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Mandalong Transmission Line TL24 Relocation Project

Air Quality Impact Assessment

Report Number 630.11353

17 March 2016

Centennial Mandalong
12 Kerry Anderson Drive
MANDALONG NSW 2264

Version: Revision 2

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Air Quality Impact Assessment

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
630.11353-R1	FINAL	17 March 2016	Varun Marwaha	Jeff Mann	Jeff Mann

EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Centennial Mandalong Pty Ltd (Centennial Mandalong), a wholly owned subsidiary of Centennial Coal Company (Centennial), to undertake an Air Quality Impact Assessment (AQIA) for the proposed Mandalong Transmission Line TL24 Relocation Project (the Project).

The Project involves relocating a section of the 330 kilovolts (kV) transmission line TL24 in order to reduce the risk of subsidence impacts on critical infrastructure. The AQIA will accompany a Section 96(2) Modification to Development Consent SSD-5144. The aim of this AQIA is to assess the air quality impacts on surrounding sensitive receivers associated with the Project.

This report presented here utilises much of that derived and provided as part of the Mandalong Southern Extension Project AQIA (SLR 2013).

In order to assess the background air quality of the region a number of industrial facilities with the potential to have a cumulative impact on the local airshed were identified. This also included the impacts of the proposed Mandalong Southern Extension Project. A dispersion modelling exercise was performed to determine suitable background concentrations of pollutants in order to appropriately assess the cumulative impacts.

Dispersion modelling was conducted for the identified emission sources for two scenarios representing the 'Foundation' and 'Demolition' phases of the construction works related to the Project. It was concluded from the dispersion modelling exercise that the maximum 24-hour concentrations of PM_{10} and $PM_{2.5}$, along with annual average levels of dust and TSP, PM_{10} and $PM_{2.5}$ concentrations are unlikely to exceed the relevant air quality criterion at any of the identified sensitive receptors.

Overall, it is concluded that in regards to the air quality impacts, there are no limiting factors for the construction of the Project.

ABBREVIATIONS

%	percent
°C	degrees Celsius
µg	Microgram
µg/m^3	microgram per cubic metre of air
µg/Nm^3	microgram per normalised cubic metre of air (273K, 101.3kPa)
µm	micrometre or micron
AGL	above ground level
AHD	Australian Height Datum
AP-42	US EPA Emission Factor Handbook
AQIA	air quality impact assessment
AWS	automatic weather station
CSIRO	Australian Commonwealth Scientific and Industrial Research Organisation
DECC	NSW Department of Environment and Climate Change (see OEH)
DECCW	NSW Department of Environment, Climate Change and Water (see OEH)
DDG	dust deposition gauge
DP&E	Department of Planning and Environment
DGRs	Director General's Requirements
EETM	Emission Estimation Technique Manual
EF	Emission Factor
EIS	Environmental Impact Statement
EHS	Environmental Health and Safety
FEL	front-end loader
g	gram
g/m^2/month	grams per square metre per month
ha	hectare
J	joule
K	degrees Kelvin
kg	kilogram
kg/hr	kilogram per hour
km	kilometre
km E	kilometres east
km N	kilometres north
L	litre
m	metre
M	million
m/s	metre per second
m^2	square metre
m^3	cubic metre
min	minute
mm	millimetre
MMAS	Mandalong Mine Access Site
MSSS	Mandalong South Surface Site
Mt	million tonnes
Mtpa	million tonnes per annum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory (Australia)
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PM	Particulate Matter
PM_{10}	particular matter with an equivalent aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particular matter with an equivalent aerodynamic diameter of 2.5 microns or less
T	Tonne
SEE	Statement of Environmental Effects
TEOM	tapered element oscillating microbalance

TL24	Mandalong Transmission Line TL24 Relocation Project
tpa	tonnes per annum
TSP	total suspended particulate matter
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WGS	World Geodetic System

GLOSSARY

air dispersion model	A computer-based software program which provides a mathematical prediction of how pollutants from a source will be distributed in the surrounding area under specific conditions of wind, temperature, humidity and other environmental factors
airshed	The geographical area associated with a given air supply
algorithms	A step-by-step problem-solving procedure, especially an established, recursive computational procedure for solving a problem in a finite number of steps
ambient	Pertaining to the surrounding environment or prevailing conditions
anemometer	An instrument for measuring wind force and velocity
atmosphere	A gaseous mass surrounding the planet Earth that is retained by Earth's gravity. It is divided into five layers. Most of the weather and clouds are found in the first layer
atmospheric stability	The tendency of the atmosphere to resist or enhance vertical motion
atmospheric pressure	The force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere
background	The existing air quality in the Project area excluding the impacts from the proposed development
baseline monitoring program	A monitoring program designed to measure the ambient concentration levels which currently exist prior to the proposed development
CALMET	A meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain
CALPOST	A post-processor used to process CALPUFF files, producing tabulations that summarize results of the simulation for user-selected averaging periods
CALPUFF	A transport and dispersion model that advects “puffs” of material emitted from modelled sources, simulating dispersion and transformation processes
climatological	The science dealing with climate and climatic phenomena
combustion	The process of thermal oxidation. A chemical change, especially oxidation, accompanied by the production of heat and light
commissioning	A systematic process of ensuring that a new facility performs according to the documented design intent and the owner’s operational needs, and that specified system documentation and training are provided to the facility staff
crushers	A machine designed to reduce large rocks into smaller rocks, gravel, or rock dust
decommissioning	Planned shut-down or removal of a building, equipment, plant, etc., from operation or usage
dust deposition	Settling of particulate matter out of the air through gravitational effects (dry deposition) and scavenging by rain and snow (wet deposition)
dispersion	The spreading and dilution of substances emitted in a medium (e.g. air or water) through turbulence and mixing effects
diurnal	Relating to or occurring in a 24-hour period; daily
downwash	The grounding of an air pollution plume as it flows over nearby buildings or other structures due to turbulent eddies being formed in the downwind side of the building, resulting in elevated ground level concentrations.
downwind	The direction in which the wind is blowing
emission factor	A measure of the amount of a specific pollutant or material emitted by a specific

	process, fuel, equipment, or source based on activity data such as the quantity of fuel burnt, hours of operation or quantity of raw material consumed.
emissions inventory	A database that lists, by source, the amount of air pollutants discharged into the atmosphere from a facility over a set period of time (e.g. per annum, per hour)
erodible	A term used to describe a soil that is vulnerable to erosion by the agents of wind, water, ice
fugitive emissions	Pollutants which escape from an industrial process due to leakage, materials handling, transfer, or storage
guideline	A general rule, principle, or piece of advice. A statement or other indication of policy or procedure by which to determine a course of action.
meteorological	The science that deals with the phenomena of the atmosphere, especially weather and weather conditions
mixing height	The height to which the lower atmosphere will undergo mechanical or turbulent mixing, producing a nearly homogeneous air mass
modelling domain	The area over which the model is making predictions
particulate	Of, relating to, or formed of minute separate particles. A minute separate particle, as of a granular substance or powder
plume	A space in air, water, or soil containing pollutants released from a point source
pollutant	A substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource
prognostic	A prediction of the value of variables for some time in the future on the basis of the values at the current or previous times
qualitative assessment	An assessment of impacts based on a subjective, non-statistical oriented analysis
quantitative assessment	An assessment of impacts based on estimates of emission rates and air dispersion modelling techniques to provide estimate values of ground level pollutant concentrations.
receptor	Coordinate locations specified in an air dispersion model where ground level pollutant concentrations are calculated by the model
sensitive receptor	Locations such as residential dwellings, hospitals, churches, schools, recreation areas etc where people (particularly the young and elderly) may often be present, or locations with sensitive vegetation and crops.
spatial variation	Pertaining to variations across an area
standard	The prescribed level of a pollutant in the outside air that should not be exceeded during a specific time period to protect public health
standard deviation of wind direction	A measure of the variation in wind direction
synoptic meteorological data	A surface weather observation, made at periodic times (usually at 3-hourly and 6-hourly intervals), of sky cover, state of the sky, cloud height, atmospheric pressure reduced to sea level, temperature, dew point, wind speed and direction, amount of precipitation, hydrometeors and lithometeors, and special phenomena that prevail at the time of the observation or have been observed since the previous specified observation
temporal variation	Pertaining to variations with time
topography	Detailed mapping or charting of the features of a relatively small area, district, or locality
wind direction	The direction from which the wind is blowing

wind erosion	Detachment and transportation of loose topsoil or sand due to action by the wind
wind rose	A meteorological diagram depicting the distribution of wind direction and speed at a location over a period of time

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Centennial Mandalong Pty Ltd (Centennial Mandalong), a wholly owned subsidiary of Centennial Coal Company (Centennial), to undertake an Air Quality Impact Assessment (AQIA) for the proposed Mandalong Transmission Line TL24 Relocation Project (the Project).

The Project involves relocating a section of the existing 330 kilovolts (kV) transmission line.

The AQIA will accompany a Section 96(2) Modification to the Extension Project [State Significant Development (SSD) 5144]. The aim of this AQIA is to assess the air quality impacts on surrounding sensitive receivers associated with the Project.

The New South Wales Environment Protection Authority (NSW EPA) "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (DEC, 2005) (the Approved Methods) outline the requirements for conducting an AQIA (and the Sections of this report where the requirements are met), as follows:

- Description of local topographic features and sensitive receptor locations (**Section 2.6** & **Section 2.7** respectively).
- Establishment of air quality assessment criteria (**Section 3**).
- Analysis of climate and dispersion meteorology for the region (**Sections 5.2**).
- Description of existing air quality environment (**Section 6**).
- Compilation of a comprehensive emissions inventory for the existing and proposed activities (**Section 4**).
- Completion of atmospheric dispersion modelling and analysis of results (**Section 7**).
- Preparation of an air quality impact assessment report comprising the above.

The report presented here utilises much of that derived and provided as part of the Mandalong Southern Extension Project AQIA (SLR 2013). Specifically, the following elements of the AQIA are identical to those applied within the Extension Project AQIA:

- Topographical data (**Section 2.6**).
- Receptor locations (some exclusions noted in **Section 2.7**).
- Air quality criteria (minor edit to *'Potential Changes to the Ambient Air Quality NEPM'* sub-heading) (**Section 3**).
- Meteorological data (edits - provision of modelled meteorological data for TL24 Project site although identical modelling approach adopted) (**Section 5.2**).
- Background air quality (addition of MSSS construction impacts, and exclusion of MMAS vent fan emissions) (**Section 6**).

Although discussion and limited detail on each of the above elements is provided within this AQIA, any additional required detail should be sought from the Mandalong Southern Extension Project AQIA (SLR, 2013)[1].

[1] Available on: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5144.

2 PROJECT OVERVIEW

Centennial Mandalong is an underground mine currently operating under the provisions of Development Consent SSD-5144. Centennial Mandalong proposes to modify SSD-5144 pursuant to Section 96(2) of the NSW Environmental Planning and Assessment Act 1979.

Specifically, Centennial Mandalong is seeking to modify SSD-5144 for the Mandalong Transmission Line TL24 Relocation Project.

The Project proposes to relocate a section of 330 kV transmission line in order to reduce the risk of subsidence impacts on critical infrastructure which may be experienced as part of the Mandalong Southern Extension Project. It is anticipated that approximately 8.5 hectares (ha) of vegetation will be cleared for the relocation in addition to establishment and upgrade of access tracks, construction of tower foundations and establishment of new towers and removal and remediation of redundant infrastructure. At the completion of the Project Transgrid will continue to operate and maintain the transmission line and easement.

There is potential that the Project activities may occur concurrently with those of the construction of the proposed Mandalong South Surface Site (MSSS). The potential impacts associated with concurrent construction of the Project and MSSS have been examined within this AQIA.

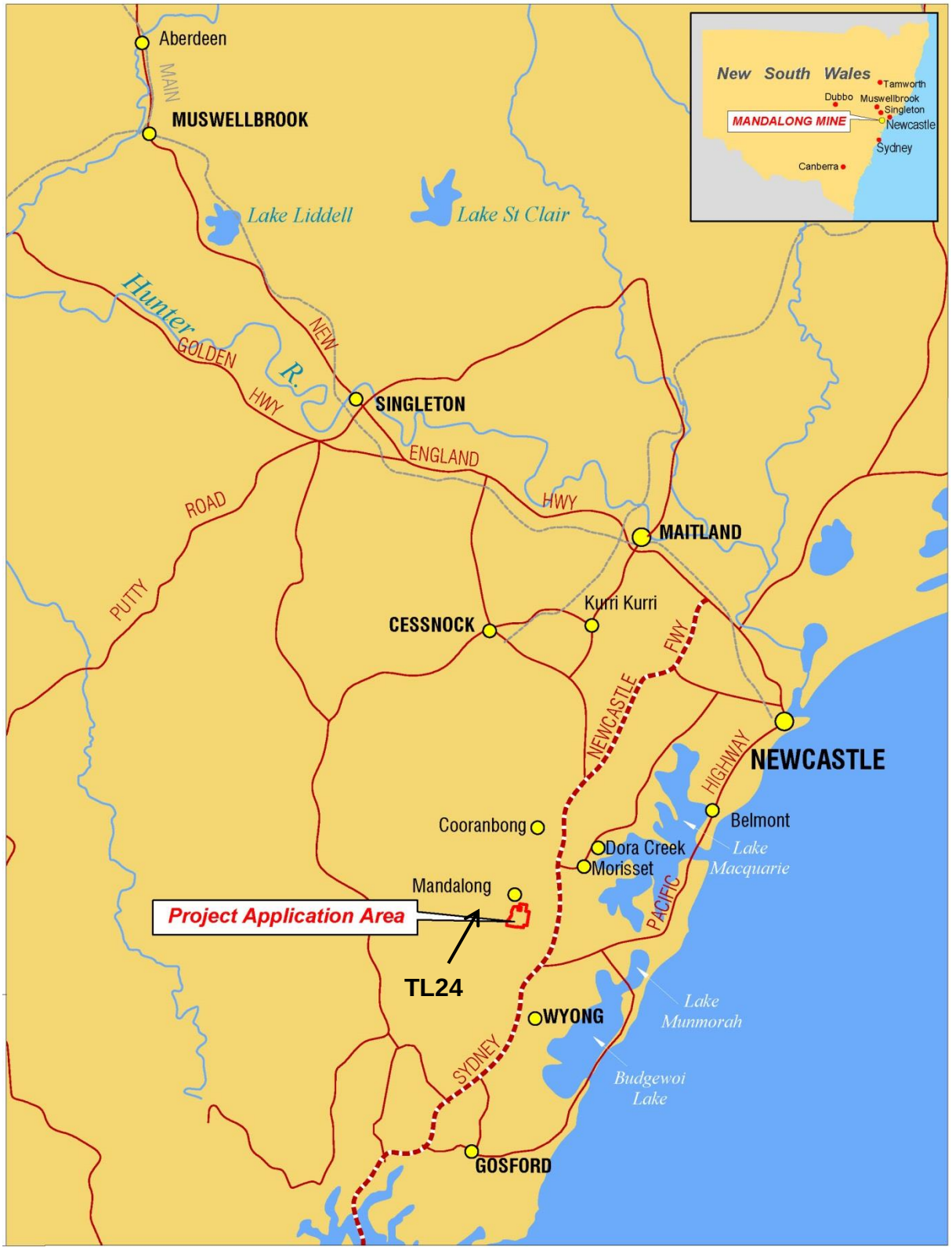
2.1 Project Location

Mandalong Mine is an existing underground coal mine operation located in the Lake Macquarie Local Government Area (LGA) approximately 130 kilometres (km) north of Sydney near Morisset within the Newcastle Coalfield of NSW.

The existing Mandalong Mine Access Site (MMAS) is located near Morisset approximately 35 km south-west of Newcastle. The MSSS is a proposed new surface facilities site to be located approximately 6.5 km south-west of the existing Mandalong Mine Access Site (MMAS).

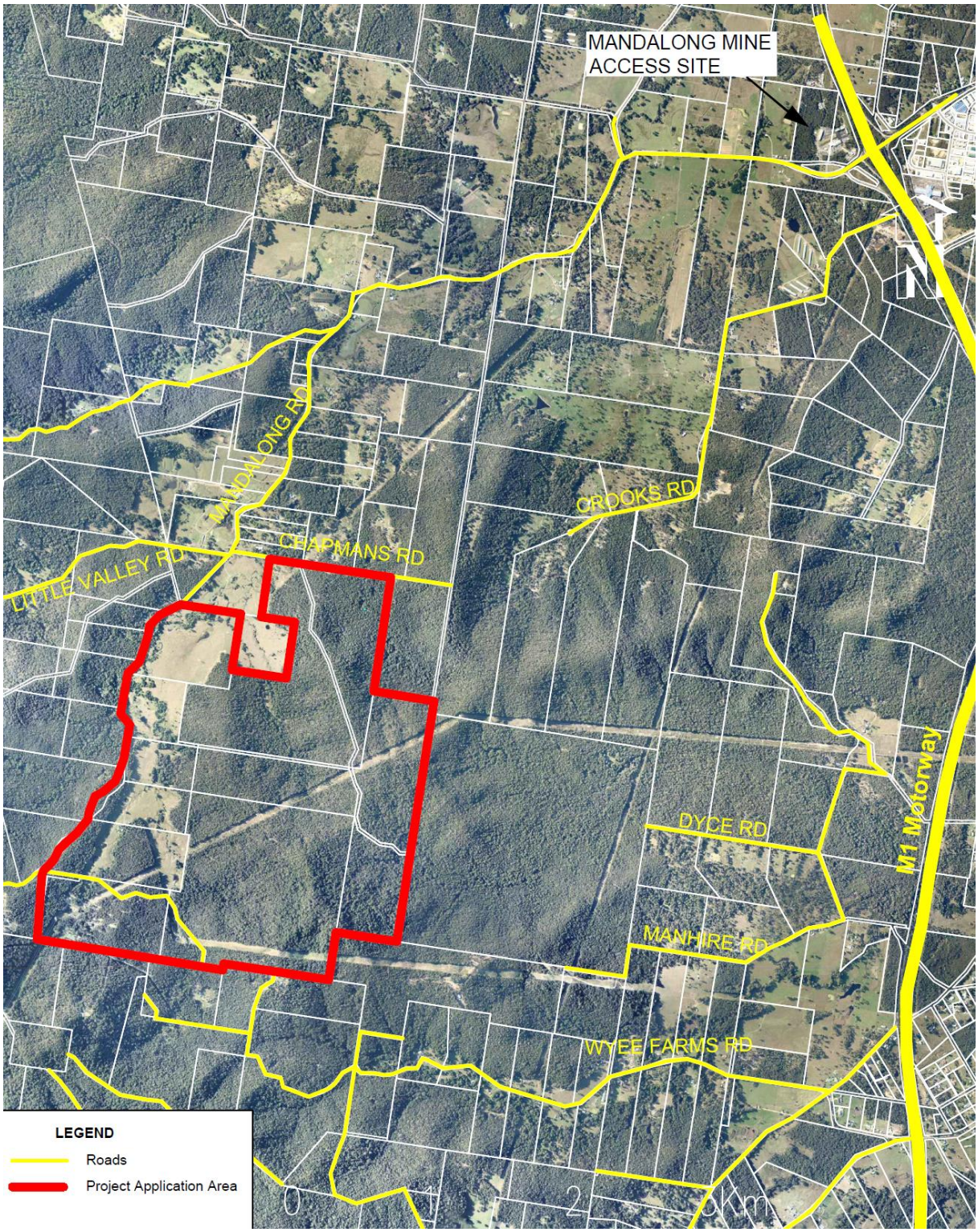
The regional location of the Project Application Area is shown in **Figure 1,** while the local setting of the Project is shown in **Figure 2**.

