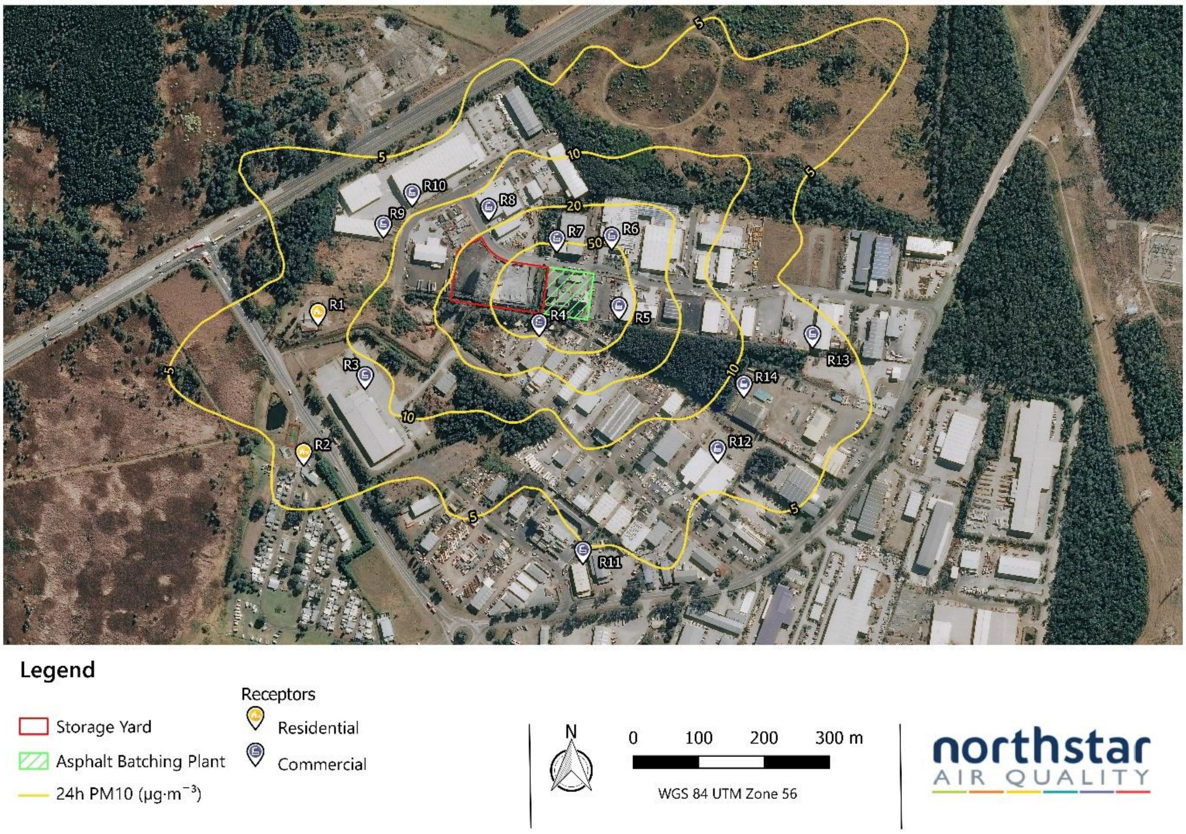
Note: Where values are less than the limit of reporting (LOR) (<0.1 $\mu g \cdot m^{-3}$) the corresponding value used in the calculation of the cumulative impact has been assumed to be 50 % of the LOR.
The value representing the calculated cumulative impact may be marginally different to the aggregate of the reported incremental values due to rounding.

Table 14 Summary of contemporaneous impact and background – $PM_{2.5}$

Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) – Receptor 2				Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) – Receptor 1			
	Incremental Impact	Storage yard	Background	Cumulative Impact		Incremental Impact	Storage yard	Background	Cumulative Impact
21/08/2015	0.1	0.1	25.9	26.1	11/02/2015	1.5	1.2	2.9	5.6
20/08/2015	0.2	0.1	20.2	20.5	19/02/2015	1.3	0.8	5.5	7.5
22/08/2015	0.2	0.2	19.7	20.1	31/10/2015	0.9	0.4	5.2	6.5
7/06/2015	<0.1	<0.1	19.6	19.7	22/11/2015	0.8	0.5	6.3	7.5
5/07/2015	0.1	0.1	17.8	18.1	15/04/2015	0.8	0.4	10.5	11.7
19/11/2015	0.8	0.2	16.8	17.9	14/02/2015	0.8	0.4	6.5	7.7
9/03/2015	0.2	<0.1	16.9	17.2	10/02/2015	0.7	0.4	4.3	5.4
19/03/2015	0.2	0.2	15.5	15.9	24/10/2015	0.7	0.3	4.2	5.2
9/07/2015	0.3	<0.1	15.2	15.6	17/03/2015	0.7	0.6	5.4	6.7
23/06/2015	<0.1	<0.1	15.1	15.2	1/04/2015	0.7	0.9	3.0	4.6
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.				

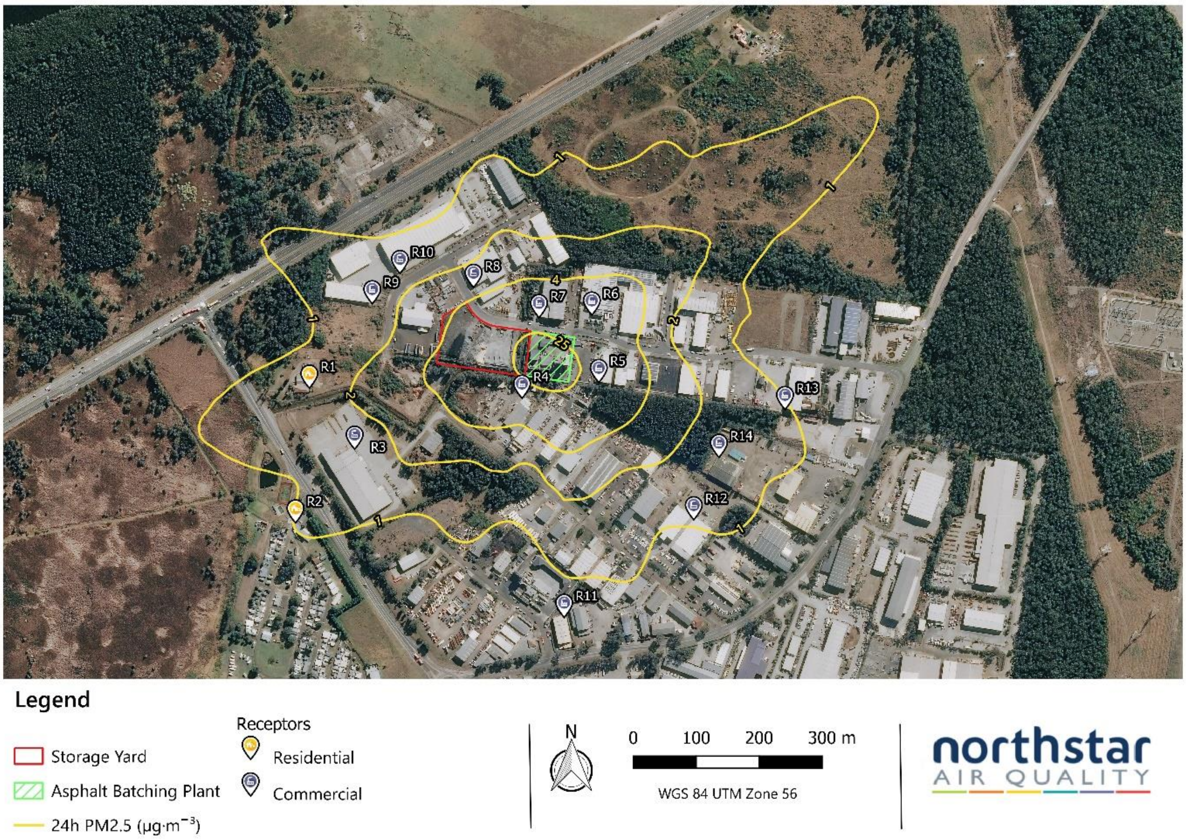
Note: Where values are less than the limit of reporting (LOR) (<0.1 $\mu g \cdot m^{-3}$) the corresponding value used in the calculation of the cumulative impact has been assumed to be 50 % of the LOR.
The value representing the calculated cumulative impact may be marginally different to the aggregate of the reported incremental values due to rounding.

Figure 4 Maximum predicted incremental 24-hour average PM_{10} concentrations



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

Figure 5 Maximum predicted incremental 24-hour average $PM_{2.5}$ concentrations



Note 1: Criterion = 25 µg·m-3 (cumulative)

6.1.3. Carbon Monoxide, Nitrogen Dioxide and Sulphur Dioxide

Presented in **Table 15** are the predicted incremental concentrations of CO at the nearest sensitive receptors. No background concentrations are included in this table, as existing CO concentrations have been assumed to be negligible (refer **Section 4.4**). The results indicate that at the maximum affected receptor, the 15-minute, 1-hour and 8-hour CO concentrations are predicted to be minimal as a result of the Proposal operation, representing 1.2 %, 3.0 % and 8.1 % respectively, of the relevant criterion.

In the assessment of cumulative impacts associated with NO_2 and SO_2, the maximum background concentrations measured at the appropriate air quality monitoring station (Beresfield AQMS or Laverton Avenue respectively) have been added to the maximum incremental concentration predicted at each receptor, which provides a highly conservative estimation of the cumulative impacts at the identified receptors.

Presented in **Table 15** are the predicted incremental concentrations of NO_2 at the nearest sensitive receptors. The results indicate that at the maximum affected receptor, the incremental 1-hour and annual average NO_2 concentrations are predicted to be minor as a result of the Proposal operation, representing 22.9 %, and 20.8 %, respectively of the relevant criterion. Adopted background concentrations are as outlined in **Section 4.4**, and the addition of background NO_2 concentrations provides a cumulative impact, which is predicted to easily meet the relevant criterion, representing 63.8 % of the 1-hour, and 49.7 % of the annual average NO_2 criteria.

In relation to SO_2, the results presented in **Table 15** provide the incremental, background and cumulative impacts predicted as result of the Proposal operation. Incremental concentrations of SO_2 are predicted to be minimal, representing 1.8 % of the 1-hour, 3.4 % of the 24-hour, and 0.6 % of the annual average criteria.

As discussed in **Section 4.4**, the adopted background SO_2 concentrations are elevated in comparison to those measured at the Beresfield AQMS and represent the likely SO_2 environment of the area surrounding the Tomago Aluminium Smelter. The background SO_2 concentrations represent 87.8 % of the 1-hour, 36.4 % of the 24-hour and 14.3 % of the annual average criteria, even without the contribution of the Proposal. However, the addition of the incremental contribution resulting from the Proposal operation results in all SO_2 criteria being achieved, with those cumulative impacts representing 89.6 % of the 1-hour, 39.8 % of the 24-hour and 14.9 % of the annual average criteria, at the maximum affected receptor.

