Centennial Coal

Angus Place Colliery

Angus Place Mine Extension Project

Air Quality and Greenhouse Gas Assessment

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Angus Place Mine Extension Project

Air Quality and Greenhouse Gas Assessment

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Angus Place Mine Extension Project

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Executive Summary

Introduction

SLR Consulting Australia Pty Ltd (SLR Consulting) has been commissioned by Centennial Angus Place Pty Ltd (Centennial) to undertake an Air Quality and Greenhouse Gas (GHG) Impact Assessment for the proposed Angus Place Mine Extension Project (APMEP).

Key objectives of the APMEP relevant to air quality issues are as follows:

- Coal production of a total of up to 4 million tonnes per annum (Mtpa) of coal from the Lithgow coal seam;
- Extraction of coal using longwall mining techniques;
- Construction and operation of the following facilities to support the extension project:
  - A ventilation facility (APC-VS3) consisting of a single downcast (intake) shaft;
  - Dewatering borehole sites to deliver water into the existing Springvale-Delta Water Transfer Scheme;
  - Water management structures; and
  - Shaft spoil emplacement area;
- Upgrade of access track from Sunnyside Ridge Road to the proposed ventilation facility (APC-VS3) and dewatering borehole sites; and
- Continue to provide employment of a full time workforce of 225 persons and up to 75 contractors.

The aim of this assessment is to quantify the air quality impacts on surrounding sensitive receivers associated with both the APMEP and estimate GHG emissions for the Project. Furthermore, an estimation of the likely air quality impacts resulting from Project rehabilitation has also been performed within this assessment.

Methodology

The air quality impact assessment has been completed in accordance with the "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (OEH, 2005) (the Approved Methods) issued by the New South Wales Office of Environment & Heritage (NSW OEH). Air quality criteria specified by the NSW OEH were adopted as stipulated in the Approved Methods. In the absence of criteria applicable to $PM_{2.5}$ in the Approved Methods, the National Environment Protection Measure (NEPM) advisory reporting standard (2003) was adopted.

Dispersion modelling was conducted for the identified sources for the proposed APMEP (construction, operation and site rehabilitation). The pollutants assessed were particulate matter as TSP, PM_{10}, $PM_{2.5}$ and deposited particulate. The particulate emissions from APMEP activities were calculated for existing and proposed activities 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 (US EPA, 2006) where suitable factors do not exist within the NPI documentation. The particulate emissions from ventilation fans were based on particulate monitoring conducted on the Angus Place Colliery ventilation fans in February 2013.

Executive Summary

In order to assess the background air quality of the region, a review of High Volume Air Sampling (HVAS) monitoring data collected on site was reviewed and compared against HVAS data collected by Centennial at the Angus Place Colliery and continuous PM_{10} monitoring data collected by NSW OEH at Bathurst. This review indicated that use of the continuous ambient monitoring data from Bathurst for 2010 would provide a conservative and appropriate approach for the assessment of potential cumulative impacts for the APMEP.

The assessment also considers emissions of Greenhouse Gases (methane (CH_4), carbon dioxide (CO_2) and sulphur hexafluoride (SF_6)) from the APMEP and includes estimates of direct and indirect GHG emissions.

Results

The predicted results showed that the proposed APMEP project is unlikely to cause any exceedences of the relevant ambient air quality criteria for TSP, PM_{10} and $PM_{2.5}$ concentrations or dust deposition at any identified surrounding sensitive receptors when considering Project construction, operation and site rehabilitation.

The total lifetime direct (Scope 1) emissions from the Project are estimated to be approximately 42,473 CO_2-e in any one year.

Indirect (Scope 2 and 3) emissions would be released in the process of mining coal, and through the transport and end use of the coal. The total lifetime indirect emissions (Scope 2 and 3) from mining coal and end use of the coal are estimated to be 1,018,551 t CO_2-e, per annum.

Comparison of Project emissions with State and National GHG emission totals indicates that the APMEP is likely to represent approximately 0.03% of NSW GHG emissions when compared to the latest available emissions data (2010) (Scope 1) and 0.01% of Australian GHG emissions (Scope 1).

Table of Contents

Table of Contents

Table of Contents

APPENDICES

TABLES

Table of Contents

FIGURES

Table of Contents

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
APMEP	Angus Place Mine Extension Project
AQIA	air quality impact assessment
AWS	automatic weather station
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
EETM	Emission Estimation Technique Manual
EF	Emission Factor
EIS	Environmental Impact Statement
g	gram
g/m^2/month	grams per square metre per month
ha	hectare
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
MPPS	Mount Piper Power Station
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
ROM	run of mine
t	tonne
TEOM	tapered element oscillating microbalance
tpa	tonnes per annum
TSP	total suspended particulate matter
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WPS	Wallerawang Power Station

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
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
crushers	A machine designed to reduce large rocks into smaller rocks, gravel, or rock dust
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

evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces
epidemiological	The branch of medicine that deals with the study of the causes, distribution, and control of disease in populations
fossil fuel	A natural fuel such as coal, diesel or gas, formed in the geological past from the remains of living organisms
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.
materiality threshold	Represents the amount of insignificant emissions allowed which do not need to be quantified and accounted for.
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
point source	A pollution source that is fixed and/or uniquely identifiable, such as a stack, chimney, outlet pipe or vent
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
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

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR Consulting) has been commissioned by Centennial Angus Place Pty Ltd (Angus Place) to undertake an Air Quality and Greenhouse Gas Impact Assessment for the proposed Angus Place Mine Extension Project (APMEP).

Angus Place proposes to extend its coal mining operations, using longwall mining techniques to the east of its existing operations at Angus Place Colliery, located 15 kilometers (km) northwest of the city of Lithgow, NSW (refer **Figure 1**). The Project Application Area boundary is also shown in **Figure 1**.

Angus Place Colliery's development consent will lapse on 18 August 2024. However, the planned longwall mining at Angus Place Colliery in accordance with the current mine plan will end in March 2016. Accordingly, the APMEP is seeking approval for the continuation of longwall mining at Angus Place Colliery to the east of the current workings within its Mining Lease (ML) 1424 lease boundary beyond March 2016.

Broadly, the objective of this assessment was to identify the potential impacts of air quality and greenhouse gas emissions associated with the APMEP, the cumulative impacts of the APMEP with approved Angus Place mining operations and the cumulative impacts of the modified Angus Place Colliery operations with other activities/operations in the proximity of Angus Place Colliery.

The air quality impact assessment has been prepared in accordance with the Office of Environment and Heritage (OEH) document Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (OEH, 2005), hereafter referred to as 'The Approved Methods'. This assessment involves the modelling of local meteorology and the dispersion of potential emissions from the Project Site to predict the level of impact that may be experienced in the surrounding environment. The sections of this report where the requirements of the Approved Methods are met are as follows:

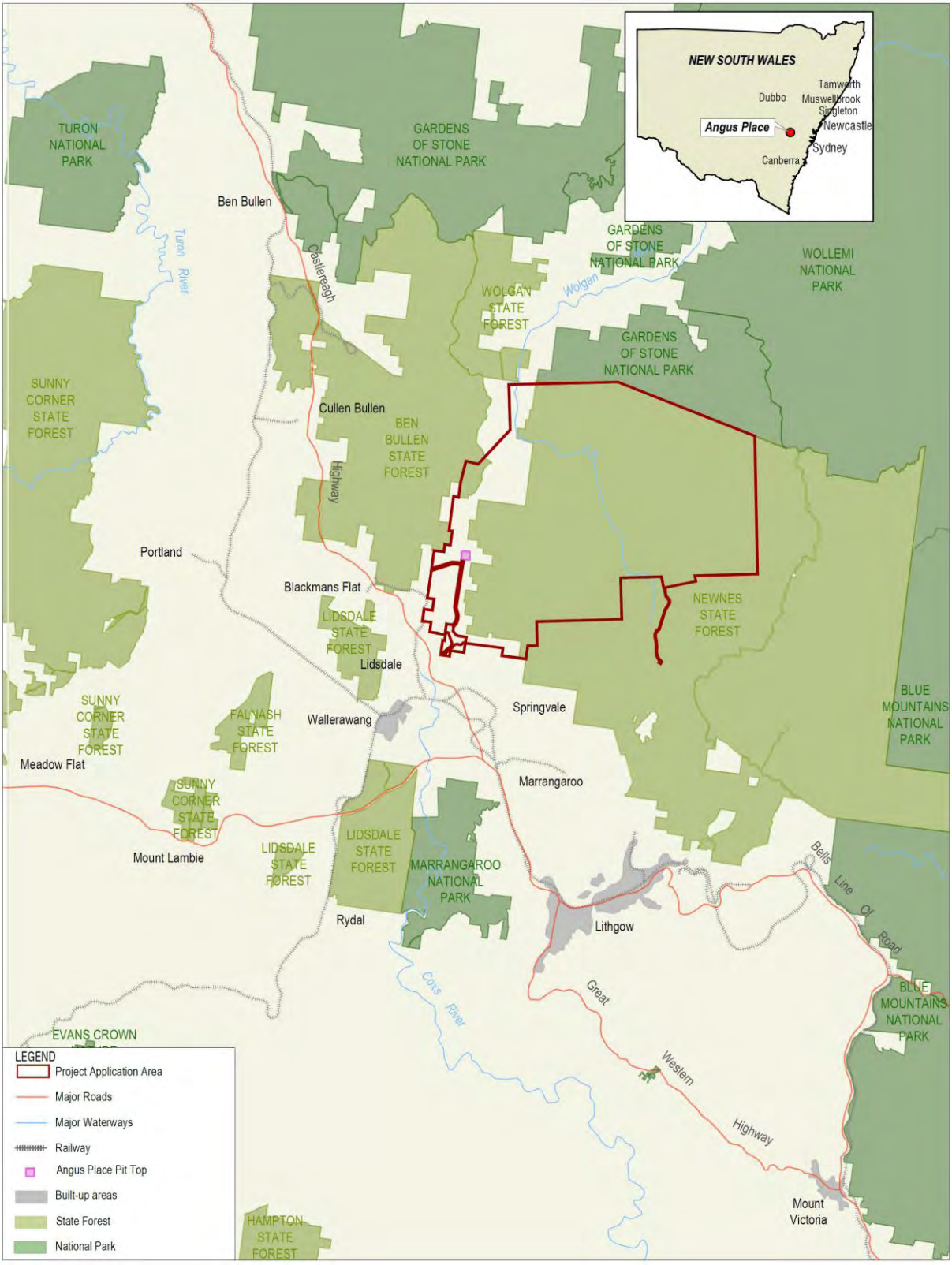
- Description of local topographic features and sensitive receptor locations (**Section 4**).
- Establishment of air quality assessment criteria (**Section 3**).
- Analysis of climate and dispersion meteorology for the region (**Section 6.3**).
- Description of existing air quality environment (**Section 7**).
- Compilation of a comprehensive emissions inventory for the existing and proposed activities (**Section 5.5**).
- Completion of atmospheric dispersion modelling and analysis of results (**Section 0** and **Section 8**).
- Preparation of an air quality impact assessment report comprising the above.

The scope of the air and greenhouse gas assessments was also designed to address the Director-Generals Requirements (DGRs) for the Project (issued 6 November 2012). A synopsis of these requirements is provided in **Table 1**.

Table 1 Director-General's Requirements

Director-General's Requirement	Section Addressed
Air Quality	
Air Quality – including a quantitative assessment of potential:	
- Construction and operational impacts, with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10} emissions and dust generation from coal transport	**Section 0** and **Section 8**
- Reasonable and feasible mitigation measures to minimise dust emissions, including evidence that there are no such other available measures	**Section 5.2.3**
- Monitoring and management measures, in particular real time air quality monitoring	**Section 5.2.3** **Section 8.3**
Greenhouse Gas	
Greenhouse Gases – including:	
- A quantitative assessment of potential Scope 1, 2 and 3 greenhouse gas emissions	**Section 9**
- A qualitative assessment of the potential impacts of these emissions on the environment	**Section 9.7**
- An assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency	**Section 9.8**
Attachment 1 Technical & Policy Guidelines **Air Quality**	
- Protection of the Environment Operations (Clean Air) Regulation 2002	**Section 3**
- The Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework and Notes (OEH)	**Not Applicable**
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW	**Section 0**
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC)	**Appendix B**
Greenhouse Gas	
- National Greenhouse Accounts Factors (Australian Department of Climate Change (DCC))	**Section 9**
- Guidelines for Energy Savings Action Plans (DEUS)	**Section 9**

Figure 1 Angus Place Colliery – Locality Plan



2 PROJECT DESCRIPTION

2.1 Background

Angus Place Colliery is an underground coal mining operation located 5 km north of the village of Lidsdale, 8 km northeast of the township of Wallerawang and approximately 15 km northwest of the city of Lithgow.

Angus Place Colliery is bordered by Baal Bone Colliery (Xstrata Coal Pty Ltd) and Invincible Colliery (CET Resources Pty Ltd) to the north, Springvale Mine (Centennial Springvale Pty Ltd) to the south and the Wolgan Valley and Newnes State Forest to the northeast. Collectively, existing land uses in the vicinity of the Angus Place Colliery include pastoral farming, open cut and underground coal mining, power generation and commercial forestry. Mount Piper Power Station (MPPS) is located 6 km to the west and Wallerawang Power Station (WPS) is located 5.5 km south-southwest.

A number of residential communities surround the Angus Place Colliery including Lidsdale approximately 5 km to the south and Blackmans Flat approximately 3.5 km to the west. A small number of rural residential properties are also located along Wolgan Road and in the Upper Wolgan Valley in the vicinity of the Angus Place Colliery. The nearest affected residential receivers to the APMEP are detailed in **Section 4**.

The additional infrastructure associated with the APMEP is located in the Newnes State Forest, approximately 7 km east of the existing Angus Place pit top. The locations of the Environmental Study Areas (ESAs) are presented in **Appendix A** along with the location of the nearest surrounding residential receivers.

2.2 Current Operations and Approvals

Angus Place commenced production in 1979, after being developed as an extension of the Newcom Mine at Kerosene Vale. Coal is extracted from the Lithgow seam using longwall mining techniques. The main components of the development are an underground longwall mine and development panels, supporting surface infrastructure (within the Angus Place Colliery pit top area and within the Newnes State Forest), a coal stockpile area (Kerosene Vale) and dedicated haul roads to Delta Electricity's Wallerawang and Mount Piper power stations.

Project Approval ((PA) 06_0021) is applicable to Angus Place, which was approved by the Department of Planning and Infrastructure (DoPI) pursuant to Part 3A of the EP&A Act. PA 06_0021 was granted on 13 September 2006 to expand the mining area and increase the production limit to 3.5 million tonnes per annum (Mtpa). PA 06_0021 is currently due to lapse on 18 August 2024.

During 2010, Angus Place submitted an application to the DoPI requesting to modify PA 06_0021 pursuant to Section 75W of the EP&A Act. This Project proposed an extension to Angus Place's operations through the development and extraction of two additional longwall panels (910 and 900W), as well as development of supporting surface infrastructure. The Project additionally provisioned to increase the annual production limit from 3.5 Mtpa to 4 Mtpa. PA 06_0021 Modification 1 was approved on 29 August 2011.

On 22 December 2011, Angus Place lodged a request to modify its existing PA with the DoPI regarding the construction and operation of a ventilation facility and supporting infrastructure in accordance with section 75W of the EP&A Act. The DGRs for the modification project were received on 18 January 2012. An Environmental Assessment in support of the modification was submitted to DoPI in September 2012.

Angus Place's coal processing and distribution network is proposed to be amalgamated into the existing Coal Services Facility. The Coal Services Facility is in the process of submitting an application for the upgrade of their facilities, and as part of this proposed upgrade, the coal processing and distribution logistics of Angus Place will be transferred into Coal Services operations. This is an administrative transfer of the existing infrastructure between Centennial's business units.

2.3 Project Objectives and Overview

The overall objective of the APMEP is to obtain approval for the continuation of mining at Angus Place Colliery.

Specific objectives of the APMEP are as follows.

- Design of the extension project in accordance with ecologically sustainable principles;
- Coal production of a total of up to 4 Mtpa of coal from the Lithgow coal seam;
- Extraction of coal using longwall mining techniques from an area identified as Angus Place East within the APMEP Application Area (refer **Figure 1**);
- Construction and operation of the following facilities to support the APMEP:
    - A ventilation facility (APC-VS3) consisting of a single downcast (intake) shaft;
    - Dewatering borehole sites to deliver water into the existing Springvale-Delta Water Transfer Scheme;
    - Water management structures; and
    - Shaft spoil emplacement area.
- Upgrade of access track from Sunnyside Ridge Road to the proposed ventilation facility (APC-VS3) and dewatering borehole sites; and
- Continue to provide employment of a full time workforce of 225 persons and up to 75 contractors.

2.4 Project Elements with Potential for Air Quality Impacts

2.4.1 Construction

Construction activities associated with the APMEP will involve site preparation and clearance, shaft sinking of the downcast ventilation shaft and dewatering boreholes, construction of the foundations, installation of the borehole infrastructure and commissioning within the proposed site compounds in addition to the construction of the required access roads.

Additional construction activities will involve the clearance and excavations for the proposed power supply along Sunnyside Ridge Road in order to operate the proposed dewatering borehole sites.

As part of the Angus Place Ventilation Facility Project Air Quality Impact Assessment (submitted in September 2012, refer **Section 2.2**), a quantitative assessment of construction and operation activities associated with the proposed upcast ventilation facility (APC-VS2 [refer **Appendix A**]) was performed. Maximum 24-hour PM_{10} concentrations associated with these activities were less than 0.6 $\mu g/m^3$ at all receptor locations (the same receptor locations as presented in **Section 4**). The proposed ventilation facility (APC-VS3) and dewatering boreholes (refer **Appendix A**) are located at similar or further distances from the sensitive receptor locations, with similar levels of construction activities proposed. Therefore it may be assumed that similar impacts for the current proposed construction works may be experienced. However, to satisfy the DGR's (refer **Table 1**) a quantitative assessment of the proposed construction activities has been performed. Further detail is provided in **Section 0**.

2.4.2 Operations

Angus Place Colliery Pit Top

No modifications are proposed to the existing Angus Place Colliery pit top as part of the APMEP. The annual production of 4 Mtpa will remain as per PA 06_0021 Modification 1. Therefore, there will be no changes to air quality emissions from the existing Angus Place pit top associated with the APMEP.

Given the proximity of the pit top operations to the sensitive receptor locations, a quantitative assessment of particulate emissions (TSP, PM_{10} and $PM_{2.5}$) has been performed as required by the DGR's (**Table 1**).

Ventilation Facilities

Upcast Ventilation Shafts (APC-VS1 and APC-VS2)

Angus Place Colliery currently operates one upcast ventilation facility (APC-VS1) and proposes to operate an additional upcast ventilation facility (APC-VS2). An environmental assessment has previously been performed for the construction and operational air quality and greenhouse gas impacts relating to the APC-VS2 facility (SLR Consulting Report 670.10168-R0, *Angus Place Colliery Ventilation Facility Project – Air Quality and Greenhouse Gas Assessment* dated 5 July 2012).