Figure 1 Regional Setting of the Mandalong Mine



Source: Centennial 2012

Figure 2 Local Setting of the Project



Source: Centennial 2015

2.2 Process Description

The Project is summarised into the following key stages:

- Establishment of access tracks and clearing of required 60 meters (m) wide easement;
- Construction of proposed tower foundations and establishment of towers for new section of TL24;
- Stringing and cutting in of lines on new section of TL24; and
- Removal and remediation of redundant TL24 structures.

The construction of the proposed MSSS may occur concurrently and is considered a major component of the potential cumulative air quality impacts (see **Section 6**).

2.3 Identification of Emission Sources

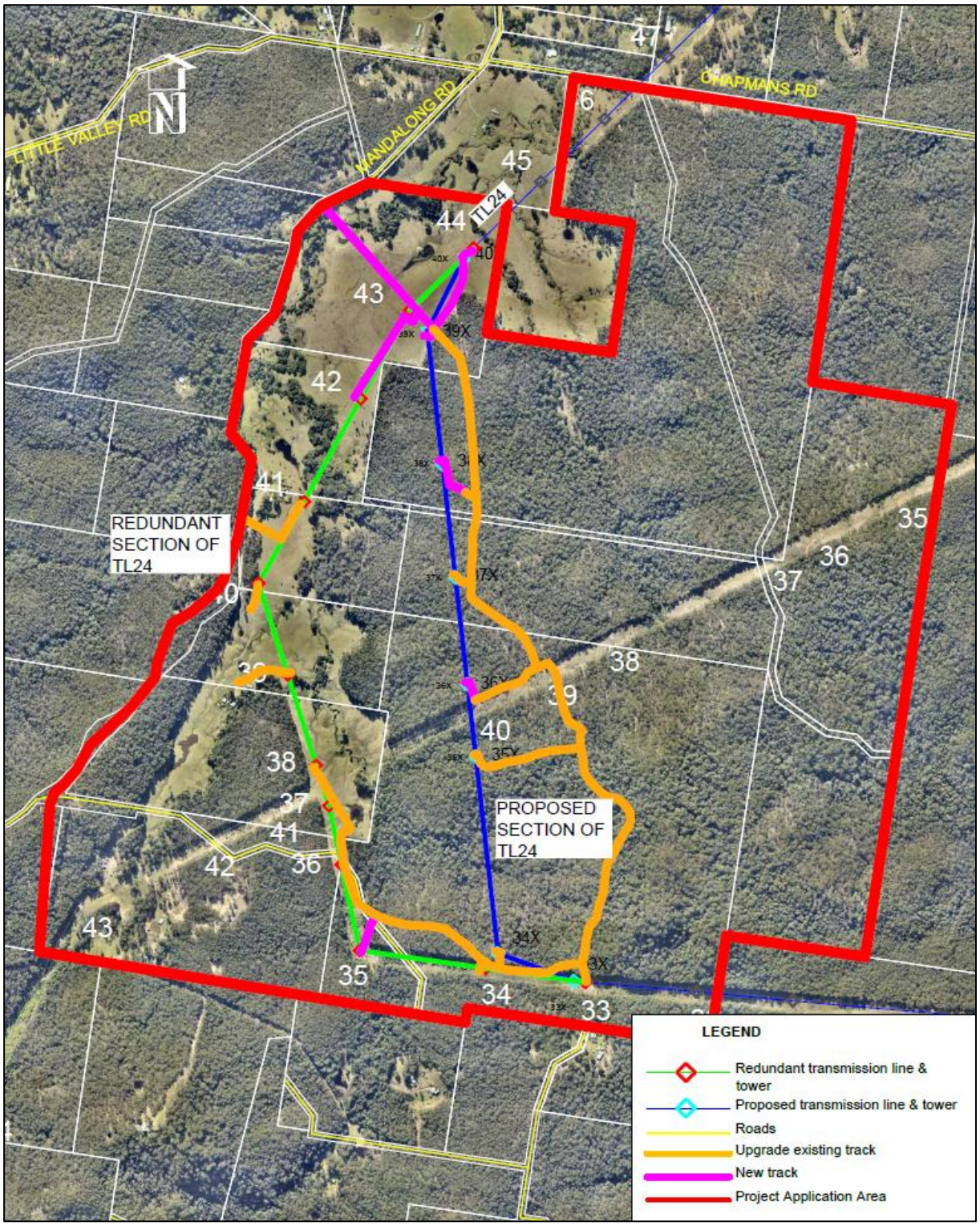
In regards to the activities identified in **Section 2.2**, the potential air pollutant emission sources for the Project are:

- Action of scrapers/front end loaders/excavators/bulldozers;
- Use of dump trucks for material movement;
- Movement of heavy vehicles on unpaved roads;
- Movement of light vehicles on unpaved roads;
- Wind erosion of exposed areas.

The conceptual layout of the proposed new transmission line layout is shown in **Figure 3**.

Although emissions may be expected during Project operation (maintenance activities), the total emissions (quantity and duration) are expected to be minimal in comparison with impacts during construction. No quantitative assessment of impacts during operation has been presented within this report. The transmission line and easement will continue to be operated and maintained by Transgrid.

Figure 3 Conceptual Layout of the Project



Source: Centennial 2015

2.3.1 Emission Controls

All construction activities will be performed to best practice, including the application of any required dust controls. It is noted that the location of the main construction activities will be within dense and newly cut forest, so it is likely that the generation of emissions from the site and subsequent transport of those emissions from source to receptor would be significantly reduced due to the 'wind break' effect. However, it is difficult to quantify the emissions control offered by the aforementioned 'wind break' effect.

As a conservative approach to this assessment, the particulate emissions due to construction activities at the Project Site are quantified with the application of no control measures, even though the adoption of best management practices during the construction activities is likely to offer significant emissions abatement.

Centennial Mandalong has indicated that additional control measures (such as water sprays) will be applied to construction activities when in close proximity to (<200 m) receptor locations (see **Section 2.7**).

A summary of the emissions sources and the associated pollutants evaluated in this assessment is shown in **Table 1**. The estimation of these emissions and the subsequent emissions inventory are discussed in detail in **Section 4**.

Table 1 Summary of Project Emission Sources and Emission Controls

Emission Source	Emission Type	Pollutants	Controls
Construction activities	Material handling Wind Erosion Wheel generated dust	TSP, PM_{10}, $PM_{2.5}$	Best management practice control measures for all construction activities (50% control at sources within 200 m of receptors)

2.4 Hours of Operation

The Project related construction activities are proposed to be conducted during daylight hours only in accordance with the NSW Interim Construction Noise Guideline (ICNG). There may be a requirement for TransGrid to undertake some stringing or cutting in activities outside of the daytime hours stipulated in the ICNG if any of the required outages on the lines are not possible during normal construction times. Throughout the construction period, Centennial Mandalong will undertake ongoing consultation to address any concerns raised by the local community.

For modelling purposes, a summary of the assumed hours of operation for construction activities is shown in **Table 2**.

Table 2 Summary of Hours of Operation

Day	Hours
Monday to Friday	7:00 am to 6:00 pm
Saturday	8:00 am to 1:00 pm
Sunday and Public Holidays	Limited work to avoid interruption to power supply

Source: Centennial 2015

2.5 Project Schedule

The Project is proposed to be conducted in sequential phases with the overall Project anticipated to be completed in approximately 9 months. At the time of preparing this assessment, only an indicative schedule is available. A summary of the indicative Project schedule is shown in **Table 3**.

Table 3 Indicative Project Schedule

Phase #	Project Phase	Estimated Duration (weeks)
1	Clearing and Site Establishment	4
2	Foundations	13
3	Tower Erection/Assembly	18
4	Stringing	2
5	Demolition	4

Source: Centennial 2015

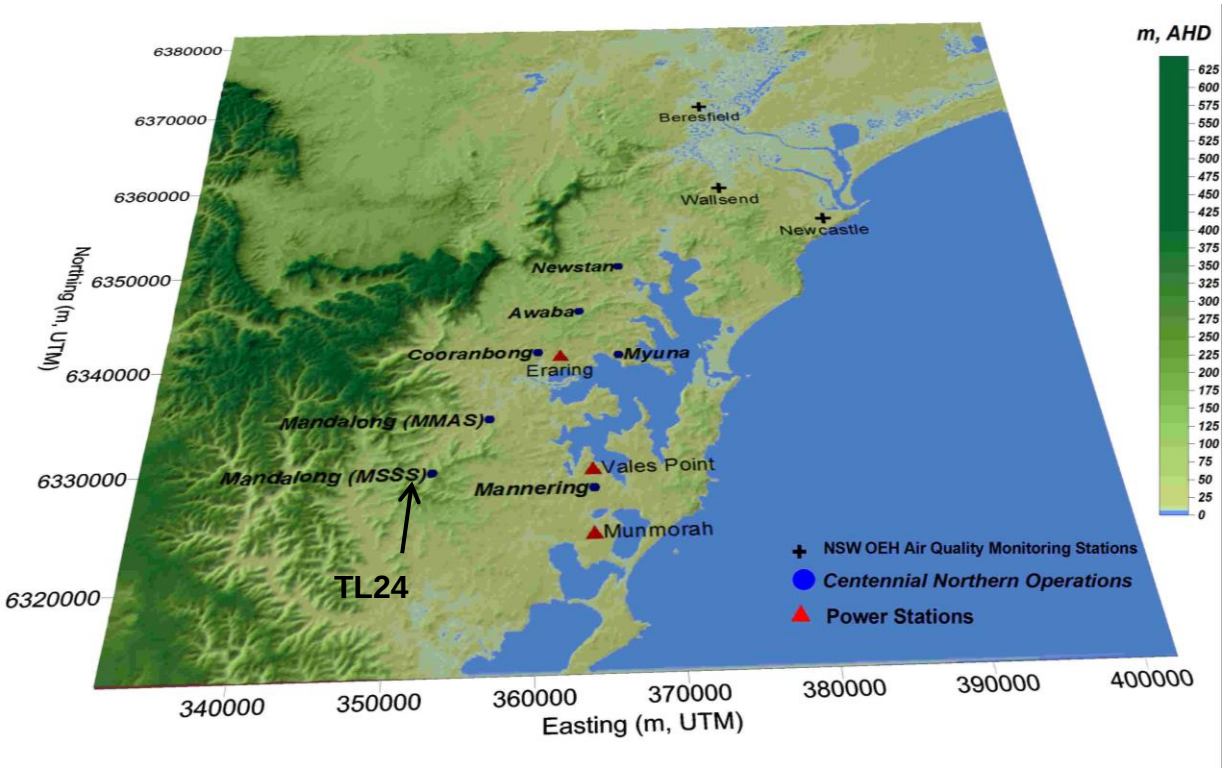
2.6 Local Topography

The topographical data used in the dispersion modelling exercise (refer **Section 5**) was sourced from the United States Geological Service's Shuttle Radar Topography Mission database that has recorded topography across Australia with a 3 arc second (~90 m) spacing.

The Project is located in undulating terrain, with elevated terrain located towards the east and west of the site. The Project is located at approximately 105 metres Australian Height Datum (m AHD).

The topography of the local region surrounding the Project Application Area and surrounds is presented in **Figure 4**.

Figure 4 Local and Regional Topography



2.7 Sensitive Receptors

A number of residences are located in the area surrounding the Project Application Area. A list of the nearest sensitive receptors in the immediate vicinity of the Project Application Area is presented in **Table 4** and **Figure 5**. These receptors are consistent with those assessed in the Extension Project AQIA.

Figure 5 Sensitive Receptors surrounding the Project Application Area

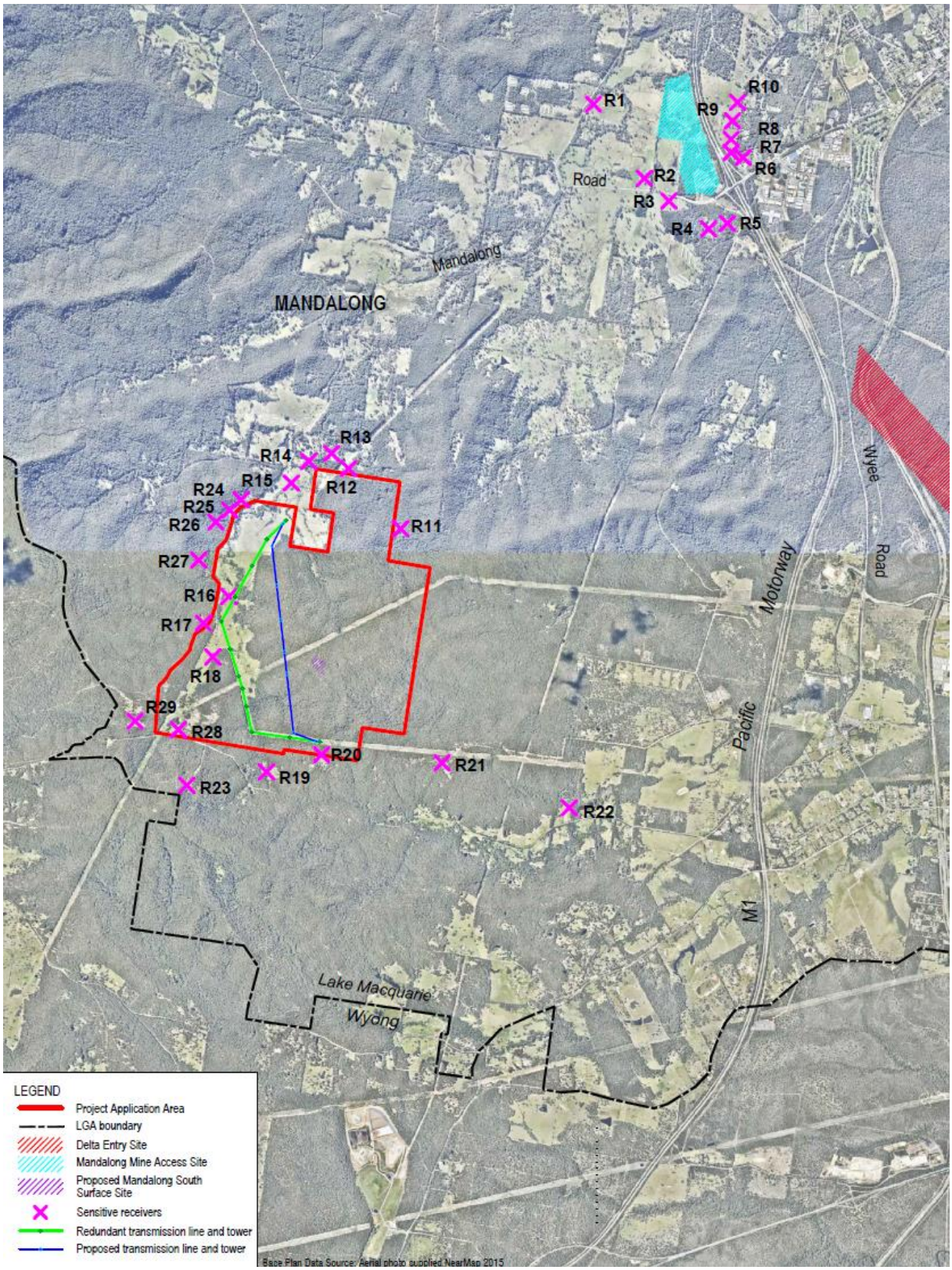


Table 4 Nearest Sensitive Receptors

Receptor ID	UTM Zone 56		Elevation (m, AHD)
	Easting (m)	Northing (m)	
R1	355,427	6,335,312	12
R2	355,895	6,334,569	10
R3	356,184	6,334,348	19
R4	356,581	6,334,067	30
R5	356,760	6,334,116	26
R6	356,922	6,334,796	17
R7	356,800	6,334,852	19
R8	356,805	6,334,981	16
R9	356,831	6,335,113	12
R10	356,863	6,335,341	10
R11	353,449	6,331,020	52
R12	353,006	6,331,635	40
R13	352,732	6,331,781	33
R14	352,513	6,331,701	29
R15	352,327	6,331,484	30
R16	351,703	6,330,361	39
R17	351,461	6,330,079	59
R18	351,554	6,329,722	51
R19	352,086	6,328,535	73
R20	352,607	6,328,751	138
R21	353,870	6,328,675	118
R22	355,151	6,328,201	43
R23	351,274	6,328,436	172
R24	351,825	6,331,330	57
R25	351,710	6,331,225	74
R26	351,570	6,331,105	72
R27	351,395	6,330,720	72
R28	351,190	6,329,000	84
R29	350,750	6,329,085	118

Although consistent with the receptors assessed as part of the Mandalong Southern Extension Project AQIA (SLR 2013), it is not considered that inclusion of all of the receptors in **Table 4** is required for the assessment of the current Project. A screening level assessment of maximum 24 hour average PM_{10} concentrations resulting from Project construction at R1 to R10 indicates that impacts are predicted to be <2 $\mu g/m^3$.

In the broader context of the AQIA provided for the Mandalong Southern Extension Project (i.e. maximum cumulative 24 hour PM_{10} impacts during construction of the Mandalong Southern Extension Project of between 14.3 $\mu g/m^3$ (R5) and 39 $\mu g/m^3$ (R7)), it is considered that exclusion of R1 to R10 from further assessment within this AQIA is appropriate. Impacts at R11 to R29 are discussed within this report.

It is noted that receptors R16 and R20 are within 200 m of the proposed construction activities. As discussed in **Section 2.3.1**, additional particulate controls will be employed at the sources close to these receptors.

