NOWA NOWA IRON PROJECT

ATTACHMENT 13 :

AIR QUALITY, NOISE AND VIBRATION ASSESSMENT AND MONITORING PLAN

Prepared for Eastern Iron Limited by Earth Systems

REVISION 2

EARTH SYSTEMS
Environment | Water | Sustainability

EASTERN IRON LIMITED

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Rev0	September 2013	Draft	Nigel Murphy
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Introduction and Background

Eastern Iron Limited, through its wholly owned subsidiary Gippsland Iron Pty Ltd, proposes to develop the Nowa Nowa Iron Project (hereafter 'the Project'), which is a greenfield development of a high grade magnetite/hematite deposit generally referred to as '5 Mile' located approximately 7 km north of the township of Nowa Nowa, which is situated on the Princes Highway between Bairnsdale and Orbost in East Gippsland, Victoria

Earth Systems has been commissioned by Eastern Iron to prepare this *Air, Noise and Vibration Assessment and* Monitoring Plan to support a referral to the Minister for Planning for advice as to whether an Environment Effects Statement is required for the Project pursuant to the *Environment Effects Act* 1978 ('EES Referral').

This study provides an initial assessment of the baseline air quality and noise in the region immediately surrounding the proposed mine site based on available data and identifies potential dust, gas, noise and vibration impacts that may occur as a result of the implementation of the Project during construction and operations. The objectives of this report are to:

- Analyse the existing air quality, noise and vibration data to establish baseline conditions;
- Identify the likely sources of air quality, noise and vibration emissions from the Project;
- Estimate the air quality, noise and vibration emissions from the proposed site;
- Identify potential sensitive receptors to air, noise and vibration emissions; and
- Provide an air, noise and vibration monitoring plan for the Project.

Given the purpose of this report is to support the EES Referral, the scope of the report is limited to the Victorian components of the Project. The potential air quality, noise and vibration issues associated with the proposed work program at the Port of Eden are expected to be assessed under the New South Wales (NSW) planning system. The scope of this report does not include the study of greenhouse gas emissions which are addressed by other studies.

Baseline Conditions

The climate in the area of the proposed mine site is temperate and moderately humid. Meteorological data is currently collected at four Bureau of Meteorology (BOM) weather stations in proximity to the mine site area. Throughout the year, prevailing winds are Westerly and North-Westerly, except in summer where Easterly and Westerly winds are dominant. The mean wind speed is on average 3.5 m/s, being higher in the mornings than in afternoons. The variation of the mean annual rainfall among the four BOM sites is minor, ranging from 739 mm at Lakes Entrance to 865 mm at Nowa Nowa Township.

Ambient sources of particulates existing locally are expected to consist of smoke particles generated by domestic wood heating, motor vehicles, transportation related to the timber and milling industry, as well as dust storms or bush fires that can generate particulate concentrations in excess of national guidelines.

There are no major industries close to the proposed mine site area. The closest industries identified in the area surrounding the proposed mine site are two mills operating in Nowa Nowa, approximately 6 km to the south of the proposed mine site. At a regional scale, fine particles can be expected to follow plume dispersion from industrial and urban activities sourced from Greater Melbourne or the Latrobe Valley. Under these conditions, concentrations are expected to decrease with distance.

There is no existing noise or vibration data for the local area of the proposed mine site. Inspections of the site found the existing noise environment in the area to be characterised by natural noise sources and ambient noise was observed to be low due to the fact that the proposed mine site is remote from any significant potential noise sources such as industrial or residential areas. The small unsealed access tracks intersecting the mine site are rarely used.

The main existing potential source of noise and vibration at the mine site is from the low volume of traffic on the adjacent sealed Bruthen-Buchan Road. With the exception of vehicle traffic, no other source of vibration was detected in the vicinity of the site. The local industry consists of two saw mills operating in Nowa Nowa, which represent a potential influence on the ambient noise levels at nearby receptors, as is the Princes Highway, which is currently used for logging trucks in the region.

Assessment Methods and Outcomes

Assessment methods and criteria for air quality, noise and vibration emissions are outlined based on relevant Australian and Victorian guidelines and standards for each aspect.

The potential dust impact to potential receptors was assessed using the Victorian EPA AUSPLUME (Version 6.0) Gaussian dispersion model to simulate dispersion of pollutants from the proposed mine site. Examination of the predicted dispersion showed 24-hour average predicted PM_{10} concentrations at Wairewa of 15.5 µg/m^3, and 8.1 µg/m^3 at Nowa Nowa, well below the SEPP PM_{10} criterion of 50 µg/m^3.

The potential for significant noise and vibration impacts from the Project to key receptors is low due to the location of the proposed mine site which is a substantial distance from the nearest residential areas, and shielded by hills surrounding the area. Topographic and vegetative protection from surrounding hills will reduce noise levels at receptors. Noise monitoring at sensitive receptors over the mine life will be required to ensure Project noise emissions meet relevant standards.

Management Program

Management and mitigation measures to minimise potential air quality, noise and vibration emissions from the mine site and Project-related transportation are outlined in accordance with legislative requirements and industry best practice. The proposed management and mitigation measures should be incorporated into the *Environmental Management Plan* (EMP) for the Project.

Monitoring

This report outlines a proposed monitoring program for potential air quality, noise and vibration emissions associated with the Project. Prior to construction, a baseline for each aspect will need to be established using representative data from the area and field monitoring in accordance with relevant regulations, SEPP's and guidelines. Periodic monitoring of the parameters specified should then be conducted over the life of the Project at the sites indicated. Investigative monitoring should also be conducted where required.

The proposed monitoring plan will need to be incorporated into the EMP for the Project. A mechanism for local communities and other stakeholders to provide feedback on air quality, noise and vibration issues over the life of the Project should also be established as part of the *Stakeholder Engagement Plan*.

1 Introduction

1.1 Background

Eastern Iron Limited, through its subsidiary Gippsland Iron Pty Ltd, proposes to develop the Nowa Nowa Iron Project (hereafter 'the Project'), which is a greenfield development of a high grade magnetite/hematite deposit generally referred to as '5 Mile' located approximately 7 km north of the township of Nowa Nowa, which is situated on the Princes Highway between Bairnsdale and Orbost in East Gippsland, Victoria

Earth Systems has been commissioned by Eastern Iron to prepare this *Air, Noise and Vibration Assessment and* Monitoring Plan to support a referral to the Minister for Planning for advice as to whether an Environment Effects Statement is required for the Project pursuant to the *Environment Effects Act* 1978 ('EES Referral').

This study provides an initial assessment of the air quality in the region immediately surrounding the proposed mine site based on available data and identifies potential dust, gas, noise and vibration impacts that may occur as a result of the implementation of the Project during construction and operations. A plan for future monitoring activities is also provided.

1.2 Brief Project Description

The Project involves an open cut mining operation from a single pit with dry processing at the site to upgrade the material to a saleable product. It is anticipated that the Project will produce up to 1Mt of ore per annum, over an initial mine life of 8-10 years. The mine will be operated using a local mining contractor and local employees (i.e. no on-site accommodation).

As illustrated in Figure 1-2, the main components of the Project at the mine site will include:

- Open Pit;
- Mine Infrastructure (includes the Run of Mine (ROM) pad, processing plant and Mine Operations Centre);
- Waste Rock Dump;
- Temporary Low Grade Ore Stockpile;
- Water Storage Infrastructure;
- Mine Access and Haul Roads; and
- Ancillary Infrastructure.

It is proposed to transport the processed ore by road to the existing South East Fibre Exports (SEFE) wharf at the Port of Eden in Edrom, NSW. The majority of the transport route between the mine and the Port is via the Princes Highway. The material will be temporarily stockpiled before being loaded onto 50-60,000 t vessels and exported to international markets.

A transport depot will be established from which transport will operate two 12 hour shifts, which is likely to be located in either Orbost or Newmerella. For both the construction and operational phases the proposed mine is likely to increase traffic volumes on the surrounding road network by up to:

- 128 light vehicles and 6 heavy vehicle trips per day during the Construction phase; and
- 216 light vehicles and 368 heavy vehicle trips per day during the Operational phase.

The operational vehicle numbers assume a maximum of 1 Mt of product is exported in a given year. Therefore, this represents the highest potential impact, given that mining rates over the life of mine are expected to average 800,000t per annum.

In the average operating scenario, the Project is expected to generate approximately 296 heavy vehicle trips per day. However, these will be distributed over the length of the route between the mine site and the Port. Therefore, up to 148 heavy vehicles trips per day would be expected on the mine – depot run, and depot – port run, respectively.

All roads associated with the transport route are approved for B-Double use, with the majority of the route along the Princes Highway. The Princes Highway is a designated arterial highway, suitable for freight generating uses such as the Project.

The ***Traffic Impact Assessment*** (EES Referral Attachment 7) concludes that the existing road network is able to accommodate the increase in traffic attributable to the Project and that no upgrades are required, other than those proposed at the intersection of the mine access road and Bruthen-Buchan Road.

Further details of the Project are provided in the ***Project Description and Proposed Mine Plan*** (EES Referral Attachment 1).

1.3 Objectives and Scope

The objectives of the Air Quality, Noise and Vibration Assessment and Monitoring Plan are to:

- Analyse the existing air quality, noise and vibration data to establish baseline conditions;
- Identify the likely sources of air quality, noise and vibration emissions from the Project;
- Estimate the air quality, noise and vibration emissions from the proposed site;
- Identify potential sensitive receptors to air, noise and vibration emissions; and
- Provide an air, noise and vibration monitoring plan for the Project.

Given the purpose of this report is to support the EES Referral, the scope of the report is limited to the Victorian components of the proposed Project. The potential air quality, noise and vibration issues associated with the proposed work program at the Port of Eden are expected to be assessed under the NSW planning system.

This report focusses primarily on the air quality, noise and vibration emissions from the proposed mine site. Potential impacts associated with the proposed product transport route to the Port of Eden are considered in detail in the ***Traffic Impact Assessment*** (EES Referral Attachment 7).

The proposed transport deport is an exclusion from the Project as it will be subject to the requirements of the transport contractor and its location is therefore yet to be determined. Accordingly, air, noise and vibration emissions from the transport depot are not assessed in this report and will be considered as part of any separate approvals.

Additionally, the scope of this report does not include the study of greenhouse gas emissions, which are considered by other studies.

1.4 Geographic Setting and Potential Sensitive Receptors

The proposed mine site is located approximately 7 km north of the township of Nowa Nowa, which is situated on the Princes Highway between Bairnsdale and Orbost in East Gippsland, Victoria. The site is wholly within the Tara State Forest (Figure 1-1). The area is characterised by low hills and creeks flowing into the Lake Tyers estuary located approximately 15 km downstream. The vegetation is dominated by Lowland Forest and Shrubby Dry Forest, with Damp Forest covering most of the creeks in area, and small patches Riparian Forest and Warm Temperate Rainforest occurring nearby.