6.1.4. Air Toxics

Presented in **Table 16** are the predicted incremental concentrations of air toxics at the nearest sensitive receptors. No background concentrations are included in this table, as existing concentrations of these pollutants have been assumed to be negligible (refer **Section 4.4**). The results indicate that at the maximum affected receptor, for the pollutant representing the highest percentage of the relevant criterion (beryllium), incremental concentrations are a maximum of 7.7 % of the relevant criterion. In relation to annual average lead (Pb) concentrations, the maximum impact at any receptor represents <0.001 % of the relevant criterion.

Table 15 Predicted carbon monoxide, nitrogen dioxide, and sulphur dioxide concentrations (µg·m^{-3})

Receptor	Carbon monoxide			Nitrogen dioxide						Sulphur dioxide								
	15-min	1 hr	8 hr	1 hr			Annual			1 hr			24-hr			Annual		
	Incr.	Incr.	Incr.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.	Incr.	Bg.	Cumul.
Criterion	100 000	30 000	10 000	246			62			570			228			60		
Max % of criterion	1.2 %	3.0 %	8.1 %	22.9 %	40.9 %	63.8 %	20.8 %	28.9 %	49.7 %	1.8 %	87.8 %	89.6 %	3.4 %	36.4 %	39.8 %	0.6 %	14.3 %	14.9 %
R1	790.0	598.7	241.0	37.4	100.5	137.9	8.5	17.9	26.4	6.9	500.5	507.4	1.0	82.9	83.9	<0.1	8.6	8.7
R2	483.6	366.5	157.2	22.9	100.5	123.4	5.2	17.9	23.1	4.2	500.5	504.7	1.0	82.9	83.9	<0.1	8.6	8.7
R3	691.2	523.8	188.0	32.7	100.5	133.2	7.5	17.9	25.4	6.0	500.5	506.5	1.4	82.9	84.3	<0.1	8.6	8.7
R4	1 191.8	903.2	773.2	56.4	100.5	156.9	12.9	17.9	30.8	10.4	500.5	510.9	6.7	82.9	89.6	0.1	8.6	8.7
R5	1 164.2	882.3	810.9	55.1	100.5	155.6	12.6	17.9	30.5	10.1	500.5	510.6	7.9	82.9	90.8	0.3	8.6	8.9
R6	878.1	665.5	558.0	41.6	100.5	142.1	9.5	17.9	27.4	7.7	500.5	508.2	5.0	82.9	87.9	0.1	8.6	8.7
R7	1 030.2	780.8	685.4	48.8	100.5	149.3	11.1	17.9	29.0	9.0	500.5	509.5	6.3	82.9	89.2	0.1	8.6	8.7
R8	564.0	427.4	255.7	26.7	100.5	127.2	6.1	17.9	24.0	4.9	500.5	505.4	1.9	82.9	84.8	0.1	8.6	8.7
R9	677.5	513.4	220.7	32.1	100.5	132.6	7.3	17.9	25.2	5.9	500.5	506.4	1.5	82.9	84.4	<0.1	8.6	8.7
R10	685.7	519.6	171.0	32.5	100.5	133.0	7.4	17.9	25.3	6.0	500.5	506.5	1.3	82.9	84.2	<0.1	8.6	8.7
R11	722.9	547.8	163.3	34.2	100.5	134.7	7.8	17.9	25.7	6.3	500.5	506.8	0.8	82.9	83.7	<0.1	8.6	8.7
R12	687.9	521.3	233.2	32.6	100.5	133.1	7.4	17.9	25.3	6.0	500.5	506.5	1.3	82.9	84.2	0.1	8.6	8.7
R13	833.0	631.3	180.1	39.5	100.5	140.0	9.0	17.9	26.9	7.3	500.5	507.8	1.2	82.9	84.1	<0.1	8.6	8.7
R14	563.6	427.1	228.5	26.7	100.5	127.2	6.1	17.9	24.0	4.9	500.5	505.4	1.7	82.9	84.6	0.1	8.6	8.7

Table 16 Predicted toxic air pollutant concentrations (mg·m^{-3})

Receptor	Arsenic	Barium	Beryllium	Cadmium	Chromium III	Chromium VI	Copper	Lead	Manganese	Mercury	Nickel	Zinc	PAH (as benzo-a-pyrene)
	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	1 hr	Annual	1 hr	1 hr	1 hr	1 hr	1 hr
	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.	Incr.
Criterion	0.00009	0.009	0.000004	0.000018	0.009	0.00009	0.0037	0.5	0.018	0.00018	0.00018	0.018	0.0004
Max % of criterion	**1.2 %**	**0.04 %**	**8.5 %**	**7.7 %**	**0.01 %**	**0.1 %**	**0.2 %**	**<0.001 %**	**0.1 %**	**0.5 %**	**3.8 %**	**0.1 %**	**<0.001 %**
R1	6.9E-07	2.3E-06	2.3E-07	9.2E-07	8.6E-07	7.2E-08	4.2E-06	4.8E-09	1.0E-05	6.2E-07	4.5E-06	1.0E-05	4.6E-10
R2	4.3E-07	1.4E-06	1.4E-07	5.6E-07	5.3E-07	4.4E-08	2.6E-06	4.9E-09	6.4E-06	3.8E-07	2.8E-06	6.3E-06	2.8E-10
R3	6.0E-07	2.0E-06	2.0E-07	8.0E-07	7.5E-07	6.3E-08	3.7E-06	6.6E-09	9.1E-06	5.4E-07	3.9E-06	8.9E-06	4.1E-10
R4	1.0E-06	3.4E-06	3.4E-07	1.4E-06	1.3E-06	1.1E-07	6.3E-06	2.3E-08	1.6E-05	9.3E-07	6.8E-06	1.5E-05	7.0E-10
R5	1.0E-06	3.3E-06	3.3E-07	1.3E-06	1.3E-06	1.1E-07	6.2E-06	6.6E-08	1.5E-05	9.1E-07	6.6E-06	1.5E-05	6.8E-10
R6	7.7E-07	2.5E-06	2.5E-07	1.0E-06	9.5E-07	8.0E-08	4.7E-06	1.6E-08	1.1E-05	6.8E-07	5.0E-06	1.1E-05	5.2E-10
R7	9.0E-07	2.9E-06	2.9E-07	1.2E-06	1.1E-06	9.4E-08	5.5E-06	2.8E-08	1.3E-05	8.0E-07	5.9E-06	1.3E-05	6.1E-10
R8	4.9E-07	1.6E-06	1.6E-07	6.5E-07	6.1E-07	5.1E-08	3.0E-06	1.0E-08	7.4E-06	4.4E-07	3.2E-06	7.3E-06	3.3E-10
R9	5.9E-07	1.9E-06	1.9E-07	7.8E-07	7.3E-07	6.2E-08	3.6E-06	5.6E-09	8.9E-06	5.3E-07	3.9E-06	8.7E-06	4.0E-10
R10	6.0E-07	2.0E-06	2.0E-07	7.9E-07	7.4E-07	6.2E-08	3.6E-06	6.4E-09	9.0E-06	5.3E-07	3.9E-06	8.8E-06	4.0E-10
R11	6.7E-07	2.2E-06	2.2E-07	8.9E-07	8.3E-07	7.0E-08	4.1E-06	2.1E-09	1.0E-05	6.0E-07	4.4E-06	9.9E-06	4.2E-10
R12	6.0E-07	2.0E-06	2.0E-07	8.0E-07	7.4E-07	6.3E-08	3.7E-06	9.8E-09	9.0E-06	5.4E-07	3.9E-06	8.9E-06	4.0E-10
R13	7.9E-07	2.6E-06	2.6E-07	1.0E-06	9.8E-07	8.3E-08	4.8E-06	6.9E-09	1.2E-05	7.1E-07	5.2E-06	1.2E-05	4.9E-10
R14	4.9E-07	1.6E-06	1.6E-07	6.5E-07	6.1E-07	5.1E-08	3.0E-06	1.4E-08	7.4E-06	4.4E-07	3.2E-06	7.3E-06	3.3E-10

6.2. Odour

Presented in **Table 17** are the 99th percentile 1-second average odour concentrations predicted at the surrounding receptor locations, as a result of the Proposal operation.

Table 17 Predicted 99th percentile odour concentrations

Receptor	99.9th percentile 1-second average odour (OU)
	Incremental Impact
R1	0.1
R2	0.1
R3	0.1
R4	0.3
R5	0.3
R6	0.2
R7	0.2
R8	0.1
R9	0.1
R10	0.1
R11	< 0.1
R12	0.1
R13	0.1
R14	0.1
Criterion	4.0

The results in **Table 17** indicate that the operation of the dryer stack results in minimal, and likely undiscernible, odour impacts at the nearest sensitive receptors.

It is noted that the impact of the load out of asphalt into trucks has not been accounted for in the assessment. Dispersion modelling was performed with the inclusion of a 'load-out' source, at a range of published proxy emission rates for 'similar' plant. However, the concentrations of odour predicted at the nearest sensitive receptors were predicted to be very high (> 40 OU) which would result in a substantial number of complaints, which is not reflected in actual complaints received (refer **Section 1.2.1**). Subsequently the modelling assumptions were not assessed as being reflective of existing operations based on ground-truth observations.