3 ASSESSMENT CRITERIA

NSW State air quality guidelines formulated by the NSW Environment Protection Authority (EPA) are published in DEC 2005, Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, Department of Environment and Conservation NSW, August 2005 (hereafter 'the Approved Methods').

3.1 Particulate Matter

3.1.1 Particulates (as TSP)

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms "dust" and "particulates" are often used interchangeably. The term "particulate matter" refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP). The annual goal for TSP recommended by the NSW EPA is 90 micrograms per cubic metre of air (µg/m^3).

The TSP goal was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

3.1.2 Particulates (as PM_{10} and $PM_{2.5}$)

Emissions of particulate matter less than 10 µm and 2.5 µm in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The NSW EPA PM_{10} assessment goals set out in the Approved Methods are as follows:

- a 24-hour maximum of 50 µg/m3; and
- an annual average of 30 µg/m3.

The Approved Methods do not set any assessment goals for $PM_{2.5}$. In December 2000, the National Environment Protection Council (NEPC) initiated a review to determine whether a national ambient air quality criterion for $PM_{2.5}$ was required in Australia, and the feasibility of developing such a criterion. The review found that:

- there are health effects associated with these fine particles;
- the health effects observed overseas are supported by Australian studies; and
- fine particle standards have been set in Canada and the USA, and an interim criterion is proposed for New Zealand.

The review concluded that there is sufficient community concern regarding $PM_{2.5}$ to consider it an entity separate from PM_{10}.

As such, in July 2003, a variation to the Ambient Air Quality NEPM was made to extend its coverage to $PM_{2.5}$, setting the following *Interim Advisory Reporting Standards* for $PM_{2.5}$:

- a 24-hour average concentration of 25 µg/m3; and
- an annual average concentration of 8 µg/m3.

It is noted that the advisory reporting standards relating to $PM_{2.5}$ particles are interim guidelines only at the present time and *are not intended to represent air quality criteria*.

3.1.3 Potential Changes to the Ambient Air Quality NEPM

On 29 April 2014, Environment Ministers signalled their intent to vary the Ambient Air Quality NEPM based on the latest scientific understanding of the health risks resulting from airborne particulate pollution. On 15 July 2015 Ministers agreed in-principle to adopt reporting standards for annual average and 24-hour $PM_{2.5}$ as outlined in **Table 5** with a move to 7 $\mu g/m^3$ and 20 $\mu g/m^3$ over the longer term. Ministers agreed to finalise their consideration of the matter by 31 December 2015, including appropriate standards for PM_{10}.

Table 5 Proposed Variation to the Ambient Air Quality NEPM

Metric	Averaging Period	Current Standard	Options for Standard	Allowed Exceedances
PM_{10}	Annual average	None	No standards with consideration of 20 $\mu g/m^3$	N/A
	24-hour mean	50 $\mu g/m^3$	50 $\mu g/m^3$, with consideration of 45 $\mu g/m^3$ and 40 $\mu g/m^3$	See note below
$PM_{2.5}$	Annual average	8 $\mu g/m^3$ (advisory)	8 $\mu g/m^3$	N/A
	24-hour mean	25 $\mu g/m^3$ (advisory)	25 $\mu g/m^3$	See note below

The four options for the form of the 24-hour standards, and specifically the treatment of exceedances, for both PM_{10} and $PM_{2.5}$ are as follows:

- Business as usual option; a rule that allows a fixed number of exceedances of a PM standard in a given year, with no exclusion of data for exceptional events.
- A rule that allows a fixed number of exceedances of a PM standard in a given year, but with exclusion of data for exceptional events.
- A rule in which the 98th percentile PM concentration in a given year is compared with a standard, with no exclusion of data for exceptional events.
- A rule in which the 98th percentile PM concentration in a given year is compared with a standard, but with exclusion of data for exceptional events.

It has been identified by the NEPC that it is likely that jurisdictions will want to identify local issues that affect the form of the standards and therefore the options for this standard have been left open for the consultation phase.

For the purposes of this assessment, the currently adopted standards for PM_{10} are referenced and the standards for $PM_{2.5}$ are referenced assuming that these will be adopted.

3.1.4 Particulates (as Deposited Dust)

The preceding section is concerned in large part with the health impacts of airborne particulate matter. Nuisance impacts need also to be considered in relation to deposited dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 g/m^2/month.

Table 6 presents the impact assessment goals set out in the Approved Methods for dust deposition, showing the allowable increase in dust deposition level over the ambient (background) level to avoid dust nuisance.

Table 6 NSW EPA Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m^2/month	4 g/m^2/month

Source: Approved Methods, NSW DEC 2005.

3.2 Summary of Project Air Quality Goals

The air quality goals adopted for this assessment, which conform to current EPA and Federal air quality criteria, are summarised in **Table 7**.

Table 7 Project Air Quality Goals

Pollutant	Averaging Time	Goal
TSP	Annual	90 $\mu g/m^3$
PM_{10}	Maximum 24 Hours Annual	50 $\mu g/m^3$ 30 $\mu g/m^3$
$PM_{2.5}$	Maximum 24 Hours Annual	25 $\mu g/m^3$ (interim advisory reporting standard at the present time) 8 $\mu g/m^3$ (interim advisory reporting standard at the present time)
Dust Deposition	Annual	Maximum Incremental increase of 2 g/m^2/month Maximum Cumulative of 4 g/m^2/month (Project and other sources)

Source: Approved Methods, DEC 2005

4 EMISSIONS ESTIMATION

This section describes the scenarios assessed (**Section 4.1**), the methodology used to estimate emissions (**Section 4.2**) and the emissions inventory for the Project (**Section 4.3**).

4.1 Scenarios Assessed

Only one scenario is quantified to assess the pollutant emissions due to the construction activities of the Project. A summary of the emission sources assessed in is shown in **Table 8**.

Table 8 Summary of the Scenarios Assessed

Scenario	Emission Sources	Pollutants
Construction	Material handling, wheel generated dust, wind erosion	TSP, PM_{10}, $PM_{2.5}$ and deposited dust

This scenario assesses the emissions due to construction activities within the Project Application Area. The construction activities for the proposed Project would be conducted in phases. A summary of the proposed activities within the respective phases is shown in **Table 9**. The timelines for the construction phases are indicative and will be refined during contract negotiations. An indicative equipment inventory (Centennial 2015) is also presented in **Appendix C**.

Table 9 Summary of the Project Construction Activities

Phase	Description	Estimated Duration (weeks)
Clearing and Site Establishment	Clearing and/or widening required for the necessary access tracks Clearing of the 60 m wide easement; and Establishment of a 100 m x 100 m site office and laydown area	4
Foundations	Clear ground at each tower location (50 m^2) Establish construction pads (whether for tower foundation work or for crane/EWP)	13
Tower Erection/ Assembly	Transport unassembled materials required for tower erection Partially assemble the steel at each tower location Erect in assembled sections	18
Stringing	Connect the earth wires to the towers Undertake the stringing of the conductors between each tower by helicopter or harnessed personnel Draw-outs of conductor/earth wire, the conductors are sagged and clipped into their new steel lattice transmission towers Install the twin spacers utilising elevated work platforms or a helicopter along the new route	2
Demolition	The 12 steel lattice towers are removed, includes eight transmission towers (approximately 20 to 36 m tall) Excavate around each leg to at least 1.5 m below ground Remove the remaining steel to 1.5 m depth and back fill with the same soil and additional fill material to achieve flat ground Remove the redundant material from site and recycle where possible or disposed of to landfill Restore the site to pasture for grazing to mirror the surrounding land use	4

Source: Centennial 2015

It is noted that the longest running construction phase with dust generating activities will be 'Tower Erection/Assembly' (approximately 18 weeks). It has been advised by Centennial that the phases will generally be occurring sequentially at each tower site.

4.2 Methodology

Particulate emissions from the construction activities have been calculated using default or calculated emission factors for the relevant emission sources. Emission factors were sourced from the National Pollutant Inventory (NPI) *EETM for Mining* version 3.1 (DSEWPC, 2012), or from the US EPA AP-42 Emission Factor Handbook (USEPA, 2006) where suitable factors do not exist within the NPI documentation.

The NPI *EETM for Mining* (DSEWPC, 2012) and US EPA AP 42 contain emission factors for TSP and PM_{10}. No emission factors for $PM_{2.5}$ are provided within the NPI *EETM for Mining* and only limited emission factors for $PM_{2.5}$ are provided in US EPA AP 42.

Limited research has been undertaken to assess the fraction of PM_{10} from the wide range of sources which would be emitted as $PM_{2.5}$. Research has been conducted by the Midwest Research Institute (MRI) on behalf of the Western Regional Air Partnership (WRAP) with findings published within the document entitled *'Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors'* (MRI, 2006). This document provides seven proposed $PM_{2.5}/PM_{10}$ ratios for fugitive dust source categories as presented in **Table 10**.

Table 10 Proposed Particle Size Ratios for AP-42

Fugitive Dust Source	AP-42 Section	Proposed $PM_{2.5}/PM_{10}$ Ratio
Paved roads	13.2.1	0.15
Unpaved roads (public & industrial)	13.2.2	0.1
Construction & demolition	-	
Aggregate handling and storage piles	13.2.4	0.1
Industrial wind erosion	13.2.5	0.15
Agricultural tilling	-	0.2
Open area wind erosion	-	0.15

The $PM_{2.5}$ / PM_{10} ratios presented in **Table 10** have been used within this assessment to calculate the emissions of $PM_{2.5}$ attributable to this Project. The most appropriate ratio has been applied to each of the sources.

The emission factors used for the estimation of TSP, PM_{10} and $PM_{2.5}$ emissions from the construction activities at the Project are presented in **Table 11**.

Table 11 Summary of Emission Factors Used to Estimate Emissions

Activity	Emission Factor Equation	Units	Source of Emission Factor	Controls Applied
Excavator/FEL on overburden	$EF_{TSP} = 0.025$ $EF_{PM10} = 0.012$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors
Trucks dumping	$EF_{TSP} = 0.012$ $EF_{PM10} = 0.0043$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors
Compactor (Emission factor for Bulldozer has been adopted, as recommended by USEPA)	$EF_{TSP} = 17$ $EF_{PM10} = 4.1$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.1 \times EF_{PM10}$	kg/h/vehicle	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors
Bobcat & Backhoe (In the absence of specific emission factors for 'Bobcat & Backhoe', emission factors for 'Excavator/FEL on overburden' have been adopted)	$EF_{TSP} = 0.025$ $EF_{PM10} = 0.012$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors
Scraper (removing topsoil)	$EF_{TSP} = 0.029$ $EF_{PM10} = 0.0073$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors
Bulldozer	$EF_{TSP} = 17$ $EF_{PM10} = 4.1$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.1 \times EF_{PM10}$	kg/h/vehicle	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors
Wind erosion	$EF_{TSP} = 0.4$ $EF_{PM10} = 0.2$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.15 \times EF_{PM10}$	kg/ha/h	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors
Wheel generated dust from unpaved roads	$EF_{TSP} = 4.23$ $EF_{PM10} = 1.25$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors
Wheel generated dust from unpaved roads (used by light duty vehicles)	$EF_{TSP} = 0.94$ $EF_{PM10} = 0.33$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.1 \times EF_{PM10}$	kg/t	DSEWPC 2012 MRI 2006	50% control at sources within 200 m of receptors

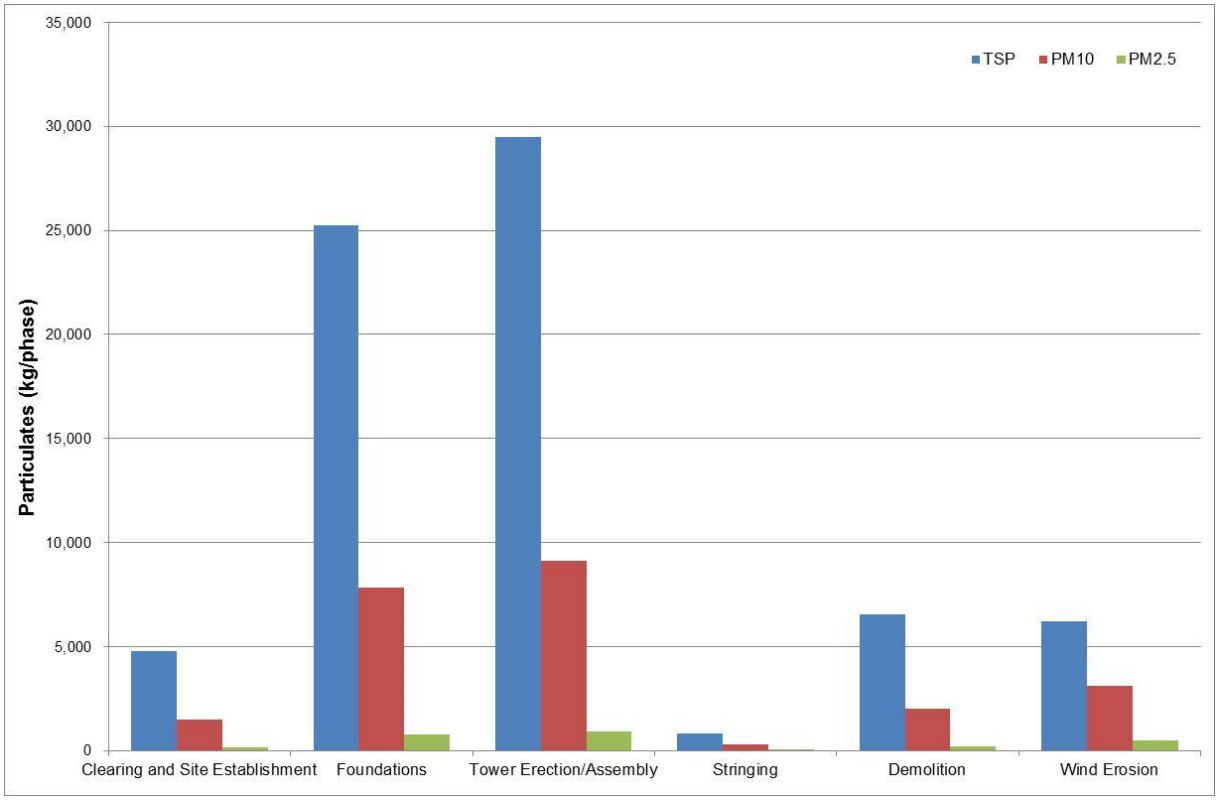
4.3 Emissions Inventory

Using the data provided by Centennial Mandalong (Centennial 2015) and the emission factors listed in **Section 4.2**, the emissions for the various construction phases have been calculated and a summary of these is shown in **Table 12** and **Figure 6**. A detailed emission inventory for the construction phase is presented in **Appendix B**

Table 12 A Summary of the Uncontrolled Emissions Inventory for each Phase (per phase)

Phase	TSP (kg/phase)	PM_{10} (kg/phase)	$PM_{2.5}$ (kg/phase)
Clearing and Site Establishment (4 weeks)	4,784	1,476	148
Foundations (13 weeks)	25,243	7,834	783
Tower Erection/Assembly (18 weeks)	29,481	9,121	912
Stringing (2 weeks)	819	287	29
Demolition (4 weeks)	6,557	2,030	203
Wind Erosion (41 weeks)	6,205	3,102	465
TOTAL	**73,090**	**23,851**	**2,540**

Figure 6 A Summary of the Uncontrolled Emissions Inventory for each Phase (per phase)



It is noted that the highest emissions are estimated during the 'Tower Erection/Assembly' phase. This is largely attributed to the highest number of days in this phase and the wheel generated emissions occurring due to the transport of material.

To estimate emissions to air during each phase it is considered appropriate to estimate the total emissions on a per day basis. The recalculated particulate emissions are shown in **Table 13**.

Table 13 A Summary of the Uncontrolled Emissions Inventory for each Phase (per day)

Phase	TSP (kg/day)	PM_{10} (kg/day)	$PM_{2.5}$ (kg/day)
Clearing and Site Establishment (4 weeks)	199	62	6
Foundations (13 weeks)	324	100	10
Tower Erection/Assembly (18 weeks)	273	84	8
Stringing (2 weeks)	68	24	2
Demolition (4 weeks)	273	85	8
Wind Erosion (41 weeks)	25	13	2

It is noted that on a per day basis, the particulate emissions are likely to be highest during the 'Foundations' construction phase followed by 'Demolition' and 'Tower Erection/Assembly' phase.

Based on the estimated emissions and the schedule of phases during the construction of the Project (see **Section 2.5**), and taking into account the likely proximity of these works to the receptor locations, it is considered appropriate to assess the potential air quality impacts of the two highest contributing construction phases ('Foundations' and 'Demolition').

Therefore, to assess the potential impact of worst case construction emissions due to the Project, two separate scenarios are assessed:

- Foundations phase – this represents a scenario where the 'foundations' phase is running for a full year. The emissions for the full year are calculated based on the emissions calculated in Table 13. This phase also includes wind erosion emissions for a full year.
- Demolition - this represents a scenario where the 'demolitions' phase is running for a full year. The emissions for the full year are calculated based on the emissions calculated in Table 13.

The impacts from these two phases will be listed for the identified sensitive receptors and the highest impact from the two phases will be taken forward for comparison against the relevant criteria.

Particulate emissions generated during the phases are assumed to occur at the maximum potential intensity for all days of the modelled year. In this way, all potential combinations of worst case emissions and meteorology have been examined. This is considered to be a highly conservative approach. A summary of the modelled particulate emissions is shown in **Table 14**.

Table 14 A Summary of the Modelled Emissions Inventory (per year)

Phase	TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)
Foundations	118,127	36,658	3,666
Demolition	99,721	30,868	3,087
Wind Erosion	9,206	4,603	690
TOTAL	**227,054**	**72,129**	**7,443**

5 AIR DISPERSION MODELLING METHODOLOGY

5.1 Model Selection

Emissions from the Project have been modelled using the US EPA's CALPUFF (Version 6.267) modelling system. CALPUFF is a transport and dispersion model that ejects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by a meteorological pre-processor CALMET, discussed further below. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentration or hourly deposition fluxes evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

The advantages of using CALPUFF (rather than using a steady state Gaussian dispersion model such as AUSPLUME) is its ability to handle calm wind speeds (<0.5 m/s) and the effects of complicated terrain on plume dispersion. Steady state models assume that meteorology is unchanged by topography over the modelling domain and may result in significant over or under estimation of air quality impacts.