The closest settlement areas to the proposed mine site area are Nowa Nowa (pop. ~150), located 7 km to the south, and the farming hamlet of Wairewa (~20 dwellings), approximately 4 km to the southeast. The proposed mine site occurs adjacent to the sealed Bruthen-Buchan Road. While no residences occur in the area directly surrounding the proposed mine site, a number of isolated farmhouses occur on agricultural land in the broader area. The nearest isolated residence to the mine site is a single farmhouse on agricultural land adjacent to Bruthen-Buchan Road approximately 3.6 km west of the processing plant, 4 km west of the pit and 3.3 km west of the mine footprint. A portion of the unsealed Nowa Nowa-Buchan Road runs through the proposed mine site, and will require diversion for the Project.

The proposed product transportation route to the Port of Eden mainly follows the Princes Highway, which will be accessed from the mine site via the Bruthen-Buchan Road and Bruthen-Nowa Nowa Road (Figure 1-1). A number of small towns and isolated residences occur along the transportation route to the Port. Orbost (pop. ~2500) is the largest town along the transportation route and is located 35 km to the east of Nowa Nowa. Notably the Princes Highway bypasses the town centre of Orbost.

Nowa Nowa and the surrounding district are supported by farming and timber milling, with two saw mills operating in Nowa Nowa. The region also supports tourism, arts and outdoor recreation.

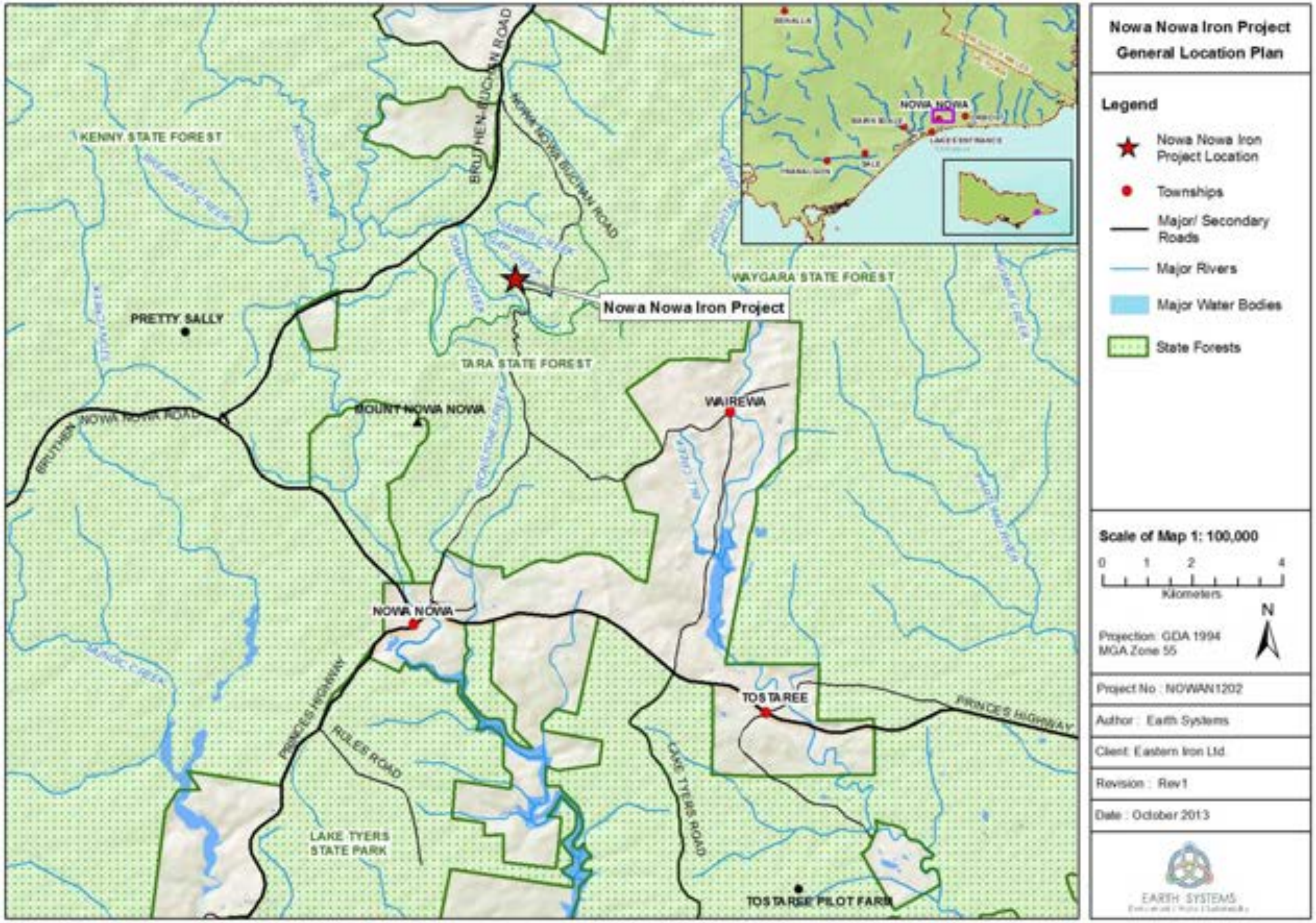


Figure 1-1. Project Location

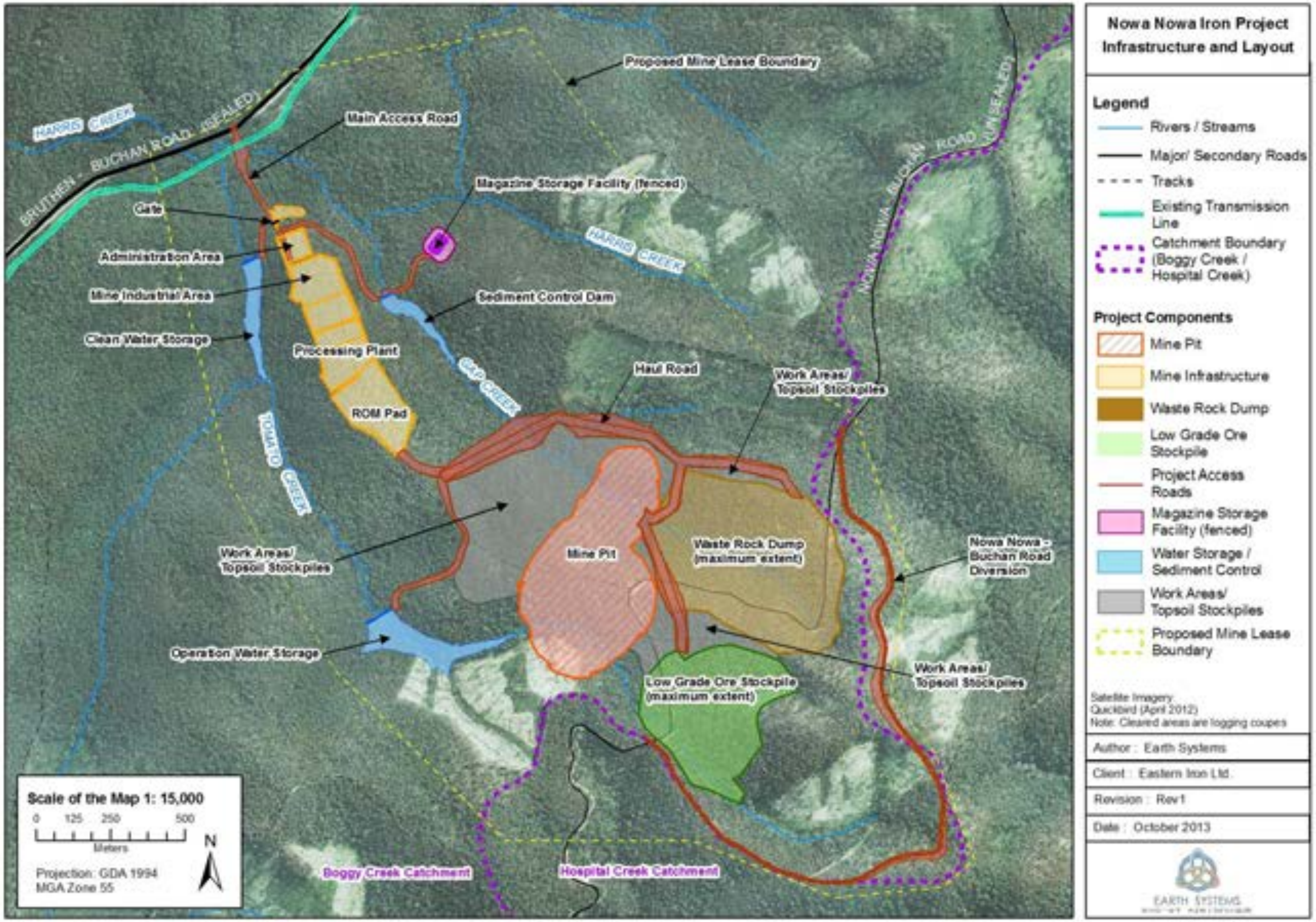


Figure 1.2. Proposed Project Infrastructure and Layout

2 Meteorology

2.1 Meteorological Baseline

The proposed mine site is located in East Gippsland (Victoria), to the east of the Latrobe Valley and south of the Southern Highlands. The climate is temperate and moderately humid, and there are a number of forest areas and national parks in the Highlands and surroundings. Meteorological data is currently collected at four Bureau of Meteorology (BOM) weather stations in proximity to the mine site area (Table 2.1).