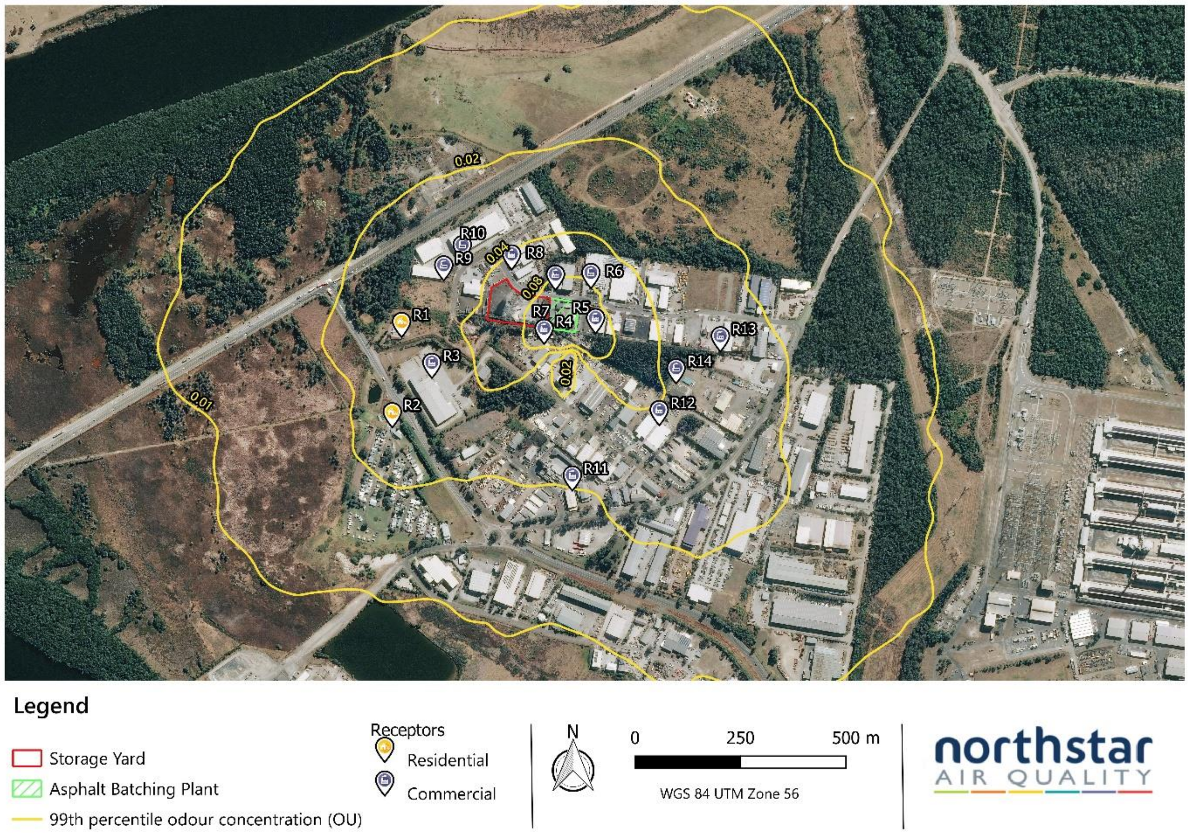
Given that the Proposal will not result in any changes to the maximum quantity of asphalt loaded into trucks in any one hour, it would be anticipated that the odour environment currently experienced in the area would not significantly change as a result of the Proposal. Increases in odour impacts may be experienced at the nearest (industrial) receptors should additional load out occur during the evening and night-time periods, although during those times, industrial units might reasonably be anticipated to be vacant.

The odour environment of the area might reasonably be expected to remain similar to that currently experienced, although with the additional annual throughout of the Proposal site, any odours may be experienced more frequently, although as previously discussed, more likely during periods when people would not be present at the nearest receptors.

Furthermore, as required by Schedule 3, Condition 1 of the current Project Approval for the site operation, which will likely be retained in any modified approval conditions, Colas will be required to '*not cause or permit the emission of offensive odours from the site, as defined under Section 129 of the* Protection of Environment Operations Act *1997*." Based on the current operation of the site, it is likely that this would be achieved following modification.

A contour plot of the predicted odour concentrations associated with the asphalt plant, is presented in **Figure 6**.

Figure 6 Maximum predicted 99th percentile 1 hour odour concentrations



7. MITIGATION AND MONITORING

7.1. Mitigation

Based on the findings of the AQIA, it is considered that the control measures proposed to be implemented and assessed will be sufficient to ensure that exceedances of all relevant air quality criteria would not be experienced as a result of the Proposal operation.

Irrespectively, the hardstand road around the premises should be kept as free from silt as possible and track out onto local roads should be avoided.

Frequent observation of the road condition beyond the site entrance should be performed, and where track-out is observed, cleaning should be performed at the earliest convenience. Similarly, frequent visual inspection of the hardstand areas should be performed, and should those observations identify a build-up of silt and/or that resuspension of road dust is occurring (wheel generated dust), cleaning of the hardstand should be performed at the earliest convenience. Cleaning of the roads and hardstand areas should be performed through water spraying and/or road sweeping.

To ensure that the management measures included within this AQIA are adopted appropriately, it is recommended that an Air Quality Management Plan (AQMP) will be prepared prior to operation. The AQMP would include information on the management of complaints via a complaint register, implementation of the adopted management measures, and contingency measures should certain measures not be able to be adopted at any time.

7.2. Monitoring

Ongoing air quality monitoring is not considered to be required as part of the Proposal operation, although campaign monitoring may be required to enable the substantiation (or otherwise) of any complaints received.

Other recommended monitoring requirements includes the observation of road and hardstand areas as outlined in **Section 7.1**.

8. CONCLUSIONS

Colas has engaged Northstar to perform an AQIA to support a modification to SSD MP07_0031 for a proposed increase in utilisation threshold for the Tomago Asphalt Batching Plant, located at 25-27 Kennington Drive, Tomago, NSW.

This AQIA forms part of the Modification Report prepared to accompany the modification application for the Proposal as requested by NSW DPIE.

The AQIA presents an assessment of the impacts of the operations at the Proposal site, taking into account the increased utilisation of the asphalt plant, associated with annual and maximum daily throughputs. The AQIA also includes the potential cumulative impacts associated with the storage yard operated by Colas at 31-33 Kennington Drive, Tomago.

The assessment has used a quantitative dispersion modelling approach performed in accordance with the relevant NSW EPA guidelines, and the assessment is presented as predicted incremental change and as a cumulative impact accounting for the prevailing background air quality conditions and the increments associated with the operation of the neighbouring storage yard.

Emissions of particulate matter from materials transport, unloading, handling, storage, and loading operations have been calculated using US EPA AP42 emission factors relevant to those operations. Emissions of criteria air pollutants and air toxics associated with the operation of the dryer stack have also been calculated using US EPA AP42 emission factors. Emissions of particulate matter and odour from the dryer stack have been based on site specific measurements.

The AQIA concludes that should emission controls as assumed in this report be implemented, all impact assessment criteria would achieved at all relevant sensitive receptor locations. No additional exceedances of the air quality criteria are predicted, and the emissions controls would act to minimise emissions of air pollutants, in accordance with best practice.

The results of the air quality impact assessment indicate that the granting of modification to the SSD Consent for the Proposal should not be rejected on the grounds of air quality.

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APPENDIX A

Report Units and Common Abbreviations

Units Used in the Report

All units presented in the report follow the International System of Units (SI) conventions, unless derived from references using non-SI units. In this report, units formed by the division of SI and non-SI units are expressed as a negative exponent, and do not use the solidus (/) symbol. For example:

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

Table A1 Common Abbreviations

Abbreviation	Term
AADT	annual average daily traffic
ABS	Australian Bureau of Statistics
ACH	air changes per hour
AHD	Australian height datum
AQIA	air quality impact assessment
AQMS	air quality monitoring station
AWS	automated weather station
BoM	Bureau of Meteorology
°C	degrees Celsius
CO	carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCP	Development Control Plan
DPE	NSW Department of Planning and Environment
EETM	emission estimation technique manual
EPA	Environmental Protection Authority
F	fluoride
FEL	front end loader
GDA	Geocentric Datum of Australia
GHG	Greenhouse gas
GIS	geographical information system
HCL	hydrogen chloride
HF	hydrogen fluoride
K	kelvin (-273°C = 0 K, ±1°C = ±1 K)
kW	kilowatt
MGA	Map Grid of Australia
$mg \cdot m^{-3}$	milligram per cubic metre of air
$mg \cdot Nm^{-3}$	Milligram per normalised cubic metre of air
$\mu g \cdot m^{-3}$	microgram per cubic metre of air
NCAA	National Clean Air Agreement
NEPM	National Environment Protection Measure
NO	nitric oxide
NO_X	oxides of nitrogen
NO_2	nitrogen dioxide

Abbreviation	Term
O_3	ozone
ODT	odour detection level
OEH	NSW Office of Environment and Heritage
OIA	odour impact assessment
OU	odour unit
Pa	Pascals
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
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEE	Statement of Environmental Effects
SO_X	oxides of sulphur
SO_2	sulphur dioxide
SSD	State Significant Development
STP	standard temperature and pressure (273.15 K, 101.3 kPa)
TAPM	The Air Pollution Model
TPM	total particulate matter
TSP	total suspended particulates
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VKT	vehicle kilometres travelled
VOC	volatile organic compounds

APPENDIX B

Meteorology

As discussed in **Section 4.3** a meteorological modelling exercise has been performed to characterise the meteorology of the Proposal site in the absence of site-specific measurements. The meteorological monitoring has been based on measurements taken at a number of surrounding automatic weather stations (AWS) operated by the Bureau of Meteorology (BoM).

A summary of the relevant monitoring sites is provided in **Table B1** and also displayed in **Figure B1** for BoM monitoring sites.

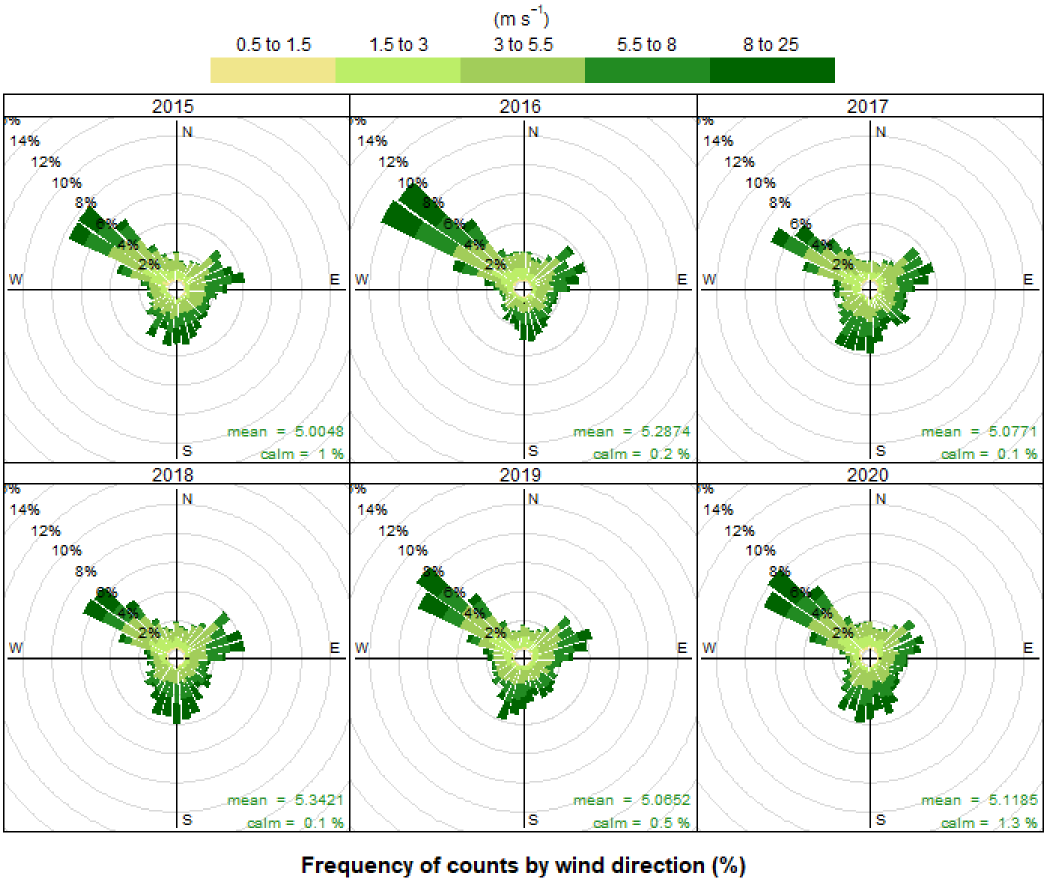
Table B1 Details of the meteorological monitoring surrounding the Proposal site

Site Name	Approximate Location (UTM)		Approximate Distance
	mE	mS	km
Newcastle Nobbys Signal Station AWS – Station # 61055	387 654	6 357 118	14.5
Williamtown RAAF AWS – Station # 61078	391 046	6 370 961	12.9

Figure B1 Meteorological monitoring surrounding the Proposal site

Meteorological conditions at Newcastle Nobbys AWS were chosen for further investigation. This site has been examined to determine a 'typical' or representative dataset for use in dispersion modelling. Annual wind roses for the years 2015 to 2020 are presented in **Figure B2.**

Figure B2 Annual wind roses 2015 to 2020, Newcastle Nobbys Signal Station AWS



The wind roses indicate that from 2015 to 2020, winds at Newcastle AWS show similar patterns across the years, with a predominant north-westerly wind direction.