More advanced dispersion models (such as CALPUFF) are approved for use by many regulatory authorities in situations where these models may be more appropriate than use of the Ausplume model. Such situations include those noted above (i.e. high frequency of calm wind conditions and/or complicated terrain).

5.2 Meteorological Modelling

5.2.1 Meteorological Modelling Approach

To adequately characterise the dispersion meteorology of the study site, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability. The meteorology of the study area was characterised based on a 3-Dimensional prognostic meteorological dataset for the region surrounding the study site.

To maintain consistency among the modelled results for several Centennial Mandalong projects, the meteorological modelling approach used for this Project is consistent with that performed for the Extension Project. Further detail on the meteorological modelling approach and validation can be found in the Mandalong Southern Extension Project AQIA.

5.2.2 Meteorological Data Used in Modelling

To provide an estimate of the predicted meteorological conditions which may be experienced at the Project Application Area, the modelled meteorological data 'extracted' at the location of construction works is presented.

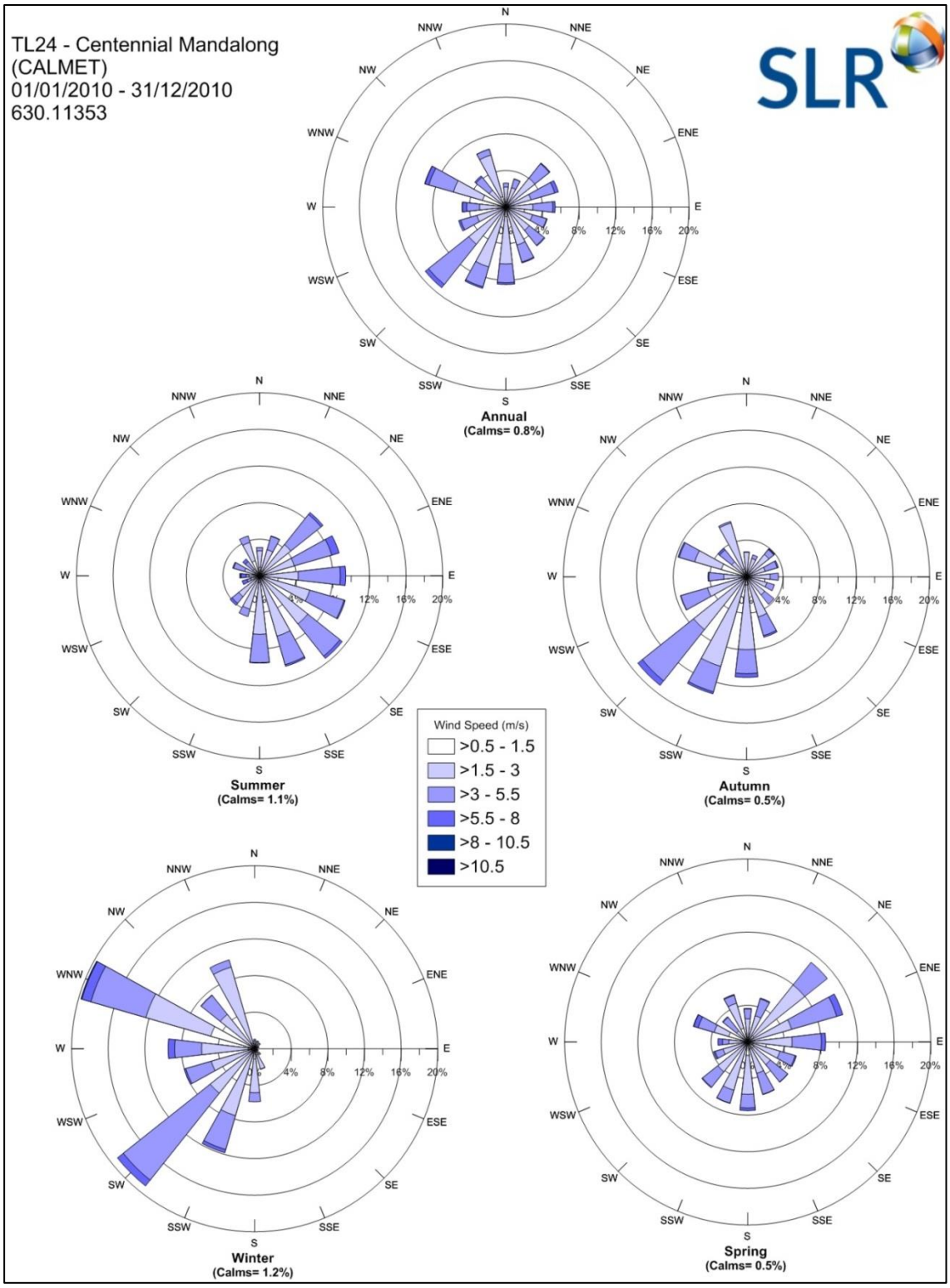
It is noted that the meteorological dataset developed for use in this assessment has been compiled to provide a robust and conservative assessment of potential downwind impacts due to particulate emissions from activities occurring within the Project Application Area.

5.2.2.1 Wind Speed and Direction

A summary of the annual wind behaviour predicted by CALMET for the Project for the year 2010 is presented as wind roses in **Figure 7**. These wind roses indicate that the region predominantly experiences light to moderate (between 1.5 m/s and 8 m/s) winds and that the wind direction is seasonally dependent. Winds occur reasonably evenly from all quadrants except the west and northwest quadrant, from which winds occur infrequently.

Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur just under 1% of the time during the year.

Figure 7 Annual Wind Roses for Project Application Area (CALMET predictions, 2010)



5.2.2.2 Atmospheric Stability

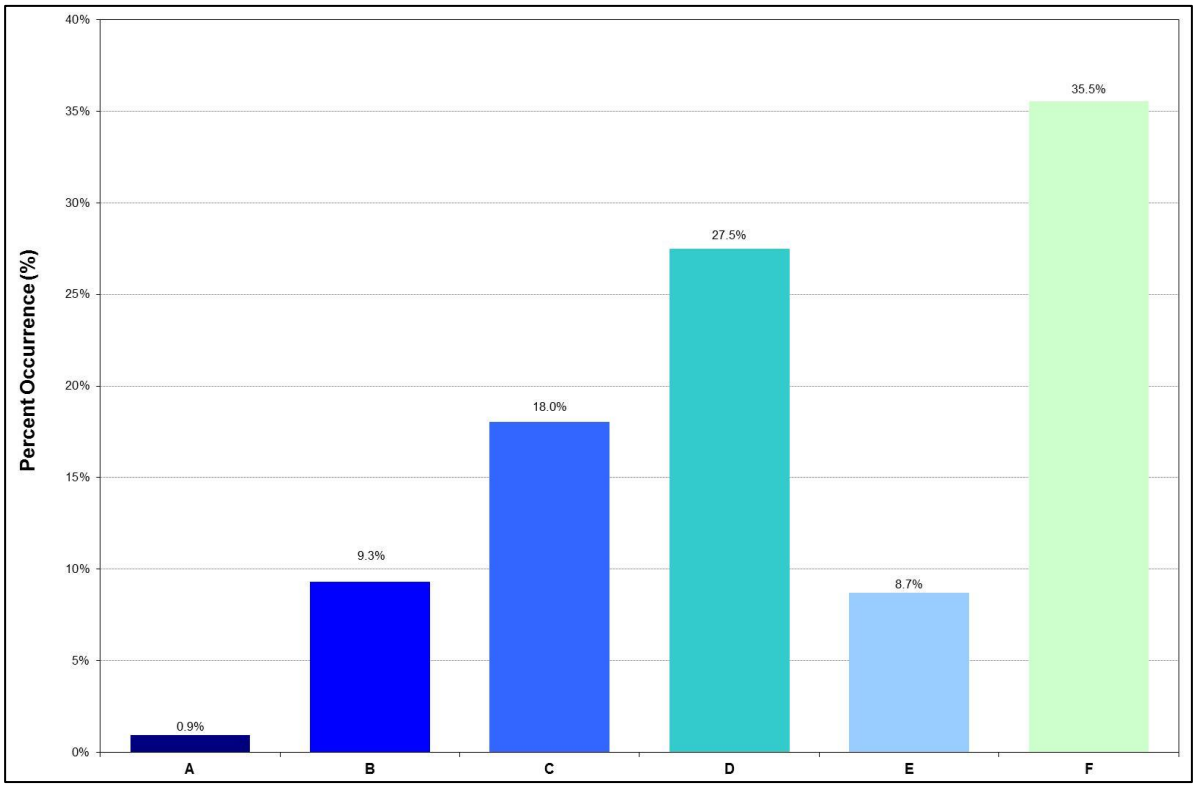
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability (see **Table 15**). These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models.

The frequency of each stability class predicted by CALMET at the Project Application Area during 2010 is presented in **Figure 8**. The results indicate a high frequency of conditions typical to Stability Class F. Stability Class F is indicative of very stable night time conditions, conducive to a low level of pollutant dispersion due to mechanical mixing.

Table 15 Description of Atmospheric Stability Classes

Atmospheric Stability Class	Category Description
A	Very unstable Low wind, clear skies, hot daytime conditions
B	Unstable Clear skies, daytime conditions
C	Moderately unstable Moderate wind, slightly overcast daytime conditions
D	Neutral High winds or cloudy days and nights
E	Stable Moderate wind, slightly overcast night-time conditions
F	Very stable Low winds, clear skies, cold night-time conditions

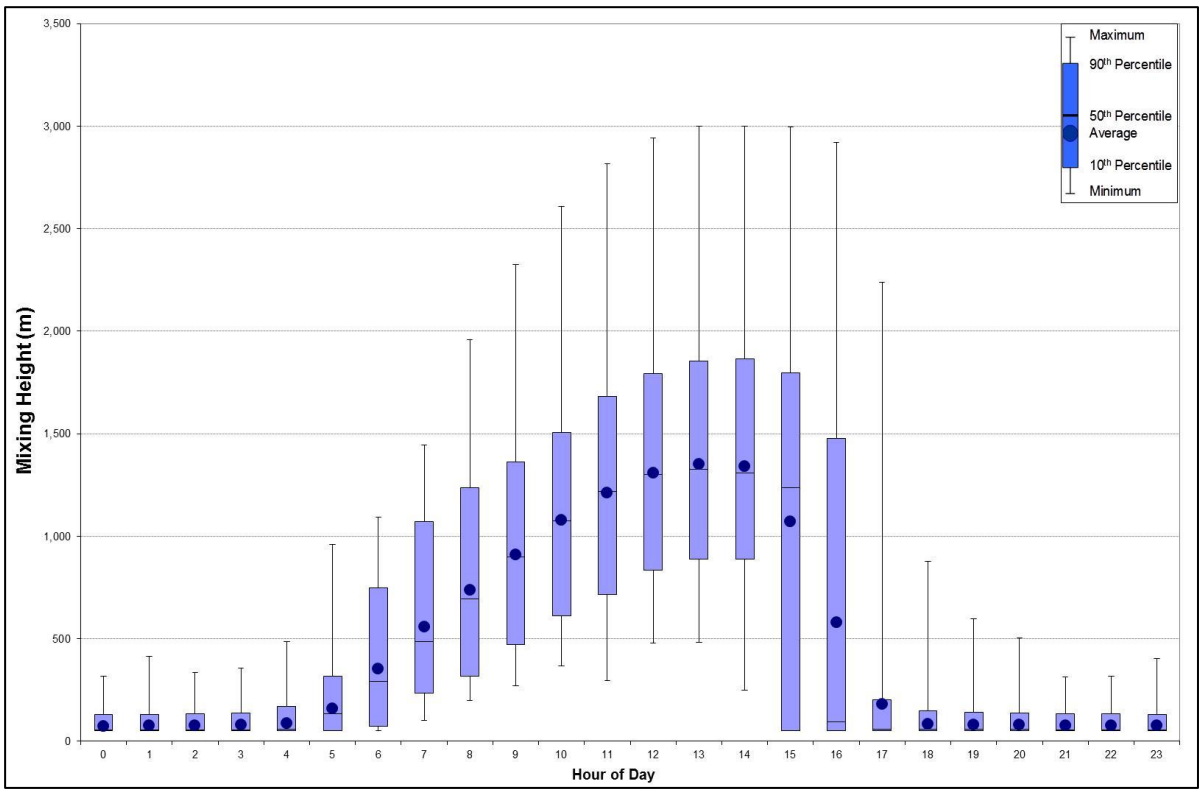
Figure 8 Stability Class Frequencies for the Project Application Area (CALMET predictions)



5.2.2.3 Mixing Heights

Diurnal variations in maximum and average mixing depths predicted by CALMET at the Project Application Area during 2010 are illustrated in **Figure 9**. As would be expected, an increase in the mixing depth 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 the growth of the convective mixing layer.

Figure 9 Mixing Heights at the Project Application Area (CALMET predictions, 2010)



5.3 Dispersion Modelling Source Setup

For dispersion modelling purposes:

- the area of each of the existing (to be demolished) towers (11) is assigned a volume source and the total emissions from the 'Demolition' phase were divided equally and allocated to each source. It is noted that there are a total of 12 towers, however demolition tower 12 (new) (co-located with the proposed tower 8 (old)) is not assumed to occur concurrently with the 'Foundations' phase.
- the area of each of the proposed towers (8) is assigned a volume source and the total emissions from the 'Foundations' phase were divided equally and allocated to each source.
- the total area of the access tracks and total area of each tower (22,520 m2) was represented in the model as a wind erosion source throughout the year.

6 EXISTING AIR QUALITY

The air quality in the region surrounding the Project Application Area is influenced by emissions generated by a range of sources, originating from both within and outside of the local area. Specifically, for the area surrounding the Project Application Area, air quality will be influenced by pollution transported into the area from more distant sources, emissions from power stations in the area, traffic-generated pollution, pollution from the Mandalong Mine (and Mandalong Southern Extension Project) and pollution generated by the Project itself.

To appropriately assess the *cumulative* impact of the Project, the incremental impact needs to be added to a dataset which includes the contributions of all other significant sources of particulate in the region. Given that air quality monitoring locations in the local area are limited to those close to major particulate sources (such as mine sites) the use of an alternative dataset has been investigated to avoid possible double-counting of Project-related emissions.

A detailed assessment of the background pollutant concentration levels was conducted in the AQIA for the Mandalong Southern Extension Project (SLR 2013). A summary of the findings is presented in the sections below.

6.1 Regional Background Air Quality

A range of monitored data sources were analysed to form a regional background dataset for the cumulative impact analysis.

The monitoring data for particulates (PM_{10} and $PM_{2.5}$) were analysed from the Wallsend monitoring station. The dust data was analysed from the dust gauges located around the Mandalong Mine Access Site (MMAS). A detailed analysis of the monitored data can be found in the AQIA for the Mandalong Southern Extension Project (SLR 2013).

A summary of the regional background data adopted for cumulative assessment purposes is shown in **Table 16**.

Table 16 Summary of the Regional Background Concentrations adopted for this Project

Pollutant	Value	Averaging Period	Data Source
PM_{10}	Varying	24-hour	Wallsend monitoring station
$PM_{2.5}$	Varying	24-hour	Wallsend monitoring station
TSP	29.4 µg/m^3	Annual	Adopted from the Wallsend data using a ratio of 2:1 (TSP:PM_{10})
Dust	2 g/m^2/month	Annual	Dust gauges - MMAS

6.2 Power Stations

The following power stations were identified in the vicinity of the Project Site:

- Eraring power station (ES1 and ES2);
- Munmorah power station; and
- Vales Point power station.

To determine the background particulate concentrations experienced across the domain, the increment from power stations located in the area needs to be added to the regional background particulate concentrations from **Section 6.1**.

A dispersion modelling exercise was performed using publicly available information to determine the contribution from power station emissions to particulate concentrations within the modelling domain. A full assessment methodology can be found in the AQIA for the Mandalong Southern Extension Project (SLR 2013). A summary of the results is shown in **Table 17**.

Table 17 Ambient Air Quality Environment for Assessment Purposes

Pollutant	Averaging Period	Summary
PM_{10}	24-hour	Maximum predicted increment 2.1 µg/m^3 at Receptor R22
	Annual	Maximum predicted increment 0.2 µg/m^3 at Receptor R22
$PM_{2.5}$	24-hour	Maximum predicted increment 0.5 µg/m^3 at Receptor R22
	Annual	Maximum predicted increment 0.04 µg/m^3 at Receptor R22
TSP	Annual	Maximum predicted increment 0.4 µg/m^3 at Receptor R22

It is noted that the power stations are located to the east of the Project. The maximum increment from power stations was predicted at receptor R22, which is the closest receptor to the power stations.

6.3 Other Concurrent Projects

The other significant projects in the vicinity of the current Project in the region (operational, approved but not constructed or proposed) are identified to be the Mandalong Southern Extension Project and the Mandalong Safety Duct and VAM RAB® Scale Up Project (located at MMAS). However it has been advised by Centennial Mandalong that the only Project likely to run concurrently with this Project is the construction of MSSS and access road. The VAMRAB® Project is also unlikely to result in cumulative air quality impacts due to the distance from the TL24 Relocation Project.

The construction of the MSSS and access road was addressed in the AQIA for Mandalong Southern Extension Project (SLR 2013) as Scenario 1. The modelled results for Scenario 1 (construction phase) of the Mandalong Southern Extension Project are reproduced in **Table 18** for R11 to R29 only. It is noted that impacts associated with the construction phase of the Mandalong Southern Extension Project resulted in maximum impacts at receptors R11 to R29.

Table 18 Predicted Air Quality Impacts resulting from Extension Project Construction (SLR 2013)

Receptor ID	PM_{10}		$PM_{2.5}$		TSP	Dust
	24-hour average	Annual Average	24-hour average	Annual Average	Annual Average	Annual Average
	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	(g/m^2/month)
R11	9.8	0.1	1.3	0.1	3.0	0.1
R12	6.2	0.1	0.9	0.1	1.7	0.1
R13	6.0	0.1	0.8	0.1	1.7	0.1
R14	7.2	0.1	0.9	0.1	1.9	0.1
R15	8.8	0.1	1.1	0.1	2.3	0.1
R16	15.5	0.1	2.0	0.2	5.4	0.2
R17	20.7	0.1	3.0	0.2	4.2	0.2
R18	27.4	0.1	3.9	0.2	5.0	0.2
R19	8.5	0.1	1.8	0.1	1.4	0.1
R20	18.1	0.1	4.3	0.1	2.3	0.1
R21	17.7	0.1	3.4	0.1	2.3	0.1
R22	4.0	0.1	0.7	0.0	0.7	0.0
R23	6.6	0.1	1.2	0.1	1.1	0.0
R24	14.2	0.1	1.9	0.1	3.4	0.2
R25	18.0	0.1	2.5	0.2	4.1	0.2
R26	16.5	0.1	2.3	0.2	4.1	0.2
R27	18.3	0.1	2.5	0.2	4.6	0.2
R28	12.8	0.1	1.7	0.1	3.2	0.1
R29	10.5	0.1	1.3	0.1	2.5	0.1

Source: SLR 2013

7 AIR QUALITY IMPACT ASSESSMENT

Dispersion modelling predictions of dust deposition rates and TSP, PM_{10} and $PM_{2.5}$ concentrations attributable to the Project at the residences/properties nominated in **Section 2.7** are presented in **Section 7.1** to **Section 7.4**. Pollutant isopleth plots are also provided in **Appendix A** which shows the maximum predicted increment concentrations and deposition rates of the pollutants assessed.