Table 2.1 Bureau of Meteorology stations in the vicinity of the proposed mine site

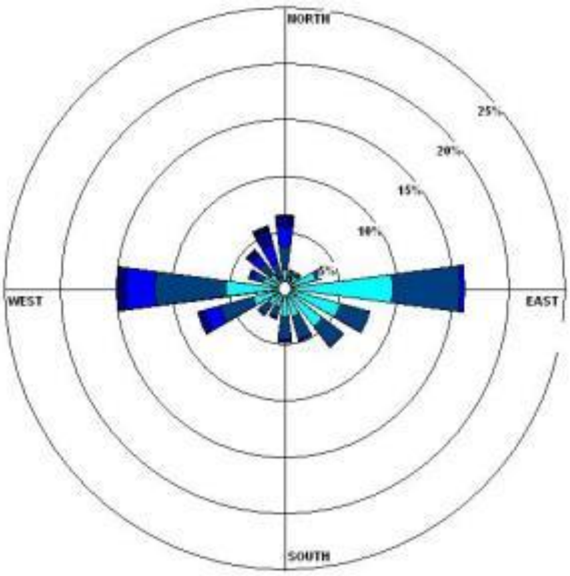
Location	Station No	Distance (km)	Data Collection Period
Mount Nowa Nowa	84144	4	1995-2013
Nowa Nowa Township	84028	7	1948-2013
Lake Tyers	84045	22	1953-2013
Lakes Entrance (Eastern Beach	84150	26	2006-2013

2.2 Wind Speed and Direction

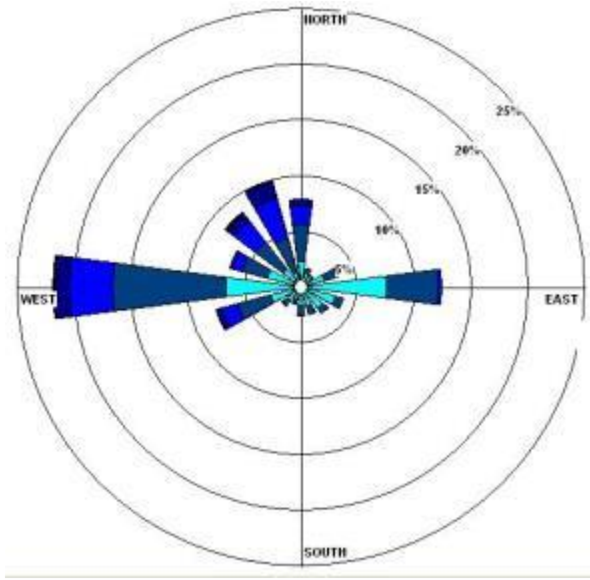
Figure 2.1 presents the seasonal wind roses from hourly wind data recorded at the Mount Nowa Nowa station between October 1995 and November 2011. Throughout the year, prevailing winds are Westerly and North-Westerly, except in summer where Easterly and Westerly winds are dominant. The mean wind speed is on average 3.5 m/s, being higher in the mornings than in afternoons. During winter, the mean wind speeds vary, increasing in mornings up to 4 m/s.

2.3 Rainfall

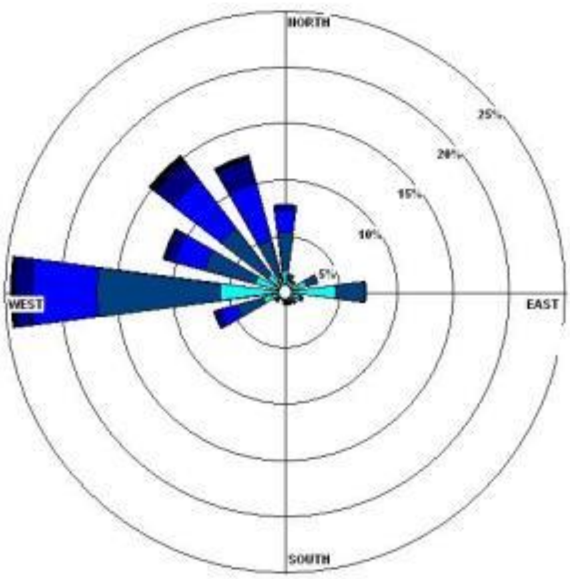
The variation of the mean annual rainfall among the four sites is minor, ranging from 739 mm at Lakes Entrance to 865 mm at Nowa Nowa Township. Meteorological records indicate that monthly rainfall varies between approximately 50 and 90 mm throughout the year, with highest mean rainfall occurring in June, November and December. The highest mean monthly rainfall was recorded at Mount Nowa Nowa with 346 mm measured in June 2007, while the highest 24hr rainfall event was 197 mm at Nowa Nowa Township in January 1949. It should be noted that major a flood event occurred in East Gippsland in June and July 2007.



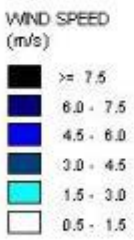
Summer: calms = 2.7%

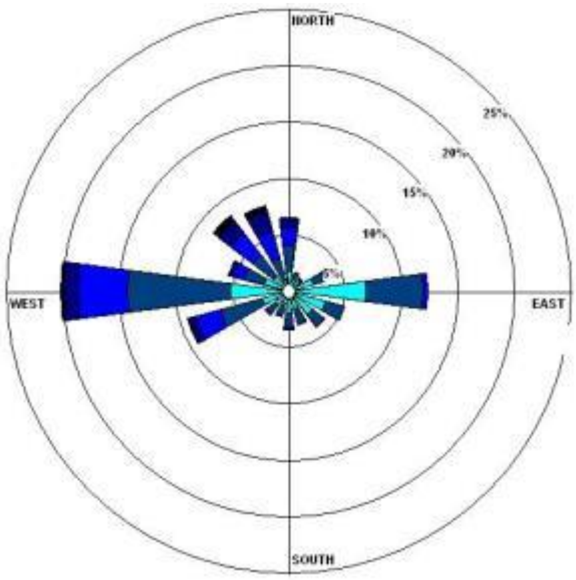


Autumn: calms = 2.2%



Winter: calms = 1.3%





Spring: calms = 1.9%

Figure 2.1 Seasonal Wind Roses for Mount Nowa Nowa, Oct 1995- Nov 2011 (Bureau of Meteorology)

3 Methods and Criteria

3.1 Air Quality

3.1.1 Australian Guidelines and Standards

In Australia, air quality legislation is administered by the National Environmental Protection Council (NEPC) which provides the framework for ambient air quality standards in Australia. This includes the National Environmental Protection Measure for Ambient Air Quality (also referred to as the Air NEPM), the Air Toxics NEPM and the National Pollutant Inventory (NPI). The Air NEPM sets standards, goals, monitoring and reporting protocols for six target pollutants: Carbon monoxide (CO), Nitrogen dioxide (NO_2), photochemical oxidants (as ozone), Sulphur dioxide (SO_2), Lead (Pb) and particulates (PM_{10} and $PM_{2.5}$).

3.1.2 Air Quality Standards in Victoria

In Victoria the key piece of State legislation regarding noise, vibration and air quality is the *Environment Protection Act* 1970. The Act also established the duties, powers and functions of its main regulatory body, the Environment Protection Authority (EPA). The *State Environmental Protection Policy* (SEPP, 1999)*, Ambient Air Quality* ('SEPP (AAQ)') sets objectives for the State of Victoria, adopting national NEPM requirements for gases and particulates and also includes a separate objective for visibility reducing particles. It does not apply to emissions from individual sources.

The Victorian *SEPP Air Quality Management* (2001) establishes the management framework and attainment program for protection of the air environment contained in the SEPP (AAQ). This addresses not only ambient and regional air quality, but also the management of particular sources (for example, industry, motor vehicles and open burning) and local air quality impacts and/or intervention levels for air toxics, odorous pollutants, greenhouse gases and ozone-depleting substances.

In addition the *Protocol for Environmental Management: Mining and Extractive Industries* (2007) ('PEM') supports the SEPP Ambient Quality Management by setting out the statutory requirements for the air quality management arising from mining activities and extractive sites.

Table 3.1 Relevant air quality standards in Victoria

Standard	Date
Environment Protection Act	1970
State Environment Protection Policy (Ambient Air Quality)	1999
State Environment Protection Policy (Ambient Air Quality Management)	2001
Protocol for Environmental Management: Mining and Extractive Industries (PEM)	2007

Tables 3.2 to 3.4 summarise the air quality assessment criteria contained in the Victorian Environmental Protection Authority's SEPP and PEM.

Table 3.2 SEPP Ambient Air Criteria

Species	Criterion	Averaging Time	Allowable Exceedance	Source
Carbon monoxide CO	9.0 ppm	8 hours	1 day a year	VIC SEPP
Nitrogen dioxide NO_2	0.12 ppm 0.03 ppm	1 hour 1 year	1 day a year none	VIC SEPP
Photochemical oxidants as Ozone O_3	0.10 ppm 0.08 ppm 0.05 ppm 0.08 ppm	1 hour 4 hours 8 hours 8 hours	1 day a year 1 day a year 3 days a year none	VIC SEPP
Sulphur dioxide SO_2	0.20 ppm 0.08 ppm 0.02 ppm	1 hour 24 hours 1 year	1 day a year 1 day a year none	VIC SEPP
Lead (maximum concentration)	0.50 µg/m^3	1 year	none	VIC SEPP
Particulates <10µm PM_{10}	50 µg/m^3	24 hours	5 days per year	VIC SEPP
Visible Particulates (minimum visual distance)	20 km	1 hour	3 days a year	VIC SEPP

Table 3.3 PEM Air Quality Criteria for mining

Species	Criterion	Averaging Time	Allowable Exceedance	Source
Particulates <10μm PM_{10}	60 μg/m^3	24 hours	/	VIC SEPP PEM
Particulates <2.5μm $PM_{2.5}$	36 μg/m^3	24 hours	/	VIC SEPP PEM
Respirable Crystalline Silica	3 μg/m^3	1-year	/	VIC SEPP PEM

Table 3.4 SEPP Air Quality Management Criteria

Species	Design Criterion	Design Criterion	Intervention Level	Averaging Time
Class 1				
Carbon monoxide CO	29 mg/m^3	25 ppm	29 ppm	1 hour
Nitrogen dioxide NO_2	0.19 mg/m^3	0.1 ppm	0.14 ppm	1 hour
Sulphur dioxide SO_2	0.45 mg/m^3	0.17 ppm	0.21 ppm	1 hour
Particulates as PM_{10}	0.08 mg/m^3	/	0.06 mg/m^3 (24 hr)	1 hour
Lead	0.003 mg/m^3	/	/	1 hour
Class 2				
Particulates as $PM_{2.5}$	0.050 mg/m^3	/	0.036 mg/m^3 (24 hr)	1 hour
Unclassified				
Nuisance Dust (TSP)*	0.33 mg/m^3	/	/	3-minutes

*Note that the design criterion for nuisance dust TSP was based on the Work Safe Australia Time-weighted Average (TWA) exposure values, divided by 30. Very few real-time TSP dust monitors have a time resolution to meet this criterion.

3.1.3 Air Quality Methods

The Victorian SEPP recommends instrumental methods for ambient air monitoring. These methods have been summarised in VIC EPA document *A Guide to the Sampling of Air Emissions and Air Quality* (2002).

Table 3.5 VIC EPA Recommended Methods for Ambient Air Sampling (2002)

Target	Method**
Siting of Sampling units	AS2922*
Measurement of horizontal wind	AS2923*
Carbon monoxide	AS3580.7.1
Nitrogen dioxide	AS3580.5.1
Oxidant	AS3580.6.1
Sulphur dioxide	AS3580.4.1
Particulates as PM_{10}	AS3580.9.6, 9.7, 9.8
Total Suspended Particulates (TSP)	AS2724.3

*Note that AS2922 and 2923 have been superseded by AS3580.1.1 and AS3580.14 respectively.

**Note that other instrumental methods may be acceptable due to technical advances – contact EPA for advice.

3.1.4 Level of Assessment

The Protocol for Environmental Management (PEM) SEPP *Air Quality Management for Mining and Extractive Industries* (2007) provides the level of assessment of air emissions required, dependant on;

- the size or scale of the operation; and
- the location of the site.

Based on the proposed Project output of above 500,000 t/annum, and the location of the proposed mine site well over 500 m from the nearest residence in a rural area, the mine site is to be considered at a **Level 2** of assessment in terms of requirements for monitoring and modelling.