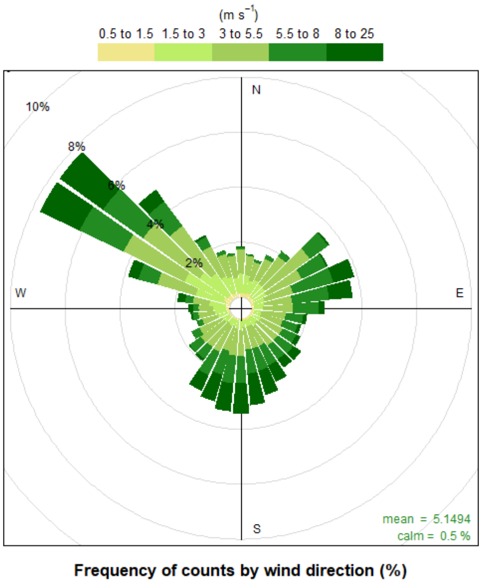
The majority of wind speeds experienced at Newcastle AWS over the 6-year period are generally in the range 3 metres per second ($m \cdot s^{-1}$) to 5.5 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from a north-westerly and south-westerly direction. Winds of this speed occur 15.1% of the observed hours over the 6-year period, at Newcastle AWS. Calm winds (<0.5 $m \cdot s^{-1}$) occur during 0.4% of hours on average across the 6-year period.

Given the wind distributions across the years examined, data for the year 2015 has been selected as being appropriate for further assessment, as it best represents the general trend across the 6-year period studied.

Presented in **Figure B3** are the annual wind rose for the 2015 to 2020 period and the year 2015 and in **Figure B4** the annual wind speed distribution for Newcastle AWS. These figures indicate that the distribution of wind speed and direction in 2015 is very similar to that experienced across the longer-term period.

It is concluded that conditions in 2015 may be considered to provide a suitably representative dataset for use in dispersion modelling.

Figure B3 Annual wind roses 2015 to 2020, and 2015 – Newcastle Nobbys Signal Station AWS



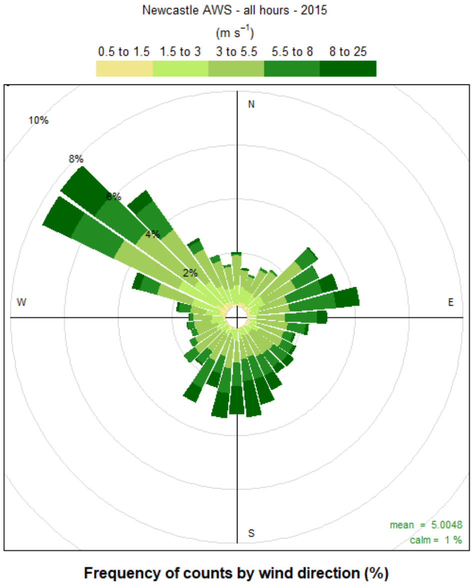
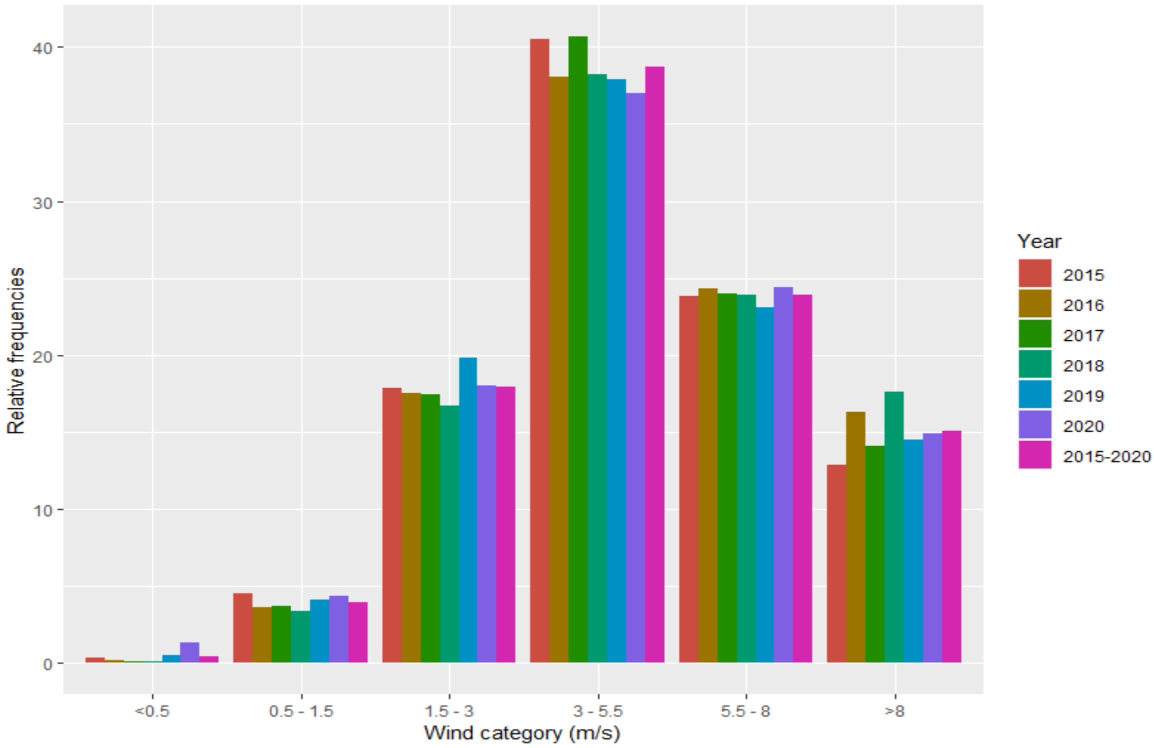


Figure B4 Annual wind speed distribution – Newcastle Nobbys Signal Station AWS



Meteorological Processing

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

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

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

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

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

The parameters used in TAPM modelling are presented in **Table B2**.

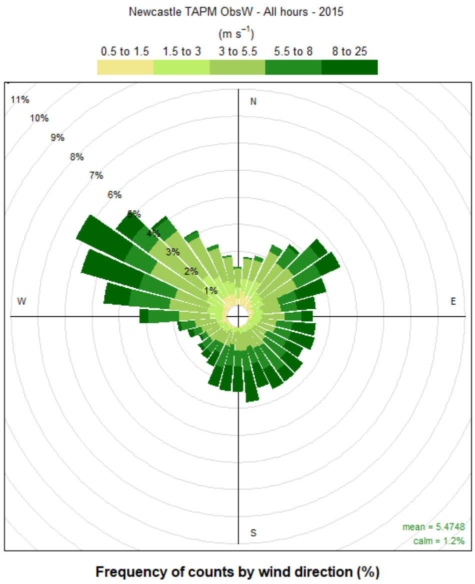
Table B2 Meteorological parameters used for this study

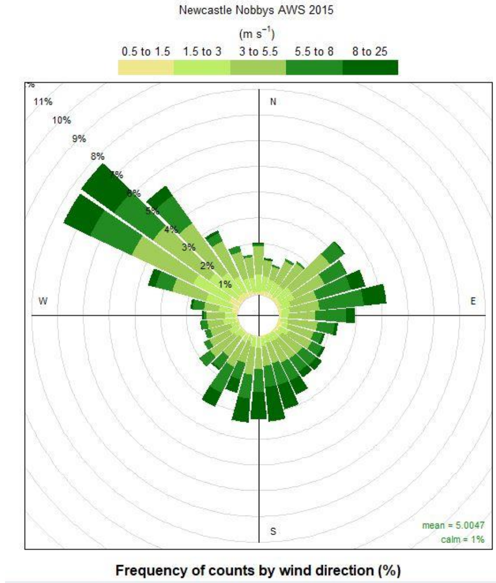
TAPM v 4.0.5	
Modelling period	1 January 2015 to 31 December 2015
Centre of analysis	383,800 mE, 6,365,600 mN (UTM Coordinates)
Number of grid points	31 x 31 x 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	Williamtown AWS

A comparison of the TAPM generated meteorological data, and that observed at the Newcastle AWS, is presented in **Figure B5**. A comparison of the TAPM generated meteorological data, and that observed at Williamtown AWS was also compared to further validate the model and is presented in **Figure B5**. These data generally compare well at both sites, which provides confidence that the meteorological conditions modelled as part of this assessment are appropriate.