As discussed in **Section 6** a detailed assessment of the background concentrations in the area surrounding the Project Application Area has been performed. A regional background concentration has been determined, to which a contribution from local power stations has been added. Within this results section, a contribution from Project activities has been added to the background dataset (refer to **Section 6**), in order to provide information on the cumulative impact of Project and other activities on the air quality within the local area. For TSP, PM_{10} and $PM_{2.5}$ concentration results, several values are presented. The value presented and an explanation of each is provided in **Table 19**.

Table 19 Results Presentation and Explanation

Description in Results Tables	Data Presented	Reason for Presentation
Increment Background	Maximum *Regional* Background Concentration	Allows identification of the maximum regional measured particulate concentration across the entire year without power station and Project related sources.
Increment Power Station	Maximum Incremental Contribution from *Power Stations*	Indicates the maximum impact at each receptor across the entire year from power station operation only.
Increment Extension Project	Maximum Incremental Contribution from the Construction of the Extension Project	Identifies the maximum impact across the entire year from the construction sources for Extension Project only.
Increment TL-24 Foundation	Maximum Incremental Contribution from *Foundation* phase of the Project	Identifies the maximum impact across the entire year from sources associated with the *Foundation* phase of the Project only.
Increment TL-24 Demolition	Maximum Incremental Contribution from *Demolition* phase of the Project	Identifies the maximum impact across the entire year from sources associated with the *Demolition* phase of the Project only.
Cumulative Total Background	Maximum Regional Background Concentration plus *Power Stations* Contribution	Allows identification of the maximum measured particulate concentration across the entire year with a likely contribution from power station sources but without Project related sources.
Cumulative Total Background + Project	Maximum Cumulative Concentration (ALL SOURCES)	Indicates the maximum particulate concentration when regional background, power station sources and Project sources (Foundation or Demolition, as appropriate) are added together. However, the day of maximum impact from the Project may not fall on the same day as maximum impact from the power stations and regional background.
Cumulative Total Background on day of Maximum Increment from Project	Regional plus Power Station Background Concentration on day of Maximum Increment from Project	This shows the background particulate concentration on the day of the maximum predicted increment from Project operations (Foundation or Demolition, as appropriate).
Cumulative Maximum Cumulative Concentration on Day of Maximum Increment from Project	Maximum Cumulative Concentration on Day of Maximum Increment from Project	This allows examination of the day on which the maximum incremental particulate concentration (Foundation or Demolition, as appropriate) falls and the likely cumulative impact (power stations plus regional background plus Project) on that day.

7.1 Dust Deposition

Table 20 shows the results of the dispersion modelling for dust deposition resulting from the construction of the Project at each of the identified receptors using the emission rates calculated in **Section 4.3**. Contour plots of the incremental increase in dust deposition are also presented in **Appendix A**.

Table 20 Predicted Incremental Annual Average Dust Deposition Rates

Receptor ID	Annual Average Dust Deposition Rate (g/m^2/month)						
	Regional Background	Power Station	Extension Project	TL-24 Foundation	TL-24 Demolition	Total Background	Total Background + Project
R11	2.0	<0.1	0.1	<0.1	<0.1	<2.2	<2.3
R12	2.0	<0.1	0.1	<0.1	<0.1	<2.2	<2.3
R13	2.0	<0.1	0.1	<0.1	<0.1	<2.2	<2.3
R14	2.0	<0.1	0.1	0.1	<0.1	<2.2	<2.4
R15	2.0	<0.1	0.1	0.1	0.1	<2.2	<2.4
R16	2.0	<0.1	0.2	0.1	0.6	<2.3	<3.0
R17	2.0	<0.1	0.2	0.1	0.3	<2.3	<2.7
R18	2.0	<0.1	0.2	0.1	0.3	<2.3	<2.7
R19	2.0	<0.1	0.1	<0.1	<0.1	<2.2	<2.3
R20	2.0	<0.1	0.1	0.1	0.1	<2.2	<2.4
R21	2.0	<0.1	0.1	<0.1	<0.1	<2.2	<2.3
R22	2.0	<0.1	<0.1	<0.1	<0.1	<2.3	<2.4
R23	2.0	<0.1	<0.1	<0.1	<0.1	<2.3	<2.4
R24	2.0	<0.1	0.2	0.1	0.1	<2.3	<2.5
R25	2.0	<0.1	0.2	0.1	0.1	<2.3	<2.5
R26	2.0	<0.1	0.2	0.1	0.1	<2.3	<2.5
R27	2.0	<0.1	0.2	0.1	0.1	<2.3	<2.5
R28	2.0	<0.1	0.1	<0.1	<0.1	<2.2	<2.3
R29	2.0	<0.1	0.1	<0.1	<0.1	<2.2	<2.3

Note: Criteria – 2 g/m^2/month (incremental), 4 g/m^2/month (cumulative)

The results indicate that incremental and cumulative annual average dust deposition rates at all nominated residences/properties surrounding the Project are predicted to be well below the criterion of 2 g/m^2/month (incremental increase in dust deposition) and below 4 g/m^2/month (cumulative dust deposition) during all scenarios. As the nominated residences/properties were chosen as being indicative of all surrounding residences/properties, it can be concluded that cumulative dust deposition levels at residences/properties surrounding those modelled would also be below the relevant criterion of 4 g/m^2/month during these scenarios.

7.2 Particles (as TSP)

Table 21 presents the annual average TSP concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the emission rates calculated in **Section 4.3** resulting from the construction of the Project. The calculated background TSP concentrations have been discussed briefly in **Section 6**.

Table 21 Predicted Annual Average TSP Concentrations

Receptor ID	Annual Average TSP Concentrations (µg/m^3)						
	Regional Background	Power Station	Extension Project	TL-24 Foundation	TL-24 Demolition	Total Background	Total Background + Project
R11	29.4	0.3	3.0	1.0	0.8	32.7	33.7
R12	29.4	0.3	1.7	1.4	1.1	31.4	32.7
R13	29.4	0.3	1.7	1.3	1.2	31.4	32.8
R14	29.4	0.3	1.9	1.6	1.4	31.6	33.2
R15	29.4	0.3	2.3	3.3	2.8	32.0	35.3
R16	29.4	0.2	5.4	2.5	15.8	35.0	50.8
R17	29.4	0.2	4.2	1.7	8.9	33.9	42.8
R18	29.4	0.2	5.0	1.6	7.6	34.7	42.3
R19	29.4	0.2	1.4	0.8	1.3	31.1	32.4
R20	29.4	0.3	2.3	4.7	3.5	32.0	36.8
R21	29.4	0.3	2.3	0.6	0.4	32.1	32.7
R22	29.4	0.3	0.7	0.2	0.2	30.4	30.6
R23	29.4	0.3	1.1	0.6	0.6	30.8	31.4
R24	29.4	0.2	3.4	3.0	2.8	33.1	36.1
R25	29.4	0.2	4.1	2.9	2.8	33.7	36.7
R26	29.4	0.2	4.1	2.4	2.5	33.8	36.3
R27	29.4	0.2	4.6	2.1	2.9	34.3	37.2
R28	29.4	0.2	3.2	0.9	1.5	32.9	34.3
R29	29.4	0.2	2.5	0.7	1.0	32.2	33.2

Note: Project criterion – 90 µg/m^3

During construction of the Project, annual average TSP concentrations are predicted to be well below the criterion of 90 µg/m^3 at all identified sensitive receptor locations. As the nominated residences/properties were chosen as being indicative sensitive locations typifying the local surrounding communities, it is unlikely that annual average $PM_{2.5}$ concentrations at other residences and properties surrounding these modelled residences are currently in exceedances of the EPA criterion of 90 µg/m^3.

7.3 Particles (as PM_{10})

7.3.1 Maximum 24-Hour Average PM_{10} Concentrations

Table 22 presents the maximum 24-hour average PM_{10} concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the emission rates calculated in **Section 4.3** for construction operations associated with the Project. The calculated background PM_{10} concentrations have been discussed briefly in **Section 6**.

The maximum increment from the Project (24.3 µg/m^3) is predicted to occur at receptor 'R20'. As stated in **Table 19** the cumulative total background in **Table 22** represents the maximum of the sum of contemporaneous increments of regional background, power station operations and construction of the Mandalong Southern Extension Project.

The maximum 24-hour average PM_{10} concentrations are predicted to be below the criterion of 50 µg/m^3 at all identified sensitive receptor locations.

The assessment has considered the maximum daily emissions to be experienced on every day of the year. In reality, the construction of the Project would take only approximately 9 months. No additional air quality mitigation measures other than those to be implemented at sources within 200 m of receptors ('R16' and 'R20') have been included within the dispersion modelling exercise. Furthermore, it has been assumed that construction of both the Mandalong Southern Extension Project and the TL24 Project will occur concurrently.

Table 22 Predicted 24-Hour Maximum PM_{10} Concentrations

Receptor ID	Increment	Increment	Increment	Increment	Increment	Cumulative	Cumulative	Cumulative	Cumulative
	Regional Background *Maximum predicted incremental result from background only*	**Power Stations** *Maximum predicted incremental result from power stations only*	**Mandalong Southern Extension Project** *Maximum predicted incremental result from construction of Extension Project only*	**TL-24 Foundation** *Maximum predicted incremental result from current project only*	**TL-24 Demolition** *Maximum predicted incremental result from current project only*	**Total Background** *Maximum predicted concurrent and cumulative result from background and power stations*	**Total Background + Project** *Maximum predicted concurrent and cumulative result from background, power stations and project*	**Total Background on day of Maximum Increment from Project** *Maximum predicted concurrent and cumulative result from background and power stations on the day of the maximum predicted incremental result from the project*	**Maximum Cumulative Concentration on Day of Maximum Increment from Project** *Maximum predicted concurrent and cumulative result from background, power stations and the project on the day of the maximum predicted incremental result from the project*
	(µg/m^3)	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**
R11	32.8	1.2	9.8	3.3	2.9	33.0	33.4	13.8	17.1
R12	32.8	1.0	6.2	6.9	6.4	33.8	33.9	14.1	20.9
R13	32.8	1.0	6.0	6.3	6.4	33.7	34.0	15.9	22.3
R14	32.8	1.0	7.2	6.0	6.3	33.6	34.1	15.9	22.2
R15	32.8	1.1	8.8	11.0	8.7	33.4	34.9	17.4	28.5
R16	32.8	1.0	15.5	4.1	21.1	32.9	46.8	16.8	37.9
R17	32.8	0.9	20.7	3.9	13.9	37.3	43.4	16.0	29.9
R18	32.8	0.8	27.4	3.0	15.6	42.0	44.4	15.8	31.4
R19	32.8	1.3	8.5	3.7	8.2	32.8	32.8	11.5	19.7
R20	32.8	1.2	18.1	24.3	12.5	32.8	48.5	24.3	48.5
R21	32.8	1.4	17.7	3.5	3.0	34.9	36.5	23.1	26.7
R22	32.8	2.1	4.0	1.1	1.4	32.8	32.8	12.3	13.7
R23	32.8	1.3	6.6	2.8	4.0	32.8	32.8	14.1	18.1
R24	32.8	1.1	14.2	10.4	6.9	39.0	41.3	18.4	28.8
R25	32.8	1.0	18.0	9.0	7.0	41.6	43.4	20.1	29.2

Receptor ID	Increment	Increment	Increment	Increment	Increment	Cumulative	Cumulative	Cumulative	Cumulative
	Regional Background *Maximum predicted incremental result from background only*	**Power Stations** *Maximum predicted incremental result from power stations only*	**Mandalong Southern Extension Project** *Maximum predicted incremental result from construction of Extension Project only*	**TL-24 Foundation** *Maximum predicted incremental result from current project only*	**TL-24 Demolition** *Maximum predicted incremental result from current project only*	**Total Background** *Maximum predicted concurrent and cumulative result from background and power stations*	**Total Background + Project** *Maximum predicted concurrent and cumulative result from background, power stations and project*	**Total Background on day of Maximum Increment from Project** *Maximum predicted concurrent and cumulative result from background and power stations on the day of the maximum predicted incremental result from the project*	**Maximum Cumulative Concentration on Day of Maximum Increment from Project** *Maximum predicted concurrent and cumulative result from background, power stations and the project on the day of the maximum predicted incremental result from the project*
	(µg/m^3)	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**
R26	32.8	1.0	16.5	6.7	7.2	39.0	40.5	21.8	28.9
R27	32.8	1.0	18.3	4.6	10.4	36.2	37.9	12.6	23.0
R28	32.8	1.0	12.8	2.4	4.7	35.6	37.1	14.1	18.9
R29	32.8	0.9	10.5	2.9	3.4	35.0	36.0	13.3	16.6

Note: The cumulative results columns may not be equal to the sum of the incremental results columns. This is because the incremental results are the maximum 24-hour average predicted over the entire year modelled as a result of the emissions from each source, while the cumulative results are the maximum 24-hour average predicted as a result of the combined emissions from each source. If the maximum incremental 24-hour impacts from each source occur on different days at a given receptor (i.e. under different meteorological conditions), then the maximum cumulative prediction may be lower than the sum of the maximum predicted incremental impacts. For further information, refer to Table 19.

Note: Project criterion – 50 µg/m^3

7.3.2 Annual Average PM_{10} Concentrations

Table 23 presents the annual average PM_{10} concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the emission rates calculated in **Section 4.3** resulting from the construction of the Project. The calculated background PM_{10} concentrations have been discussed briefly in **Section 6**.

Table 23 Predicted Annual Average PM_{10} Concentrations

Receptor ID	Annual Average PM_{10} Concentrations ($\mu g/m^3$)						
	Regional Background	Power Station	Mandalong Southern Extension Project	TL-24 Foundation	TL-24 Demolition	Total Background	Total Background + Project
R11	14.7	0.1	0.8	0.4	0.3	15.7	16.1
R12	14.7	0.1	0.5	0.5	0.5	15.3	15.8
R13	14.7	0.1	0.5	0.5	0.5	15.3	15.8
R14	14.7	0.1	0.5	0.6	0.5	15.4	16.0
R15	14.7	0.1	0.7	1.2	1.0	15.5	16.7
R16	14.7	0.1	1.5	0.9	5.3	16.3	21.6
R17	14.7	0.1	1.2	0.7	3.1	16.0	19.1
R18	14.7	0.1	1.4	0.6	2.7	16.2	18.9
R19	14.7	0.1	0.4	0.3	0.5	15.2	15.7
R20	14.7	0.1	0.6	1.7	1.3	15.5	17.2
R21	14.7	0.1	0.6	0.3	0.2	15.5	15.8
R22	14.7	0.1	0.2	0.1	0.1	15.1	15.1
R23	14.7	0.1	0.3	0.2	0.2	15.1	15.4
R24	14.7	0.1	1.0	1.1	1.0	15.8	16.9
R25	14.7	0.1	1.2	1.1	1.0	16.0	17.1
R26	14.7	0.1	1.2	0.9	1.0	16.0	17.0
R27	14.7	0.1	1.3	0.8	1.1	16.1	17.2
R28	14.7	0.1	0.9	0.4	0.6	15.7	16.3
R29	14.7	0.1	0.7	0.3	0.4	15.5	15.9

Note: Project criterion – 30 $\mu g/m^3$

During the construction operations for the Project, annual average PM_{10} concentrations are predicted to be below the criterion of 30 $\mu g/m^3$ at all identified sensitive receptor locations. As the nominated residences/properties were chosen as being indicative sensitive locations typifying the local surrounding communities, it is unlikely that annual average $PM_{2.5}$ concentrations at other residences and properties surrounding these modelled residences are currently in exceedances of the EPA criterion of 30 $\mu g/m^{3.}$

7.4 Particles (as $PM_{2.5}$)

7.4.1 Maximum 24-Hour Average $PM_{2.5}$ Concentrations

Table 24 presents the maximum 24-hour average $PM_{2.5}$ concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the emission rates calculated in **Section 4.3** for the Project. The calculated background PM_{10} concentrations have been discussed briefly in **Section 6**.

The maximum increment from the Project (2.5 µg/m^3) is predicted to occur at receptor 'R20'. As stated in **Table 19** cumulative total background in **Table 22** represents the maximum of the sum of contemporaneous increments of regional background, power station operations and construction of the Mandalong Southern Extension Project.

The maximum 24-hour average PM_{10} concentrations are predicted to be below the criterion of 25 µg/m^3 at all identified sensitive receptor locations.