3.1.5 Modelling Guidelines

The SEPP *Air Quality Management* provides guidelines for computer dispersion modelling, in order to;

- predict the potential air quality impact of proposed new source of emissions;
- evaluate emission control strategies;
- evaluate the application of different models, meteorology and modelling parameters; and
- assess predicted concentrations from proposed or modified sources.

Potential generators of emissions are required to minimise their emissions in accordance with the SEPP, but should model a “worst-case scenario” to determine maximum predicted concentrations. Ground-level concentrations (GLCs) of the target species, are predicted by the computer model to compare with the SEPP criteria. At least 1 year (8760 hours) of meteorological data is employed, and data presented at the 99.9th percentile, removing the most extreme 0.1% from the predictions.

3.2 Noise

3.2.1 Noise Theory

The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, including road traffic, industries, wind, birds, animals and insects. The human ear has a wide sound-sensitivity range, and thus the decibel (dB) is a logarithmic unit that allows this range to be compressed into a comprehensible range of 0 to 120 dB. The decibel is ten times the logarithm of the ratio of a sound level to a reference sound level.

The human ear is less sensitive to low frequency sound than high frequency sound. Sound level meters have an in-built weighting, termed the "A-weighted" dB(A) scale that approximates the human loudness response. LAeq, the most commonly used indicator for noise, is the equivalent continuous A-weighted sound pressure level. Decibel noise levels cannot be added or averaged arithmetically since they are logarithmic parameters. For example, if one source is generating a noise level of 50 dB(A), and another similar source is placed beside it, the level will increase to 53 dB(A), not 100 dB(A). Ten similar sources placed side by side increase the sound level by 10 dB(A), and one hundred sources increase the sound level by 20 dB(A).

It is common practice to measure background noise using a sound level meter with a Statistical Noise Level measurement capability. Statistically the LA_{90} value is defined as the level exceeded for 90% of the measured time and is often used to describe nominal background noise levels. LA_{10} is used as a useful descriptor of road traffic or industrial noise as it correlated well with disturbance when in close proximity to busy roads as well as more rural situations. By definition the LA_{10} value is the level exceeded for 10% of the time, so it is biased towards higher noise levels, and takes account of peaks of noise.

3.2.2 Methods and Criteria

The noise environment in Victoria is protected by the *Environmental Protection Act* 1970 and State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade). The Control of Noise from Commerce, Industry and Trade SEPP aims to protect people from the effects of noise in noise-sensitive areas (e.g. residential zones). There are no specific policies in these documents regarding the impacts of vibration, but are included in noise regulations (e.g. low-frequency noise) and OHSE policies.

The SEPP document N-1 sets noise limits in Metropolitan Melbourne. The *Noise from Industry in Rural Victoria* or "NIRV" (EPA publication 1411) explains how to set recommended levels for a regional site. The NIRV adopts the SEPP N-1's procedure for measurements of noise and recommended noise levels in urban areas. VIC EPA publication 1413 explains how to apply the NIRV to existing or proposed sites.

Table 3.6 summarises the relevant noise control standard documentation in Victoria.

Table 3.6 Relevant noise control standards in Victoria

Standard	Date
Environment Protection Act	1970
State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade)	1999
Noise From Industry in Regional Victoria (NIRV)	2011
Applying NIRV to Proposed and Existing Industry	2011

3.2.3 Noise Variations for Mines and Resources

SEPP N-1 clause 19 advises that all new or replaced equipment on-site should be installed with the quietest equipment available where a significant reduction in noise exposure can be expected to result. This obligation also applies to the *Noise from Industry in Regional Victoria* (NIRV) document. The NIRV uses a zoned land use noise system as a basis for noise levels, which does include variation of noise levels for mines and earth resources industries. However, these criteria do not apply to vibration or blasting, which are presented in the following section. The NIRV includes five checks to determine applicable noise levels as follows:

- Step 1 – Zone Level
- Step 2 – Distance-Adjusted Level
- Step 3 – Base Noise Level Check
- Step 4 – Background Level Check and Adjustment
- Step 5 – High-Traffic Noise Areas

The proposed mining area is located entirely on Crown Land within the Tara State Forest which is zoned as a Public Conservation and Resource Zone (PCRZ), in accordance with the East Gippsland Planning Scheme. The PCRZ entails both the noise-generating and noise-receiving locations. Consequently the following earth resources levels should be applied.

Table 3.7 Noise Assessment Criteria for Public Conservation and Resource Zone (NIRV 2011)

Time Period	Earth Resources Levels
Day	45 dB(A)
Evening	39 dB(A)
Night	34 dB(A)

3.3 Vibration

3.3.1 Assessment Methods and Criteria

The key Victorian standard regarding vibration/airblast is the *Ground Vibration and Airblast Limits for Blasting in Mines and Quarries* published by what was then the Department of Natural Resources and Environment

(2001). This document describes the environmental guidelines for blasting impacts at sensitive sites concerning new and existing mines or quarries activities. New sites should meet the requirements outlined in Table 3.8 at sensitive sites.

Table 3.8 Vibration and Airblast Assessment Criteria (DNRE 2001)

Parameter	Assessment criteria
Ground Vibration	Below 5 mm/s (Peak Particle Velocity) for 95% of all blasts.
Airblast	Below 115 dB (Linear Peak) for 95% of blasts.

Vehicle traffic on the main road, particularly heavy vehicle traffic, is also likely to result in some vibration emissions. The factors that affect vibration levels from traffic include the composition (heavy vehicle to light vehicle), volume and speed of traffic, road surface conditions and the transmission path (distance, topography) between the source and the receiver. Vehicle traffic induces vibration in two ways (Hajek *et al*. 2006):

- Ground-borne vibration – caused by the dynamic impact forces of tyres on the pavement or other surface that can propagate and excite building foundations, resulting in vibrations of building components; and
- Air-borne vibration – caused by low frequency sound produced by engines and exhaust systems (primarily associated with large diesel trucks) that can excite building components above ground.

Both types of vibration can be caused by the same vehicle at the same time. The generation of ground-borne vibration is strongly linked to surface evenness – the more uneven the surface, the greater the ground-borne vibration. Heavier vehicles typically produce higher ground-borne and air-borne vibration, and an increase in the number of heavy vehicles tends to result in more vibration peaks, but not necessarily higher peaks. Higher speeds increase both ground-borne and air-borne vibrations.

4 Initial Air Quality Assessment

4.1 Existing Air Quality

The identification of existing air emission sources entails the differentiation between man-made and natural sources. The potential man-made sources include:

- Motor vehicles;
- Industrial processes;
- Domestic and industrial incineration; and
- Heating and power generation.

The potential natural sources include:

- Windblown dust;
- Bushfires;
- NOx from biogenic sources;
- VOCs from eucalypt trees; and
- Salt spray (marine aerosols) from the ocean.

Ambient sources existing locally are expected to consist of smoke particles generated by domestic wood heating, motor vehicles, transportation related to the timber and milling industry, dust storms or bush fires that can generate particulate concentrations in excess of national guidelines.

There are no major industries close to the proposed mine site area. The closest industries identified in the area surrounding the proposed mine site are two saw mills operating in Nowa Nowa, approximately 6 km to the south of the proposed mine site. At a regional scale, fine particles can be expected to follow plume dispersion from industrial and urban activities sourced from Greater Melbourne or the Latrobe Valley. Under these conditions, concentrations are expected to decrease with distance.

4.2 Potential Air Quality Impacts

Air emissions will occur as a result of exploration, construction and operational activities during the proposed mine site development. Particulate matter (PM_{10} and $PM_{2.5}$) from mining, processing and transportation activities is expected to be the primary emission of concern. Air emissions from the proposed mine site will primarily occur during the construction and operational phases. The principal source of dust emissions is likely to be from exposed surfaces.

During construction and operations, the main dust / particulate generating activities from the Project are expected to include:

- Clearing of vegetation and topsoil;
- Drilling;
- Blasting;

- Loading and unloading of topsoil, ore and waste;
- Hauling ore and waste to the plant, waste rock dump and low grade ore stockpile;
- Transportation of workers, materials and supplies to the mine site;
- Transport of product to the Port of Eden for export;
- Use of graders and bulldozers;
- Crushing;
- Wind erosion from exposed areas; and
- Vehicle exhaust emissions.

During construction, land clearance and earthworks activities are likely to result in short term dust emissions from a number of Project components. Unsealed haul roads are expected to be the main source of dust emissions at the mine site during operations. Dust impacts are strongly correlated with the meteorological conditions. Between 1995 and 2012, the months with highest mean rainfall levels were June, November and December offering natural dust suppression. During times when natural dust suppression does not occur, management and mitigation measures will be required to avoid and minimise dust emissions.

During operations, dust impacts may also occur due to increased traffic along the transportation route to the Port of Eden, however dust generation is expected to be minor due to the entire route being along sealed roads, and primarily the Princes Highway.

Potential gaseous pollutant emissions include CO, NOx and SO_2 from the exhaust of diesel and petrol powered vehicles; and from fuel combustion in site sources, such as generators and blasting. Vehicle exhaust emissions may impact air quality in the proximity of the access and haul roads.

4.3 Background Dust

The air quality monitoring network in Victoria is composed of 13 metropolitan air monitoring stations located in Greater Melbourne and two regional stations in the Latrobe Valley. The closest stations to the mine site are Traralgon and Mooroolbark located 170 and 330 km away from Nowa Nowa, respectively.

The 2011 EPA Air Monitoring report evaluates the compliance of the air monitoring stations in Victoria with the National Environment Protection (Ambient Air Quality) Measure (NEPM). Table 4-1 presents the 75th percentiles daily concentrations for PM_{10} for the Victorian stations.

The State Environment Protection Policy for Air Quality Management (SEPP-AQM) sets a method to estimate background dust levels where no background data is available. This method is known as “70th percentile”: the 70th percentile value of a year of hourly observations can be used a constant background value for numerical modelling, as required by the SEPP PEM.

Considering the westerly prevailing winds at Nowa Nowa, dispersion from industrial emissions from the Latrobe Valley can be normally expected. During summer, the easterlies along the coast should reduce the potential of particles dispersion from the Metropolitan and Latrobe Valley region. For this reason, an estimate of 15 $\mu g/m^3$ was chosen for the daily PM_{10} background concentration at the mine site.

Table 4.1 75th percentiles of daily PM_{10} concentrations at Victorian monitoring stations during 2011.