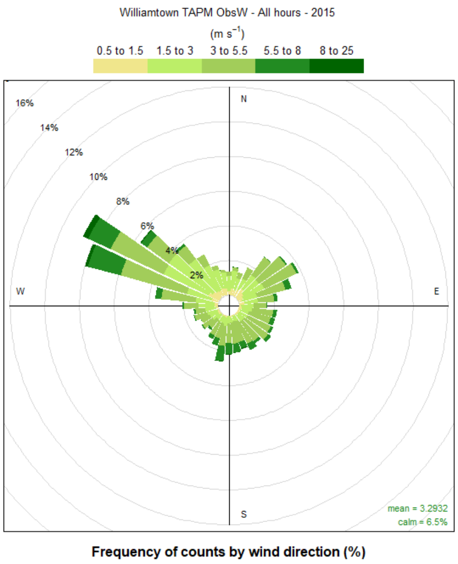
Figure B5 Modelled and observed meteorological data – Newcastle & Williamtown AWS, 2015

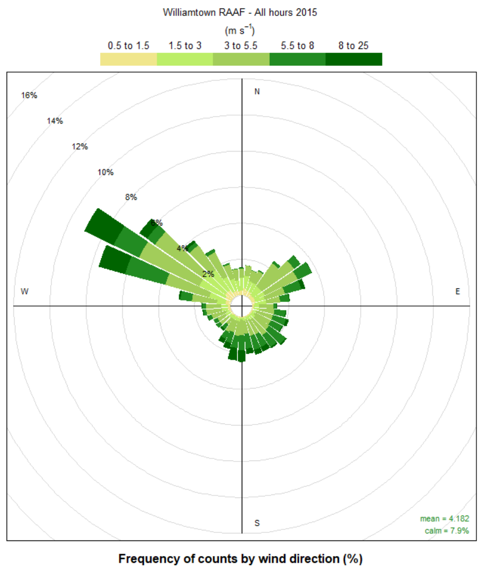
TAPM generated windrose	Observations at Newcastle AWS





TAPM generated windrose	Observations at Williamtown AWS



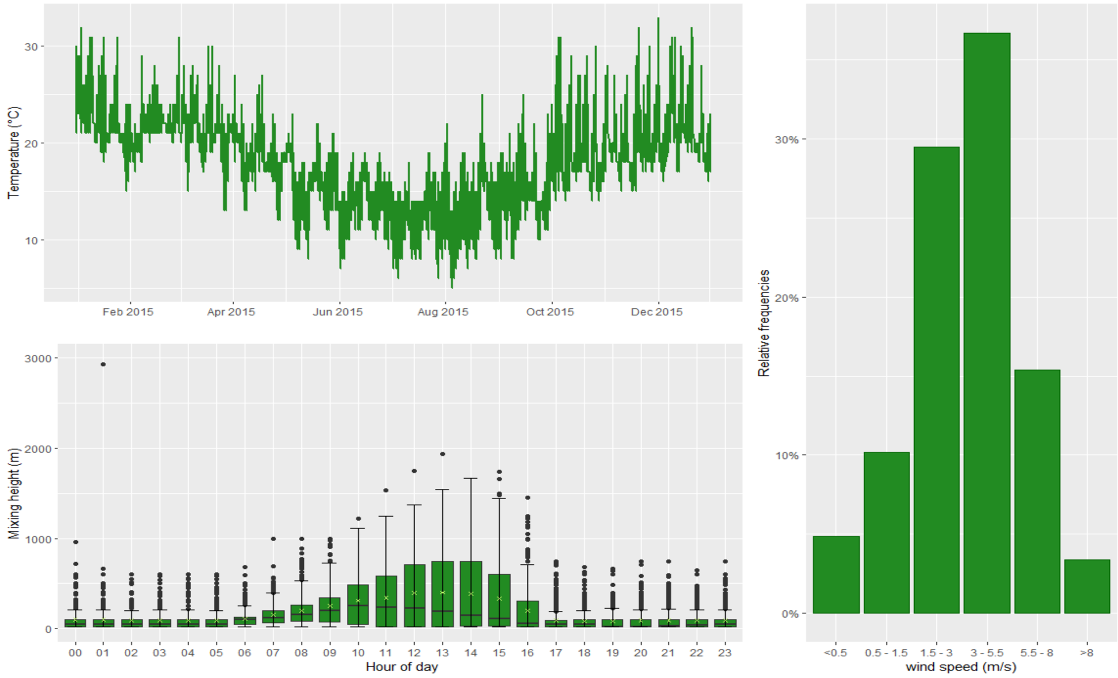


As generally required by the NSW EPA the following provides a summary of the modelled meteorological dataset. Given the nature of the pollutant emission sources at the Proposal site, detailed discussion of the humidity, evaporation, cloud cover, katabatic air drainage and air recirulation potential of the Proposal site has not been provided. Details of the predictions of wind speed and direction, mixing height, temperature and stability class at the Quarry site are provided in **Figure B6**.

The modelled temperature variations at the Proposal site during 2015 predicted a maximum temperature of 33°C on 1 December 2015 and a minimum temperature of 5°C on the 5 August 2015.

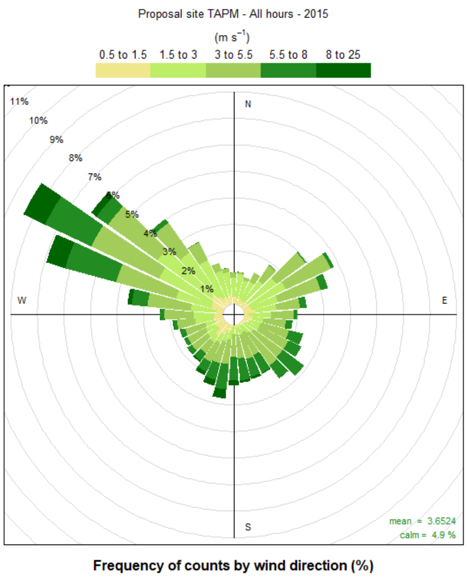
Diurnal variations in maximum and average mixing heights during the 2015 period shows that, as expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground based temperature inversions and growth of the convective mixing layer.

Figure B6 Predicted temperature, mixing height and wind speed frequency – Proposal site 2015



The modelled wind speed and direction at the Proposal site during 2015 are presented in **Figure B7**.

Figure B7 Predicted wind speed and direction – Proposal site 2015



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APPENDIX C

Background Air Quality Data

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

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

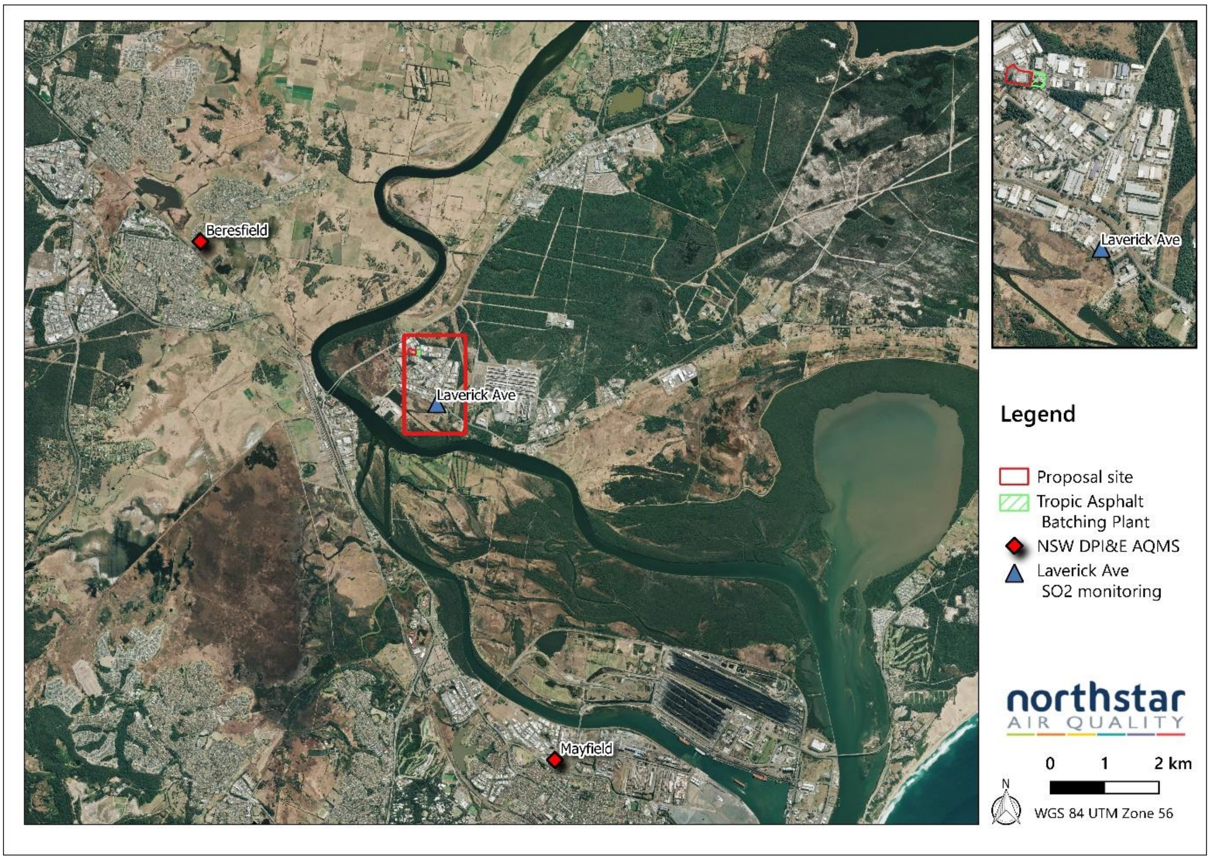
Air quality monitoring is performed by the Department of Planning, Industry and Environment (DPIE) at three air quality monitoring station (AQMS) within a 10 km radius of the Proposal site. Details of the monitoring performed at these AQMS is presented in **Table C1** and **Figure C1**.

Table C1 Details of Closest AQMS Surrounding the Site

AQMS Location	Distance to Site (km)	Screening Parameters					
		2015 Data	Measurements				
			PM_{10}	$PM_{2.5}$	TSP	NO_2	SO_2
Beresfield	4.3	✓	✓	✓	×	✓	✓
Mayfield	8.0	✓	✓	✓	×	✓	✓
Wallsend	9.0	✓	✓	✓	×	✓	✓

As discussed in **Section 4.4**, Tomago Aluminium perform air quality monitoring for sulphur dioxide at a location in closer proximity to the Proposal site than the Beresfield AQMS, and for the purposes of this AQIA, that data gas been obtained. Tomago Aluminium operates five sites for the monitoring of SO_2. The closest to the Proposal Site is Laverick Ave presented **Figure C1**.