Emissions of particulate matter and odour from both ventilation shafts are considered within this assessment as "current" operations. Emissions data were derived from site specific testing of the APC-VS1 upcast shaft (refer **Section 5.2.2**).

Backup Diesel Generator

Emissions of combustion related pollutants relating to the backup diesel generator at the APC-VS2 have previously been assessed (SLR Consulting, 2012a). Predicted concentrations of pollutants at all sensitive receptors were far below the relevant criteria. No changes to these emissions are proposed as part of the current Project and therefore they are not assessed further.

Downcast Ventilation Shaft (APC-VS3)

APC-VS3 will consist of a single downcast ventilation shaft. Once constructed, APC-VS3 will not require any supporting infrastructure such as electric power.

Potential air quality impacts associated with the construction of APC-VS3 have been quantitatively assessed within this assessment as required by the DGR's (refer **Table 1**). Given that APC-VS3 is a proposed downcast, no emissions of air pollutants is anticipated during operation.

Dewatering Boreholes

Dewatering bores will be used for the management of mine inflows as part of safety and operational requirements.

The APMEP has considered the operation of an additional seven (7) dewatering boreholes as presented in **Appendix A**.

The proposed plant and equipment associated with each borehole facility is as follows:

- Submersible pump(s).
- 11kV to 3.3kV transformers.
- High Voltage switching and control equipment.

No air quality impacts will be experienced during the operation of the boreholes and they are not considered further within this assessment.

Emissions associated with construction activities have been assessed within this report however, as required by the DGR's (refer **Table 1**). Further detail is provided in **Section 0**.

2.4.3 Site Rehabilitation

Following the finalisation of mining activities at the Angus Place Colliery, the site will be completely rehabilitated. Although emissions from all coal processing and ancillary operations will cease, emissions relating to infrastructure removal, land clearance, earth moving and shaping and topsoil spreading will occur.

A quantitative assessment of the potential air quality impacts associated with site rehabilitation is presented within this report. Further detail is provided in **Section 0**.

3 AIR QUALITY CRITERIA

3.1 Air Pollutants Considered

Given the foregoing discussion relating to the current Project approval and previously performed assessments, only emissions of particulate matter (TSP, deposited particulate, PM_{10} and $PM_{2.5}$) are considered within this current assessment. It is not considered necessary to re-assess already approved infrastructure where no additional impacts are envisaged due to the proposed Project operation.

Emissions of particulate from the ventilation shafts have been modelled however, given the updated information now available to Angus Place relating to these emissions (refer **Section 5.2**).

3.2 Review of Air Quality Criteria

State air quality guidelines adopted by the NSW EPA are published in the Approved Methods (OEH, 2005).

As specified within the DGR's, the Approved Methods has been consulted during the preparation of this assessment report. The Approved Methods lists the statutory methods that are to be used to model and assess emissions of air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria for the Project. The criteria listed in the Approved Methods are derived from a range of sources (including NHMRC, NEPC, WHO and ANZECC). The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW, and are considered to be appropriate for the setting.

3.2.1 Suspended Particulate Matter

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.

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/m^3.
- an annual average of 30 µg/m^3.

The World Health Organisation (WHO) also provide guidelines for PM_{10} in the 2005 document "WHO Air Quality Guidelines" which are designed to offer global guidance on reducing the health impacts of air pollution.

The WHO guidelines are as follows:

- a 24-hour maximum of 50 µg/m^3.
- an annual average of 20 µg/m^3.

The WHO 24 hour PM_{10} guideline is identical to that set out in the Approved Methods. The annual average guideline is more stringent than that set out in the Approved Methods. Both annual average guidelines of 30 µg/m^3 (NSW EPA) and 20 µg/m^3 (WHO) are assessed within this assessment.

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.
- 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/m^3; and
- an annual average concentration of 8 µg/m^3.

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

The WHO also provide guideline values for $PM_{2.5}$ which are as follows:

- a 24-hour average concentration of 25 µg/m^3; and
- an annual average concentration of 10 µg/m^3.

The NEPM advisory standards are more stringent than the WHO guidelines (for annual average $PM_{2.5}$ concentration) and therefore the NEPM guidelines will be evaluated within this assessment.

A summary of the particulate guidelines is shown in **Table 2**.

Table 2 EPA Goals for Suspended Particulates

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m^3
PM_{10}	24 Hours Annual Annual	50 µg/m^3 30 µg/m^3 (NSW EPA) 20 µg/m^3 (WHO)
$PM_{2.5}$	24 Hours Annual	25 µg/m^3 (interim advisory reporting standard only) 8 µg/m^3 (interim advisory reporting standard only)

3.2.2 Deposited Particulate

The preceding section is concerned in large part with the health impacts of airborne particulate matter. Nuisance impacts need also to be considered, mainly 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 grams per square metre per month (g/m^2/month).

Table 3 presents the impact assessment goals set out in the Approved Methods for dust deposition, to avoid dust nuisance.

Table 3 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 OEH 2005.

3.3 Summary of Project Air Quality Goals

The air quality goals adopted for this assessment, which confirm to current EPA and Federal air quality criteria, are summarised in **Table 4**.

Table 4 Project Air Quality Goals

Pollutant	Averaging Time	Goal
TSP	Annual	90 $\mu g/m^3$
PM_{10}	24 HoursAnnual Annual	50 $\mu g/m^3$ 30 $\mu g/m^3$ (NSW EPA) 20 $\mu g/m^3$ (WHO)
$PM_{2.5}$	24 Hours Annual	25 $\mu g/m^3$ (interim advisory reporting standard only) 8 $\mu g/m^3$ (interim advisory reporting standard only)
Dust Deposition	Annual	Maximum Incremental (Project only) increase of 2 g/m^2/month Maximum Total of 4 g/m^2/month (Project and other sources)

Source: Approved Methods, OEH 2005.

4 LOCAL TOPOGRAPHY AND RESIDENTIAL RECEIVERS

The topographical data used in the meteorological and dispersion modelling 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 topography of the local region surrounding the APMEP area is presented in **Figure 2**.

Angus Place Colliery is located within a region of significant topographical variation as shown in **Figure 2**. The boundary of the Angus Place Colliery lies along the western edge of the Great Dividing Range and is situated at an altitude of between approximately 900 m to 1100 m AHD. It is bordered by the Wolgan Valley to the north and the Newnes Plateau to the east.

A number of residences are located in the area surrounding the APMEP. A list of the identified nearest sensitive receptors in the immediate vicinity of the Angus Place Colliery is presented in **Table 5** and **Figure 4**. Concentrations of particulate matter have been assessed at each of these receptors, for relevant averaging periods as discussed in **Section 3**.

Figure 2 Topography of the Local Area

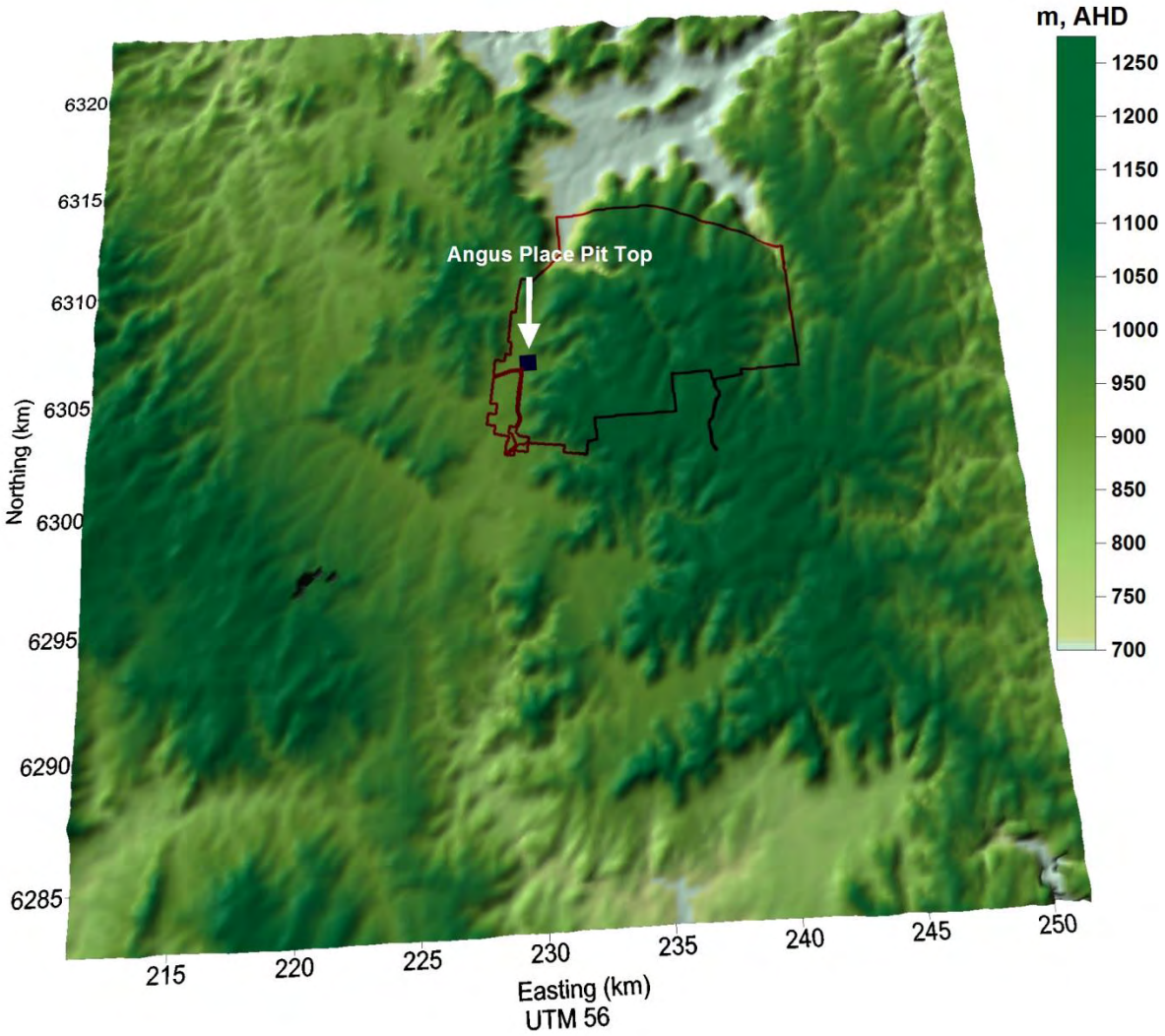


Figure 3 Sensitive Receptor Locations

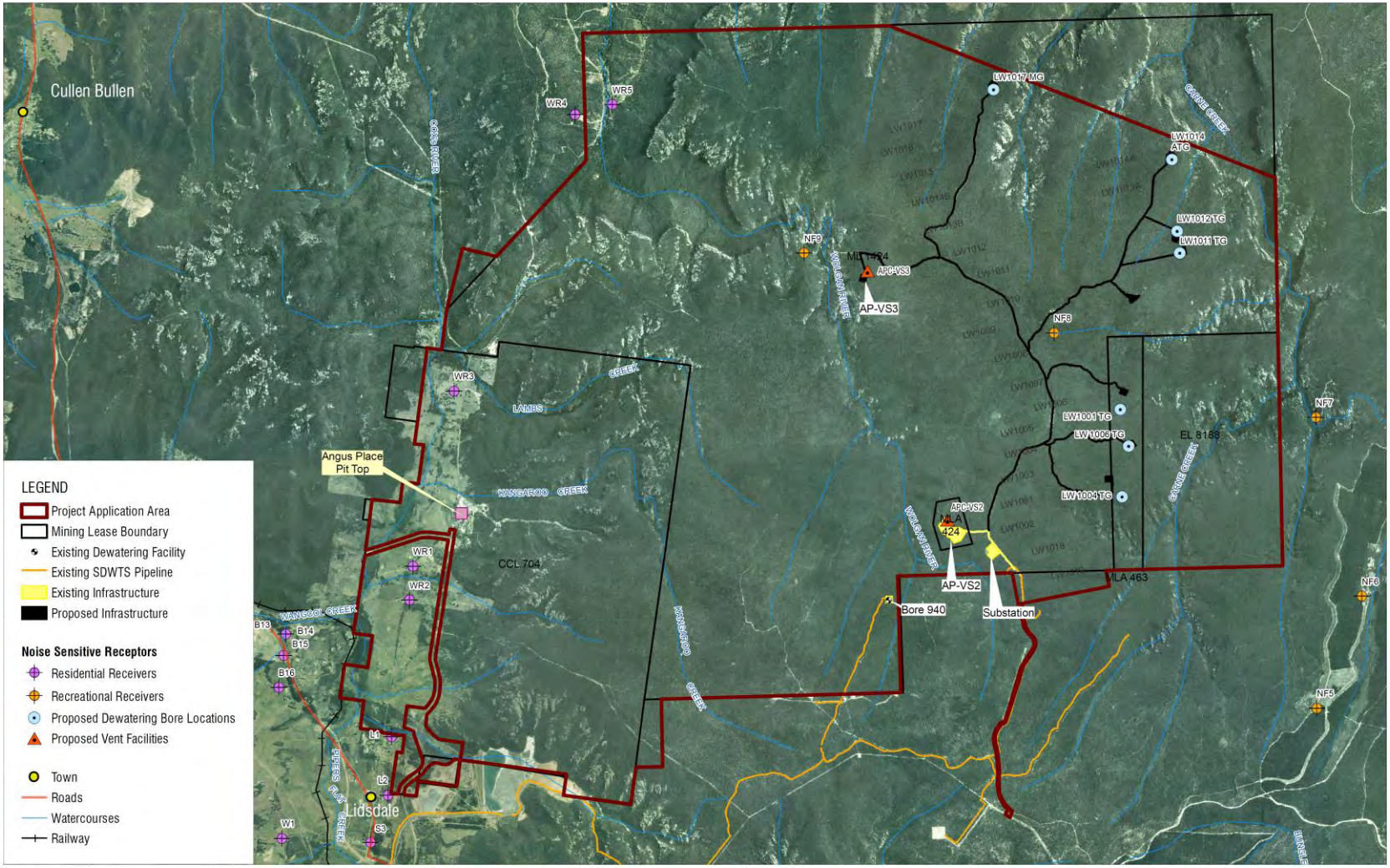


Table 5 Locations of Nearest Residential Receivers

Receptor[1]	Easting (m)	Northing (m)	Zone	Elevation (m)	Approximate Distance to Nearest Site Component
WR1 (Sharpe)[2]	229,408	6,305,100	56H	905	1.1 km (APC Pit Top)
WR2 (Mason)[2]	229,351	6,304,614	56H	910	1.6 km (APC Pit Top)
WR3	229,990	6,307,652	56H	930	1.7 km (APC Top)
WR4	231,748	6,311,673	56H	780	4.8 km (APC-VS3)
WR5	232,286	6,311,814	56H	760	4.4 km (APC-VS3)
L1	232,286	6,311,814	56H	760	3.4 km (APC Pit Top)
L2	229,028	6,301,777	56H	905	4.3 km (APC Pit Top)

1 – WR refers to Wolgan Road receptors. L refers to Lidsdale Village receptors

2 – Property names in accordance with the Angus Place Project Approval (PA 06_0021).

Given that construction of dewatering boreholes and ventilation shaft is to occur in proximity to areas of recreational use, it is considered appropriate to estimate concentrations of particulate matter at these locations. It is noted that air quality impact assessment criteria as outlined in **Section 3** are also applicable to areas where a transient population of primarily recreational users may be located, and as such it is considered to be appropriate to present predicted impacts at these locations for information. The locations of these receptors are presented in **Table 6** and **Figure 4**.

Table 6 Approximate Location of Nearest Sensitive Receivers and distance to Newnes Plateau sites

Receptor	Easting (m)	Northing (m)	Zone	Elevation (m)	Approximate Distance to Nearest Site Component
NF1	239,483	6,300,390	56H	1,165	5.9 km (APC-VS2)
NF2	237,015	6,298,782	56H	1,030	7.0 km (APC-VS2)
NF3	243,358	6,295,836	56H	1,100	10.9 km (LW 1004 TG)
NF4	245,299	6,297,921	56H	970	9.9 km (LW 1004 TG)
NF5	242,528	6,303,041	56H	1,080	4.1 km (LW 1004 TG)
NF6	243,182	6,304,671	56H	1,045	3.8 km (LW 1004 TG)
NF7	242,516	6,307,266	56H	925	2.8 km (LW 1001 TG)
NF8	238,709	6,308,496	56H	1,110	2.0 km (LW 1001 TG)
NF9	235,079	6,309,656	56H	1,030	950 m (APC-VS3)

5 EMISSION ESTIMATION

5.1 Particulate Emission Sources

5.1.1 Construction

Activities associated with the construction of APMEP elements that are likely to generate dust emissions include:

- Land clearance (compounds and roadways);
- Wind erosion of exposed areas;
- Construction of APC-VS3 downcast shaft;
- Construction of dewatering boreholes;
- Construction of associated infrastructure and infrastructure corridors;
- Shaft spoil emplacement area; and,
- Construction of water management structures.

Particulate emissions from these activities have been estimated as discussed in **Section 5.2.1**.

5.1.2 Operation

Activities associated with the APMEP that are likely to generate dust emissions include:

- Material handling (conveyor transfer points);
- Crushing;
- Dozers;
- Loading coal to trucks;
- Ventilation shaft emissions; and,
- Wind erosion.

Particulate emissions from these activities have been estimated as discussed in **Section 5.2.2**.

It is noted that Angus Place Colliery's coal processing and distribution network is being proposed to be amalgamated into the existing Coal Services Facility. Therefore, potential dust emissions from hauling crushed coal from Angus Place to WPS and MPPS were not included in this assessment. The Coal Services Facility has submitted an application for the upgrade of their facilities, and as part of this proposed upgrade, the coal processing and distribution logistics of Angus Place will be transferred into Coal Services operations.

5.1.3 Site Rehabilitation

Following the end of mining activities at Angus Place Colliery, the site will be rehabilitated. Activities associated with this rehabilitation will have the potential to generate particulate emissions and include (at the surface):

- Demolition and removal of roads, buildings and footings;
- Excavation and removal of contaminated material;
- Reshaping of landforms;
- Spreading of topsoil and revegetation of entire site.

Particulate emissions from these activities have been estimated as discussed in **Section 5.2.3**.

5.2 Activity Data and Assumptions

The fugitive particulate emissions from APMEP construction and operation and the life of mine rehabilitation were estimated based on emission estimation techniques listed in the NPI EET Manual for Mining, v 3.1 (DSEWPC, 2012) and USEPA AP42 emission factors (USEPA 1997 and updates).

Where measured data was available, this is identified within the following sections. The following sections outline the assumptions made during the construction of the emissions inventories and outlines the activity data used for each emissions source.

5.2.1 Construction

The assumptions used in the compilation of the construction emissions inventory are summarised in **Table 7**.