Region	Performance Monitoring Station	75th Percentile (µg/m^3)	Data Availability (%)
City	Richmond	20.2	92.3
East	Alphington	19.5	97.0
	Brighton	19.9	98.6
	Dandenong	21.5	99.5
	Mooroolbark	21.7	99.2
West	Footscray	23	98.9
Geelong	Geelong South	23.2	98.9
Latrobe Valley	Traralgon	18.2	99.5

4.4 Mine Site Dispersion Modelling

The impact to potential receptors was assessed using the Victorian EPA AUSPLUME (Version 6.0) Gaussian dispersion model, to simulate dry dispersion of pollutants from the proposed mine site.[1] The meteorological station at Mt Nowa Nowa does not record pressure or upper air parameters, hence prognostic meteorological data for the region was produced using the CSIRO TAPM model ('The Air Pollution Model', CSIRO 2005) over a 20x20 km grid at a resolution of 500 metres. TAPM includes parameterisations for cloud, rain, turbulence, urbanisation, vegetation, soil and radiative fluxes.

In the AUSPLUME simulations, terrain influences were accounted for using the Egan Half-Height Method. The AUSPLUME model assumes that the wind speed and direction remain constant over the full length of the dispersed plume, and thus can only partially simulate terrain effects. Gaussian plume models are considered appropriate at distances of less than 20 km from the source, but can over-estimate pollutant concentrations at longer ranges.

As per the requirements of the SEPP AQM, a worst-case emission scenario was simulated, with source emissions taken from the National Pollutant Inventory (NPI) *Emissions Estimation Technique Manual for Mining* (2012).

The following parameters were assumed;

- continuous operation 24 hours per day, 365 days a year;
- production of 1Mt per annum;
- no emission controls or mitigation;
- no cover of stockpiles or waste rock;
- maximum extent of stockpiles, pit and waste rock areas;
- two blasts per day & two 1MW Diesel generators;
- emissions from on-site vehicles included (trucks, excavators, wheel & bucket);

[1] The modelling output files are available for review on request.

- emissions from off-site road transport not included; and
- assumed $PM_{2.5}$ as 20% of PM_{10} and respirable crystalline silica as 10% of $PM_{2.5}$.

Employing an annual TAPM meteorological dataset, the AUSPLUME model predicted that over a 24 hour average, PM_{10} particulates would be dispersed to the south and south-east of the proposed mine site (see model dispersion maps, Annex A). Examination of the predicted dispersion showed 24-hour average predicted PM_{10} concentrations at Wairewa of 15.5 µg/m^3, and 8.1 µg/m^3 at Nowa Nowa, well below the SEPP PM_{10} criterion of 50 µg/m^3 (Table 4.2).

Table 4.2 Predicted worst-case concentrations at 99.9th percentile (µg/m^3)

Location	24-hour average PM_{10}	24-hour average $PM_{2.5}$	Annual average Respirable Silica
Bruthen-Buchan access road	24.8	5.0	0.03
Wairewa	15.5	3.1	0.03
Mt Nowa Nowa	9.7	1.9	0.02
Nowa Nowa	8.1	1.6	0.01
SEPP PEM Criteria	**60.0**	**36.0**	**3.0**
NEPM Criteria	**50.0**	**25.0**	**n/a**

These predicted concentrations consider the contribution from the proposed mine site only, and do not include near-field contribution from transport traffic through the region. Dispersion maps of predicted impacts, including assumed PM_{10} background at 15 µg/m^3 are also included in Annex A. Any future modelling should employ measured background values from planned monitoring in the region, on-site emissions, and any adopted mitigation measures, for accurate representation of regional impacts.

4.5 Air Quality Management and Mitigation

Consistent with the VIC EPA Best Practice Environmental Management document *Environmental Guidelines for Major Construction Sites* (1996) the measures in Table 4.3 are recommended to prevent or minimise the impact of dust emissions from land clearing, top soil removal, windblown and stockpile-generated dust.

Table 4.3 Recommended control procedures for dust (VIC EPA, 1996)

Source	Control procedures
Areas disturbed by mining	Ensure the area of cleared land is minimised during the drier months of the year when dust generation is greatest. Ensure smooth surfaces are deep ripped and left rough to reduce the wind velocity at the surface Install wind fences wherever appropriate
Stockpiles	Minimise the number and size of stockpiles Locate stockpiles away from drainage lines, at least 10 m away from natural waterways, and to where they are protected from wind erosion. Ensure stockpiles are designed with slopes no more than 2:1 (horizontal/vertical) Suppress dust on stockpiles as circumstances demand

Haul roads	Pave and water haul roads where required. The frequency of watering will be determined by weather conditions and the erodibility of the soil.
Topsoil stockpiling	Keep topsoil separate from underburden when stockpiling soil

The ***Traffic Impact Assessment*** (EES Referral Attachment 7) recommended that a 'truck driver code of behaviour' be developed and implemented for drivers. This code should include the following measures to minimise potential air quality impacts:

- Regular maintenance of vehicles (in accordance with the vehicle manufacturer's instructions);
- Regular review of tyre air pressure; and
- Prohibit vehicles from idling in residential areas and turn off engines when the vehicle is parked near residences, offices or eating areas.

5 Initial Noise Assessment

5.1 Existing Noise & Vibration

There is no existing noise data for the local area of the proposed mine site. Inspections of the study area found the existing noise environment to be characterised by natural noise sources. There was also a low volume of normal speed traffic on the Bruthen-Buchan Road and ambient noise was observed to be low. The ***Traffic Impact Assessment*** (EES Referral Attachment 7) indicates annual average daily traffic (AADT) volumes on the Bruthen-Buchan Road are approximately 200 cars each way (average ~17 cars per hour in either direction). Traffic volume data for nearby unsealed roads such as the Nowa-Nowa Buchan Road are not available, However observations suggest these roads are used very rarely with vehicle use primary associated with forestry activities. The local industry consists of two saw mills operating in Nowa Nowa, which represent a potential influence on the ambient noise levels at nearby receptors.

The majority of the transport route between the mine site and the Port of Eden is via the Princes Highway, which is identified as an arterial highway under the control of VicRoads. The existing and historical use of this road includes significant heavy vehicles movements, including those associated with the forestry industry in the region. From data provided in the ***Traffic Impact Assessment*** (EES Referral Attachment 7), in 2011 the proportion of traffic that was heavy vehicles ranged from 15% to 32% for different parts of the Princes Highway along the proposed route.

5.2 Potential Noise Impacts

Noise levels emanating from the proposed mine site activities in excess of background conditions can potentially disturb wildlife and cause nuisance effects for the local community. Noise from early site preparation and construction activities will vary over time depending on the phase of the Project development. During the construction phase a variety of equipment will be utilized and the noise produced is expected to vary widely. Construction noise is likely to be associated with the following activities:

- Clearing of vegetation;
- Spoil removal;
- Leveling and grading;
- Excavation/earthworks;
- Pile driving;
- Building erection/steelworks;
- Mechanical installation;
- Commissioning and startup;
- On-site vehicle/heavy equipment traffic; and
- Transportation of workforce and construction materials.

The predominant noise sources from construction equipment are from internal combustion engines and impact construction equipment. For the Project, internal combustion engines will provide power to wheels and working mechanisms of construction equipment including trucks and dozers etc. The main noise from internal combustion engines is from exhaust noise. Impact construction equipment is expected to include pile drivers and excavators used for earthworks. Sound levels from typical construction equipment for a mining site are provided in Table 5.1.

Table 5.1 Typical Maximum Construction Equipment Sound Levels at 15 m (Holland and Attenborough, 1981)

Noise Source	A-Weighted Sound Level (dBA)
Earth-moving	
Crawler tractors, dozers	81-85
Front-end Loaders	81-86
Graders	79-83
Earth haulers	88-90
Dump trucks	88
Materials Handling	
Mobile Cranes	83
Concrete mixers (truck)	85
Concrete pumps	82
Impact Equipment	
Jackhammers	88
Pneumatic tools	86
Auxiliary Equipment	
Pumps	76
Generators	78
Compressors	87
Paging systems	80-92
Warning horns	98-102
Other Equipment	
Saws	78
Vibrators	76

Operations noise is likely to be associated with the following activities:

- Drilling;
- Blasting;
- Hauling ore and waste to the plant and waste rock dump and low grade ore stockpile;
- Use of graders and bulldozers;
- Crushing and screening in the processing plant;
- Transport of processed ore to the Port of Eden for export; and
- Transportation of workers and supplies to the proposed mine site.

Pit noise will primarily include blasting and 100 -120 tonne class hydraulic excavators loading 85-120 tonne capacity off-road dump trucks. Typical measured noise levels for pit noise sources are listed in Table 5.2. Noise emissions outside the pit will vary depending on the amount of shielding provided by the pit walls. The use of explosives creates airborne pressure fluctuations (airblast) which are audible and can be perceived as 'noise' when in the higher frequency range. At frequencies lower than approximately 20 Hertz, the sound energy is inaudible but is capable of causing vibration impacts (refer Section 6).

Plant noise will primarily be associated with loading of the ore into the hopper and the operation of the crushers. Auxiliary noise would be generated by front-end loaders, conveyors, screening, pumps, service vehicles, and diesel powered generators.

Table 5.2 Typical operations noise levels at different distances from noise sources (Environment Australia, 1998)

Noise Source	Operating Condition	Typical Measured Noise Level
Haul tuck	Laden pass by	91 dBA Lmax @ 7 m
Haul truck	Empty pass by	87 dBA Lmax @ 7 m
Product truck	Laden pass by	88 dBA Lmax @ 7 m
Front-end loader	Loading	85 dBA Lmax @ 7 m
Primary jaw crusher	Crushing	104 dBA Lmax @ 4 m
Haul truck	Laden/uphill	98 dBA Lmax @ 7 m
Rock breaker	Breaking	100 dBA Lmax @ 7 m
Hydraulic drill	Maximum	100 dBA Lmax @ 7 m
Excavator	Scraping	90 dBA Lmax @ 7 m
Reversing alarm		92 dBA Lmax @ 4 m
Production blast		110 dBA Lmax @ 100 m

The potential for significant noise and vibration impacts from the Project to key receptors is low due to the location of the proposed mine site which is a substantial distance from the nearest residential areas, and shielded by hills surrounding the area. The nearest residence to the mine site is a single farmhouse on agricultural land adjacent to Bruthen-Buchan Road approximately 3.6 km west of the processing plant, 4 km west of the pit and 3.3 km west of the mine footprint. The closest settlement is Wairewa which is centered 4 km from the proposed mine site in the next catchment (Hospital Creek Catchment), with the next closest residential area being Nowa Nowa, which is located 7 km to the south (Figure 1-1).

For the Project, topographic and vegetative protection from surrounding hills is expected to reduce noise levels at receptors to levels acceptable by the community. However, changes in meteorological conditions can result in significant daily fluctuations in noise levels at receivers (for identical on-site operations). This is primarily a factor of wind direction and prevalence of temperature inversions (Australian Government, 2009). Noise monitoring at sensitive receptors over the mine life will therefore be required to ensure Project noise emissions meet relevant standards (refer Section 7).

5.3 Noise Management and Mitigation

Vibration-proofing and noise-reduction measures should be applied for various noise sources, including the recommended measures outlined below. Noise emissions from blasting should also be minimised through implementing the recommended measures outlined in Section 6.3.