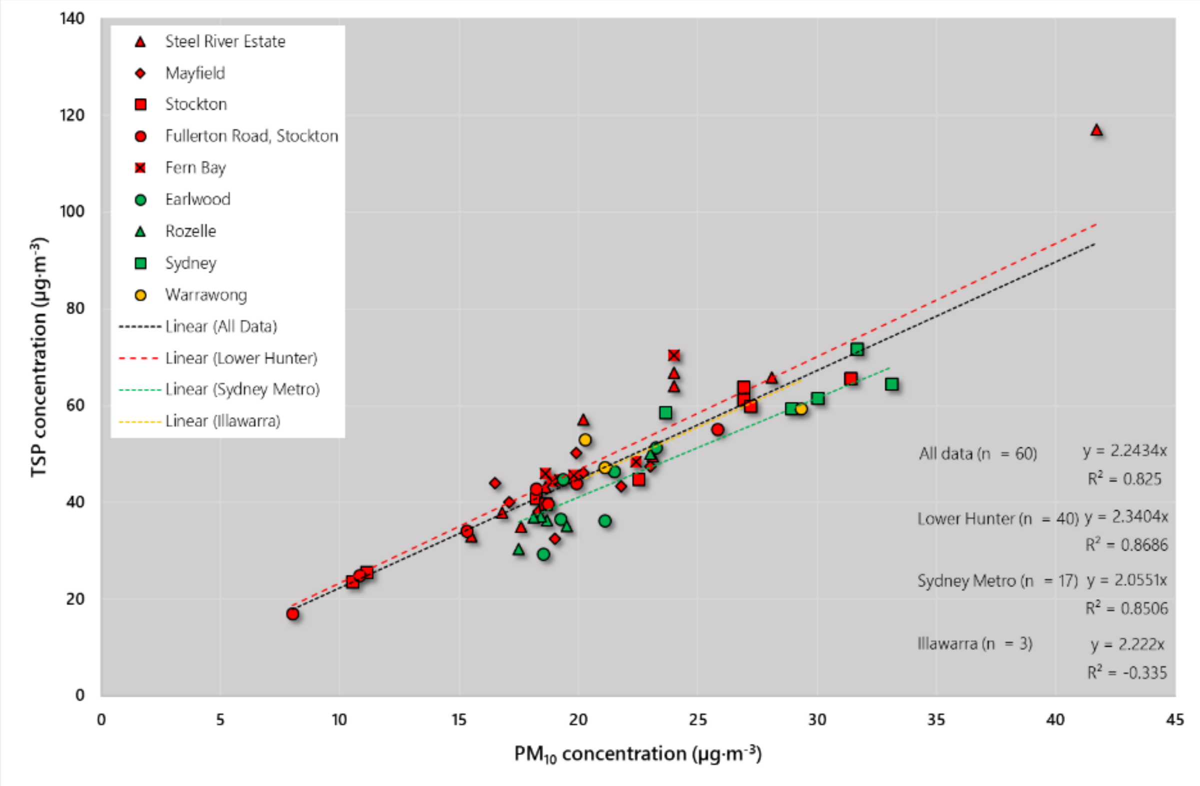
Figure C1 Air quality monitoring surrounding the Proposal site



The closest representative AQMS operated by the DPIE is noted to be located at Beresfield, and is considered to be the monitoring location most reflective of the conditions at the Proposal site.

Concentrations of TSP are not measured at any AQMS surrounding the Proposal site. An analysis of co-located measurements of TSP and PM_{10} in the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions is presented in **Figure C2**. The analysis concludes that, on the basis of the measurements collected in all regions between 1999 to 2011, the derivation of a broad TSP:PM_{10} ratio of 2.3404 : 1 (i.e. PM_{10} represents ~ 43 % of TSP) from the Lower Hunter is appropriate. In the absence of any more specific information, this ratio has been adopted within this AQIA, resulting in a background annual average TSP concentration of 43.8 $\mu g \cdot m^{-3}$ being adopted.

Figure C2 Co-located TSP and PM_{10} Measurements, Lower Hunter, Sydney Metro and Illawarra



Summary statistics are for TSP, PM_{10} and $PM_{2.5}$, NO_2 and SO_2 are presented in **Table C2**. Note that information relating to SO_2 is presented for the Beresfield AQMS, although the data presented in **Table 9** has been adopted as background air quality for the purposes of this assessment.

Table C2 Background air quality data statistics 2015 – Beresfield ($\mu g{\cdot}m^{-3}$)

Pollutant	TSP	PM_{10}	$PM_{2.5}$	NO_2	SO_2	SO_2
Averaging Period	Annual	24-Hour	24-Hour	1-Hour	1-Hour	24-Hour
Data Points (number)	357	357	342	7873	8221	354
Mean	43.8	18.8	7.3	17.9	3.0	3.0
Standard Deviation	-	7.7	3.5	13.7	7.2	3.1
Skew[1]	-	1.4	1.2	0.8	7.6	1.5
Kurtosis[2]	-	4.7	2.6	0.4	154.6	4.9
Minimum	43.8	4.7	1.4	0.0	-5.7	-2.9
Percentiles ($\mu g{\cdot}m^{-3}$)						
1	-	7.1	2.0	0.0	-2.9	2.0
5	-	9.0	3.0	2.1	-2.9	3.0
10	-	10.1	3.6	2.1	0.0	3.6
25	-	13.1	4.7	6.2	0.0	4.7
50	-	17.8	6.6	14.4	0.0	6.6
75	-	22.8	9.3	26.7	2.9	9.3
90	-	28.3	12.4	36.9	8.6	12.4
95	-	32.3	13.4	43.1	14.3	13.4
97	-	35.2	14.2	47.2	20.0	14.2
98	-	35.8	15.7	51.3	25.7	15.7
99	-	40.5	18.9	55.4	31.5	18.9
Maximum	43.8	64.9	25.9	100.5	234.5	22.9
Data Capture (%)	97.8	97.8	93.7	89.9	93.8	96.7

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.

Graphs presenting the daily varying PM_{10} and $PM_{2.5}$ data recorded at Beresfield in 2015 are presented in **Figure C3** and **Figure C4**, respectively.

It is also noted that during late August 2015 a particle pollution event occurred as a result of extensive hazard reduction burning. This event is evident in the PM_{10} and $PM_{2.5}$ daily recordings as illustrated in **Figure C3** and **Figure C4**.

Figure C5 and **Figure C6** present the hourly varying NO_2 and SO_2 data recorded at Beresfield in 2015. **Figure C7** present the daily varying SO_2 data recorded at Beresfield in 2015.