Table 7 Summary of Activity Data used to Estimate Particulate Emissions - Construction

Parameter	Activity Data
Dozers clearing access roads to Borehole and Ventilation Facility sites[1] Dozers clearing Borehole and Ventilation Facility sites	2 operating for 10 hours/day at each access road
Graders operating on access roads	1 trip/day
Trucks used to move material	5 trips/day
Material handling rate (excavator)	100 tonne/hour
Wind erosion	10 ha active in total (roads and borehole compounds and ventilation facility site)

[1]It is understood that concurrent operation of 2 dozers at each access road is unlikely. However to predict the worst case impact concurrent operation of two dozers at each site was used in estimating potential particulate emissions.

For the purpose of developing the emission inventories, the following assumptions have also been applied.

- 3% silt content for all material handled; and
- 4% moisture content for all material handled.

No appropriate emission factor exists for drilling of boreholes or sinking of ventilation shafts within either the NPI or AP 42 documentation. To provide an approximation of these activities, an assumption has been made that the NPI emission factor for blast hole drilling is appropriate. A rate of drilling of 5 holes per hour is considered to be appropriate to provide an estimation of borehole and ventilation shaft sinking during the construction phase of the Project.

Note that construction activities have been assumed to run concurrently with Angus Place Colliery pit top operations. It is also acknowledged that the construction of the dewatering boreholes and ventilation shaft may take up to 120 days, however for the purposes of estimating the maximum 24-hour average particulate concentrations, construction has been assumed to occur for all days of the year.

It is unclear at the current time how many of the dewatering bores may be in operation, or constructed concurrently. Therefore, predicted impacts due to construction are likely to be less than those presented in **Section 8**.

5.2.2 Operation

Measured data was used to estimate the potential particulate emissions from the existing and proposed upcast ventilation shafts at Angus Place Colliery. A monitoring survey was performed at the existing Angus Place Colliery vent shaft on 5 February 2013 and a full monitoring report is provided in **Appendix B**. Data relevant to this assessment is provided in **Table 8**.

Table 8 Emission Parameters – Upcast Ventilation Shaft

Parameter	Unit	Measured Value
Temperature	°C	25.4
Velocity	m/s	12.1
Volumetric Flow	Nm^3/s	221.06
Moisture	%	1.6
Oxygen	%	20.7
Total Solid Particulates	mg/Nm^3	0.6
PM_{10}	mg/Nm^3	<0.04
$PM_{2.5}$	mg/Nm^3	0.03

Note: Data used for both existing upcast and proposed APC-VS2 upcast
Note: A different method was used for $PM_{2.5}$ analysis than for PM_{10} and TSP analysis. The limit of reporting (LOR) for the $PM_{2.5}$ analysis method is lower than for the PM_{10} method, A value at the LOR for PM_{10} has been used in the assessment.

Additional activity data used in the emission estimation calculations are summarised in **Table 9**. For the purpose of developing the emission inventories, the following assumptions have also been applied.

- 5% silt content for coal in stockpile (SLR, 2012);
- 10% moisture content for coal in stockpile (SLR, 2012); and,
- The crushing operation is enclosed.

Table 9 Summary of Activity Data used to Estimate Particulate Emissions

Parameter	Activity Data
Coal throughput	4.0 Mtpa
Dozer operation	2,334 hrs/annum
Potential wind erosion area	1.56 ha

5.2.3 Rehabilitation

The fugitive particulate emissions from the Project Application Area rehabilitation were estimated based on emission estimation techniques listed in the NPI EET Manual for Mining, v 3.1 (DEH, 2012) and USEPA AP-42 emission factors.

The assumptions used in the construction of the rehabilitation emissions inventory are summarised in **Table 10**.

Table 10 Summary of Activity Data used to Estimate Particulate Emissions - Construction

Parameter	Activity Data
Dozers clearing site and shaping material	5 operating for 10 hours/day
Graders operating on site	1 trip/day
Trucks used to remove material	10 trips/day
Material handling rate (excavator)	100 tonne/hour
Wind erosion	1.56 ha active in total (pit top area)

For the purpose of developing the emission inventories, the following assumptions have also been applied.

- 3% silt content for all material handled; and
- 4% moisture content for all material handled.

Note that site rehabilitation is assumed to occur as a stand-alone activity. No mining will be in operation at the time of site rehabilitation

5.3 Emission Controls

Based on the information provided by Angus Place, the following emission control techniques employed on site have been incorporated into the emission estimation. No particular design measures can be incorporated into the Project to avoid impacts associated with particulate emissions. The measures detailed below are generally management measures.

5.3.1 Construction

Although a range of best practice measures will be implemented during the construction of the dewatering boreholes, ventilation shaft and associated infrastructure, no such controls have been assumed in the compilation of the construction emissions inventory. In this way, a conservative estimation of air quality impacts on surrounding sensitive receivers can be determined.

5.3.2 Operation

Coal Conveying Transfer Points

There are three coal transfer points within the Angus Place Colliery that have been considered within this assessment. These include:

- unloading from the conveyor onto the ROM Stockpile;
- transfer of ROM coal to the Coal Handling Plant (CHP); and
- transfer of crushed material onto the load-out bin.

The transfer points are enclosed on three sides. It has been estimated that this will reduce the particulate emissions by 40% (Table 96, Katestone 2011). These controls will continue to be in operation throughout the Project.

Crushing

The crusher operation is enclosed. It has been estimated that this will potentially reduce the particulate emissions by 70% (Table 4, DSEWPC 2012). These controls will continue to be in operation throughout the Project.

Wind Erosion

Water sprays are used to suppress emissions of dust from coal stockpiles. It has been estimated that this will reduce the particulate emissions by 50% (Table 72, Katestone 2011). These controls will continue to be in operation throughout the Project.

5.3.3 Rehabilitation

As for the construction scenario, although a range of best practice measures will be implemented during the rehabilitation of the Project Application Area, no such controls have been assumed in the compilation of the rehabilitation emissions inventory. In this way, a conservative estimation of air quality impacts on surrounding sensitive receivers can be determined.

5.4 Emission Estimation Techniques

Emission Factors

The emission factors used for the estimation of TSP and PM_{10} emissions from the Project Site are presented overleaf in **Table 11**.

At Angus Place Colliery, the crushed coal from the CHP is conveyed to a load-out bin. Coal is then loaded from the load-out bin into trucks using an overhead silo. The loading operation is relatively similar to that used for train loading. Therefore the emission factor for 'loading to trains' from NPI EET Manual for Mining (Version 2.3) was used in estimating emission from truck loading operations. It is noted that the Katestone (2011) report on "*NSW Coal Mining Benchmark Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*" also suggests to use the train loading emission factor for this type of operation (Table 98, Katestone (2011)).

The National Pollutant Inventory Manual for Mining, Version 3.1 (DSEWPC, 2012) and US EPA AP-42 Compilation of Emission Factors contain emission factors for TSP and PM_{10}. $PM_{2.5}$ emission factors are provided for some activities, however no $PM_{2.5}$ emission factors are provided for wind erosion within the NPI or US EPA AP-42. Some 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 a proposed $PM_{2.5}/PM_{10}$ ratio of 0.15 for wind erosion sources. This ratio was used within this assessment to calculate the emissions of $PM_{2.5}$ attributable to wind erosion at the Project Application Area.

Table 11 Summary of Emission Factors Used to Estimate Emissions

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied
Dozers on coal	$EF_{TSP} = 35.6 \times \frac{(s)^{1.2}}{M^{1.3}}$ $EF_{PM_{10}} = 0.75 \times 8.44 \times \frac{(s)^{1.5}}{M^{1.4}}$ $EF_{PM2.5} = 0.022 \times 35.6 \times \frac{(s)^{1.2}}{M^{1.3}}$	kg/h/vehicle	AP42	M = Moisture content (%) s = silt content (%)	No Control
Dozers on overburden (representing land clearance, material movement during construction and rehabilitation)	$EF_{TSP} = 2.6 \times \frac{(s)^{1.2}}{M^{1.3}}$ $EF_{PM_{10}} = 0.75 \times 0.45 \times \frac{(s)^{1.5}}{M^{1.4}}$ $EF_{PM2.5} = 0.105 \times 2.6 \times \frac{(s)^{1.2}}{M^{1.3}}$	kg/h/vehicle	AP42	M = Moisture content (%) s = silt content (%)	No Control
Miscellaneous Transfer Points and Excavator	$EF = k \times 0.0016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$	kg/t	AP42	k = 0.74 (TSP) k = 0.35 (PM_{10}) U = mean wind speed (m/s) M = Moisture content (%)	Transfer point enclosed on three sides– 40%
Primary Crusher	$EF_{TSP} = 0.01$ $EF_{PM10} = 0.004$	kg/t	NPI EETM v3.1	-	Enclosed – 70%
Loading Coal to Trucks	$EF_{TSP} = 0.0004$ $EF_{PM10} = 0.002$	kg/t	Katestone (2011)		No Control

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied
Wind Erosion	$EF_{TSP} = 0.4$ $EF_{PM10} = 0.2$ $\mathrm{EF}_{\mathrm{PM2.5}} = 0.03$	kg/ha/yr	NPI EETM v3.1	Assumed $PM_{2.5}/PM_{10}$ ratio of 0.15	Water Sprays – 50% control for operation. No control for construction and rehabilitation.
Wheel generated dust from unpaved roads (used by light duty vehicles)	$EF = \frac{0.4536}{1.6093} * k \times \left(\frac{s}{12}\right)^{a} \times \left(\frac{W}{3}\right)^{b}$	kg/VKT	NPI EETM v3.1	k = 4.9 (TSP) k = 1.5 (PM_{10}) k = 0.15 ($PM_{2.5}$) a = 0.7, b = 0.45 (TSP) a = 0.9, b = 0.45 (PM_{10}) S = mean wind speed (m/s) M = moisture content (%) s = silt content (%)	Level 2 Watering – 50% control for construction and rehabilitation. No control for operation
Grading	$EF_{TSP} = 0.0034 \times (s)^{2.5}$ $EF_{PM10} = 0.0056 \times 0.6 \times (s)^{2.0}$ $EF_{PM10} = 0.031 \times EF_{TSP}$	Kg/VKT	AP42	s = silt content (%)	No Control
Drilling	$EF_{TSP} = 0.59$ $EF_{PM10} = 0.23$ $EF_{PM2.5} = 0.03$	Kg/hole	AP42		No Control

5.5 Emission Inventory

Based on the information presented above, a particulate emissions inventory has been compiled for the proposed Project construction (**Table 12**), operation (**Table 13**) and site rehabilitation (**Table 14**). Details of the emission calculations and emission factors used in estimating emissions are presented in **Appendix C**. It is noted that the particulate emissions estimated for the site are not expected to change as a result of the proposed APMEP, hence these emission estimates also represent current operations. In addition, the APMEP construction and operation are assumed to occur concurrently.

Table 12 Emission Inventory for the APMEP - Construction

Activity	Estimated Emissions (kg/annum)		
	TSP	PM_{10}	$PM_{2.5}$
Dozers on access roads	46,798	7,353	4,914
Grader on access roads	193	110	6
Trucks on access roads	67,751	15,718	1,572
Dozers clearing borehole and ventilation sites	46,798	7,353	4,914
Excavator at borehole and ventilation sites	23,372	11,054	1,674
Drilling of boreholes and ventilation shaft	86,140	33,664	4,031
Wind erosion from exposed areas (borehole sites)	28,032	14,016	2,102
Wind erosion from exposed areas (ventilation facility)	7,008	3,504	526
Total Particulate Emissions	**299,083**	**89,268**	**19,213**

Table 13 Emission Inventory for the APMEP - Operation

Activity	Estimated Emissions (kg/annum)		
	TSP	PM_{10}	$PM_{2.5}$
Transfer points	1,997	945	143
Crushing	12,000	4,800	480
Dozers	28,729	6,576	632
Loading coal to trucks	1,600	680	30
Wind erosion from Main ROM Stockpile	5,463	2,731	819
Existing upcast ventilation fan 1	4,184	279	209
Upcast ventilation fan (APC-VS2)	4,184	279	209
Total Particulate emissions (kg/yr)	**58,156**	**16,290**	**2,523**

Table 14 Emission Inventory for the APMEP – Rehabilitation

Activity	Estimated Emissions (kg/annum)		
	TSP	PM_{10}	$PM_{2.5}$
Dozers moving and shaping material	70,196	11,029	7,371
Grading of site	19	11	1
Haulage of material	3,388	1,572	157
Material handling	730	345	52
Wind erosion from exposed areas	5,463	2,731	410
Total Particulate Emissions	**79,796**	**15,689**	**7,990**

Emissions from construction and rehabilitation activities are shown to be greater than those for operation when assessed over a 1 year timeframe. However, both construction and rehabilitation activities will be shorter term in nature and therefore total emissions will be expected to be lower than those quoted above.

6 ATMOSPHERIC DISPERSION MODELLING

6.1 Model Selection

Emissions from the proposed operations 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).

6.2 Meteorological Modelling

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

6.2.1 MM5

The three dimensional prognostic dataset generated by the Pennsylvania State University/National Centre for Atmospheric Research, or MM5, model was created and assimilated in the CALMET modelling process. The MM5 model is a prognostic mesoscale wind field model with four-dimensional data assimilation. CALMET's wind model allows MM5 generated data to be used as initial pseudo-observations (Scire *et al.*, 2006).

For this study, an MM5 meteorological dataset was obtained for a 120 km x 120 km domain for the 2009 and 2010 calendar years, centred over the study area, with a spatial grid resolution of 12 km. The model has 40 vertical levels, with the lowest level beginning at 11 m above ground level ranging to 3,500 m. The MM5 dataset contains the two-dimensional and three-dimensional parameters listed in **Table 15**.

Table 15 MM5 Dataset Parameters

Hourly 3-Dimensional Parameters	Hourly 2-Dimensional Parameters
Wind speed and direction	Sea-level pressure
Temperature	Rainfall amount
Pressure	Snow cover
Geopotential height	Short wave and long wave radiation at the surface
Vertical velocity	Air temperature and specific humidity at 2m
Relative humidity	Wind speed and direction at 10m
Mixing ratios for water vapour, cloud water, rain and other precipitation	Sea surface temperature

6.2.2 CALMET

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

The MM5 data generated by the Pennsylvania State University/National Centre for Atmospheric Research was used for input into CALMET. The CALMET model was run for both the 2009 and 2010 calendar years. **Table 16** details the parameters used in the meteorological modelling. No surface, upper air or buoy observations were used in the CALMET model ('No-Obs Mode' hereafter). This approach is recommended by NSW EPA (2010) as:

- No-Obs mode allows the important benefits of the non-steady-state approach in CALPUFF to be included in the dispersion modelling (e.g., spatially varying meteorology and dispersion, causality, recirculation, stagnation, pollutant build-up, fumigation, etc.);
- No-Obs mode makes use of three-dimensional, hourly prognostic meteorological data often available at high resolution to drive CALMET and CALPUFF;
- No-Obs mode greatly simplifies the preparation of the CALMET inputs because a large number of input variables dealing with observational data are not required and the difficulties of dealing with potentially incomplete observational datasets are eliminated;
- No-Obs mode provides a relatively straightforward approach that facilitates agency review and approval of the CALMET/CALPUFF simulations;

It was concluded from the meteorological analysis for the years 2009 and 2010, that there was no apparent trend in the meteorological parameters suggesting the suitability of one year over the other. Therefore the meteorological conditions in the most recent year of available data (2010) were used for CALPUFF dispersion modelling. The modelled data for year 2010 for Angus Place Colliery are presented in the following sections. The data for 2009 and 2010 can be found in **Appendix D**.

Table 16 CALMET Configuration Used for this Study

Meteorological grid domain	40 km x 40 km
Meteorological grid resolution	0.2 km
Vertical Resolution (Cell Heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1,200 m, 2,000 m, 3,000 m and 4,000m)
Modelling Year	2010
Initial guess field	3D output from MM5 data

6.3 Meteorological Data Used in Modelling

6.3.1 Wind Speed and Direction

A summary of the annual wind behaviour predicted by CALMET for the site is presented overleaf in **Figure 4**. The frequency of wind speed variation is presented in **Figure 5**.

Figure 4 Wind Roses for the Project Site, as Predicted by CALMET (2010)

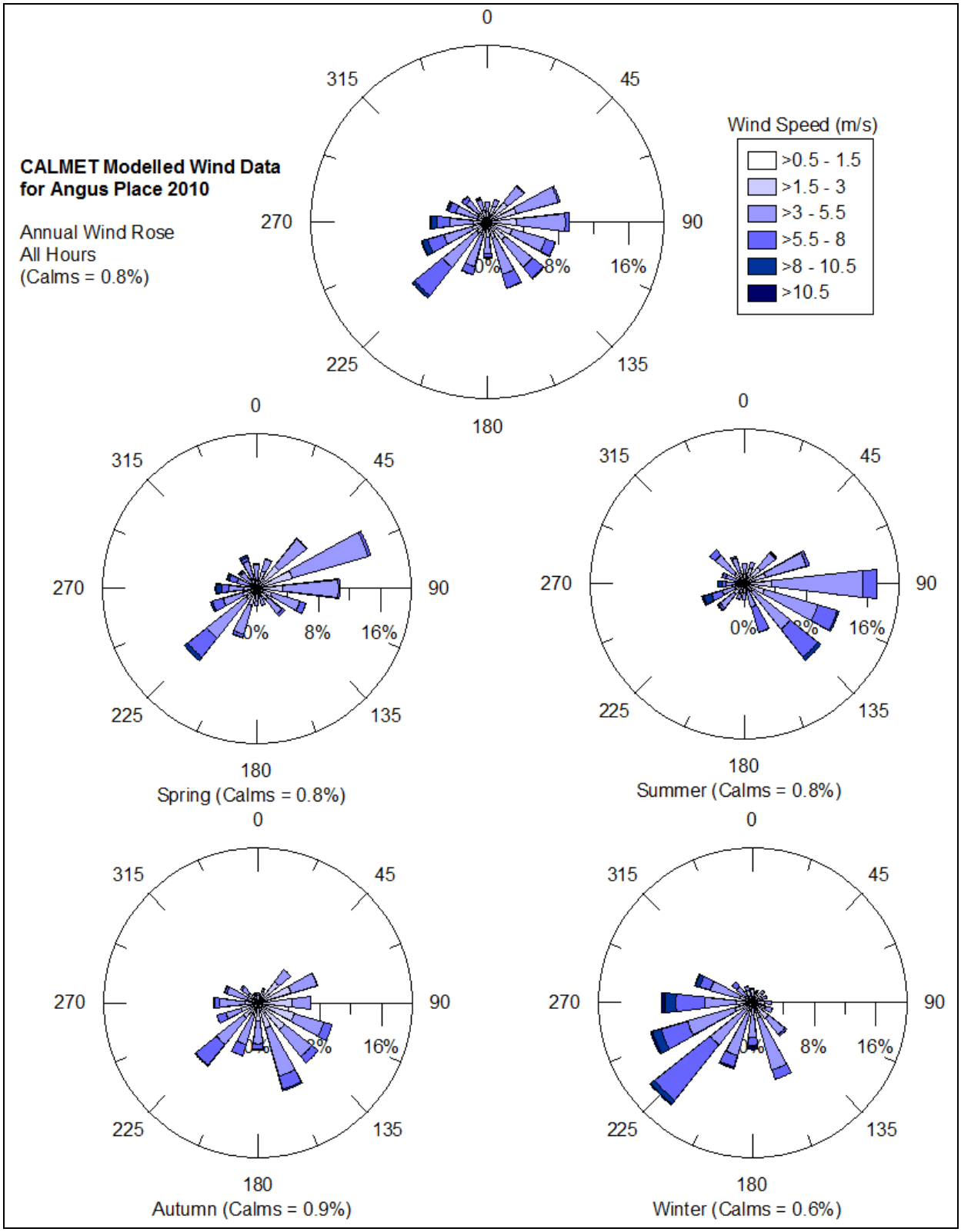


Figure 5 Wind Speed Distribution Predicted by CALMET for the APMEP site (2010)