Table 24 Predicted 24-Hour Maximum $PM_{2.5}$ Concentrations

Receptor ID	Increment	Increment	Increment	Increment	Increment	Cumulative	Cumulative	Cumulative	Cumulative
	Regional Background *Maximum predicted incremental result from background only*	**Power Stations** *Maximum predicted incremental result from power stations only*	**Mandalong Southern Extension Project** *Maximum predicted incremental result from construction of Extension Project only*	**TL-24 Foundation** *Maximum predicted incremental result from current project only*	**TL-24 Demolition** *Maximum predicted incremental result from current project only*	**Total Background** *Maximum predicted concurrent and cumulative result from background and power stations*	**Total Background + Project** *Maximum predicted concurrent and cumulative result from background, power stations and project*	**Total Background on day of Maximum Increment from Project** *Maximum predicted concurrent and cumulative result from background and power stations on the day of the maximum predicted incremental result from the project*	**Maximum Cumulative Concentration on Day of Maximum Increment from Project** *Maximum predicted concurrent and cumulative result from background, power stations and the project on the day of the maximum predicted incremental result from the project*
	(µg/m^3)	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**
R11	18.8	0.43	1.3	0.3	0.3	1.3	19.0	4.9	5.3
R12	18.8	0.40	0.9	0.7	0.7	0.9	19.4	4.2	4.9
R13	18.8	0.37	0.8	0.7	0.7	0.8	19.3	4.9	4.9
R14	18.8	0.35	0.9	0.6	0.7	0.9	19.3	4.8	4.8
R15	18.8	0.32	1.1	1.1	0.9	1.1	19.4	3.5	4.6
R16	18.8	0.26	2.0	0.5	2.1	2.1	18.8	4.1	4.1
R17	18.8	0.24	3.0	0.4	1.5	3.1	18.8	6.2	6.2
R18	18.8	0.22	3.9	0.3	1.7	4.1	18.8	6.0	6.0
R19	18.8	0.33	1.8	0.4	0.8	1.8	18.8	4.2	4.2
R20	18.8	0.30	4.3	2.5	1.3	4.3	18.8	6.2	8.8
R21	18.8	0.34	3.4	0.4	0.3	3.4	18.8	6.8	7.2
R22	18.8	0.49	0.7	0.1	0.1	0.7	18.8	5.2	5.2
R23	18.8	0.33	1.2	0.3	0.4	1.2	18.8	4.8	4.8
R24	18.8	0.27	1.9	1.1	0.7	1.9	18.9	4.9	6.0
R25	18.8	0.26	2.5	0.9	0.7	2.5	18.9	5.4	6.3

Receptor ID	Increment	Increment	Increment	Increment	Increment	Cumulative	Cumulative	Cumulative	Cumulative
	Regional Background *Maximum predicted incremental result from background only*	**Power Stations** *Maximum predicted incremental result from power stations only*	**Mandalong Southern Extension Project** *Maximum predicted incremental result from construction of Extension Project only*	**TL-24 Foundation** *Maximum predicted incremental result from current project only*	**TL-24 Demolition** *Maximum predicted incremental result from current project only*	**Total Background** *Maximum predicted concurrent and cumulative result from background and power stations*	**Total Background + Project** *Maximum predicted concurrent and cumulative result from background, power stations and project*	**Total Background on day of Maximum Increment from Project** *Maximum predicted concurrent and cumulative result from background and power stations on the day of the maximum predicted incremental result from the project*	**Maximum Cumulative Concentration on Day of Maximum Increment from Project** *Maximum predicted concurrent and cumulative result from background, power stations and the project on the day of the maximum predicted incremental result from the project*
	(µg/m^3)	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**	**(µg/m^3)**
R26	18.8	0.26	2.3	0.7	0.7	2.4	18.8	5.7	5.7
R27	18.8	0.25	2.5	0.5	1.1	2.5	18.8	3.9	3.9
R28	18.8	0.24	1.7	0.3	0.5	1.7	18.8	4.8	4.8
R29	18.8	0.22	1.3	0.3	0.3	1.3	18.8	3.3	3.3

Note: The cumulative results columns may not be equal to the sum of the incremental results columns. This is because the incremental results are the maximum 24-hour average predicted over the entire year modelled as a result of the emissions from each source, while the cumulative results are the maximum 24-hour average predicted as a result of the combined emissions from each source. If the maximum incremental 24-hour impacts from each source occur on different days at a given receptor (i.e. under different meteorological conditions), then the maximum cumulative prediction may be lower than the sum of the maximum predicted incremental impacts. For further information, refer to Table 19.

Note: Project criterion – 25 µg/m^3

7.4.2 Annual Average $PM_{2.5}$ Concentrations

Table 25 presents the annual average $PM_{2.5}$ concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the emission rates calculated in **Section 4.3** resulting from the construction of the Project. The calculated background $PM_{2.5}$ concentrations have been discussed briefly in **Section 6**.

Table 25 Predicted Annual Average $PM_{2.5}$ Concentrations

Receptor ID	Annual Average $PM_{2.5}$ Concentrations (µg/m^3)						
	Regional Background	Power Station	Extension Project	TL-24 Foundation	TL-24 Demolition	Total Background	Total Background + Project
R11	4.6	<0.1	0.1	<0.1	<0.1	<4.8	<4.9
R12	4.6	<0.1	0.1	0.1	<0.1	<4.8	<5.0
R13	4.6	<0.1	0.1	0.1	<0.1	<4.8	<5.0
R14	4.6	<0.1	0.1	0.1	0.1	<4.8	<5.0
R15	4.6	<0.1	0.1	0.1	0.1	<4.8	<5.0
R16	4.6	<0.1	0.2	0.1	0.5	<4.9	<5.5
R17	4.6	<0.1	0.2	0.1	0.3	<4.9	<5.3
R18	4.6	<0.1	0.2	0.1	0.3	<4.9	<5.3
R19	4.6	<0.1	0.1	<0.1	0.1	<4.8	<4.9
R20	4.6	<0.1	0.1	0.2	0.1	<4.8	<5.0
R21	4.6	<0.1	0.1	<0.1	<0.1	<4.8	<4.9
R22	4.6	<0.1	<0.1	<0.1	<0.1	<4.8	<4.9
R23	4.6	<0.1	0.1	<0.1	<0.1	<4.8	<4.9
R24	4.6	<0.1	0.1	0.1	0.1	<4.8	<5.0
R25	4.6	<0.1	0.2	0.1	0.1	<4.9	<5.1
R26	4.6	<0.1	0.2	0.1	0.1	<4.9	<5.1
R27	4.6	<0.1	0.2	0.1	0.1	<4.9	<5.1
R28	4.6	<0.1	0.1	<0.1	0.1	<4.8	<5.0
R29	4.6	<0.1	0.1	<0.1	<0.1	<4.8	<4.9

Note: Project criterion – 8 µg/m^3

During the construction operations at the Project, annual average $PM_{2.5}$ concentrations are predicted to be below the criterion of 30 µg/m^3 at all identified sensitive receptor locations. As the nominated residences/properties were chosen as being indicative sensitive locations typifying the local surrounding communities, it is unlikely that annual average $PM_{2.5}$ concentrations at other residences and properties surrounding these modelled residences are currently in exceedances of the EPA criterion of 8 µg/m^3.

8 CONCLUSION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Centennial Mandalong Pty Ltd (Centennial Mandalong), a wholly owned subsidiary of Centennial Coal Company (Centennial), to undertake an Air Quality Impact Assessment (AQIA) for the proposed Mandalong Transmission Line TL24 Relocation Project (the Project).

The Project involves relocating a section of the 330 kilovolts (kV) transmission line TL24 in order to reduce the risk of subsidence impacts on critical infrastructure. The AQIA will accompany a Section 96(2) Modification to Development Consent SSD-5144. The aim of this AQIA is to assess the air quality impacts on surrounding sensitive receivers associated with the Project.

This report presented here utilises much of that derived and provided as part of the Mandalong Southern Extension Project AQIA (SLR 2013).

In order to assess the background air quality of the region a number of industrial facilities with the potential to have a cumulative impact on the local airshed were identified. This also included the impacts of the proposed Mandalong Southern Extension Project. A dispersion modelling exercise was performed to determine suitable background concentrations of pollutants in order to appropriately assess the cumulative impacts.

As a conservative approach to this assessment, the particulate emissions due to construction activities at the Project Site are quantified with the application of no control measures (except at sources in close proximity [<200 m] to receptor locations), even though the adoption of best management practices during the construction activities is likely to offer significant emissions abatement. Centennial Mandalong has indicated that additional control measures (such as water sprays) will be applied to construction activities when in close proximity to (<200 m) receptor locations (receptors ‘R16’ and ‘R20’).

Dispersion modelling was conducted for the identified emission sources for two scenarios representing the ‘Foundation’ and ‘Demolition’ phases of the construction works related to the Project. It was concluded from the dispersion modelling exercise that the maximum 24-hour concentrations of PM_{10} and $PM_{2.5}$, along with annual average levels of dust and TSP, PM_{10} and $PM_{2.5}$ concentrations are unlikely to exceed the relevant air quality criterion at any of the identified sensitive receptors.

Overall, it is concluded that in regards to the air quality impacts, there are no limiting factors for the construction of the Project.

9 REFERENCES

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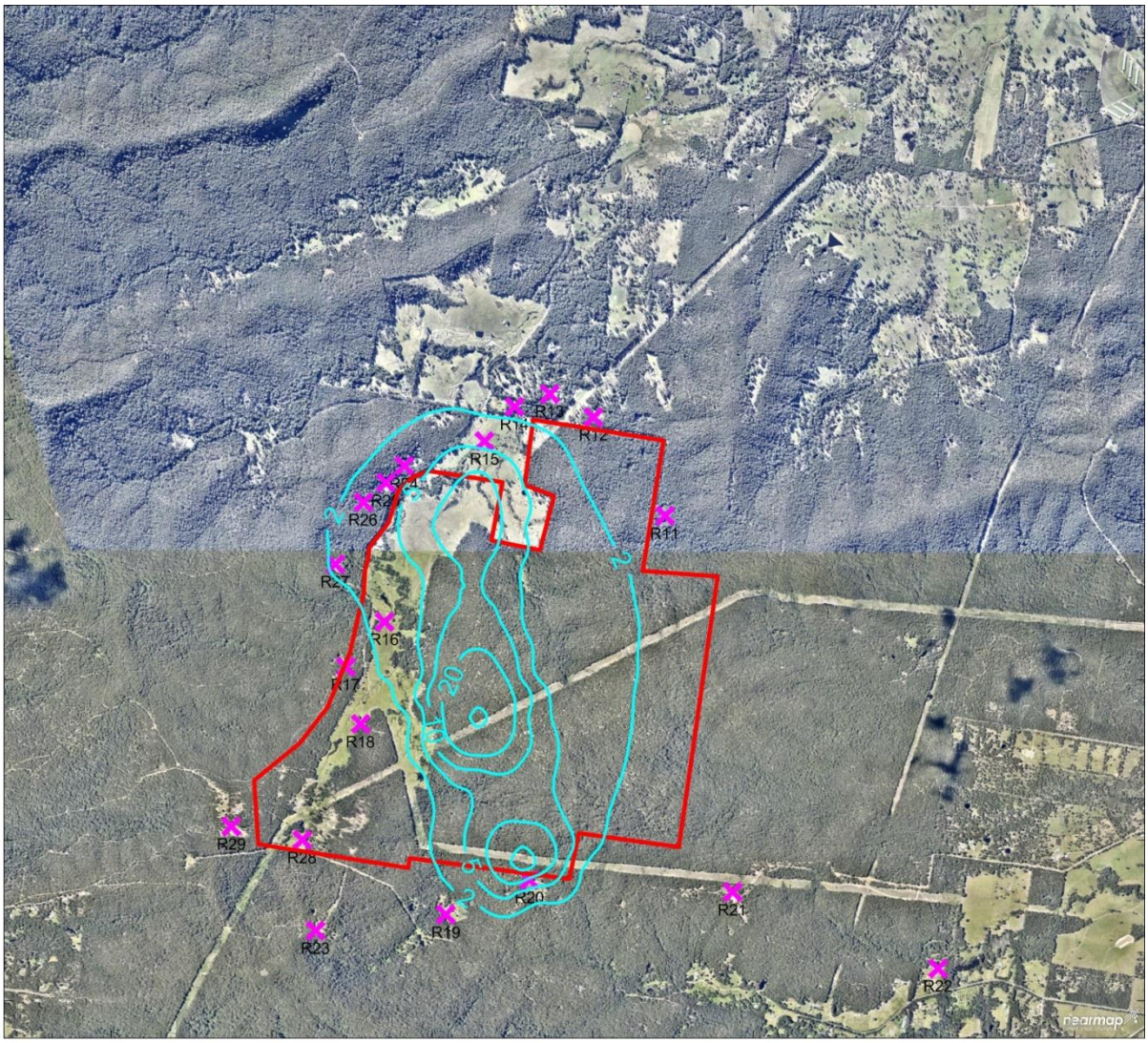
- USEPA 2006, United States Environmental Protection Authority, Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.2 Unpaved Roads.

SCENARIO 1 (FOUNDATIONS)



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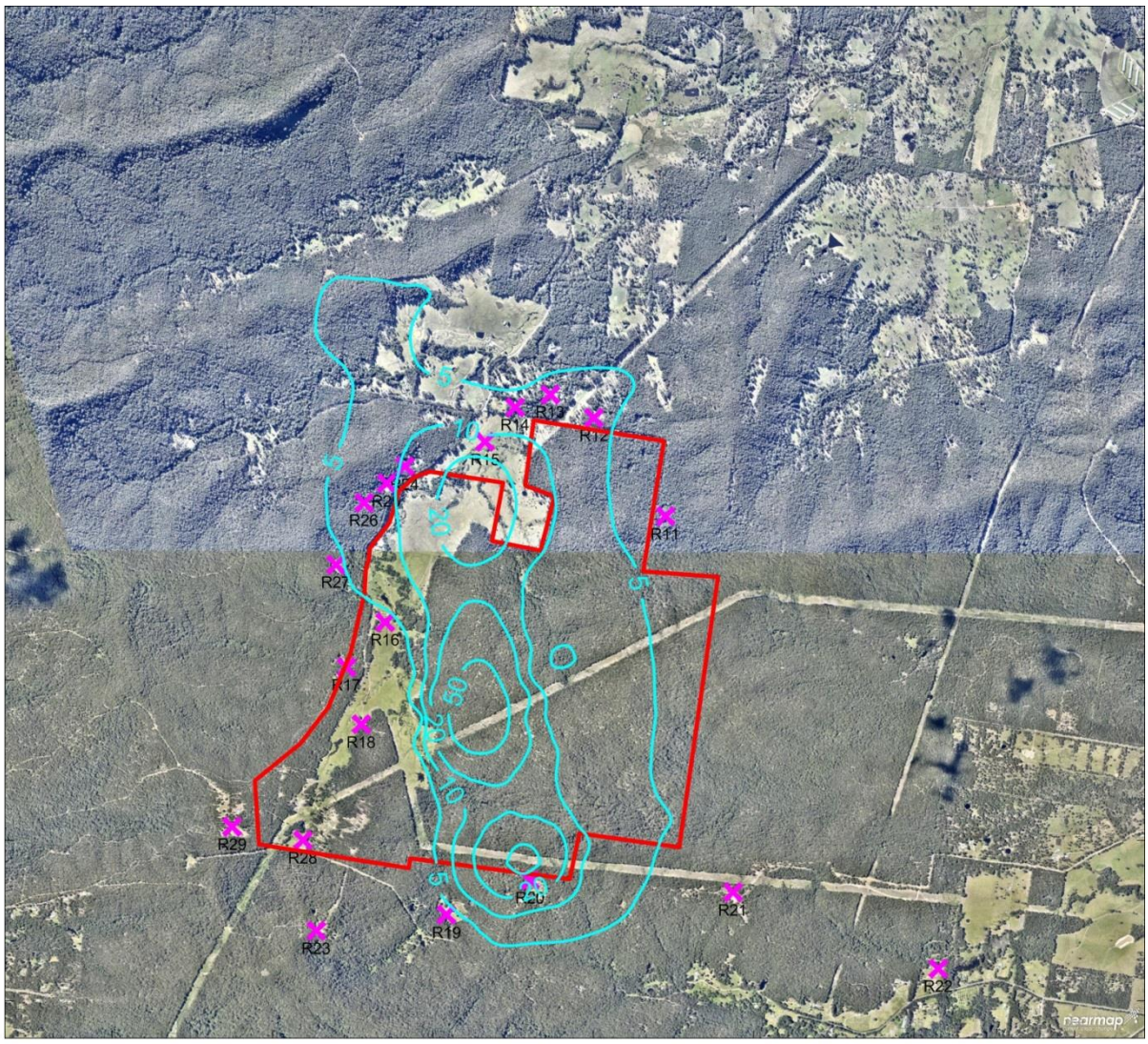
Project Number:	630.11353
Dispersion Model:	CALPUFF
Modelling Period:	2010
Projection:	UTM Zone 56
Date:	29/09/2015

Centennial Mandalong
Transmission Line TL24 RelocationProject
Air Quality Impact Assessment
Increment Impact - Scenario 1 (Foundations)

Pollutant	TSP	Averaging Period	Annual	Unit	µg/m³



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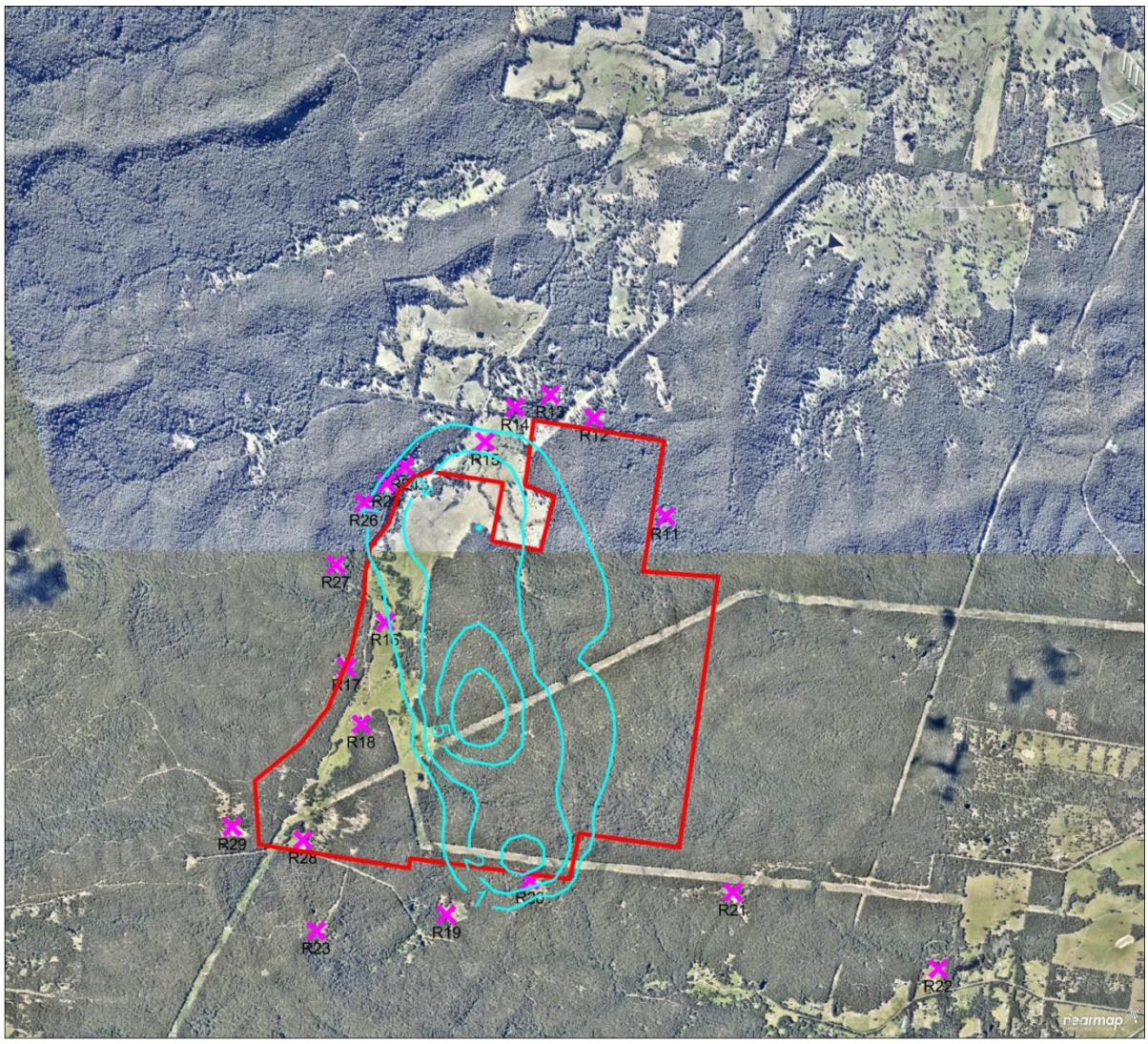
Centennial Mandalong
Transmission Line TL24 RelocationProject
Air Quality Impact Assessment
Increment Impact - Scenario 1 (Foundations)