Figure C3 PM$_{10}$ Measurements, Beresfield 2015

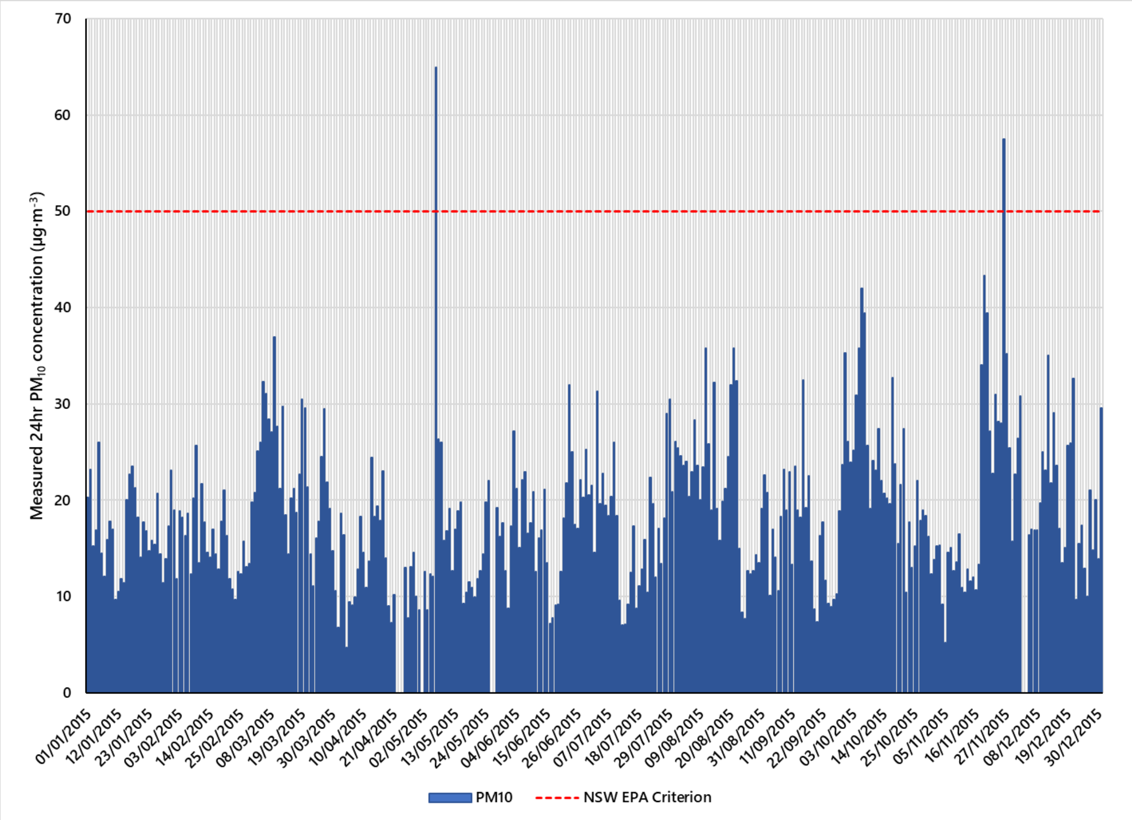


Figure C4 PM$_{2.5}$ Measurements, Beresfield 2015

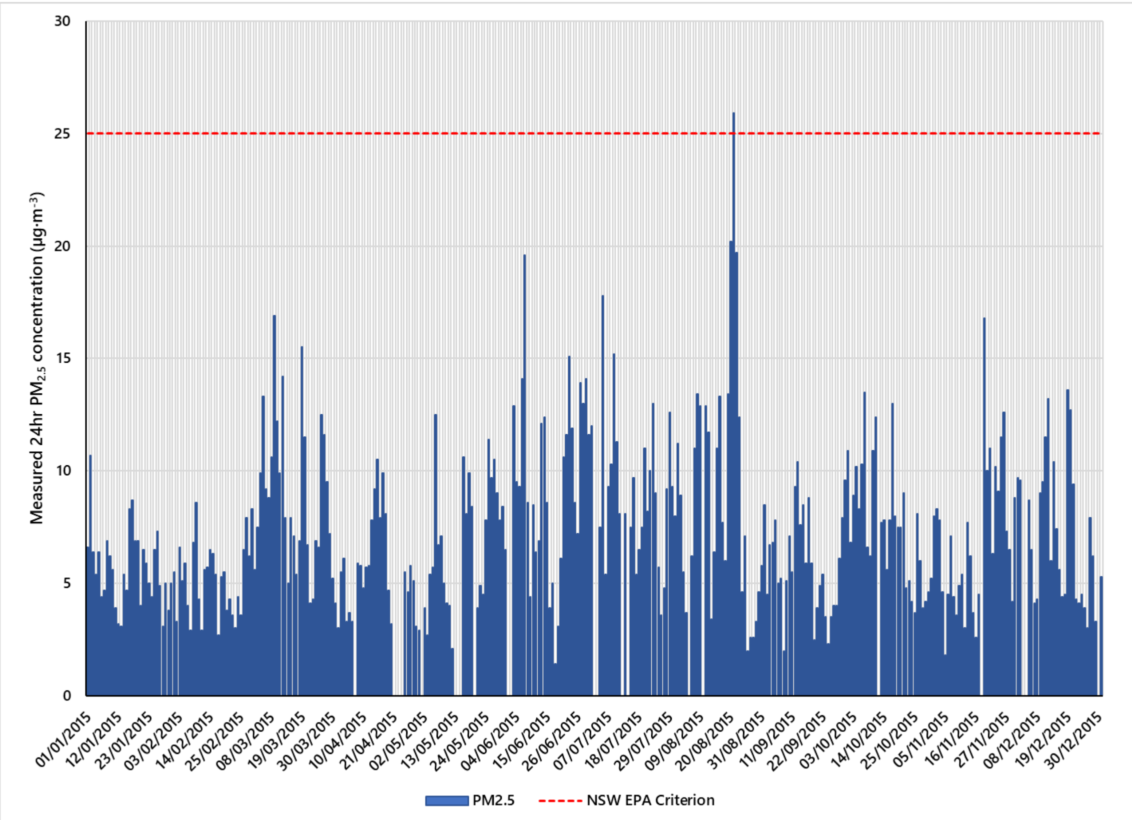


Figure C5 NO_2 Measurements, Beresfield 2015

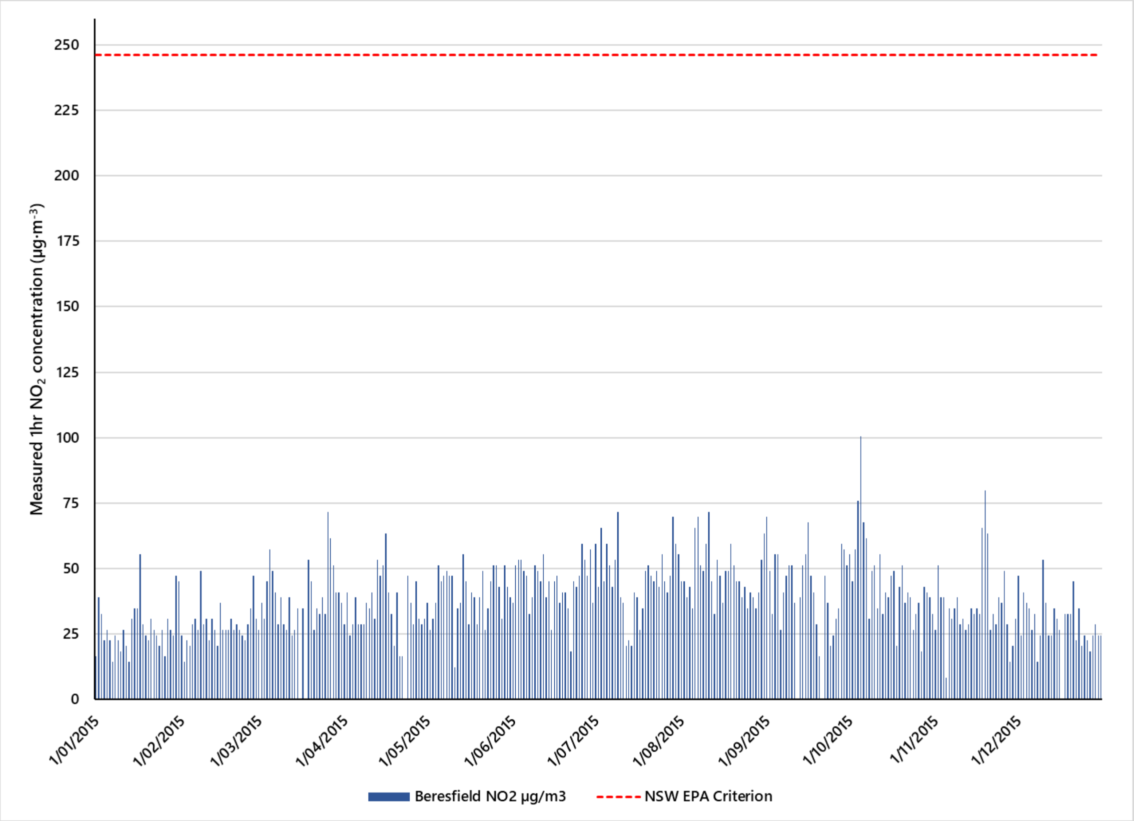


Figure C6 1h SO_2 Measurements, Beresfield 2015

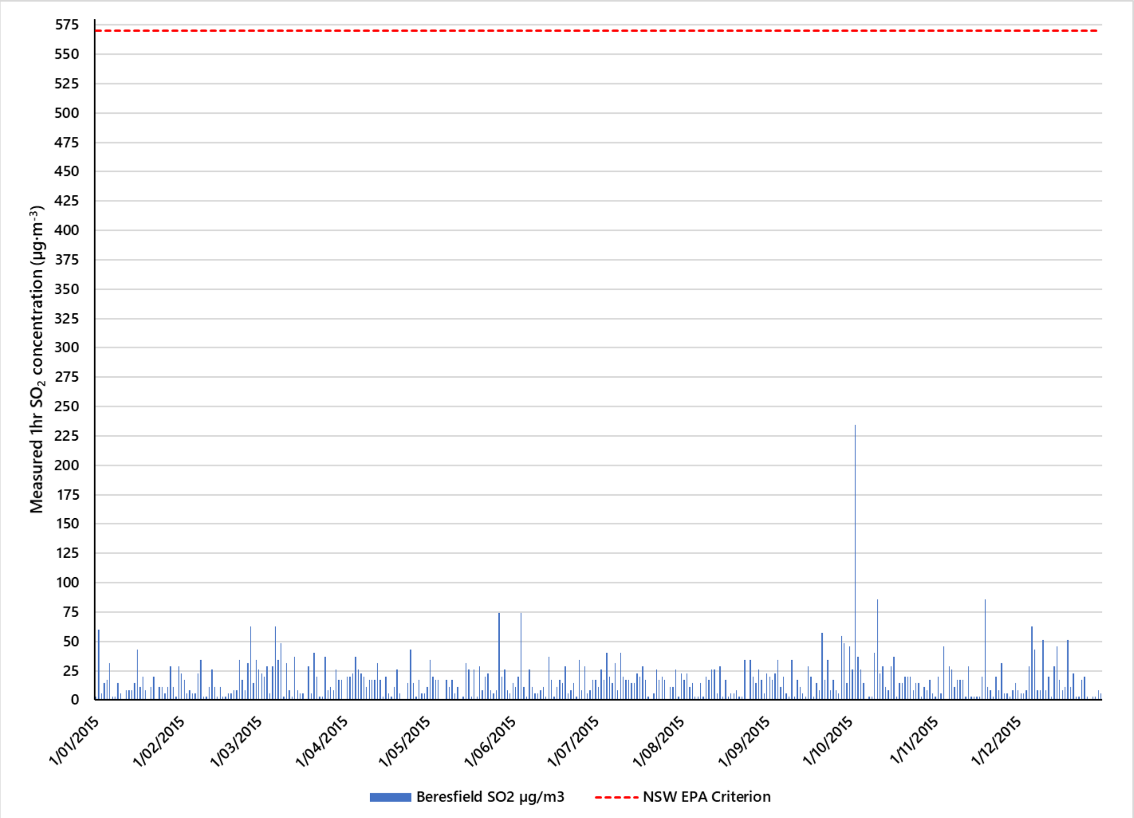
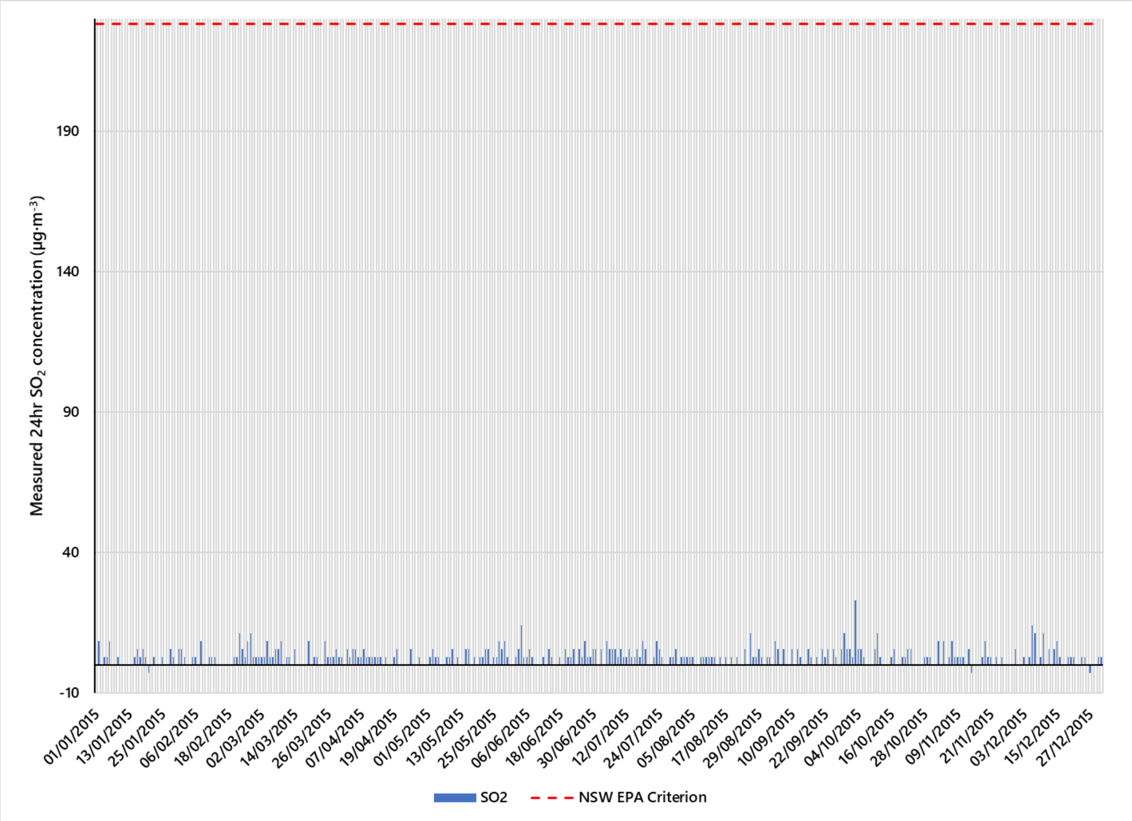


Figure C7 24h SO_2 Measurements, Beresfield 2015



APPENDIX D

Emissions Inventory

As outlined in **Section 2.3**, several operations to be performed as part of the Proposal have the potential to result in emissions of particulate matter. A detailed outline of the emission estimation techniques adopted to derive total emissions from the sources identified are presented below.

A detailed summary and justification of all parameters adopted within the emissions estimation calculations is provided. Emission factors are presented in alphabetical order.

The silt content of all materials was based on site specific data (see table below) while the moisture content was conservatively assumed to be 2 % (w/w).