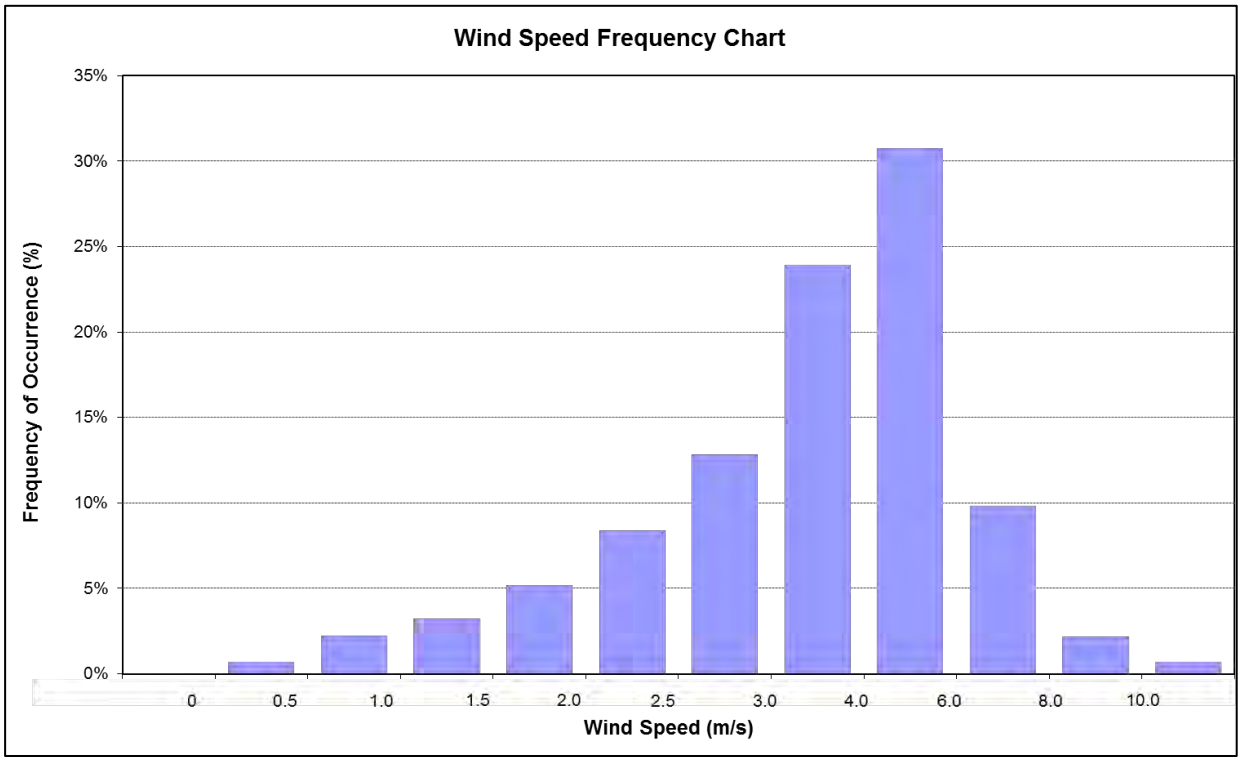


Figure 4 and **Figure 5** indicate that the site experiences predominantly light to moderate winds (between 1.5 m/s and 8 m/s), with the prevailing wind direction from the southwest and southeast quadrants. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur 0.8% of the year during 2010.

The seasonal wind roses indicate that:

- In spring, winds are light to moderate (1.5 m/s to 8 m/s) from the south-western and east-northeastern quadrants.
- In summer, the winds are light to moderate (1.5 m/s to 8 m/s) from the eastern quadrant.
- In autumn, winds are light to moderate (1.5 m/s to 8 m/s) from the south-southeastern quadrant.
- In winter, winds are light to high (1.5 m/s to 10.5 m/s) and are predominantly from the southwest.

6.3.2 Atmospheric Stability

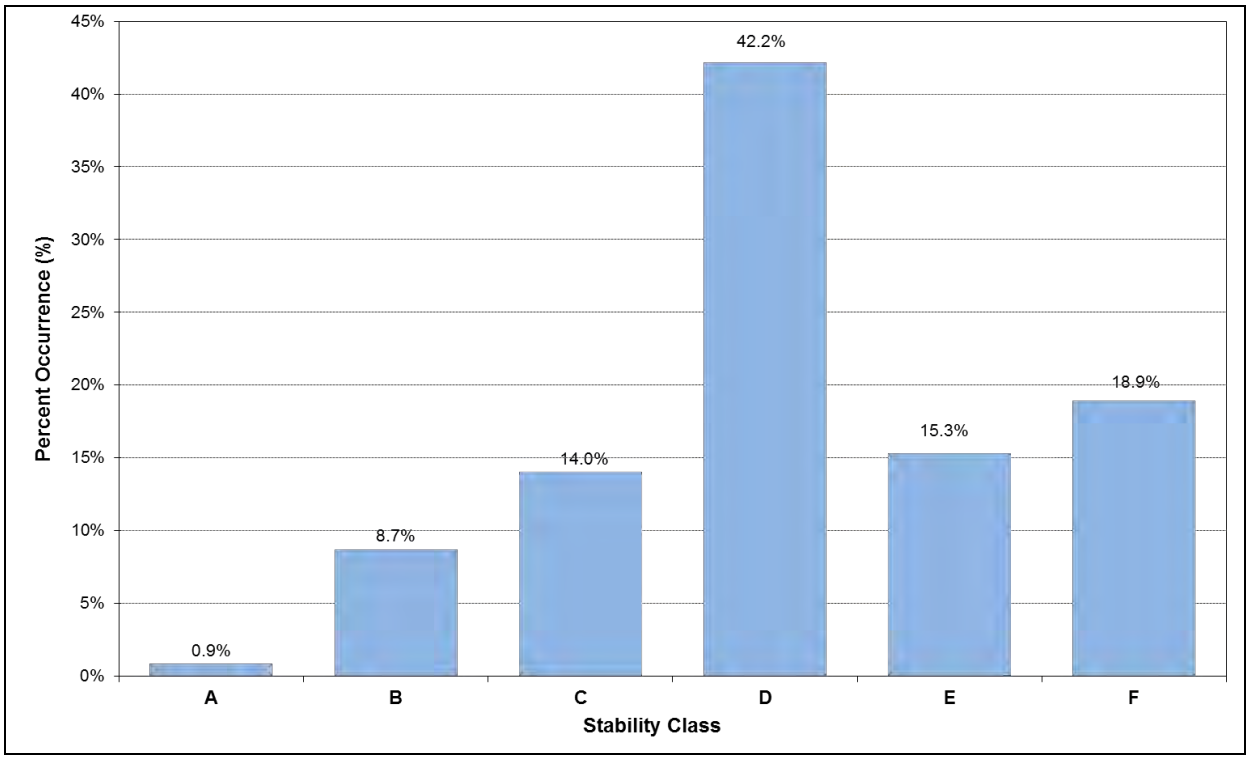
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability (see **Table 17**). These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models.

The frequency of each stability class predicted by CALMET is presented in **Figure 6**. The results indicate a high frequency of conditions typical to Stability Class D. Stability Class D is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing.

Table 17 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

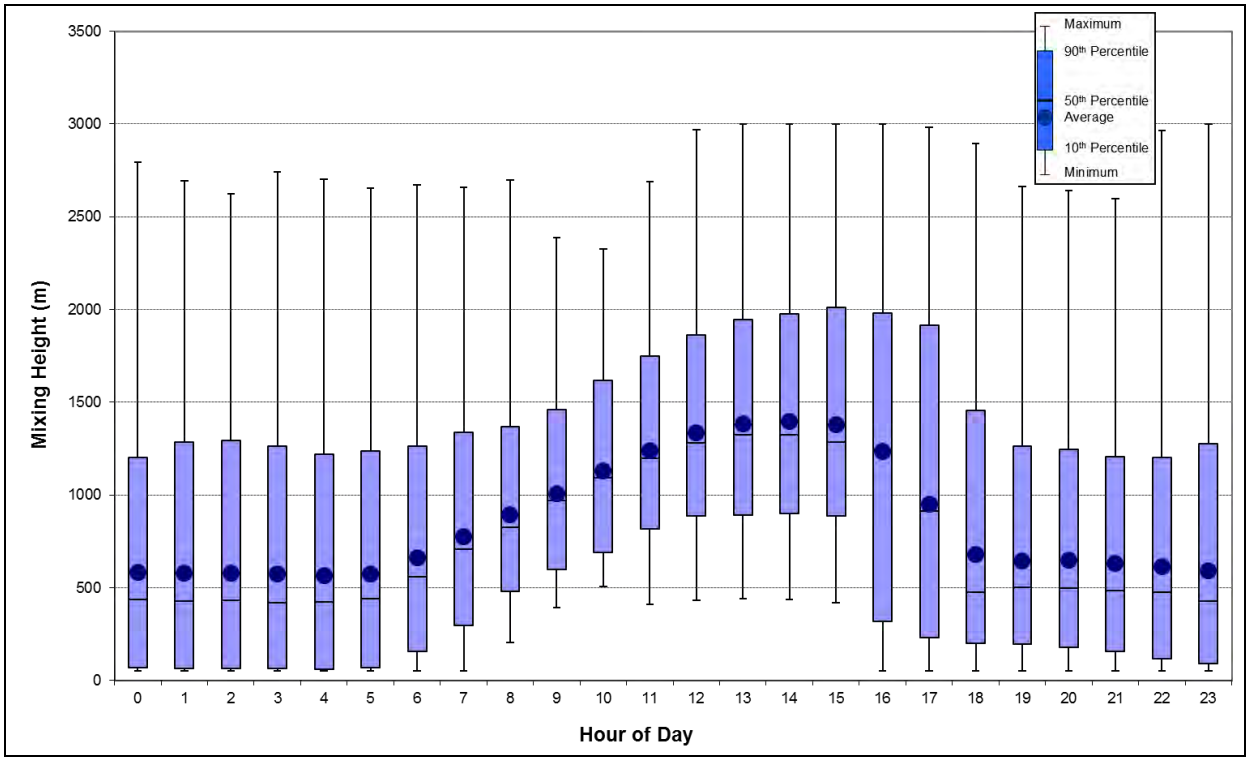
Figure 6 Stability Class Distribution Predicted by CALMET for the Project Site (2010)



6.3.3 Mixing Heights

Diurnal variations in maximum and average mixing depths predicted by CALMET at the Project Site during 2011 are illustrated in **Figure 7**. 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 7 Mixing Heights Predicted by CALMET for the Project Site (2010)



6.4 Comparison with Observed Data

Angus Place Colliery operates a meteorological monitoring station collecting information on a range of parameters. SLR Consulting performed an audit of this automatic weather station (AWS) in 2011, which concluded that the siting was not in accordance with the relevant standards. Since that time, Angus Place Colliery has relocated the station which is now operating to the relevant standards as required by the Project Approval conditions. Given these past issues, data from the on-site AWS has not been used in this study but is available for use in subsequent assessments and in day to day management of particulate matter on site.

The use of 'No-Obs Mode' for meteorology preparation (refer **Section 6.2**) is recommended by the NSW OEH and therefore the approach taken is considered appropriate for this assessment.

6.5 Modelling of Wind Erosion Emissions

An hourly-variable emission file was developed for the wind erosion sources from the total estimated annual emissions using a relationship between the cube of the hourly averaged wind speeds and sum of the hourly cubic wind speeds contained in the meteorological file. This cubic relationship provides a more realistic distribution of emissions with the peak emissions being modelled during high wind speed events and lower emissions being modelled during lower wind speed events.

7 EXISTING BACKGROUND PARTICULATE LEVELS

The main focus of this report is the assessment of the potential impacts of the APMEP on the closest sensitive receptors to the mine. In this case, these sensitive receptors are six residences and eight recreational areas, identified in **Section 4**. The purpose of assessing background air quality is to determine the concentrations of air pollutants currently experienced at these residences, with the predicted concentrations from the APMEP operation added to these background concentrations to identify the likely future air quality impacts. It is therefore important to gain an understanding of current background air quality at these residential locations.

The air quality in the region surrounding the Angus Place Colliery is influenced by emissions generated by a range of sources, originating from both within and outside of the local area. Specifically, air quality will be influenced by traffic-generated pollution (e.g. motorised recreational vehicles travelling in the Newnes State Forest), emissions from power stations and associated ash dams in the area, other coal mining operations, pollution transported into the area from more distant sources and pollution generated by the Project itself.

To determine the incremental impact of particulate emissions from the APMEP on the surrounding environment and sensitive receptors, a dispersion modelling exercise has been performed, as detailed in **Section 0** and **Section 0**. To appropriately assess the *cumulative* impact of the Project, this incremental impact needs to be added to a dataset which includes the influences of all other sources of particulate in the region and is representative of the air quality likely to be experienced at sensitive receptor locations without the impact of the Project.

As required by the Approved Methods, this background dataset is required to be contemporaneous with the meteorological data used within the assessment, and (for PM_{10}) include daily measurements. Given the limited availability of datasets in the area which meet both of these criteria, data from Bathurst has been selected for use within the assessment where appropriate, with justification for its use detailed below.

7.1 Suspended Particulate Matter

TSP and PM_{10}

On-site ambient TSP and PM_{10} monitoring has been performed at the Angus Place Colliery since June 2009. The ambient air quality monitoring program has been incorporated into a wider environmental monitoring campaign, and includes PM_{10} and TSP measurements using two co-located High Volume Air Samplers. The monitoring is undertaken in accordance with AS3580.9.3:2003 and AS3580.9.6:2003 for TSP and PM_{10}, respectively.

The measured 24-hour average PM_{10} and TSP concentrations are presented graphically in **Figure 8**, while the annual average TSP and PM_{10} concentrations recorded during 2010, 2011 and 2012 are summarised in **Table 18**.

Of note, the ratio of mean TSP to PM_{10} measurements in 2010 is of the order of 2.5 to 1. This ratio is the same as that measured at the nearby Springvale Mine which indicates that the mining operations occurring at both sites results in the same ratio of TSP/PM_{10} emissions. Also, it is noted that the monitored TSP and PM_{10} concentrations at the Angus Place HVAS includes contributions from existing activities at Angus Place Colliery as well as other industrial facilities in the region.

The monitoring data was measured on a 1-in-6-day cycle and therefore is not suitable for use in a contemporaneous cumulative impact analysis.

Figure 8 24-Hour Average TSP and PM_{10} Concentrations Measured by the Angus Place HVAS

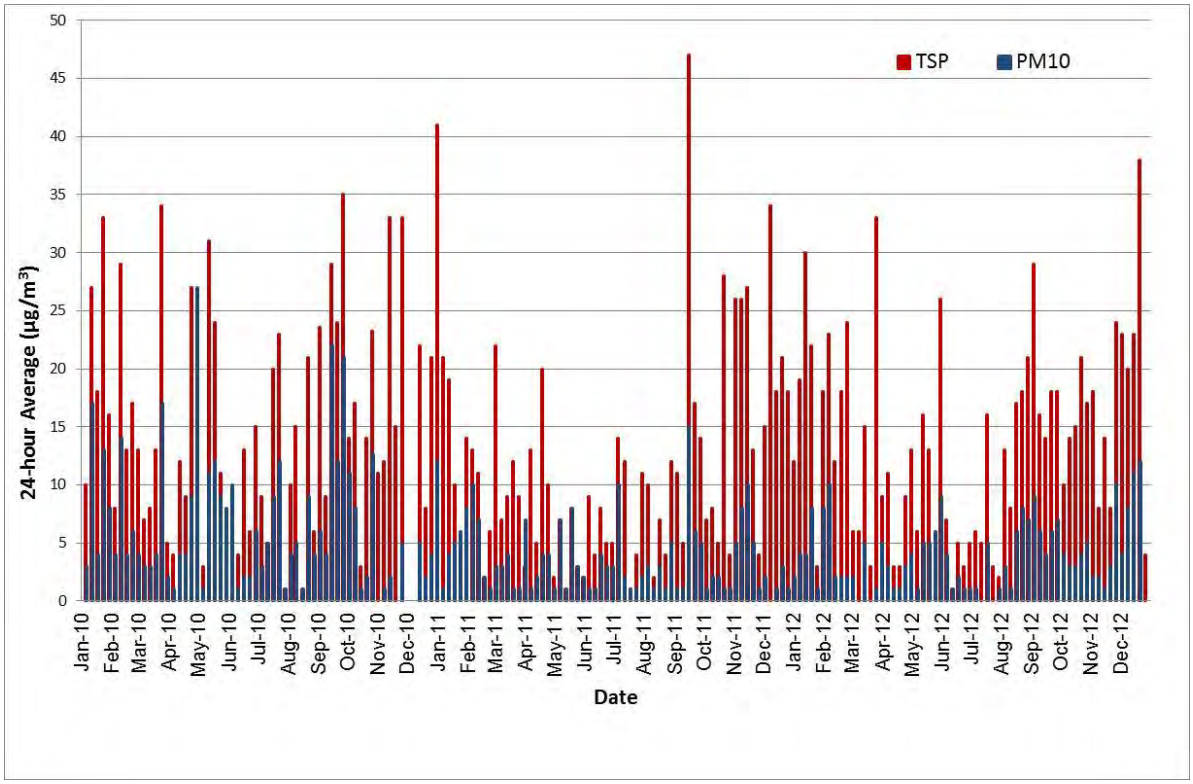


Table 18 Angus Place HVAS 2010 Annual Average Particulate Concentrations

Particulate Size	2010 Annual Average ($\mu g/m^3$)	2011 Annual Average ($\mu g/m^3$)	2012 Annual Average ($\mu g/m^3$)
TSP	16.7	11.5	13.9
PM_{10}	6.7	3.5	4.3

The nearest OEH monitoring station measuring continuous PM_{10} concentrations is located in Bathurst, approximately 50 km west of the project site. It is recognised that local dust generating activities surrounding the APMEP and Bathurst are significantly different. Mining and coal processing activities are the key local potential suspended particulate sources in the area surrounding the Angus Place Colliery. Residential activities (such as lawn mowing, wood heaters) and vehicle emissions are the likely local source of suspended particulate in the Bathurst area. Since the intensity and type of potential dust generating activities at Bathurst and the area surrounding the Angus Place Colliery are different, a further investigation was carried out to justify the use of ambient monitoring data recorded at the OEH operated Bathurst monitoring site in this assessment.