<u>On-site Measures</u>

Where avoidance is not possible, the preferred method for controlling noise from stationary sources is to implement noise control measures at source. As per the *Environmental Guidelines for Major Construction Sites* (EPA Victoria 1996), the following measures should be implemented:

- Fit and maintain appropriate mufflers on earth-moving and other vehicles on-site;
- Enclose noise equipment; and

- Provide noise attenuation screens where appropriate.

As per the *Leading Practice Sustainable Development Program for the Mining Industry: Airborne Contaminants, Noise & Vibration* (Australian Government, 2009), the following noise reduction options should also be considered in the implementation of the Project:

- Selecting low noise equipment;
- Applying additional silencing measures for fixed and mobile plant and mine ventilation fans;
- Installing acoustic enclosures around process plant, if required;
- Strategically design bund walls for acoustical screening;
- Using 'smart alarms' to minimise complaints regarding vehicle reversing alarms; and
- Minimising tonal components or impulsive or intermittent characteristics of noise where possible.

Transportation Route Measures

The ***Traffic Impact Assessment*** (EES Referral Attachment 7) recommended that a 'truck driver code of behaviour' be developed and implemented for drivers. This code should include the following measures to minimise potential noise impacts:

- Regular maintenance of vehicles (in accordance with the vehicle manufacturer's instructions);
- Prohibit vehicles from idling in residential areas and turn off engines when the vehicle is parked near residences, offices or eating areas;
- Enforcing vehicle speed limits through residential areas; and
- Prohibit use of air brakes in residential areas.

The Proponent should also monitor any noise complaints along the main Project transportation routes.

6 Initial Vibration Assessment

6.1 Existing Vibration

With the exception of vehicle traffic, no obvious source of existing vibration was detected in the vicinity of the proposed mine site. Vibrations from local industry are expected to be negligible. Nowa Nowa and the surrounding district are supported by farming and timber milling. The main existing source of vibration at potential receptors surrounding the proposed mine site is from existing heavy vehicle traffic. This traffic is predominantly along sealed roads such as the Bruthen-Buchan Road and Princes Highway, although unsealed roads within the Tara State Forest would be occasionally used by logging trucks and other vehicles.

6.2 Vibration and Blasting Potential Issues

The most significant vibrations from mining operations are typically associated with blasting activities. Blasting is described as an 'impulsive' vibration source characterised by a succession of brief vibration periods that can significantly exceed the background level and cause community concerns.

The airblast levels received at a location remote from a blast are a function of many factors, including (Australian Government, 2009):

- Charge mass;
- Stemming height and type of stemming;
- Burden;
- Blast hole spacing, blast initiation sequence and timing delay between holes;
- Ratio of the blast hole diameter to the burden;
- Face height and orientation of face;
- Topographic shielding;
- Distance from the blast; and
- Meteorological conditions.

In addition to blasting, the following activities are also likely to cause some vibration impacts:

- Mining equipment – typically conveyors, excavators or processing plant – known for emitting vibrations with small variations of amplitude over time. Ground-borne vibration can be a nuisance above approximately 5 mm/s due to movement being perceptible. The impacts caused by these vibrations are typically not perceptible at a distance greater than 20 m away from the source.
- Crushing activities can produce low-frequency sound waves that could potentially cause vibrations in a structure located in a sensitive area; and
- Vehicle traffic at mine site and along transportation routes.

6.3 Vibration and Blasting Management and Mitigation

The *Leading Practice Sustainable Development Program for the Mining Industry: Airborne Contaminants, Noise & Vibration* (Australian Government, 2009) states that the use of electronic initiation of blasts rather than traditional shock-tube detonations significantly reduces the vibrations caused by the blast. The electronic detonation has been shown to:

- Reduce the maximum vibration readings;
- Reduce the number and intensity of high vibration readings;
- Increase the uniformity of the blast; and
- Minimise the low frequencies of the vibration.

Recommended measures to control the impacts of airblast include:

- Reducing the charge mass;
- Optimising the stemming height and ensuring the type of stemming is adequate;
- Eliminating the exposed detonating cord and secondary blasting;
- Orientating blast faces way from potentially sensitive receivers;
- Applying best practice design of the blast initiation sequence and timing delay; and
- Providing optimum buffer zone.

The Proponent should also monitor any vibration complaints along the main Project transportation routes.

7 Monitoring

This section outlines a monitoring program for air quality, noise and vibration for the Project components within Victoria. Prior to construction, a baseline for each aspect will be established using representative data from the area and field monitoring in accordance with relevant regulations, SEPP's and guidelines. Periodic monitoring of the parameters specified will then be conducted over the life of the Project at the sites indicated. Investigative monitoring will also be conducted where required.

Detailed monitoring plans and procedures are expected to be developed as part of the *Work Plan* for the Project, in consultation with the EPA. A mechanism for local communities and other stakeholders to provide feedback on air quality, noise and vibration issues over the life of the Project should also be established as part of the *Stakeholder Engagement Plan*.

7.1 Monitoring Objectives

Monitoring objectives for the Project are to:

- Provide a database against which any short or long term environmental impacts of the Project can be determined;
- Provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- Monitor the performance of the Project and the effectiveness of the mitigation measures; and
- Take remedial action if unexpected problems or unacceptable impacts arise.

7.2 Monitoring Stations

It is recommended that field monitoring is conducted at four monitoring stations as summarised in Table 7.1. The locations of these stations are also illustrated in Figure 7.1.

Table 7.1 Coordinates of proposed monitoring stations

Code	Latitude	Longitude	Location	Notes
Station 1	37°39'3.89" S	148° 6'7.75" E	Bruthen-Buchan mine access road	Located at entrance to the Mine site, this station will capture construction of road & mine site, and on-going road transport emissions
Station 2	37° 41' 29"S	148° 10' 3"E	Wairewa	As the main closest settlement, this station will be used as a residential baseline for the proposed mine site.
Station 3	37°41'33" S	148° 5' 27" E	Mt Nowa Nowa	Located adjacent to the existing BOM station.
Station 4	37°43'53.928"S	148°5'33.712"E	Nowa Nowa Township	Nowa Nowa Township is located approximately 7 km south of the proposed mine site, and is also located on the transportation route to the Port of Eden.

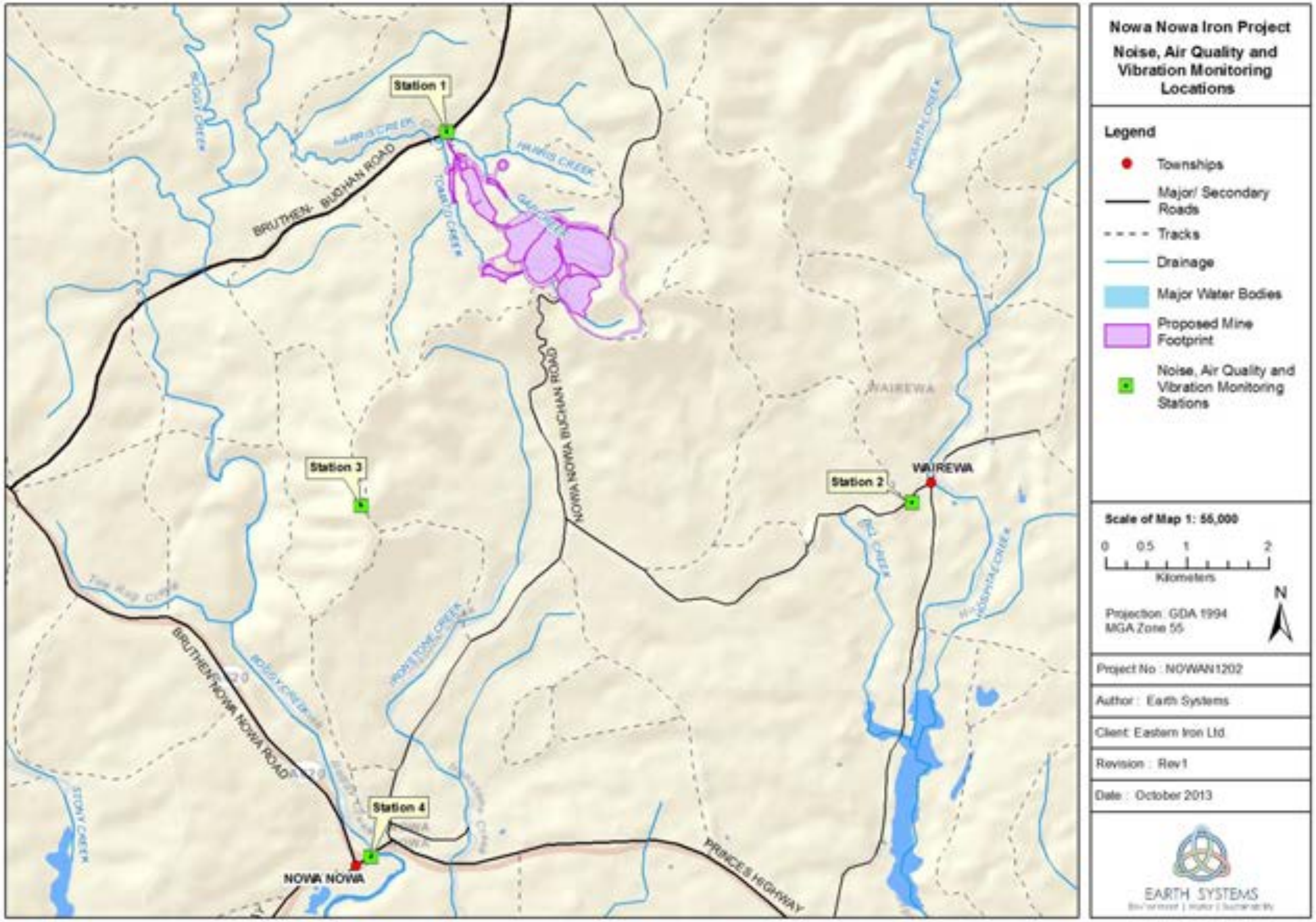


Figure 7.1 Locations of proposed monitoring stations

7.3 Monitoring Parameters

The monitoring program is proposed to be conducted at the monitoring stations as follows:

- Particulates and gases to be monitored at all sites;
- Noise to be monitored at Stations 1, 2 and 4 (locations of potential sensitive receptors); and
- Vibration to be monitored at Stations 1 and 4 (sites along the proposed transportation route to the Port of Eden).

The proposed monitoring parameters and duration of monitoring for each aspect are summarised in Table 7.2. The implementation of the proposed management and mitigation measures for air quality, noise and vibration will also need to be monitored over the Project life.