Site-specific silt content

Material	Silt content %(w/w)
20 mm	0
14 mm	0
10 mm	1
7 mm	1
14 mm Slag	0
10 mm Slag	0
Manufactured sand (dust)	6

Note: Based on site specific data (Colas, 2021a) (Colas, 2021b), (Hunter Civil Lab, 2020), (Colas, 2021c)

Conveyor Transfer Point

The emissions of particulate matter from the conveyor transfer point process have been estimated using emission factors presented in Section 11.19.2-1 of AP-42 (Crushed Stone Processing and Pulverised Mineral Processing) (US EPA, 2004).

The emission factors within table 11.19.2-1 have been adopted for the operations outlined above. $PM_{2.5}$ emission factors are not available for conveyor transfer point sources in AP-42 although have been taken to be 10% of PM_{10} as per aggregate handling sources (MRI, 2006).

For uncontrolled conveyor transfer:

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

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

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

The quality rating for these emission factors is: conveyor transfer point (uncontrolled) = E & D (TSP & PM_{10} respectively).

Paved Roads

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

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

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

where:

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

k = particle size multiplier (dimensionless)

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

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

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

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

The road surface silt loading of the paved haul road from the entrance, through the Proposal site to the exit (one way loop) has been taken to be 120 g·m^{-2} which is the average value for a paved road at an asphalt batching plant as outlined in Table 13.2.1-3 of (US EPA, 2011).

Trucks that transport raw materials into the site will be a combination of rigid trucks and triaxle twins while rigid and truck and dog combinations will be used to transport material from the asphalt plant. The table below lists the mean weight of trucks used.

Truck load capacity

Truck type	Weight (tonnes)			
	Payload	Empty	Loaded	Mean weight of trucks traversing the road
Rigid truck	12.5	6	18.5	17
Tri-axle twins	22.5	10.5	33	
Truck and dog	38	18	56	24.6
Rigid	12.5	6	18.5	

Batch Drop

The emissions of particulate matter from the batch drop process have been estimated using emission factors presented in Section 13.2.4.3 of AP-42 (Aggregate Handling and Storage Piles) (US EPA, 2006b).

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

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

where:

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

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

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

M = material moisture content (%)

The quality rating for this application is rated A.

Note: Silt content is not included in this equation. It is reasonable to expect that silt content and emission factors are interrelated however no significant correlation was found under the parameters conducted by the US EPA. Hence it is recommended that if the source parameters lie outside of the studied range, that the equations quality rating be reduced by 1 level. The parameters of the study are: Silt Content (%) = 0.44 – 19; Moisture Content (%) = 0.25 – 4.8; Wind Speed ($m \cdot s^{-1}$) = 0.6 – 6.7 (US EPA, 2006b).

Dryer Stack Emissions

Emissions of TSP and PM_{10} have been measured from the dryer stack by RCA Australia between March 2010 and most recently in October 2019 by RCA Australia (RCA Australia, 2019b). The average results of those tests have been adopted in the dispersion modelling, with the exception of one outlier TSP reading in July 2014. The adopted parameters are presented in the table below (all at stack conditions). No monitoring of $PM_{2.5}$ was performed, although the ratio of PM_{10}:$PM_{2.5}$ as outlined in the USEPA AP42 documentation for dryer stack emissions (USEPA, 2004) of 6 % has been adopted.

Dryer stack particulate emissions

Parameter	Units	Value
TSP concentration	$mg \cdot m^{-3}$	22.5
PM_{10} concentration	$mg \cdot m^{-3}$	8.9
Stack emission velocity	$m \cdot s^{-1}$	7.6
Volumetric flow rate	$m^3 \cdot s^{-1}$	11.8
Stack height	m	14.75
Stack diameter	m	1.4
Emission temperature	°C	110.4

Parameter	Units	Value
TSP emission rate (derived)	$g \cdot s^{-1}$	0.26
PM_{10} emission rate (derived)	$g \cdot s^{-1}$	0.1
$PM_{2.5}$ emission rate (derived)	$g \cdot s^{-1}$	0.006

Emissions of odour from the dryer stack were measured in November 2014 by RCA Australia (RCA Australia, 2014) which measured an odour concentration of 790 OU and a volumetric flow of 15.4 $m^3 \cdot s^{-1}$ at stack conditions. The resulting odour emission of 12 129.8 $OU \cdot m^{-3} \cdot s^{-1}$ has been adopted in the dispersion modelling assessment.

Emissions of CO, NO_X, SO_2, and air toxics have been determined through review of (USEPA, 2004) and are presented below for an annual average and peak daily throughput. Emissions are provided in (USEPA, 2004) in $lb \cdot ton^{-1}$ which have been converted to $kg \cdot t^{-1}$ by multiplication by 0.5.

Dryer stack CO, NO_X, SO_2 and air toxic emissions

Pollutant	Emission rate ($g \cdot s^{-1}$)	
	Annual throughput (250 000 t)	Peak daily throughput (30 000 t)
CO	1.6E+00	6.9E+00
NO_X	9.9E-02	4.3E-01
SO_2	1.8E-02	8.0E-02
Acetaldehyde	1.3E-03	5.6E-03
Benzene	1.1E-03	4.9E-03
Ethylbenzene	8.7E-03	3.8E-02
Formaldehyde	2.9E-03	1.3E-02
Toluene	4.0E-03	1.7E-02
Xylene	1.1E-02	4.7E-02
Benzo[a]pyrene	1.2E-09	5.4E-09
Arsenic	1.8E-06	8.0E-06
Barium	5.9E-06	2.6E-05
Beryllium	5.9E-07	2.6E-06
Cadmium	2.4E-06	1.1E-05
Chromium III	2.3E-06	9.9E-06
Chromium VI	1.9E-07	8.3E-07
Copper	1.1E-05	4.9E-05
Lead	3.5E-06	1.5E-05
Manganese	2.7E-05	1.2E-04
Mercury	1.6E-06	7.1E-06
Nickel	1.2E-05	5.2E-05
Zinc	2.7E-05	1.2E-04

24-hour maximum

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls (% efficiency)	Controlled Emissions (kg·day-1)		
		TSP	PM_{10}	$PM_{2.5}$					TSP	PM_{10}	$PM_{2.5}$
Transport of material from yard to site	AP-42 Pav	4.532	0.870	0.210	kg/VKT	33.3	VKT	L1 watering (50%) Speed restriction (85%)	11.3	2.2	0.5
Unloading of RAP into 3 sided enclosures	AP-42 - Ba	0.00193	0.00092	0.00014	kg/t	690.0	t	Partial enclosure (70%)	0.4	0.2	0.0
Unloading of all other aggregates (incl slag) into 3-sided enclosure	AP-42 - Ba	0.00193	0.00092	0.00014	kg/t	1,950.0	t	Water sprays (50%) Partial enclosure (70%)	0.6	0.3	0.0
Loading of RAP for hoppers (rehandle)	AP-42 - Ba	0.00193	0.00092	0.00014	kg/t	690.0	t		1.3	0.6	0.1
Unloading of RAP into hoppers (rehandle)	AP-42 - Ba	0.00193	0.00092	0.00014	kg/t	690.0	t		1.3	0.6	0.1
Conveyor transfer point (aggregates/slag)	AP-42 - Ba	0.00193	0.00092	0.00014	kg/t	1,950.0	t	Partial enclosure (70%)	1.1	0.5	0.1
Unloading of other aggregates incl slag (rehandle) into hoppers	AP-42 - Ba	0.00193	0.00092	0.00014	kg/tonne	1,950.0	t	Partial enclosure (70%)	1.1	0.5	0.1
Conveyor Transfer point - RAP hopper to conveyor	AP-42 - Co	0.00150	0.00055	0.00015	kg/tonne	690.0	tonnes	Partial enclosure (70%)	0.3	0.1	0.0
Conveying of all materials into plant	AP-42 - Co	0.00150	0.00055	0.00015	kg/t	2,640.0	tonnes	covering - roof and side wall (70%) 0 (0%)	1.2	0.4	0.1
Loading trucks	AP-42 - Ba	0.00193	0.00092	0.00014	kg/t	3,000.0	t		5.8	2.7	0.4
Transport of final product offsite	AP-42 Pav	6.614	1.270	0.307	kg/ha/yr	43.2	VKT	L1 watering (50%) Speed restriction (85%)	21.5	4.1	1.0

Annual average

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls (% efficiency)	Controlled Emissions (kg·year^{-1})		
		TSP	PM_{10}	$PM_{2.5}$					TSP	PM_{10}	$PM_{2.5}$
Transport of material from yard to site	AP-42 Paved roads - Section 13.2.1	4.532	0.870	0.210	kg/VKT	2,771.4	VKT	L1 watering (50%) Speed restriction (85%)	942.1	180.8	43.7
Unloading of RAP into 3 sided enclosures	AP-42 - Batch drop - Section 13.2.4.3	0.0019	0.0009	0.0001	kg/t	57,500.0	t	Partial enclosure (70%)	33.4	15.8	2.4
Unloading of all other aggregates (incl slag) into 3-sided enclosure	AP-42 - Batch drop - Section 13.2.4.3	0.0019	0.0009	0.0001	kg/t	192,500.0	t	Water sprays (50%) Partial enclosure (70%)	55.9	26.4	4.0
Loading of RAP for hoppers (rehandle)	AP-42 - Batch drop - Section 13.2.4.3	0.0019	0.0009	0.0001	kg/t	57,500.0	t		111.3	52.6	8.0
Unloading of RAP into hoppers (rehandle)	AP-42 - Batch drop - Section 13.2.4.3	0.0019	0.0009	0.0001	kg/t	57,500.0	t		111.3	52.6	8.0
Conveyor transfer point (aggregates/slag)	AP-42 - Batch drop - Section 13.2.4.3	0.0019	0.0009	0.0001	kg/t	162,500.0	t	Partial enclosure (70%)	94.3	44.6	6.8
Unloading of other aggregates incl slag (rehandle) into hoppers	AP-42 - Batch drop - Section 13.2.4.3	0.0019	0.0009	0.0001	kg/tonne	162,500.0	t	Partial enclosure (70%)	94.3	44.6	6.8
Conveyor Transfer point - RAP hopper to conveyor	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.0015	0.0006	0.0002	kg/tonne	57,500.0	tonnes	Partial enclosure (70%)	25.9	9.5	2.7
Conveying of all materials into plant	AP-42 - Conveyor transfer point - Table 11.19.2.1	0.0015	0.0006	0.0002	kg/t	250,000.0	tonnes	covering - roof and side wall (70%) 0 (0%)	112.5	41.3	11.6
Loading trucks	AP-42 - Batch drop - Section 13.2.4.3	0.0019	0.0009	0.0001	kg/t	250,000.0	t		483.7	228.8	34.6
Transport of final product offsite	AP-42 Paved roads - Section 13.2.1	6.614	1.270	0.307	kg/ha/yr	3,604.0	VKT	L1 watering (50%) Speed restriction (85%)	1,787.7	343.2	83.0