Figure 9 and **Figure 10** present comparisons of the 24-hour average PM_{10} concentrations measured at Bathurst and Angus Place HVAS. Also included are the data collected by HVAS at Springvale Mine for comparison purposes.. It can be observed from **Figure 9** and **Figure 10** that measured data at Angus Place Colliery is consistently lower than that measured at the Bathurst monitoring station. It is difficult to identify any trend between the two datasets but from examination of **Figure 13**, which shows a scatter plot of contemporaneous PM_{10} measurements at Angus Place and Bathurst, the Bathurst data can be seen to provide a conservative approximation of the background air quality experienced at the Angus Place Colliery and surrounding receptors.

Based on the comparison shown in **Figure 9** and **Figure 10**, the use of continuous ambient monitoring data from Bathurst for 2010 is concluded to be a conservative and appropriate approach for the assessment of potential cumulative impacts for the Angus Place Colliery.

Figure 9 Comparison of Measured 24-Hour Average PM_{10} Concentrations – All days

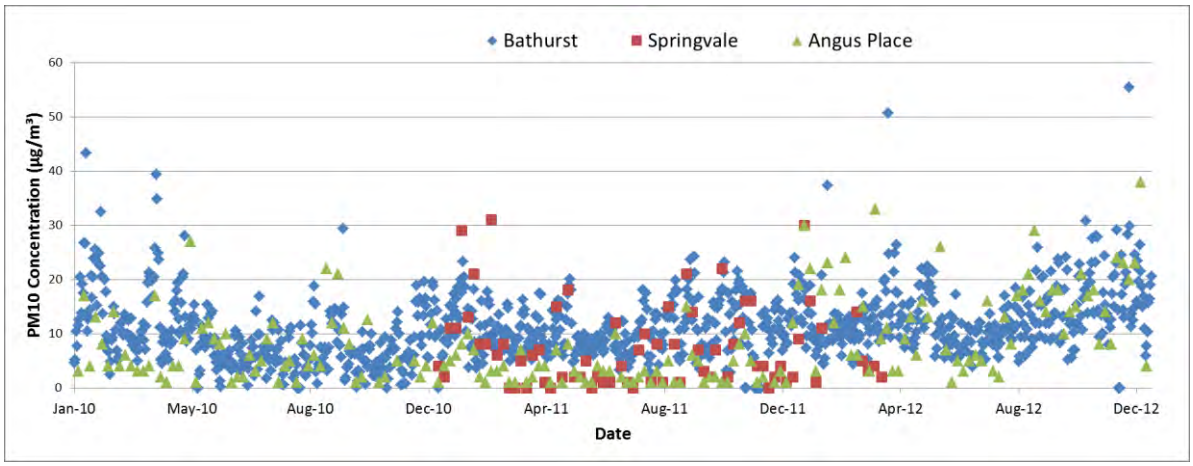


Figure 10 Comparison of Measured 24--Hour Average PM_{10} Concentrations – HVAS Sampling Days Only

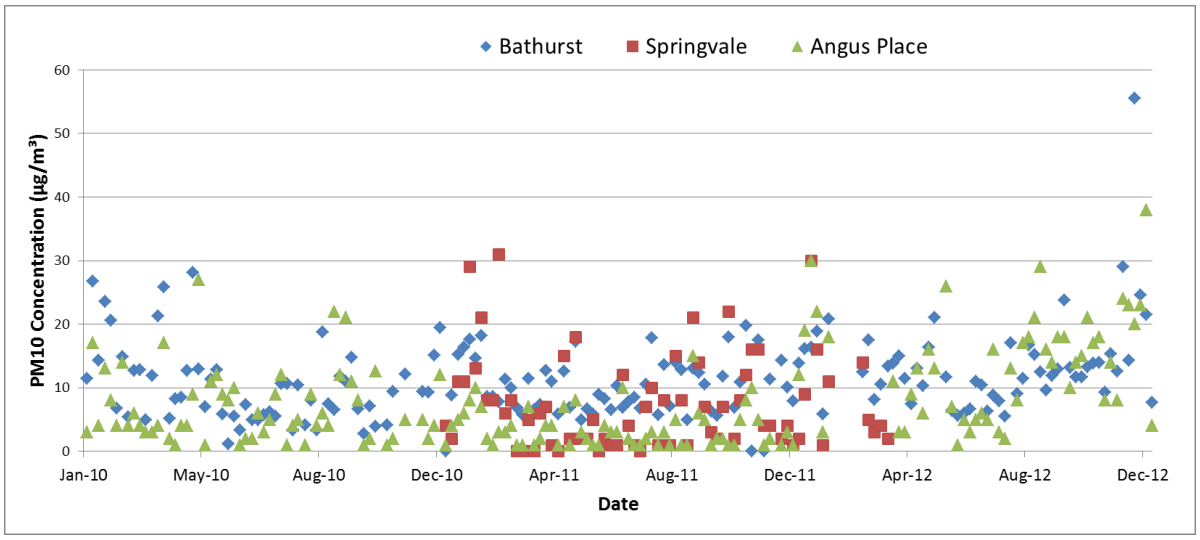
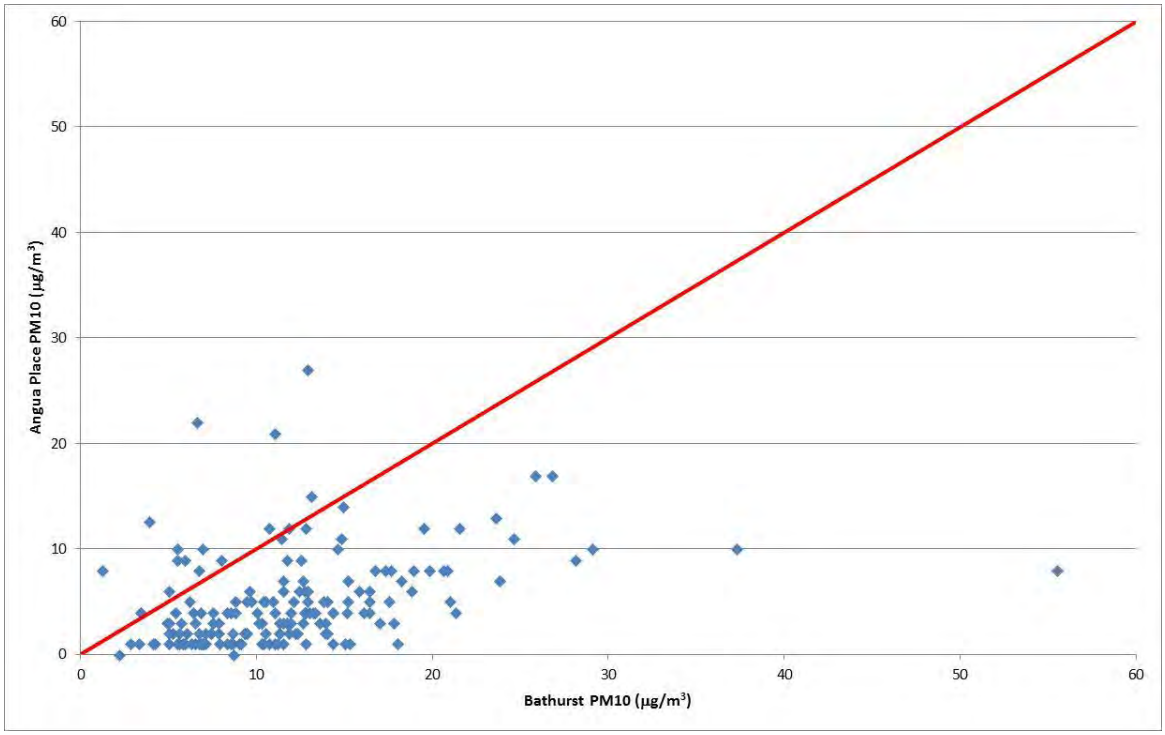


Figure 11 Bathurst PM_{10} versus Angus Place PM_{10} data (2010 to 2012)



Note: Red line denotes 1:1 relationship

A summary of the 24-hour average PM_{10} monitoring concentrations measured at the Bathurst monitoring site is presented in **Table 19**. All data is presented as 24-hour average concentrations in µg/m^3, except averaging period (hours), monitoring start and end dates (dates), skew and kurtosis (dimensionless), and data capture (percentage of the monitoring period).

Table 19 indicates that the mean PM_{10} 24-hour concentrations for both 2010, 2011 and 2012 calendar years range between 9.5 µg/m^3 and 13.5 µg/m^3). The maximum PM_{10} 24-hour concentration for 2010 (43.3 µg/m^3) is significantly higher than 2011 (24.3 µg/m^3) but approximately 12 µg/m^3 lower than for 2012.

Table 19 Statistical Summary of Measured 24-Hour Average PM_{10} Concentration at Bathurst

Statistic				
Averaging period		24 hours	24 hours	24 hours
Monitoring data start		01-01-2010	01-01-2011	01-01-2012
Monitoring data end		31-12-2010	31/12/2011	31-12-2012
Data points		357	355	364
Mean		9.5	11.0	13.4
Standard deviation		6.5	4.4	6.3
Skew[1]		1.6	0.6	2.0
Kurtosis[2]		3.8	-0.2	8.5
Minimum		0.1	2.8	3.9
Percentiles	1	0.5	3.4	4.7
	2	0.7	3.8	5.2
	3	1.3	4.5	5.5
	5	1.9	5.2	5.8
	10	3.1	5.9	6.8
	25	5.0	7.8	9.2
	50	8.0	10.3	12.2
	75	12.5	13.8	16.3
	90	18.3	17.5	21.3
	95	21.1	18.6	24.1
	97	24.8	20.0	26.4
	98	26.5	21.0	27.9
	99	30.8	22.3	30.2
Maximum		43.3	24.3	55.5
Data Capture		98%	97%	99%

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

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

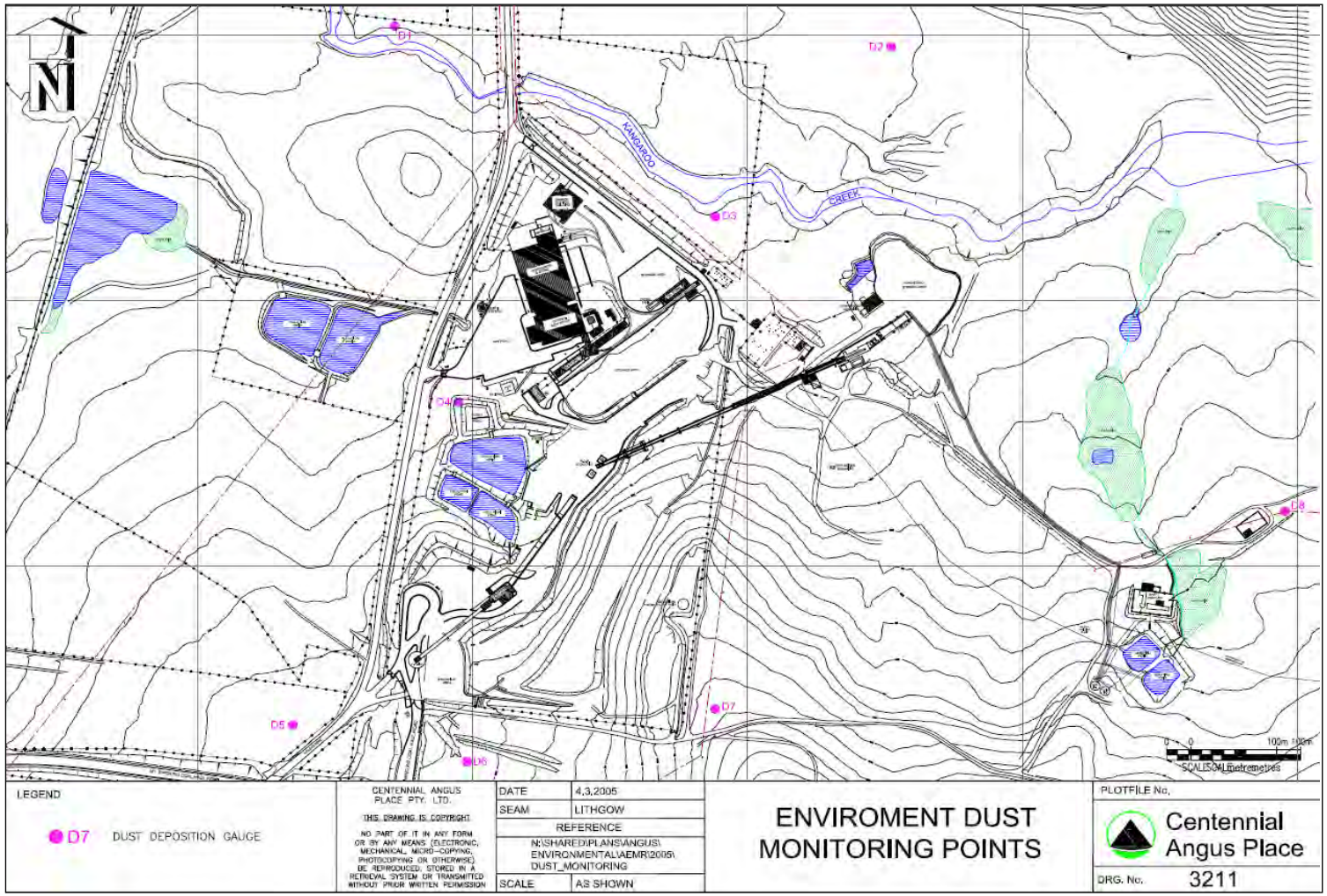
$PM_{2.5}$

No ambient background monitoring data for $PM_{2.5}$ are available in the local area or at the nearest OEH monitoring sites. Therefore a background $PM_{2.5}$ dataset cannot be used within this assessment and comparison of the incremental concentrations to the criteria has been performed.

7.2 Deposited Dust

Static dust monitoring commenced in January 2001 at eight monitoring locations (DG1, DG2, DG3, DG4, DG5, DG6, DG7 and DG8) surrounding the Project site. The locations of the eight dust deposition gauges are shown in Error! Reference source not found..

Figure 12 Location of the Dust Deposition Gauges at Angus Place Colliery

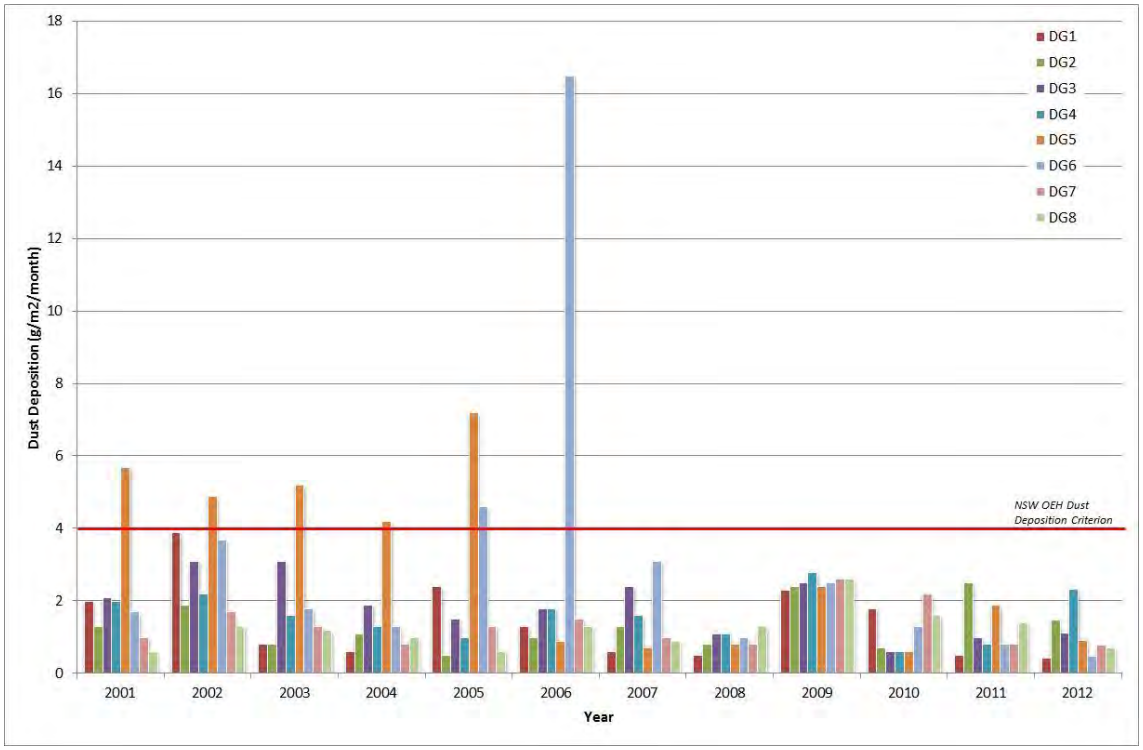


Monitoring results for dust deposition are presented in **Table 20** and **Figure 13** for the years 2001 to 2012. All dust deposition results met the assessment criterion of 4 g/m^2/month with the exception of 2009. Monthly dust deposition results were shown to be elevated in September 2009 (between 10 g/m^2/month and 28 g/m^2/month) and October 2009 (between 7 g/m^2/month and 10 g/m^2/month) due to several dust storms experienced at the end of September 2009.

Table 20 Historic Dust Depositional Monitoring Results - January 2001 to December 2011

Date	Dust Gauge ID – Annual Average Dust Deposition (g/m^2/month)							
	DG1	DG2	DG3	DG4	DG5	DG6	DG7	DG8
2001	2.0	1.3	2.1	2.0	5.7	1.7	1.0	0.6
2002	3.9	1.9	3.1	2.2	4.9	3.7	1.7	1.3
2003	0.8	0.8	3.1	1.6	5.2	1.8	1.3	1.2
2004	0.6	1.1	1.9	1.3	4.2	1.3	0.8	1.0
2005	2.4	0.5	1.5	1.0	7.2	4.6	1.3	0.6
2006	1.3	1.0	1.8	1.8	0.9	16.5	1.5	1.3
2007	0.6	1.3	2.4	1.6	0.7	3.1	1.0	0.9
2008	0.5	0.8	1.1	1.1	0.8	1.0	0.8	1.3
2009	2.3	2.4	2.5	2.8	2.4	2.5	2.6	2.6
2010	1.8	0.7	0.6	0.6	0.6	1.3	2.2	1.6
2011	0.5	2.5	1.0	0.8	1.9	0.8	0.8	1.4
2012	0.4	1.5	1.1	2.3	0.9	0.5	0.8	0.7
Maximum	3.9	2.5	3.1	2.8	7.2	16.5	2.6	2.6
Average	1.4	1.3	1.9	1.6	3.0	3.2	1.3	1.2
Minimum	0.4	0.5	0.6	0.6	0.6	0.5	0.8	0.6

Figure 13 Monitoring Results for Dust Deposition – Angus Place Colliery



It is noted that the annual average dust deposition monitored during the year 2010 have been adopted for this assessment. This is consistent with the adopted meteorological year (2010) and other regional background concentrations (see **Section 7.1**) adopted within this assessment.

7.3 Assessment of Cumulative Impacts

A number of other industrial facilities located in the vicinity of Angus Place Colliery have been identified which may contribute to the cumulative impacts on the local airshed. The identified industrial facilities which are likely to have a cumulative impact on the local airshed are identified in **Table 21**.