Table 7.2 Summary of proposed monitoring parameters and frequency of monitoring for each aspect

Aspect	Parameters	Equipment	Duration
Particulates	PM_{10}, $PM_{2.5}$, (TSP), & crystalline silica content	Particulate monitor Dust Deposition gauge	24-hours for 1 year* Monthly
Gases	CO, NO_2, SO_2, O_3	Gas monitors	1-hr (NOx & CO), 8-hrs (O_3), 24-hrs (SO_2), for minimum 7 days
Noise	LAeq, LA10, LA90, LAmax	Portable Sound Monitor, Class 2 minimum	Hourly data during a minimum period of 7 consecutive days
Vibration	Peak Particle Velocity and Peak noise level.	Peak reading analogue equipment and a portable sound level meter.	Hourly data during a minimum period of 7 consecutive days

* A 12 month Project baseline for particulates will be modeled using representative data from the area and field monitoring as per the requirements for a Level 2 project in the SEPP PEM. Thereafter periodic monitoring will be conducted, as well as investigative monitoring where required.

7.4 Monitoring Standards and Criteria

The air quality, noise and vibration monitoring standards and criteria relevant to the Project are outlined in Chapter 3. Where any standards or criteria are exceeded at any monitoring station as a result of the Project, management and mitigation measures will need to be adapted accordingly.

8 Glossary

A-Weighting An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound pressure level is described by the symbol dB(A).

Decibel The decibel (dB) describes the sound pressure level of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

EPA Environmental Protection Authority

LA10 An LA10 level is an A-weighted noise level which is exceeded for 10 percent of the measurement period.

LA90 An LA90 level is an A-weighted noise level which is exceeded for 90 percent of the measurement period. An LA90 level is considered to represent the "background" noise level.

LAeq The equivalent steady-state A-weighted sound level ("equal energy") which, in a specified time period contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

LAmax A LAmax level is the maximum A-weighted noise level during the measurement period.

Linear Peak The maximum level of air pressure fluctuation measured in Decibels without frequency weighting.

MDL Method Detection Level – The lowest concentration of an analyte that can be detected in a sample, when processed through the complete method. For instrumental techniques a signal to noise ratio of 3:1 is acceptable.

PM Particulate Matter suspended in the air in the form of minute solid particles or liquid droplets, especially when considered as an atmospheric pollutant.

$PM_{2.5}$ Particulate matter particles 2.5 micrometres or less in size.

PM_{10} Particulate matter particles 10 micrometres or less in size.

PPV Peak Particle Velocity – The instantaneous sum of the velocity vectors measured in mm/s of the ground movement caused by vibration from the passage of vehicles or from blasting.

TSP Total Suspended Particulates

9 References

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Annex A Predicted Dispersion Maps