Pollutant	PM_{10}	Averaging Period	24-Hour	Unit	µg/m³



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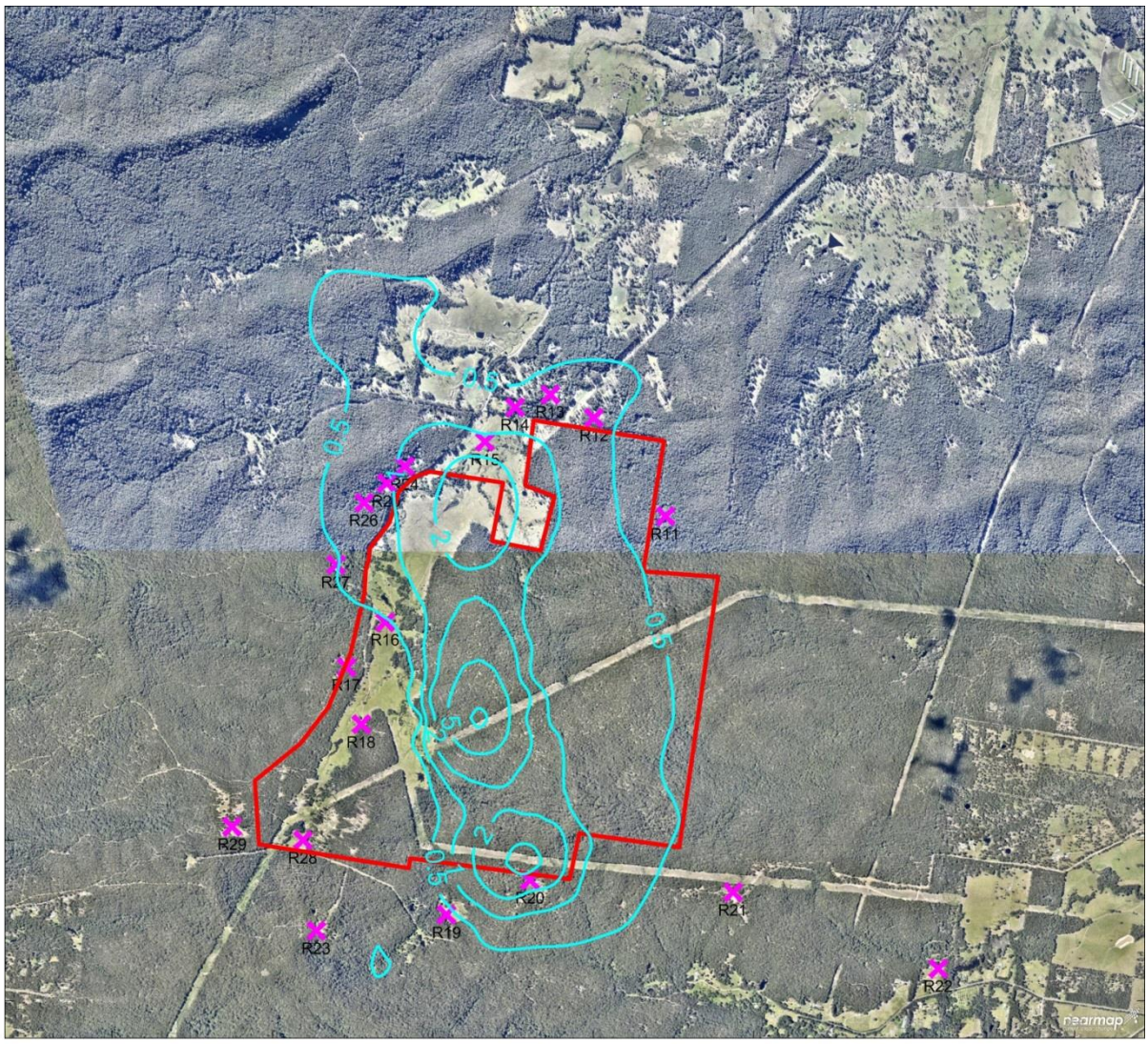
Centennial Mandalong
Transmission Line TL24 RelocationProject
Air Quality Impact Assessment
Increment Impact - Scenario 1 (Foundations)

Pollutant	PM_{10}	Averaging Period	Annual	Unit	$\mu g/m^3$



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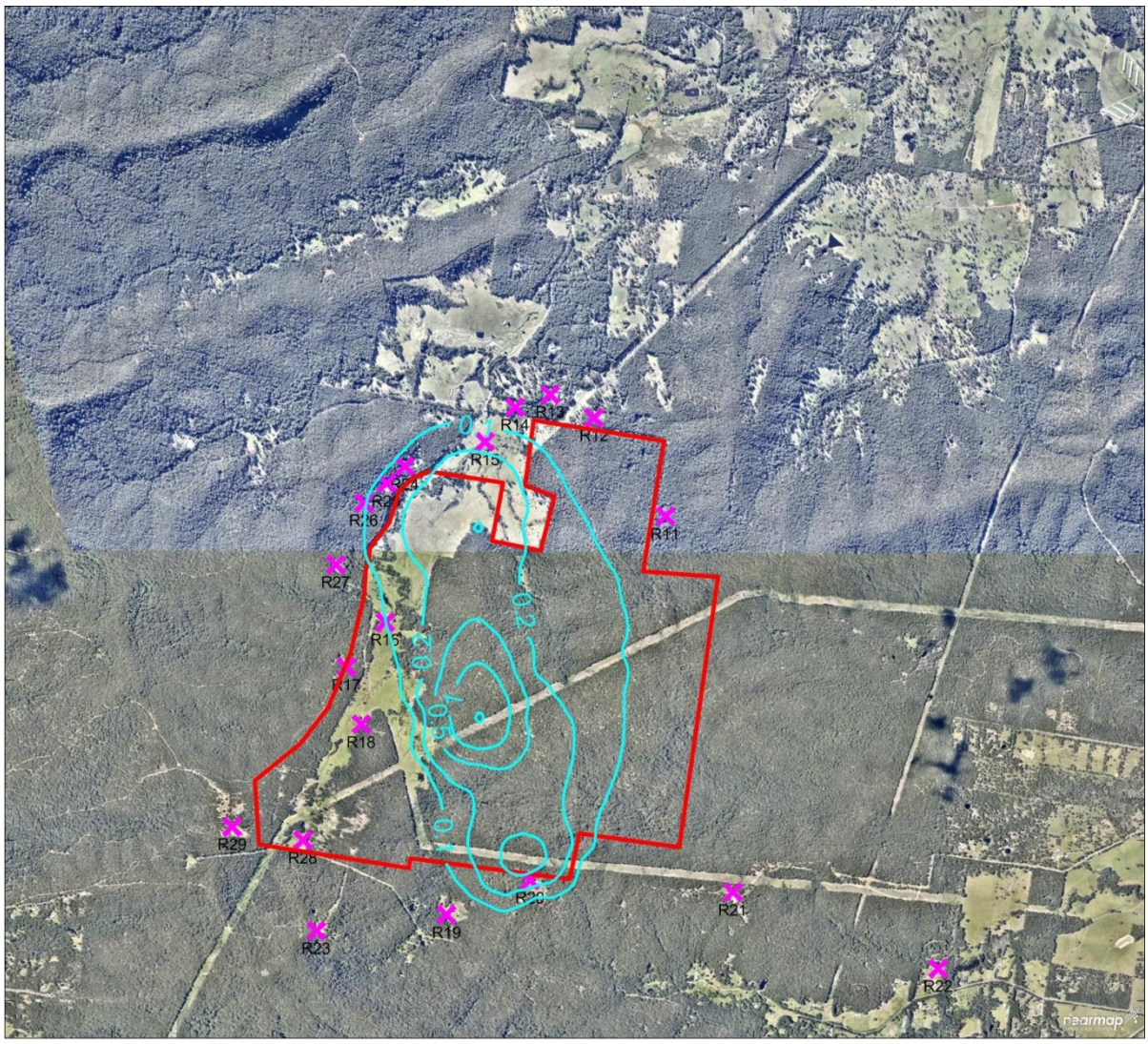
Project Number:	630.11353
Dispersion Model:	CALPUFF
Modelling Period:	2010
Projection:	UTM Zone 56
Date:	29/09/2015

Centennial Mandalong
Transmission Line TL24 RelocationProject
Air Quality Impact Assessment
Increment Impact - Scenario 1 (Foundations)

Pollutant	$PM_{2.5}$	Averaging Period	24-Hour	Unit	µg/m³



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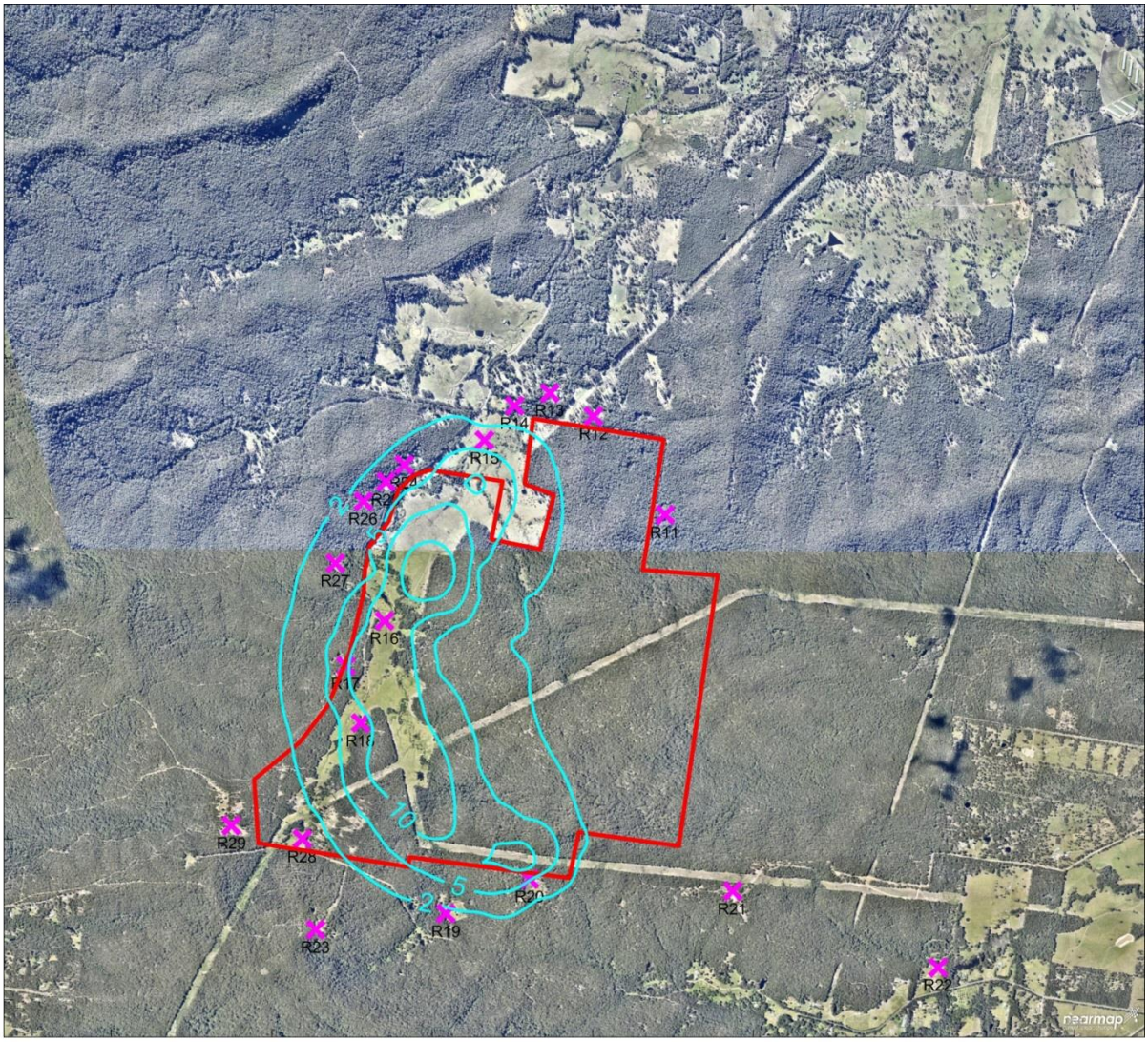
Increment Impact - Scenario 1 (Foundations)

Pollutant	$PM_{2.5}$	Averaging Period	Annual	Unit	µg/m³

SCENARIO 2 (DEMOLITION)



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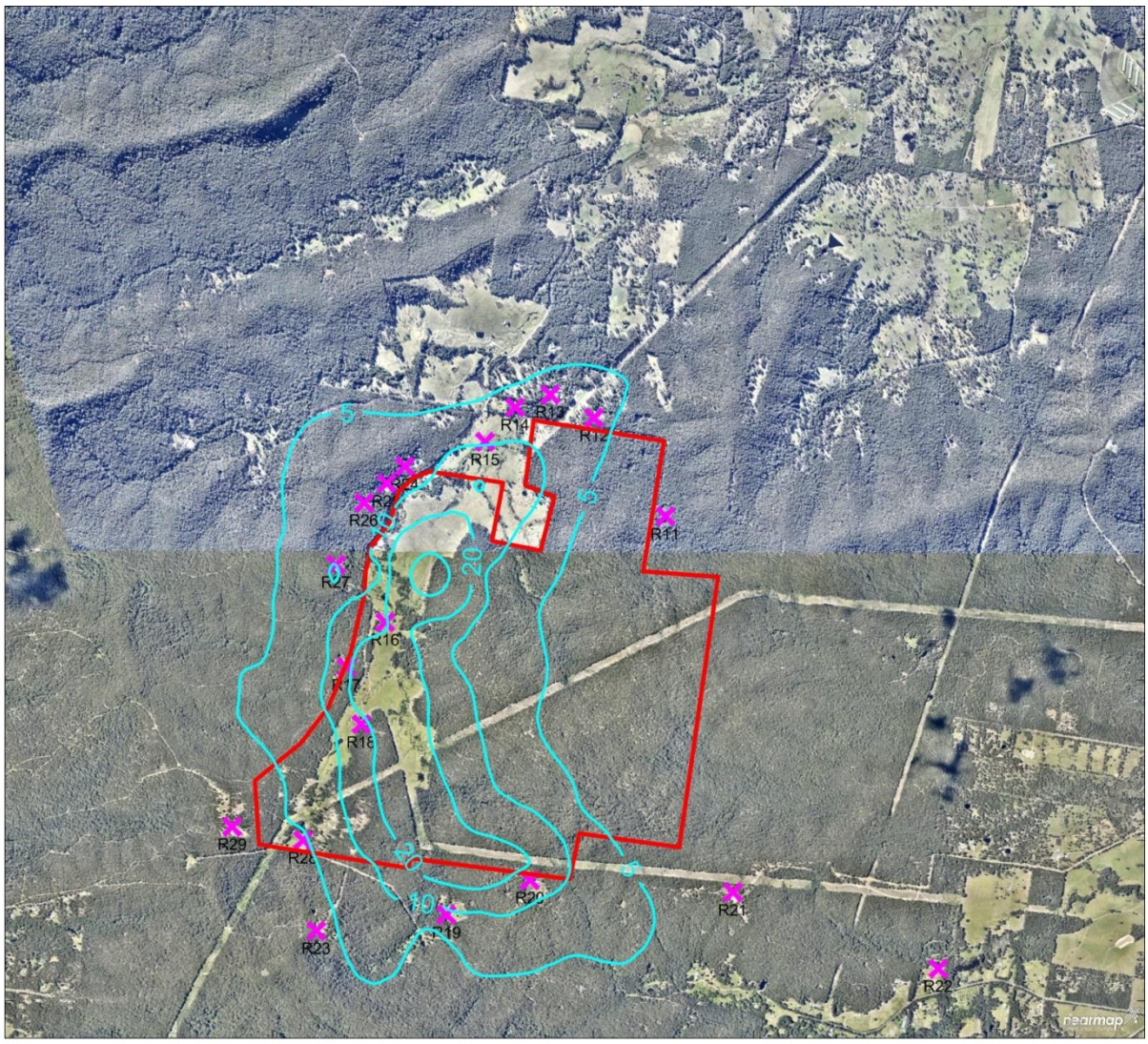
Centennial Mandalong
Transmission Line TL24 RelocationProject
Air Quality Impact Assessment
Increment Impact - Scenario 2 (Demolition)