Table 21 Identified Industrial Facilities in the Vicinity of the Angus Place Colliery

Industrial Facility	Location (Figure 14)	Impact Assessment
Angus Place Colliery Pit Top	A	**Section 8**
Springvale Coal Services, south of Blackmans Flat	B	**Section 7.3.1**
Mount Piper Power Station (Mt Piper A)	C1	**Section 7.3**
New Base Load Power Station (Mt Piper B)	C2	**Section 7.3**
Western rail coal unloader	C3	**Section 7.3.2**
Wallerawang Power Station (WPS)	D	**Section 7.3**
Springvale Mine	E	**Section 7.3.3**
Lidsdale Siding Coal Loading Facility (LSCLF)	F	**Section 7.3.4**
Pine Dale Coal Mine (Yarraboldy extension)	G	**Section 7.3.5**
Clarence Colliery	Not Shown	**Section 7.3.6**

The location of the Angus Place Pit Top with respect to the locations of other identified industrial facilities in its vicinity is shown in **Figure 14**.

It is noted that the Western rail coal unloader (C3) associated with Mount Piper Power Station was approved in June 2009 but construction is yet to start on this facility. Also included in this assessment is the Mount Piper Base Load power station which was approved in January 2010.

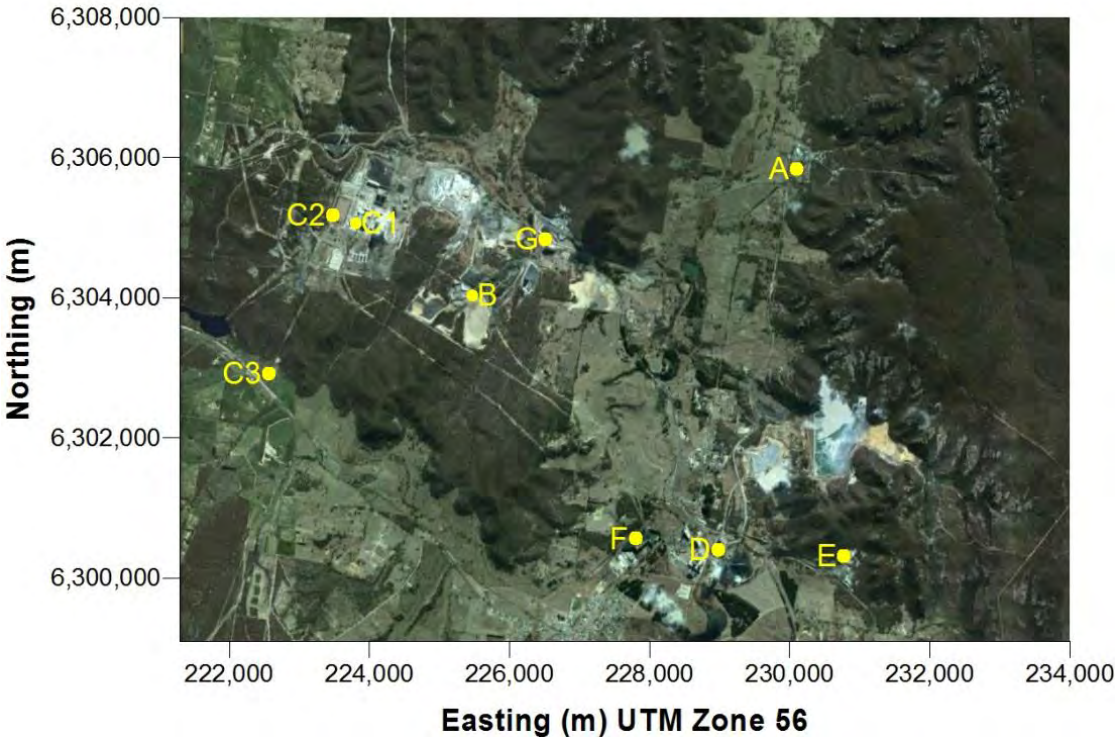
Given that the continuous particulate monitoring data obtained from the Bathurst OEH site is clearly shown to be a conservative estimation of the actual particulate environment (as monitored) surrounding the Angus Place Colliery, it can be confidently considered that the following existing activities and projects located in the area surrounding the APMEP are taken into account within the AQIA.

- Wallerawang Power Station (coal-fired, 1,000 MW).
- Mount Piper Power Station (Mt Piper A).

The above also include associated infrastructure such as coal stockpiles and ash dams.

- Haul roads from Angus Place to Mt Piper and Wallerawang Power Stations.
- Existing Springvale Mine including longwalls 415 to 417 beneath Sunnyside Ridge Road and existing vent shaft.
- Current Lidsdale Siding and Coal Services Operations.
- Clarence Colliery.
- Surrounding forestry activities and recreational activities (e.g. vehicles within the Newnes State Forest).

Figure 14 Location of Angus Place Colliery and other Industrial Facilities



Given the conservatism in the adoption of the Bathurst particulate data it can also be considered that applications not approved, but advanced within the planning system may also be appropriately taken into account within the AQIA. Further discussion of each of the following projects is considered below:

- Wallerawang Power Station Development Application (024/11DA) for new storage silos.
- Mount Piper Power Station (Mt Piper B) approved in January 2010 and new rail coal unloader (new rail line of 5 km length and coal conveyor 4 km length) approved June 2009.
- Part 3A application for new ash placement areas at the existing Mount Piper Power Station.
- Part 3A application for an open cut mining extension to the Pine Dale Coal Mine (located near Blackmans Flat 17 km northwest of Lithgow).
- Springvale Mine including:
  - an application currently being made for two new dewatering bores; and
  - the approved upgrade to the vent shaft No. 3.
- Lidsdale Siding Upgrade Project – a Centennial project to improve rail loading facilities including a reclaim tunnel and train track extension, near Wallerawang.
- Coal Services Washery Upgrade and Coal Distribution Project – a Centennial project for a new washery, haul road (via a bridge from the existing haul road between Angus Place and Mt Piper), and new reject emplacement areas.

7.3.1 Springvale Coal Services

Springvale Coal Services is located approximately 5 km to the southwest of the Angus Place Colliery and processes coal from the Springvale operations. All processing operations within the Springvale Coal Services site are enclosed and it is not considered that cumulative impacts would occur between that operation and the Project Application Area, especially given the 5 km separation distance between these two operations.

7.3.2 Mount Piper Power Station Western Coal Unloader

The Western Coal Unloader (WCU) associated with the Mt Piper Power Station gained Project Approval in June 2009. The WCU is designed to enable the supply of coal by rail to the Power Station from a number of mines, mainly to the north of the Power Station (SKM, 2007). The WCU will be located approximately 2 km to the south of the Mt Piper Power Station and approximately 9 km northwest of the Project Application Area. The Environmental Assessment (SKM, 2007) for the WCU assessed the impact of particulate matter for the construction and operational scenarios.

It was concluded that during the operational scenario, maximum predicted 24-hour average incremental PM_{10} concentration at 'Receiver 1' was 9 $\mu g/m^3$ (SKM, 2007). The location of 'Receiver 1' is approximately 7 km from the Angus Place Pit Top.

Given such low concentrations at these distances from the Angus Place Pit Top, it is considered that the WCU will not have a cumulative impact on particulate concentrations associated with the Project. The WCU has therefore not been considered further within this report.

7.3.3 Springvale Mine

Springvale Mine is located approximately 5 km to the south of the Angus Place Colliery and is an underground mining operation. Project Approval documentation has recently been submitted relating to the Springvale Mine Extension Project. No significant impacts relating to air quality were predicted from this proposed Project at nearest sensitive receptors. During the construction of the Project, maximum incremental 24 hour average concentrations of 0.4 $\mu g/m^3$ were predicted at a receptor at a similar distance from the Angus Place Colliery. Given the separation distance between the Springvale Mine and the Angus Place Colliery, it is not considered that cumulative impacts would occur between the two operations and has not been considered further within this report.

7.3.4 Lidsdale Siding

A dispersion modelling exercise has been performed by SLR Consulting (SLR 2012c) and the impacts from the upgraded Project operations were assessed at ten identified sensitive receptors in the vicinity of the Lidsdale Siding Coal Loading Facility (LSCLF). The maximum incremental (Project only) 24-hour average PM_{10} concentrations (17.1 $\mu g/m^3$) were predicted to occur at a receptor which is approximately 6 km to the southwest of the Angus Place Colliery.

Further investigation of the potential cumulative impacts from this Project on the receptors closest to the Angus Place pit top indicate maximum incremental PM_{10} concentrations of 1 $\mu g/m^3$ approximately 1 km from the LSCLF site (5 km from the Angus Place pit top).

Considering the small incremental concentration resulting from the proposed operation of the LSCLF at receptors surrounding the Project Application Area, it is considered that the background data from Bathurst (refer **Section 7.1**) will appropriately include such impacts. The operation of the LSCLF is not considered further within this assessment.

7.3.5 Pine Dale Coal Mine Extension Project

The Pine Dale Coal Mine is located approximately 3.5 km southwest of the Angus Place Colliery pit top operations. The Pine Dale Yarraboldy Extension has been approved and is currently operational. Planning is currently underway for the Pine Dale Stage 2 Extension Project, although no detailed air quality modelling has been performed for this proposed expansion to date. For the purposes of this assessment, it has been assumed that impacts experienced at nearby receptors due to the Stage 2 Extension Project may be similar to those experienced during the Yarraboldy Extension operations.

Dispersion modelling predictions of the proposed operations (Yarraboldy extension) indicated predicted maximum incremental 24-hour average PM_{10} concentrations of between 2 $\mu g/m^3$ and 5 $\mu g/m^3$ at a receptor located approximately 500 m to the east of Receptor WR1 (refer **Table 5**). Given the small predicted incremental impact from the Pine Dale Extension, the proposed Stage 2 Extension Project has not been considered further within this report.

7.3.6 Clarence Colliery

Clarence Colliery is located approximately 17 km to the southeast of the Angus Place Colliery. Given the separation distance between the Clarence Colliery and the Angus Place Colliery, it is not considered that cumulative impacts would occur between the two operations.

7.3.7 Forestry and Recreation Activities

Forestry and recreation activities occur within the Newnes State Forest although in the immediate area surrounding the Project will be limited to unsealed road use by 4WD vehicles and occasional forestry vehicles. Given the likely infrequent nature of these activities, it is not considered that these will have cumulative effects with the Project operation.

7.4 Adopted Background for this Assessment

To provide an assessment of potential cumulative pollutant concentrations at surrounding sensitive receptors, measured long term (≥1 year) ambient air quality data are required. However, as stated above, no long term continuous ambient monitoring data are available in the vicinity of the project area.

Following the analysis presented in **Section 7.1**, it has been established that the use of continuous PM_{10} monitoring data (2010) from the OEH operated monitoring site at Bathurst provides a conservative estimate of regional background levels and includes the impact of surrounding industries as discussed in **Section 7.3**.

The annual average TSP concentration was calculated based on the annual average PM_{10} concentration at Bathurst and the TSP to PM_{10} ratio derived from Angus Place HVAS data (presented in **Section 7.1**). An annual average background dust deposition rate was calculated based on the average of 2010 data measured at the eight dust deposition gauges surrounding the Angus Place Colliery site. 2010 data was used for meteorology and particulate background to maintain consistency. The adopted background data are presented in **Table 22**.

Table 22 Adopted Background Data

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)	Basis
PM_{10}	24-hour	Daily varying background	Monitoring data at Bathurst (2010)
	Annual	9.5	Monitoring data at Bathurst (2010)
TSP	Annual	22.8	TSP to PM_{10} ratio of 2.4
Dust Deposition	Annual	1.2 g/m^2/month	Average of dust deposition monitoring data in 2010

8 AIR DISPERSION MODELLING RESULTS

The ground level particulate concentrations and deposition rates predicted by the modelling at the nearest sensitive receptors are presented and discussed below for each scenario.

8.1 Dust Deposition

Table 23 shows the results of the dispersion modelling for dust deposition from the Project Site at each of the identified receptors using the emission rates calculated in **Section 0** Contour plots of the predicted incremental increase in dust deposition rates are also presented in **Appendix E.**

Table 23 Predicted Annual Average Dust Deposition Rates

Receptor ID	Annual Average Dust Deposition Rate (g/m^2/month)						
	Background	Increment			Cumulative		
		Construction	Operation	Rehabilitation	Construction	Operation	Rehabilitation
WR1	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
WR2	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
WR3	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
WR4	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
WR5	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
L1	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
L2	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF1	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF2	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF3	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF4	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF5	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF6	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF7	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF8	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
NF9	1.4	<0.1	<0.1	<0.1	<1.5	<1.5	<1.5
Criteria		**2.0**	**2.0**	**2.0**	**4.0**	**4.0**	**4.0**

The results indicate that incremental and cumulative annual average dust deposition rates at all nominated residences/properties/sensitive areas surrounding the Project Application Area 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). The incremental increase predicted as a result of the APMEP operations including the construction and final rehabilitation of the Project Application Area are negligible and would not result in a measureable increase above existing levels.

8.2 Suspended Particulate

8.2.1 TSP

Table 24 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 0**. The calculated background TSP concentrations have been discussed in detail in **Section 7.1**. Contour plots of the predicted cumulative increase in TSP concentrations are presented in **Appendix E**.

Annual average TSP concentrations are predicted to be well below the criterion of 90 µg/m^3 at all nominated residences/properties/sensitive areas surrounding the Project Application Area. The incremental increase predicted as a result of the APMEP operations including the construction and final rehabilitation of the Project Application Area are very low and are not predicted to give rise to a significant increase above existing levels.

Table 24 Predicted Annual Average TSP Concentrations

Receptor ID	Annual Average TSP Concentration (µg/m^3)						
	Background	Increment			Cumulative		
		Construction	Operation	Rehabilitation	Construction	Operation	Rehabilitation
WR1	23.4	0.7	0.7	0.7	24.1	24.1	24.1
WR2	23.4	0.4	0.3	0.3	23.8	23.7	23.7
WR3	23.4	0.2	0.2	0.2	23.6	23.6	23.6
WR4	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
WR5	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
L1	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
L2	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF1	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF2	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF3	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF4	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF5	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF6	23.4	<0.1	<0.1	<0.1	<23.5	<23.5	<23.5
NF7	23.4	0.1	<0.1	<0.1	23.5	<23.5	<23.5
NF8	23.4	0.4	<0.1	<0.1	23.8	<23.5	<23.5
NF9	23.4	0.1	<0.1	<0.1	23.5	<23.5	<23.5
Criterion					**90**	**90**	**90**

8.2.2 PM_{10}

Annual Average PM_{10} Concentrations

Table 25 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 0**. The calculated background PM_{10} concentrations have been discussed in detail in **Section 7.1**. Contour plots of the predicted cumulative increase in annual average PM_{10} concentrations are presented in **Appendix E**.

Annual average PM_{10} concentrations are predicted to be well below the NSW EPA criterion of 30 µg/m^3 and WHO criterion of 20 µg/m^3 at all nominated residences/properties/sensitive areas surrounding the Project Application Area. The incremental increase predicted as a result of the APMEP operations including the construction and final rehabilitation of the Project Application Area are very low and are not predicted to give rise to a significant increase above existing levels.

Table 25 Predicted Annual Average PM_{10} Concentrations

Receptor ID	Annual Average PM_{10} Concentration (µg/m³)						
	Background	Increment			Cumulative		
		Construction	Operation	Rehabilitation	Construction	Operation	Rehabilitation
WR1	9.5	0.3	0.3	0.2	9.8	9.8	9.7
WR2	9.5	0.2	0.2	0.1	9.7	9.7	9.6
WR3	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
WR4	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
WR5	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
L1	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
L2	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF1	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF2	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF3	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF4	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF5	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF6	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF7	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
NF8	9.5	0.2	<0.1	<0.1	9.7	<9.6	<9.6
NF9	9.5	<0.1	<0.1	<0.1	<9.6	<9.6	<9.6
Criterion					**30**	**30**	**30**

Maximum 24-Hour Average PM_{10} Concentrations

To assess the cumulative maximum 24-hour average PM_{10} concentrations at each of the identified sensitive receptors, a contemporaneous analysis was performed following the Approved Methods. At each receptor, each individual incremental prediction was added to the corresponding measured background concentration to obtain cumulative 24-hour average PM_{10} concentrations.

Construction

Table 26 presents the summary of this contemporaneous analysis at each surrounding sensitive receptor listed in **Table 5** and **Table 6** during Project construction.

The results presented in **Table 26** show that the predicted cumulative 24-hour average PM_{10} concentrations are below the criterion of 50µg/m³ and therefore the proposed construction activities are unlikely to cause any exceedences at any surrounding sensitive receptor locations. Contour plots of the predicted cumulative increase in 24-hour average incremental PM_{10} concentrations are presented in **Appendix E**.

Table 26 Summary of Contemporaneous Analysis During Construction

Receptor ID	Date	PM_{10} 24-Hour Average (µg/m³)			Date	PM_{10} 24-Hour Average (µg/m³)		
		Highest Background	Increment	Total		Background	Highest Increment	Total
WR1	13-01-2010	43.3	<0.1	<43.4	15-04-2010	17.9	6.0	23.9
WR2	13-01-2010	43.3	<0.1	<43.4	15-04-2010	17.9	3.3	21.2
WR3	13-01-2010	43.3	0.4	43.7	17-11-2010	6.6	1.8	8.4
WR4	13-01-2010	43.3	<0.1	<43.4	15-05-2010	8.7	0.2	8.9
WR5	13-01-2010	43.3	<0.1	<43.4	15-05-2010	8.7	0.2	8.9
L1	13-01-2010	44.3	<0.1	<44.4	28-07-2010	10.7	0.3	11.0
L2	13-01-2010	43.3	<0.1	<43.4	28-07-2010	10.7	0.3	11.0
NF1	13-01-2010	43.3	<0.1	<43.4	09-05-2010	3.1	0.7	3.8
NF2	13-01-2010	43.3	<0.1	<43.4	28-07-2010	10.7	0.3	11.0
NF3	13-01-2010	43.3	<0.1	<43.4	09-05-2010	3.1	0.4	3.5
NF4	13-01-2010	43.3	<0.1	<43.4	17-07-2010	5.7	0.2	5.9
NF5	13-01-2010	43.3	<0.1	<43.4	24-07-2010	5.6	0.6	6.2
NF6	13-01-2010	43.3	<0.1	<43.4	24-07-2010	5.6	0.6	6.2
NF7	13-01-2010	43.3	0.2	43.5	10-05-2010	8.2	0.3	8.5
NF8	13-01-2010	43.3	<0.1	<43.4	28-07-2010	10.7	2.3	13.0
NF9	13-01-2010	43.3	<0.1	<43.4	20-09-2010	11.8	0.6	12.4
Criterion				**50**				**50**

Operation

Table 27 presents the summary of this contemporaneous analysis at each surrounding sensitive receptor listed in **Table 5** and **Table 6** during Project operation.

The results presented in **Table 27** show that the predicted cumulative 24-hour average PM_{10} concentrations are below the criterion of 50µg/m³ and therefore the proposed operational phase activities are unlikely to cause any exceedences at any surrounding sensitive receptor locations. Contour plots of the predicted cumulative increase in 24-hour average incremental PM_{10} concentrations are presented in **Appendix E**.