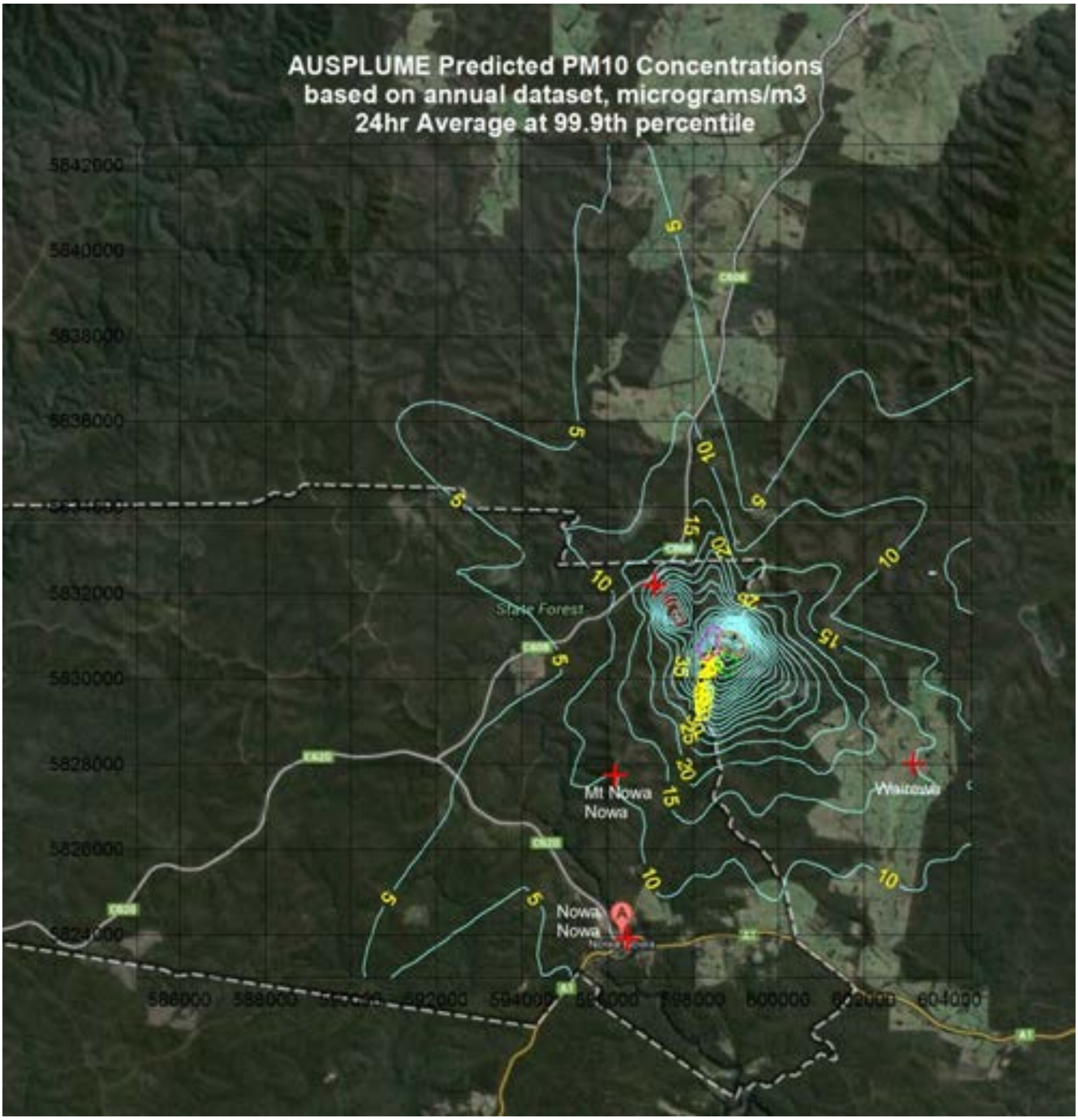

Figure A-1 Predicted PM_{10} Dispersion

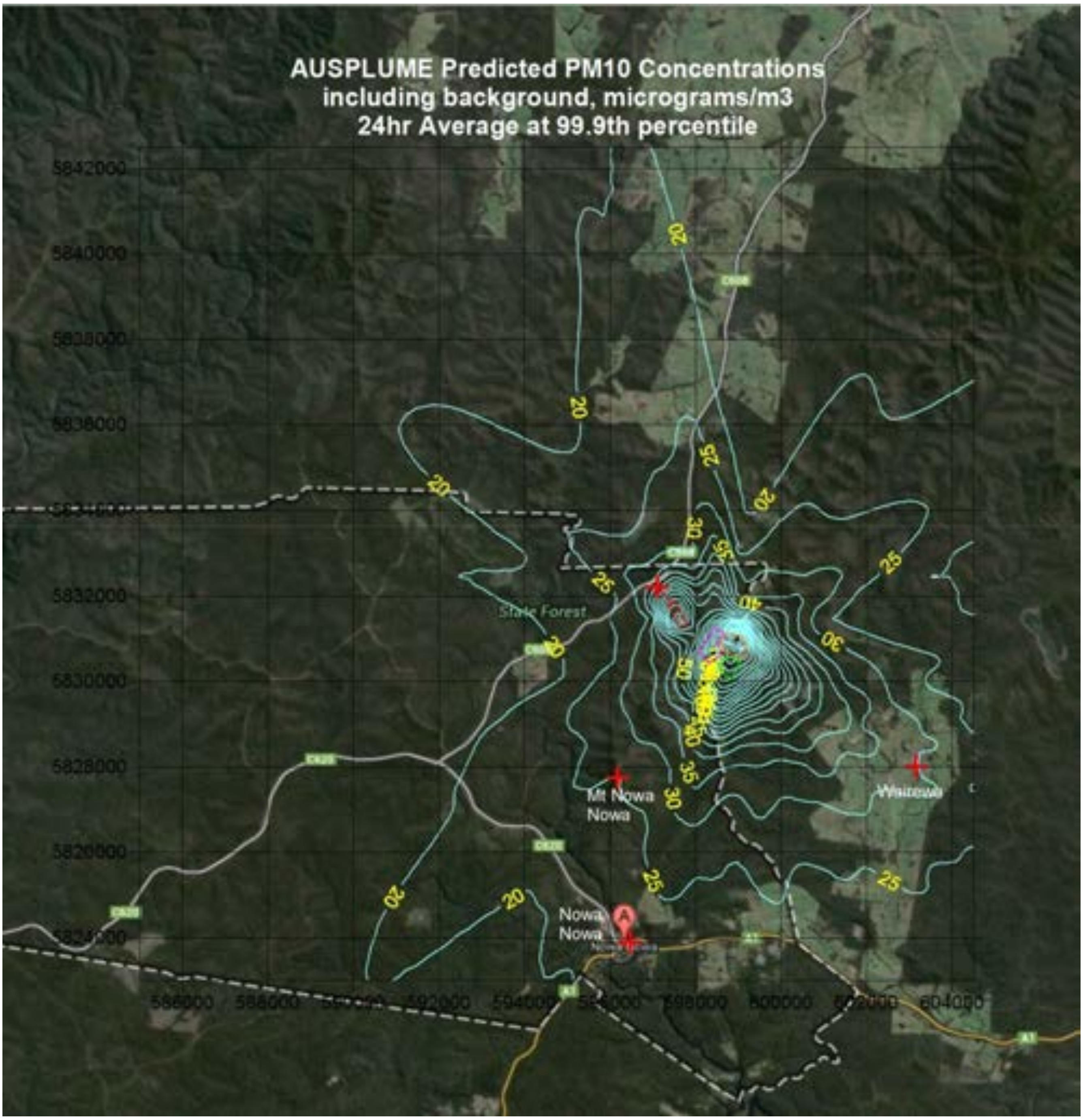

Figure A-2 Predicted PM_{10} concentrations including background

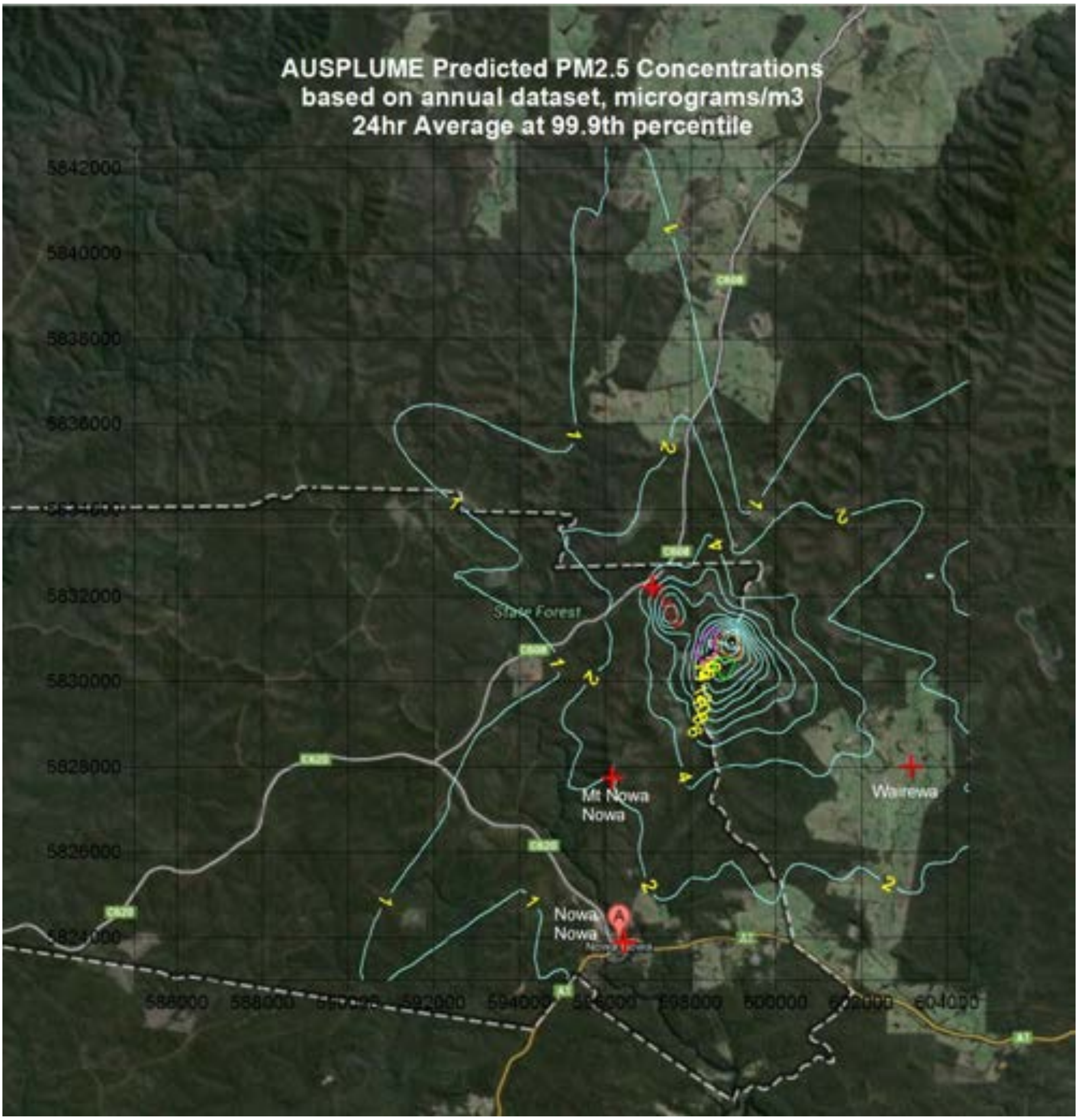

Figure A-3 Predicted $PM_{2.5}$ Dispersion

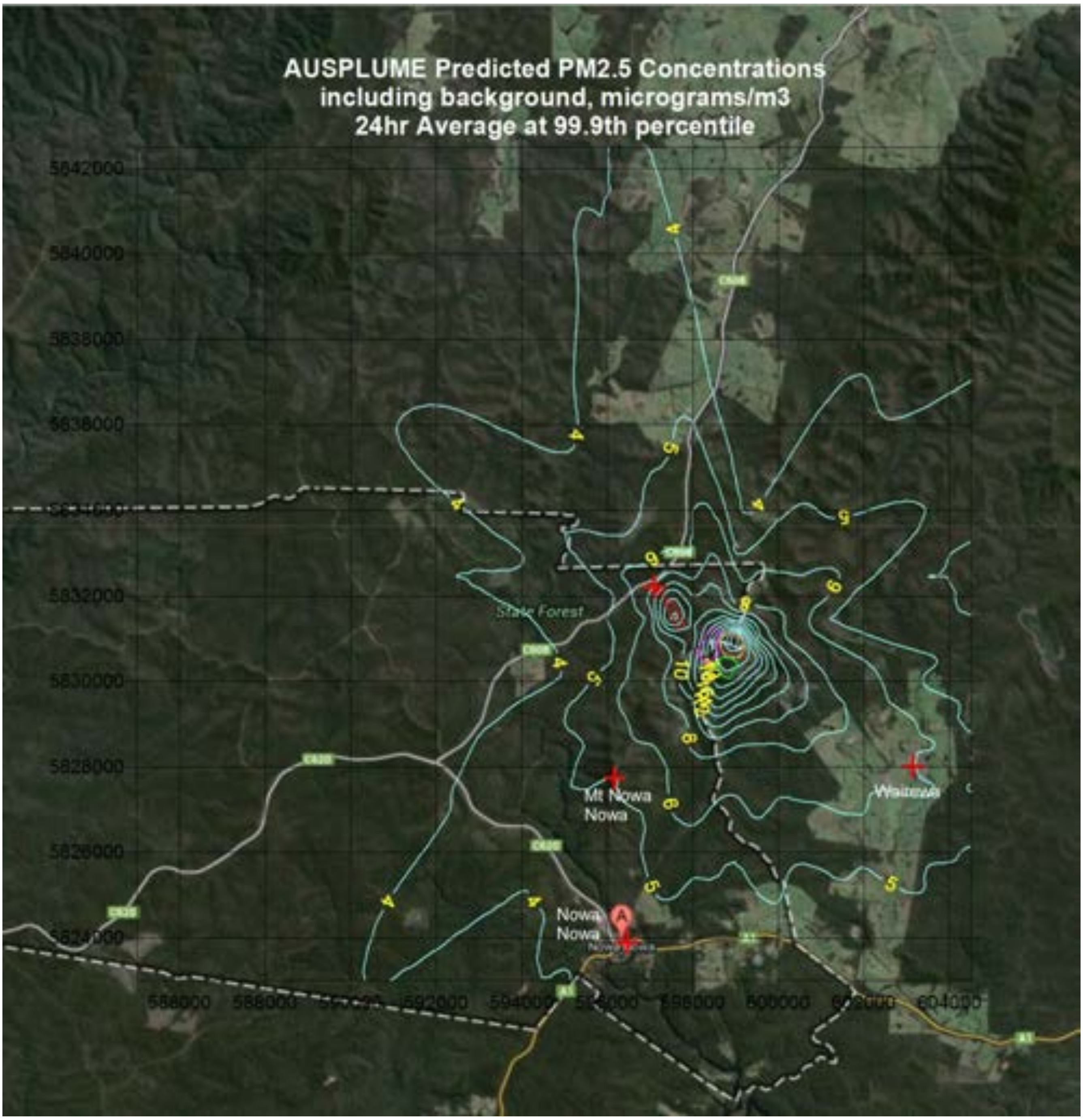

Figure A-4 Predicted $PM_{2.5}$ concentrations including background

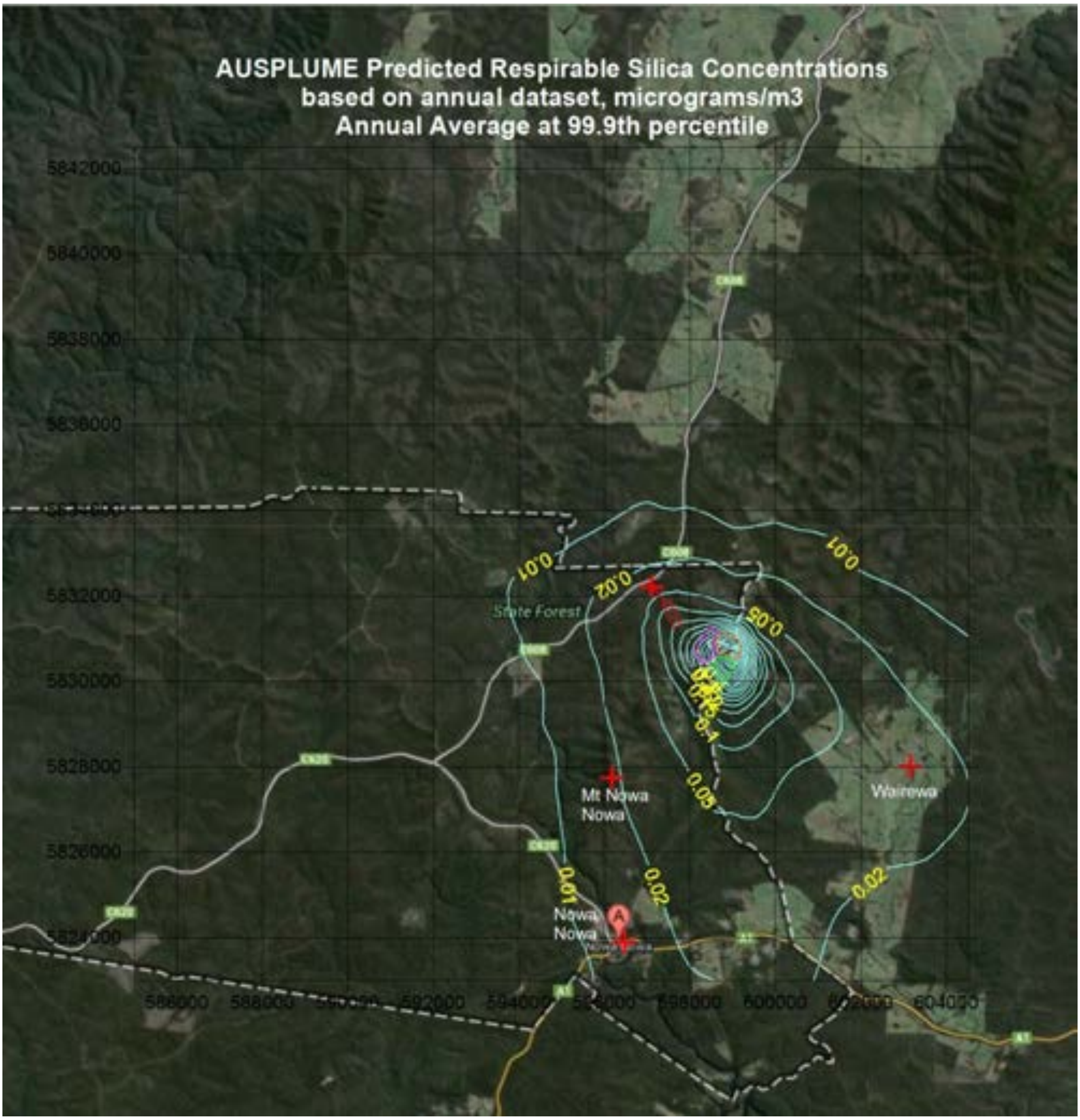

Figure A-5 Predicted Respirable Silica Dispersion