Pollutant	TSP	Averaging Period	Annual	Unit	µg/m³



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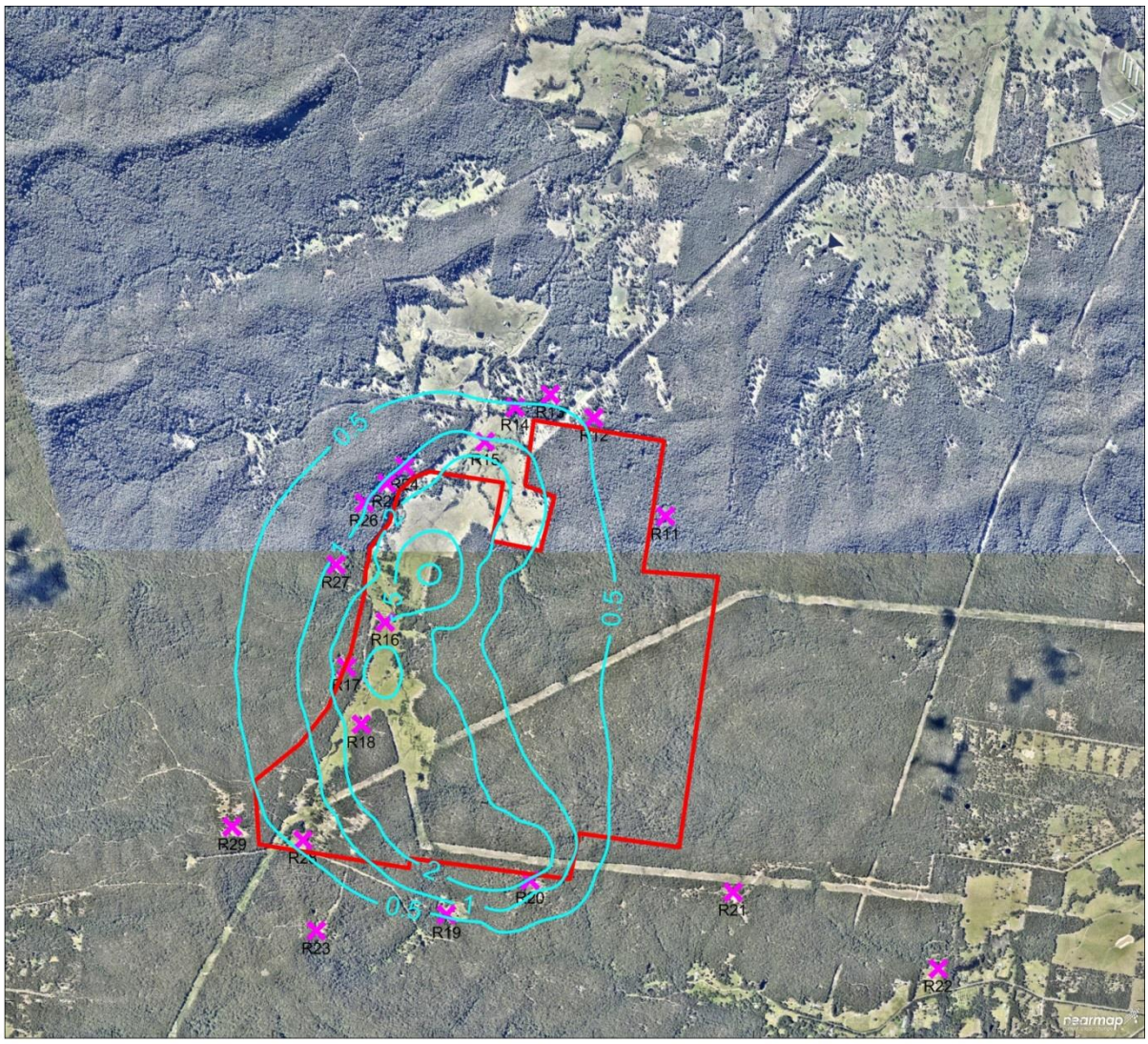
Air Quality Impact Assessment
Increment Impact - Scenario 2 (Demolition)

Pollutant	PM_{10}	Averaging Period	24-Hour	Unit	µg/m³



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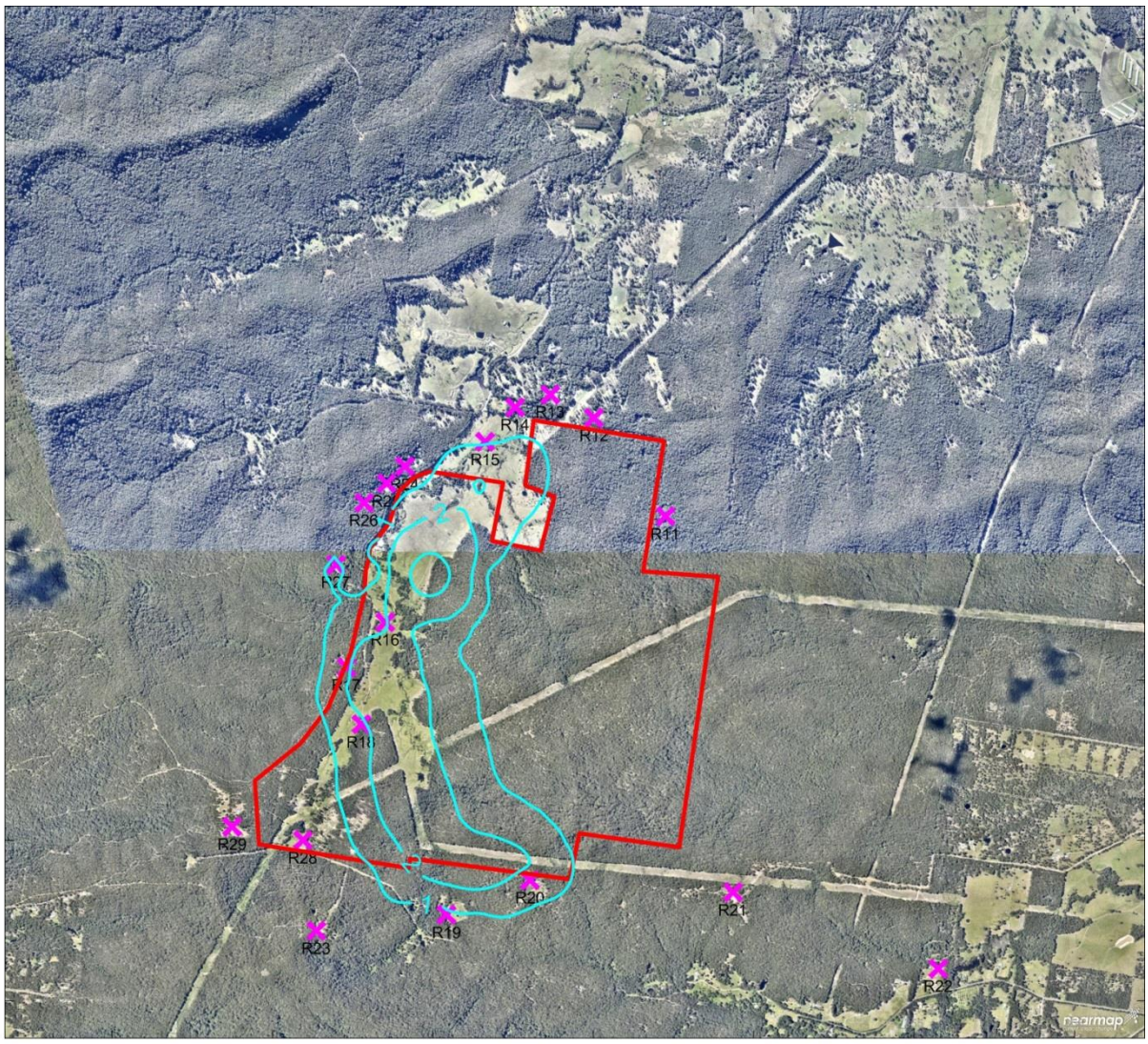
Increment Impact - Scenario 2 (Demolition)

Pollutant	PM_{10}	Averaging Period	Annual	Unit	µg/m³



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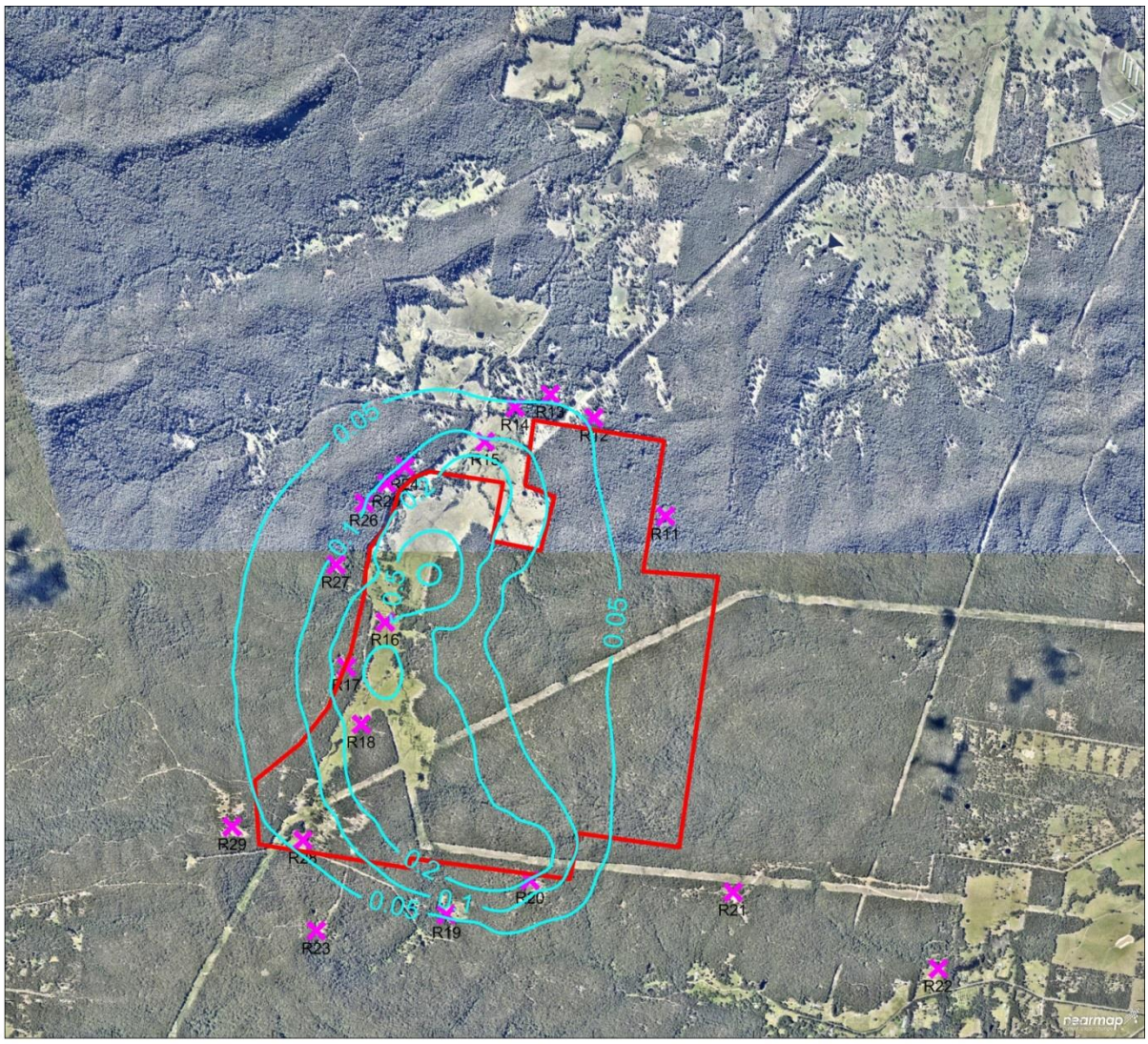
Increment Impact - Scenario 2 (Demolition)

Pollutant	$PM_{2.5}$	Averaging Period	24-Hour	Unit	µg/m³



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Centennial Mandalong
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Air Quality Impact Assessment
Increment Impact - Scenario 2 (Demolition)

Pollutant	$PM_{2.5}$	Averaging Period	Annual	Unit	µg/m³

Emission Source	Emission Factor			Units	VKT/hr	Tonnes per hr	Control Applied	Control Factor	Emission Rate (kg/hr)			Hours per Phase	Emissions (kg/phase)		
	TSP	PM_{10}	$PM_{2.5}$						TSP	PM_{10}	$PM_{2.5}$		TSP	PM_{10}	$PM_{2.5}$
Clearing and Site Establishment															
Bobcat & Backhoe (FEL EF)	0.025	0.012	0.0012	kg/t		27.9			0.696	0.334	0.033	264	184	88	9
Moxy 1 (dump truck)	0.012	0.0043	0.00043	kg/t		27.9			0.334	0.120	0.012	264	88	32	3
Moxy 2 (dump truck)	0.012	0.0043	0.00043	kg/t		27.9			0.334	0.120	0.012	264	88	32	3
Moxy moving - Transport / delivery trucks (including semi-trailers , 6x6 rigid, flatbeds, in-transit concrete mixers etc.);	4.23	1.25	0.125	kg/VKT	2.2				9.306	2.750	0.275	264	2,457	726	73
Bulldozer	17	4.1	0.41	kg/h/vehicle					1.700	0.410	0.041	264	449	108	11
Scraper 1 (removing topsoil)	0.029	0.0073	0.00073	kg/t		27.9			0.808	0.203	0.020	264	213	54	5
Scraper 1 (removing topsoil)	0.029	0.0073	0.00073	kg/t		27.9			0.808	0.203	0.020	264	213	54	5
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	264	546	192	19
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	264	546	192	19
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	264	546	192	19
Foundations															
30 tonne excavator x 1	0.025	0.012	0.0012	kg/t		1.0			0.025	0.012	0.001	858	22	10	1
Franna cranes x1	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Drilling rigs/Soilmecs x2	0.59	0.31	0.031	kg/hole		1.0			0.590	0.310	0.031	858	506	266	27
Drilling rigs/Soilmecs x2	0.59	0.31	0.031	kg/hole		1.0			0.590	0.310	0.031	858	506	266	27
Compaction plates/ whacker packers x2 (dozer EF), recommended by USEPA	17	4.1	0.41	kg/h/vehicle					1.700	0.410	0.041	858	1,459	352	35
Cranes (80-100 t) x1	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Transport / delivery trucks (including semi-trailers , 6x6 rigid, flatbeds, in-transit concrete mixers etc.); x2 - (at any one time)	4.23	1.25	0.125	kg/VKT	2.2				9.306	2.750	0.275	858	7,985	2,360	236
Transport / delivery trucks (including semi-trailers , 6x6 rigid, flatbeds, in-transit concrete mixers etc.); x2 - (at any one time)	4.23	1.25	0.125	kg/VKT	2.2				9.306	2.750	0.275	858	7,985	2,360	236
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	858	1,774	623	62
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	858	1,774	623	62
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	858	1,774	623	62
Tower Erections/Assembly															
Transport / delivery trucks (including semi-trailers , 6x6 rigid, flatbeds, in-transit concrete mixers etc.); x2 - (at any one time)	4.23	1.25	0.125	kg/VKT	2.20				9.306	2.750	0.275	1,188	11,056	3,267	327
Transport / delivery trucks (including semi-trailers , 6x6 rigid, flatbeds, in-transit concrete mixers etc.); x2 - (at any one time)	4.23	1.25	0.125	kg/VKT	2.20				9.306	2.750	0.275	1,188	11,056	3,267	327
Generators x2	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Air compressors / hand tools, rattle guns etc.;	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Franna cranes; x1	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Cranes (80-100 tonnes); x1	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Elevated work platforms (up to 75m reach); x1	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	1,188	2,457	862	86
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	1,188	2,457	862	86
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	1,188	2,457	862	86
Stringing Works/Cut in works															
Elevated work platforms (up to 75m reach); x1	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA

Emission Source	Emission Factor			Units	VKT/hr	Tonnes per hr	Control Applied	Control Factor	Emission Rate (kg/hr)			Hours per Phase	Emissions (kg/phase)		
	TSP	PM_{10}	$PM_{2.5}$						TSP	PM_{10}	$PM_{2.5}$		TSP	PM_{10}	$PM_{2.5}$
Brake and winch machinery for stringing purposes	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Possible helicopter use for the laying out of the draw wire;	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	132	273	96	10
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	132	273	96	10
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	132	273	96	10
Demolition															
30 tonne excavator x 1	0.025	0.012	0.0012	kg/t		0.8			0.021	0.010	0.001	264	6	3	0
Franna cranes x1	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Cranes (80-100 tonnes); x1	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Generators x2	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Air compressors / hand tools, rattle guns etc.;	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Brake and winch machinery for stringing purposes	NA	NA	NA	NA					NA	NA	NA	NA	NA	NA	NA
Transport / delivery trucks (including semi-trailers , 6x6 rigid, flatbeds, in-transit concrete mixers etc.); x2 - (at any one time)	4.23	1.25	0.125	kg/VKT	2.2				9.306	2.750	0.275	264	2,457	726	73
Transport / delivery trucks (including semi-trailers , 6x6 rigid, flatbeds, in-transit concrete mixers etc.); x2 - (at any one time)	4.23	1.25	0.125	kg/VKT	2.2				9.306	2.750	0.275	264	2,457	726	73
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	264	546	192	19
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	264	546	192	19
Light vehicles (4WDs). X3	0.94	0.33	0.033	kg/VKT	2.20				2.068	0.726	0.073	264	546	192	19
Wind Erosion															
Wind erosion	0.4	0.2	0.03	kg/ha/h					0.901	0.450	0.068	6,888	6,205	3,102	465

- **Possession of site**
  - Backhoes;
  - Bobcats;
  - Bulldozers;
  - Scrapers;
  - Forklifts;
  - Franna cranes;
  - Generators;
  - Light vehicles (4WDs).
- **Access track, clearing o Chainsaws / brush cutters;**
  - Backhoes;
  - Bobcats;
  - Dump trucks;
  - Bulldozers;
  - Scrapers;
  - Light vehicles (4WDs).
- **Foundations**
  - Bulldozers;
  - Franna cranes;
  - Drilling rigs / Soilmecs;
  - Compaction plates / whacker packers;
  - Cranes (80 – 100 tonnes);
  - Transport / delivery trucks (including semi-trailers, flatbeds, in-transit concrete mixers etc.);
  - Light vehicles (4WDs).
- **Tower erection / assembly**
  - Transport / delivery trucks (including semi-trailers, water tankers, flatbeds, in-transit concrete mixers etc.);
  - Generators;
  - Air compressors / hand tools, rattle guns etc.;
  - Franna cranes;
  - Elevated work platforms (up to 75m reach);
  - Light vehicles (4WDs).
- **Stringing works**
  - Elevated work platforms (up to 75m reach);
  - Brake and winch machinery for stringing purposes;
  - Possible helicopter use for the laying out of the draw wire;
  - Light vehicles (4WDs).
- **Cut in works**

- Elevated work platforms (up to 75m reach);
- Brake and winch machinery for stringing purposes;
- Possible helicopter;
- Cranes (80 – 100 tonnes);
- Light vehicles (4WDs).

- **Demolition**
  - Excavators;
  - Franna cranes;
  - Cranes (80 – 100 tonnes);
  - Generators;
  - Air compressors / hand tools, grinders, rattle guns etc.;
  - Brake and winch machinery for de-stringing purposes;
  - Transport trucks (including semi-trailers and/or flatbeds to remove steel and line equipment from site);
  - Light vehicles (4WDs).