Table 27 Summary of Contemporaneous Analysis During Operation

Receptor ID	Date	PM_{10} 24-Hour Average (µg/m³)			Date	PM_{10} 24-Hour Average (µg/m³)		
		Highest Background	Increment	Total		Background	Highest Increment	Total
WR1	13-01-2010	43.3	<0.1	<43.3	15-04-2010	17.9	5.9	23.8
WR2	13-01-2010	43.3	<0.1	<43.3	15-04-2010	17.9	3.2	21.1
WR3	13-01-2010	43.3	0.4	43.7	17-11-2010	6.6	1.7	8.3
WR4	13-01-2010	43.3	<0.1	<43.3	11-08-2010	0	<0.1	<0.1
WR5	13-01-2010	43.3	<0.1	<43.3	08-05-2010	2.4	<0.1	<2.5
L1	13-01-2010	43.3	<0.1	<43.3	03-05-2010	15.3	0.3	15.6
L2	13-01-2010	43.3	<0.1	<43.3	09-01-2010	19.1	0.3	19.4
NF1	13-01-2010	43.3	<0.1	<43.3	24-09-2010	14.3	<0.1	<14.4
NF2	13-01-2010	43.3	<0.1	<43.3	17-07-2010	5.7	<0.1	<5.8
NF3	13-01-2010	43.3	<0.1	<43.3	24-09-2010	14.3	<0.1	<14.4
NF4	13-01-2010	43.3	<0.1	<43.3	09-03-2010	8.9	<0.1	<9
NF5	13-01-2010	43.3	<0.1	<43.3	10-05-2010	8.2	<0.1	<8.3
NF6	13-01-2010	43.3	<0.1	<43.3	02-05-2010	13.3	<0.1	<13.4
NF7	13-01-2010	43.3	<0.1	<43.3	12-07-2010	7.6	<0.1	<7.7
NF8	13-01-2010	43.3	<0.1	<43.3	22-08-2010	6.1	<0.1	<6.2
NF9	13-01-2010	43.3	<0.1	<43.3	18-11-2010	3.7	0.1	3.8
Criterion				**50**				**50**

Rehabilitation

Table 28 presents the summary of this contemporaneous analysis at each surrounding sensitive receptor listed in **Table 5** and **Table 6** during Project rehabilitation.

The results presented in **Table 27** show that the predicted cumulative 24-hour average PM_{10} concentrations are below the criterion of 50µg/m³ and therefore the proposed rehabilitation activities are unlikely to cause any exceedences at any surrounding sensitive receptor locations. Contour plots of the predicted cumulative increase in 24-hour average incremental PM_{10} concentrations are presented in **Appendix E**.

Table 28 Summary of Contemporaneous Analysis During Rehabilitation

Receptor ID	Date	PM_{10} 24-Hour Average (µg/m³)			Date	PM_{10} 24-Hour Average (µg/m³)		
		Highest Background	Increment	Total		Background	Highest Increment	Total
WR1	13-01-2010	43.3	<0.1	<43.4	15-04-2010	17.9	3.5	21.4
WR2	13-01-2010	43.3	<0.1	<43.4	15-04-2010	17.9	2.0	19.9
WR3	13-01-2010	43.3	0.2	43.5	17-11-2010	6.6	1.0	7.6
WR4	13-01-2010	43.3	<0.1	<43.4	11-08-2010	0	<0.1	<0.1
WR5	13-01-2010	43.3	<0.1	<43.4	14-09-2010	6.6	<0.1	<6.7
L1	13-01-2010	43.3	<0.1	<43.4	03-05-2010	15.3	0.2	15.5
L2	13-01-2010	43.3	<0.1	<43.4	09-01-2010	19.1	0.2	19.3
NF1	13-01-2010	43.3	<0.1	<43.4	17-02-2010	12	<0.1	<12.1
NF2	13-01-2010	43.3	<0.1	<43.4	17-07-2010	5.7	<0.1	<5.8
NF3	13-01-2010	43.3	<0.1	<43.4	24-09-2010	14.3	<0.1	<14.4
NF4	13-01-2010	43.3	<0.1	<43.4	10-05-2010	8.2	<0.1	<8.3
NF5	13-01-2010	43.3	<0.1	<43.4	10-05-2010	8.2	<0.1	<8.3
NF6	13-01-2010	43.3	<0.1	<43.4	02-05-2010	13.3	<0.1	<13.4
NF7	13-01-2010	43.3	<0.1	<43.4	12-07-2010	7.6	<0.1	<7.7
NF8	13-01-2010	43.3	<0.1	<43.4	18-11-2010	3.7	<0.1	<3.8
NF9	13-01-2010	43.3	<0.1	<43.4	18-11-2010	3.7	<0.1	<3.8
Criterion				**50**				**50**

The receptor predicted to experience the greatest impacts from the proposed APMEP activities are R1 during project construction and operation although incremental impacts are approximately 12% of the criterion at this location and no exceedances of the criterion (cumulative) are predicted at any receptor during any of the three modelled scenarios.

8.2.3 $PM_{2.5}$

Table 29 presents the maximum 24-hour and 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 0**. As discussed in **Section 7.1**, no ambient background monitoring data for $PM_{2.5}$ are available in the local area or at the nearest OEH monitoring sites hence the modelling results have been assessed by comparison of the incremental concentrations against the criteria.

Table 29 Predicted 24-Hour and Annual Average $PM_{2.5}$ Concentrations

Receptor ID	Annual Average $PM_{2.5}$ Increment (µg/m^3)			24-Hour $PM_{2.5}$ Increment (µg/m^3)		
	Construction	Operation	Rehabilitation	Construction	Operation	Rehabilitation
WR1	<0.1	<0.1	0.1	0.7	0.6	2.1
WR2	<0.1	<0.1	<0.1	0.4	0.4	1.2
WR3	<0.1	<0.1	<0.1	0.2	0.2	0.6
WR4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
WR5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
L1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
L2	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
NF1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
NF2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NF3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NF4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NF5	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
NF6	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
NF7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
NF8	<0.1	<0.1	<0.1	0.5	<0.1	<0.1
NF9	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
Advisory Reporting Standards		**8 (Cumulative)**			**25 (Cumulative)**	

Table 29 shows that the incremental increase in 24-hour average and annual average $PM_{2.5}$ concentrations predicted as a result of the proposed APMEP construction, operation and rehabilitation of the Project Application Area at the end of mine life are minor and are unlikely to cause any exceedences at any surrounding sensitive receptor locations.

8.3 Air Quality Monitoring

Given the foregoing minor impacts relating to Project construction, operation and rehabilitation predicted by the dispersion modelling exercise, it is not considered to be justifiable to install and operate real-time particulate monitoring equipment near to the geographically disperse sensitive receptor locations. Impacts can be mitigated through the implementation of management measures such as water spraying, minimisation of exposed areas and ceasing work during adverse weather conditions.

Continuation of the HVAS monitoring at the Colliery pit top will be continued, as will be the monitoring of dust deposition.

9 GREENHOUSE GAS ASSESSMENT

The Director-General's Requirements (DGR's) issued for the Project in relation to greenhouse gas (GHG) emissions are as follows:

- A quantitative assessment of potential Scope 1, 2 and 3 GHG emissions;
- A qualitative assessment of the potential impacts of these emissions on the environment; and,
- An assessment of reasonable and feasible measures to minimise GHG emissions and ensure energy efficiency.

This GHG assessment has been performed with reference to the Australian Department of Climate Change and Energy Efficiency (DCCEE) document "*National Greenhouse Accounts Factors*" (July, 2013), the NSW Department of Energy, Utilities and Sustainability (DEUS) document "*Guidelines for Energy Savings Action Plans*" (2005), the National Greenhouse and Energy Reporting Act 2007, the Centennial Coal Greenhouse Gas Assessment Guidance Notes (Centennial Coal, 2010) and Climate Change Response Policy (Centennial Coal, 2012b).

A Greenhouse Gas Assessment was also recently prepared by SLR Consulting for the Angus Place Colliery as part of the air quality assessment for the Angus Place Colliery Ventilation Facility Project (SLR, July 2012). For the purposes of this assessment is has been assumed that the Ventilation Facility Project will be approved. The operation of the Angus Place Ventilation Facility Project therefore is assumed to represent the baseline conditions for this assessment.

In the GHG Assessment, any reference to 'baseline' operations relates to current operations plus the Angus Place Ventilation Facility Project, and references to 'proposed' operations relates to the baseline operations plus the proposed APMEP.

The GHG assessment for the Angus Place Ventilation Facility Project used activity data for the National Greenhouse and Energy Reporting System (NGERS) reporting period of July 2010 to June 2011. Activity data used within this report reference data collected during the most recent NGER reporting period of July 2011 to June 2012. There are identified differences in the data collected during these two periods which has impacts on the GHG emissions reported. However, use of most recent data allows a more representative picture of the Colliery operation to be presented.

Activity data for the following have been obtained from Angus Place for the period July 2011 to June 2012:

- Total Run of Mine (ROM) Coal Production (tonnes[t]);
- Total Electricity Consumption (kilowatt-hours [kWh]);
- Total Diesel Consumption (litres[L]);
- Solid Waste to Landfill (t);
- Fugitive Emissions of Coal Seam Methane (CH_4) and CO_2 via ventilation shafts (m^3 and percentage content of CO_2 and CH_4 in ventilation return air);
- Emissions from use of sulphur hexafluoride (SF_6);
- Emissions from the use of Liquid Petroleum Gas (LPG);
- Emissions from the use of oils and greases (consumed without combustion); and,
- Weekly Total Employee Vehicle Movements.

Data have been sourced primarily from the Angus Place provided spreadsheet 'ANG Greenhouse Report 1112' with data on employee transport provided separately.

Data was made available for the period July 2011 to June 2012, being the most recent complete financial year of data which has been independently audited and verified to meet the requirements of the NGERS legislation. The product extracted during this reporting period was 3.73 million tonnes (Mt). Data presented in this report for Scope 1 and 2 emissions is directly extracted from the Angus Place NGERS report for the July 2011 to June 2012 period and utilises NGERS emission factors, or other acceptable NGERS emission calculation methodologies. Scope 3 emissions have been calculated using proponent provided data, or activity data reported under NGERS in the case of diesel and electricity consumption. Data has also been obtained from the Angus Place Energy Savings Action Plan (ESAP) to identify baseload and non baseload energy consumption.

9.1 Energy Saving Action Plan

High energy users in NSW, such as large businesses, government departments and councils, are required to complete an Energy Savings Action Plan (ESAP). The process involves determining current energy use, undertaking a management and technical review and identifying measures to save power. ESAP's are required to be completed under initiatives established within the Energy and Utilities Administration Act 1987 No 103 Part 6A. The ESAP for Angus Place was constructed with reference to the DEUS "*Guidelines for Energy Savings Action Plans*" (2005).

The energy consumed at the Project Site is primarily diesel and electricity.

Equipment at the colliery which provides relatively constant demand regardless of coal production are items such as mine ventilation fans, surface facilities and air compressor pumping used in mine dewatering. These items operate 24 hours, 365 days per year and the associated energy use is considered to be a ***baseline energy usage*** and is not affected by changes in the production rate or schedule. The remaining energy usage is associated with activities which are directly related to production and will therefore change with production volumes.

According to the 2010 ESAP, electricity consumption at the Colliery was approximately 35.3 GWh. The main areas of electricity consumption are presented in **Table 30** which indicates that approximately 17 GWh (48%) of electricity usage is baseline usage with the remaining 18.3 GWh (52%) being directly related to production.

The use of diesel is generally split between underground fleet (70%) and surface fleet (30%). A large proportion of the underground diesel consumption is used in the day to day transport of men, materials and equipment, which is not strongly linked to production.

Table 30 Electricity Consumption at Angus Place Colliery (From 2010 ESAP Report)

Area	Consumption (GWh, [%])	Baseline or Production Related
Ventilation	11.72 (33%)	Baseline
Compressed Air	4.1 (12%)	Baseline
Surface Infrastructure	1.18 (3%)	Baseline
Coal Production Equipment	7.99 (23%)	Production
Underground Conveyors	6.9 (20%)	Production
Tertiary Crushing and Loading Plant	1.2 (3%)	Production
U/G Pumps	2.17 (6%)	Production

Note: Most up to date information (NGERS 2011/2012 report) indicates an annual electricity consumption of 41.2 MWh

9.2 Activity Data

9.2.1 Baseline for Comparison of Project Impacts

The baseline against which the Project impacts are assessed is the currently approved ROM extraction and processing rate of 4 Mtpa. Data has been provided by Angus Place for the NGERS reporting period of July 2011 to June 2012. The product extracted during this reporting period was 3.73 Mt. Data has therefore been scaled appropriately (described further below) to enable a comparison of approved versus proposed activities occurring as part of the APMEP.

9.2.2 Energy Consumption

The APMEP will not involve any changes in the production rate or the installation of any new fuel burning equipment. Once constructed, APC-VS3 will not require any supporting infrastructure such as electric power. The additional dewatering boreholes however, will include electrically-powered submersible pumps, and these will increase the baseline energy usage of the mine.

It is unclear at the current time how many of the dewatering bores may be in operation concurrently. For the purposes of this assessment, it is assumed that in addition to the current 940 dewatering bore on the Newnes Plateau (for which electricity usage data has been reported within the most recent NGER report [although not disaggregated]), one additional dewatering bore will be in operation at any one time.

A study has recently been performed for the Springvale Mine (SLR Consulting, 2012b), in which the GHG impact of the operation of one dewatering bore was assessed. In the Springvale Bore 8 study it was assumed that a figure of 11,216,822 kWh would be representative of the annual electricity consumption of one dewatering bore. To assess the GHG impact of the proposed APMEP, this figure has been adopted within this assessment.

To assess the GHG impact of the proposed APMEP at the approved 4 Mtpa extraction rate, activity data has been scaled where appropriate as outlined in **Table 31**. The assessment includes the additional baseline diesel and electricity consumption and electricity infrastructure for the APC-VS2 Ventilation Facility, based on information previously provided by the Proponent (SLR, July 2012).

9.2.3 Construction Traffic

There will be an increase in traffic (along public roads and Forest NSW tracks) and personnel during the construction period. The anticipated construction traffic movements are as follows:

- Borehole Construction
  - 6 light vehicle movements per day including crews and management.
  - 10-12 semi-trailer truckloads of equipment.
  - 3 water truck movements per day.
  - 5 concrete truck loads (10 movements) per day during foundation construction.
- Ventilation Shaft Sinking
  - 10 light vehicle movements per day including crews and management.
  - 60 semi-trailer truck loads of equipment (maximum load 35 tonnes) needed for shaft sinking (40 loads) and lining (20 loads) and a further 3 low-loader truck loads for earth moving machine delivery (e.g. excavator and loader).
  - 50 water truck movements per week, with trucks based in Lithgow (maximum 100,000 litres per day).
  - 15 concrete truckloads per day during foundation construction.

These additional construction related vehicles will be owned and operated by contractors, likely originating from Lithgow. Emissions of GHG associated with these contractor vehicles are reportable under Scope 3 emissions (refer **Section 9.3**) and have been calculated within this assessment (see **Section 9.5.3**). It is noted that these emissions are likely to have occurred *without* the construction of the APMEP, rather the location of the emission is dependent upon the APMEP. To provide a conservative assessment, these emissions are taken into account within this GHG assessment.

Assumptions regarding the likely fuel usage in contractor vehicles are required to be made, and within this assessment, it is assumed that all contractor vehicles (light and heavy) have a fuel consumption of 10 l/100 km. It is also assumed that the distance travelled by each contractor vehicle per day is 40 km (Lithgow to APMEP to Lithgow). The construction period is assumed to be 24 months, with construction occurring 6 days per week. It is also assumed that peak vehicle generation occurs throughout the construction period. Based on these assumptions, total fuel usage by contractor construction vehicles per annum is estimated to be 48,384 L.

9.2.4 Operational Traffic

Outside of this period, traffic and personnel movements associated with the dewatering sites will be minimal with the occasional light vehicle trip required for maintenance and inspection purposes only. It is anticipated that these vehicles would be owned and operated by Angus Place and the additional emissions of GHG would be considered to be a Scope 1 (direct) emission. It has been assumed that these additional operational trips (assuming a 40 km round trip once per week and 10 L/100km fuel efficiency) would result in an additional 200 L of diesel combustion per year.

9.2.5 Summary of Activity Data

A summary of activity data related to the baseline and proposed Project is provided in **Table 31**.

Table 31 Summary of Project Related Activity Data Relevant to GHG Emissions (Current and Approved Operations)

Activity	Quantity		Scaling Factor Applied[1]
	Baseline Project Operations	Proposed Project Operations	
Annual ROM Production (Mt)	4	4	1.07 (4.0 Mt/3.73 Mt)
Annual Electricity Consumption (kWh)	58,356,820[2]	69,573,702[3]	1.07 applied to non-baseload use
Annual Diesel Consumption (litres) (Angus Place)	752,885[4]	752,885[4]	1.07 applied to non-baseload use
Annual Diesel Consumption (litres) (Contractor)	64,595	64,595	1.07 applied to non-baseload use
Annual Diesel Consumption (litres) (Construction contractor)	48,384	48,384	-
Annual Fugitive Emissions from Mine Ventilation Shaft (Million m^3)	13,771	13,771	None Assumed no change in total methane quantity (refer **Section 9.4.1**)
Solid Waste to Landfill (tonnes)	511	511	None Assumed no change in waste generation from 2011/12
Sulphur Hexafluoride (SF_6) (kg)	14.826[5]	22.239[6]	-
Liquid Petroleum Gas (LPG) (kg)	0.0	0.0	None Assumed no change from 2011/12
Petroleum Based Oil/Greases Used (L)	199,153	199,153	None Assumed no change from 2011/12
Employee Vehicle Movements (number)	82,125	82,125	None Assumed no change in (Angus Place) employee numbers
Vehicle Movements during Construction (number)	42 per day (22 light vehicles, 20 heavy vehicles)[7]	42 per day (22 light vehicles, 20 heavy vehicles)[7]	-
Vehicle Movements during Operation (number)	10 light vehicles per week	10 light vehicles per week	-

Note 1: Factor applied to activity data related to current (3.73 Mt) coal extraction rate

Note 2: Additional 15,592,800 kWh used by additional APCVFP Ventilation Fan

Note 3: Additional 11,216,882 kWh used by additional dewatering bore pump

Note 4: Additional 53,676 L of diesel used in standby generator at APCVFP plus 14,600 L in Angus Place vehicles

Note 5: Assumed SF_6 charge in APFVP electricity sub-station results in doubling of current SF_6 charge

Note 6: Assumed SF_6 charge in APMEP borehole electricity sub-station results in increase in SF_6 charge of 1.5 times

Note 7: Contractor construction vehicles assumed to consume 48,384 L per annum (for 24 months only)

9.3 Direct and Indirect Emissions (Emissions Scope)

National Greenhouse and Energy Reporting Regulations 2008 defines scope 1 and scope 2 emissions as;

Division 2.5 Meaning of *emissions*, production and consumption: section 10

2.23 Meaning of *emissions*, *production* and *consumption*

(1) ***Emissions*** of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one of the following:

(a) an activity, or series of activities (including ancillary activities) that constitute the facility (***scope 1 emissions*****)**;

(b) 1 or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility (***scope 2 emissions*****)**.

Meaning of production

(2) ***Production*** of energy, in relation to a facility, means 1 of the following:

(a) the extraction or capture of energy from natural sources for final consumption by or from the operation of the facility or for use other than in the operation of the facility;

(b) the manufacture of energy by the conversion of energy from 1 form to another form for final consumption by or from the operation of the facility or for use other than in the operation of the facility.

Meaning of consumption

(3) ***Consumption*** of energy, in relation to a facility, means the use or disposal of energy from the operation of the facility including own-use and losses in extraction, production and transmission.

The NGERS legislation does not include scope 3 emissions.

The National Greenhouse Accounts workbook (NGA) the methodology used for estimating scope 3 emissions in this assessment is defined as follows:

- Various emission factors can be used to calculate scope 3 emissions. For ease of use, this workbook reports specific 'scope 3' emission factors for organisations that:

  (a) burn fossil fuels: to estimate their indirect emissions attributable to the extraction, production and transport of those fuels; or

  (b) consume purchased electricity: to estimate their indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the T&D network.

It is noted that Angus Place Colliery has a restricted capacity to reduce their GHG emissions under Scope 3. Reductions in the emissions of GHG resulting from the extraction and transport of fossil fuels for use in electricity production or onsite diesel combustion are beyond the control of Angus Place Colliery but are reported here for completeness, as required by the Department of Planning.

9.4 Greenhouse Gas Calculation Methodology

Quantification of potential Project emissions has been undertaken in relation to both carbon dioxide (CO_2) and other non-CO_2 greenhouse gas emissions.

For comparative purposes, non-CO_2 greenhouse gases are awarded a "CO_2-equivalence" (CO_2-e) based on their contribution to the enhancement of the greenhouse effect. The CO_2-e of a gas is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non-CO_2 greenhouse gases are contained within the Intergovernmental Panel on Climate Change (IPCC), (1996) document "*Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*".

The GWPs of relevance to this assessment are:

- methane (CH_4): GWP of 21 (21 times more effective as a greenhouse gas than CO_2);
- nitrous oxide (N_2O): GWP of 310 (310 times more effective as a greenhouse gas than CO_2); and,
- Sulphur hexafluoride (SF_6): GWP of 23,900 (23,900 times more effective as a greenhouse gas than CO_2).

The short-lived gases such as carbon monoxide (CO), nitrogen dioxide (NO_2), and non-methane volatile organic compounds (NMVOCs) vary spatially and it is consequently difficult to quantify their global radiative forcing impacts. For this reason, GWP values are generally not attributed to these gases nor have they been considered further as part of this assessment.

It is noted that at the United Nations Framework Convention on Climate Change meeting in November-December 2011 in Durban (South Africa), countries agreed to adopt updated GWPs including new greenhouse gases published in the Intergovernmental Panel on Climate Change's (IPCC) 2007 Fourth Assessment Report (AR4) from 2015 onwards (reporting emissions for the 2013 inventory year) and for commitments under a second commitment period. These GWPs replace those used from the IPCC's Second Assessment Report (AR2).

The most significant change is the increase in methane's GWP from 21 to 25. A new greenhouse gas has been added, nitrogen trifluoride, as well as new species of hydrofluorocarbons. As these updated GWP's are related to reporting from 2015 onwards, the GWP's for each GHG from the AR2 report are adopted within this assessment.

The greenhouse gas emissions associated with the modified Project have been assessed in terms of direct (Scope 1) emission potential, indirect (Scope 2) emission potential and significant upstream/downstream (Scope 3) emission potential.

A summary of the potential Project GHG emission sources is provided in **Table 32**.

Table 32 Summary of Potential Project Greenhouse Gas Emissions

Project Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Fugitive Emissions	Emissions from the release of coal seam methane and carbon dioxide as a result of extraction activities.	N/A	N/A
Diesel	Emissions from the combustion of diesel at the Project in both mobile and fixed plant and equipment (Includes ROM coal transport by coal haulage contractor)	N/A	Estimated emissions attributable to the extraction, production and transport of diesel consumed at the Project Site. Contractor or outsourced activities performed as part of the Project activities
Consumption of sulphur hexafluoride	Consumption of SF_6 for gas insulated switchgear and circuit breaker applications	N/A	N/A
Use of Oils and Greases	Consumption (non-combustion) of oils and greases	N/A	Estimated emissions attributable to the extraction, production and transport of oils and greases consumed at the Project Site.
Electricity	NA	Emissions associated with the consumption of generated and purchased electricity at the Project Site.	Estimated emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed at the Project Site and the electricity lost in delivery in the transmission and distribution network.
Solid Waste	N/A	N/A	Emissions associated with the disposal of solid waste to landfill
Coal Combustion	N/A	N/A	Emissions from the combustion of coal from the Project.

N/A = Not applicable

9.4.1 Scope 1 (Direct) Emissions

Fugitive emissions - Coal Seam Methane and Carbon Dioxide

The process of coal formation creates significant amounts of CH_4. Some of this CH_4 remains trapped in the coal until the pressure on the coal is reduced, which occurs during the coal mining process. The stored CH_4 is then released to the atmosphere.

Fugitive emissions from extraction of coal as defined by NGERS were estimated for the 11-12 financial year using Method 4, subdivision 3.2.2.2 of the NGERS Measurement Determination 2008.

Based on information provided by the Proponent, the Ventilation Fans at the Angus Place Colliery currently result in ventilation emissions of:

- 6,885 Mm^3/yr at 0.18% CO_2 and 0.03% CH_4

The molecular weight of CO_2 and CH_4 have been taken to be 44.01 and 16.04, respectively. Temperature of the gas stream has been provided by Angus Place to be 290 K.

The addition of APC VS2 at ESA 9 is designed to aid the removal of CH_4 from underground workings associated with the proposed underground roadways and trial mining. As per the Angus Place Colliery Ventilation Facility Project AQIA (SLR Consulting, July 2012), it is considered that the quantity of methane to be removed from underground workings will remain constant with the addition of APC VS2 and therefore the composition and flow rate of each of the existing and proposed ventilation exhaust gas streams is assumed to be:

- 13,770 Mm^3/yr at 0.09% CO_2 and 0.015% CH_4

The proposed construction of underground roadways and trial mining will result in the exposure of coal seams which will have the capacity to release CH_4 which will be required to be extracted through the proposed ventilation system. However, in concert with this seam exposure, other areas of longwall will be sealed, resulting in effectively no net change in coal seam exposure in the Angus Place underground mine. It may therefore be assumed that the rate of CH_4 release into the underground workings will remain relatively constant over the course of the Project, and therefore the quantity of CH_4 to be removed through the ventilation system will also remain relatively constant.

Scope 1 emissions are calculated to be as presented in **Table 33** for the approved operations and approved operations plus APMEP, using information on the temperature, gas volumes and composition of the ventilation gas stream (provided within the NGER data).

Table 33 Calculated Fugitive Emissions from Ventilation (tonnes) SCOPE 1

Source	Fugitive Emissions (tonnes CO_2-e)
Baseline	
Existing and Approved Ventilation Systems	41,507
Proposed	
Existing and Approved Ventilation Systems	41,507

Diesel Usage

The primary fuel source for the vehicles operating at the Project Site is diesel. Diesel consumption for all mobile and fixed equipment is calculated as presented in **Table 34**.

Scope 1 emissions from use of diesel fuel as defined by NGERS were estimated for the 11-12 financial year using Method 1, Division 2.4.2 section 2.41 of the NGERS Measurement Determination 2008. The energy content of diesel fuel is taken to be 38.6 GJ/kL with a Scope 1 emission factor of 69.9 kg CO_2-e/GJ (DCCEE, 2011).

Scope 1 emissions are calculated for Angus Place diesel usage. Any diesel consumption associated with contractors is reported as a Scope 3 emission.

As part of the APMEP, no additional diesel fuel is anticipated to be consumed, as outlined within **Table 31**.

Scope 1 emissions of CO_2-e from the combustion of diesel fuel are presented in **Table 34** for the approved operations and approved operations plus APMEP.

Table 34 Calculated Emissions from Diesel Combustion (tonnes) SCOPE 1

Source	Emissions (tonnes CO_2-e)
Baseline	
Angus Place	784.4
Total	**784.4**
Proposed	
Angus Place	784.4
Total	**784.4**

Emissions of Sulphur Hexafluoride

Sulphur hexafluoride (SF_6) is used in gas insulated switchgear and circuit breaker applications on site.

The stock of SF_6 for the financial year 11-12 is estimated as 7.413 kg per annum, with an additional 7.413 kg per annum assumed to be associated with the proposed electrical switchyard and substation for the Angus Place Ventilation Facility Project. For the switchyard associated with the assumed additional dewatering bore compound, a further 7.413 kg of SF_6 is assumed.

Scope 1 emissions from use of SF_6 as defined by NGERS were estimated for the 11-12 financial year using Method 1, Division 2.48A of the NGERS Measurement Determination.

It has been assumed that the leakage rate from switchgear is 0.5% per annum as per Table 25 of the NGA Factors Workbook (DCCEE, 2013). Emissions have been calculated using information contained in Table 24 of the NGA Factors Workbook (DCCEE, 2013) using a GWP for SF_6 of 23,900.

Scope 1 emissions of CO_2-e associated with leakage from gas insulated switchgear are presented in **Table 35** for the approved operations and approved operations plus APMEP.

Table 35 Calculated Emissions from SF_6 Leakage (tonnes) SCOPE 1

Source	Emissions (tonnes CO_2-e)
Baseline	
SF_6 Leakage	1.8
Total	**1.8**
Proposed	
SF_6 Leakage	2.7
Total	**2.7**

Oils and Greases

Oils and greases are used for lubrication of equipment and machinery. Oil and grease consumption are estimated as presented in **Table 31**.

Scope 1 emissions from use of oils and greases as defined by NGERS were estimated for the 11-12 financial year using the method detailed in Section 2.68 part b (iii) of the NGERS Measurement Determination 2008. The energy content of oil and grease is taken to be 38.6 GJ/kL with a Scope 1 emission factor of 27.9 kg CO_2-e/GJ (DCCEE, 2013).

Scope 1 emissions of CO_2-e from the use of oils and greases are presented in **Table 36**.

Table 36 Calculated Emissions from Oil and Grease Consumption (tonnes) SCOPE 1

Source	Emissions (tonnes CO_2-e)
Baseline	
Oil and Grease consumption	214
Total	**214**
Proposed	
Oil and Grease consumption	214
Total	**214**

9.4.2 Scope 2: Indirect Emissions through the Consumption of Purchased Electricity

Scope 2 GHG emissions as defined by NGERS were estimated for the 11-12 financial year using Method 1, Chapter 7, section 7.2 of the NGERS Measurement Determination 2008

State emission factors are used because electricity flows between states are significantly constrained by the capacity of the inter-state interconnectors and in some cases there are no interconnections.

Electricity consumption at the Project Site has been calculated as (approximately) 41.2 Megawatt-hours (MWh) in the current year of mining (July 2011 to June 2012). Based on the adopted scaling factor of 1.07 (applied to non-baseload electricity consumption only) plus the additional electricity use by the ventilation fan (15.5 MWh) the estimated electricity consumption resulting from baseline Project operations is assumed to be (approximately) 58.3 MWh per annum. With the additional assumed electricity consumption of 11.2 MWh per annum associated with the dewatering pump, the total proposed electricity consumption is calculated to be approximately 69.6 MWh.

The emission factor for Scope 2 (0.87 kg CO_2-e/kWh) represents the consumption of purchased electricity in NSW.

Scope 1 emissions of CO_2-e from the consumption of purchased electricity are presented in **Table 37**.

Table 37 Calculated Emissions from Electricity Consumption (tonnes) SCOPE 1

Source	Emissions (tonnes CO_2-e)
Baseline	
Electricity consumption	50,770
Total	**50,770**
Proposed	
Electricity consumption	60,529
Total	**60,529**

9.4.3 Scope 3: Other Indirect Emissions

As discussed previously, Scope 3 emissions of GHG attributable to the Project are reported for completeness although they are not required to be reported by Angus Place under the NGER reporting scheme.

Angus Place has a restricted capacity to reduce their GHG emissions under Scope 3 at Angus Place Colliery. Reductions in the emissions of GHG resulting from the extraction and transport of fossil fuels for use in electricity production or onsite diesel combustion are beyond the control of Angus Place. Also beyond the control of Angus Place are the operations of coal consumers.

Combustion of Product Coal

Indirect emissions of GHG from the combustion of product coal are expected "downstream" due to the combustion of coal produced by the Project. Up to 4.0 Mtpa of ROM coal may be produced by Angus Place during a year which does not experience a longwall changeover, with the majority destined for the domestic energy generation sector, specifically Mt Piper and Wallerawang Power Stations.

This calculation assumes that 100% of ROM coal produced by the Project is combusted to produce electricity at Mt Piper and Wallerawang Power Stations.

The GHG emissions from combustion of product coal by other (non-Angus Place) entities have been based on a coal energy content of 27 GJ/t for thermal (black coal) (Table 1 of the NGA Factors).

It is noted that no Scope 3 emission factor exists for black coal used for electricity generation purposes within the most recent (July 2013) version of the NGA Factors. In this instance, the Scope 3 emission factor for "Black coal for electricity NSW" published in Table 1 of the January 2008 version of the NGA Factors has been used within this assessment (8.74 kg CO_2-e/GJ).

Scope 3 emissions of CO_2-e from the combustion of saleable product coal are presented in **Table 38**.

Table 38 Calculated Emissions from Combustion of Product Coal (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Combustion of Product Coal (4 Mtpa)[1]	943,920

Note 1: No changes to coal production will occur as part of the APMEP

Extraction, Production and Transport of Fuel Burned for the Generation of Electricity and Electricity Consumed in the Transmission and Distribution System

The NGA Factors provides Scope 3 emission factors for the consumption of purchased electricity by each state. State emission factors are used because electricity flows between states are significantly constrained by the capacity of the inter-state interconnectors and in some cases there are no interconnections.

The NSW Scope 3 emission factor (0.19 kg CO_2-e/kWh) covers both the emissions from the extraction, production and transport of fuels used in the production of the purchased electricity (i.e. fugitive emissions and stationary and mobile fuel combustion emissions) and also the emissions associated with the electricity lost in transmission and distribution on route to the customer. In this report, Scope 2 and 3 emissions for the consumption of purchased electricity have been reported separately so that the share of the transport and distribution loss can be correctly attributed under Scope 3 emissions - Generation of Electricity Consumed in a transmission and distribution system.

Scope 3 emissions of CO_2-e from the consumption of purchased electricity are presented in **Table 39**.

Table 39 Calculated Emissions from Electricity Consumption (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Electricity consumption	11,088
Total	**11,088**
Proposed	
Electricity consumption	13,219
Total	**13,219**

Extraction, Production and Transport of Diesel Consumed at the Project

Scope 3 GHG emissions attributable to diesel used at the Project relate to its extraction, production and transport.

The annual emissions of CO_2 and other GHG from this source have been estimated using Table 38 of the NGA Factors, an emission rate of 5.3 kg CO_2-e/GJ and an assumed energy content of diesel of 38.6 GJ/kL.

Scope 3 emissions of CO_2-e from the combustion of diesel fuel are presented in **Table 40** for the approved operations and approved operations plus APMEP. Emissions associated with the contractor and construction contractor vehicles are included within this calculation (refer **Section 9.2.3**) as are emissions associated with additional Angus Place vehicle trips during the APMEP operation (refer **Section 9.2.4**).

Table 40 Calculated Emissions from Diesel Combustion (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Angus Place	57
Contractor	13
Total	**70**
Proposed	
Angus Place	57
Contractor	23
Total	**80**

Extraction, Production and Transport of Oils and Greases Consumed at the Project

Scope 3 GHG emissions attributable to oils and greases used at the Project relate to its extraction, production and transport.

The annual emissions of CO_2 and other GHG from this source have been estimated using an emission rate of 5.3 kg CO_2-e/GJ and an assumed energy content of 38.8 GJ/kL (NGA Factors, 2013).

Scope 3 emissions of CO_2-e from the use of oils and greases are presented in **Table 41** for the approved operations and approved operations plus APMEP.

Table 41 Calculated Emissions from Oil and Grease Consumption (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Oil and Grease consumption	41
Total	**41**
Proposed	
Oil and Grease consumption	41
Total	**41**

Waste Generation

Solid waste generated at the Project Site and disposed of in landfill is estimated as presented in **Table 31**. It has been assumed that generation of waste will remain at 511 tonnes per annum.

Waste sent to landfill results in emissions of CH_4 as waste is degraded. Table 42 of the NGA Factors provides GHG emission factors based on broad waste streams (municipal solid waste, commercial and industrial waste and construction and demolition waste). To provide a worst case assessment of GHG emissions from waste sent to landfill, the emission rate for municipal solid waste (1.2 t CO_2-e / tonne waste) has been used within this assessment.

Scope 3 emissions of CO_2-e from the disposal of solid waste are presented in **Table 42**.

Table 42 Calculated Emissions from Waste Disposal (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Waste Disposal	614
Total	**614**
Proposed	
Waste Disposal	614
Total	**614**

Employees Commuting To and From Work

Fuel usage and consequent GHG emissions attributable to company employees commuting to and from work can be reported under Scope 3 GHG emissions. Data has been provided by Angus Place on the assumed number of vehicle trips undertaken by mine employees per week. It has been assumed that the number of trips per week will be 225 vehicle movements per day or 82,125 movements per year (one way). This is not expected to change as a result of the APMEP.

43% of staff originate from Lithgow. It has therefore been assumed that 43% of employee vehicle trips originate in Lithgow, approximately 19.5 km to the southeast of the Project Site, with the remaining 57% of staff trips originating in Bathurst, approximately 63 km to the west of the Project site. Assuming that all employee-owned vehicles have a fuel efficiency of 10 L/100 km and operate on diesel as a *worst case assumption*, the total annual diesel consumption by employee owned vehicles would be 728 kL per annum.

The annual emissions of CO_2 and other GHG from this source have been estimated using Table 38 of the NGA Factors, an emission rate of 5.3 kg CO_2-e/GJ and an assumed energy content of diesel of 38.6 GJ/kL.

Scope 3 emissions of CO_2-e from the combustion of diesel fuel in employee vehicles are presented in **Table 43**.

Table 43 Calculated Emissions from Diesel Combustion (tonnes) SCOPE 3

Source	Emissions (tonnes CO_2-e)
Baseline	
Employee Vehicles	149
Total	**149**
Proposed	
Employee Vehicles	149
Total	**149**

Sources not Included

The following Scope 3 GHG emission sources were not included within the assessment:

- Employee business travel; and
- Outsourced activities.

9.5 Greenhouse Gas Calculation Results

Calculated Scope 1, Scope 2 and Scope 3 emissions of greenhouse gas resulting from the emissions sources outlined above for the existing operations (July 2011 to June 2012), scaled to 4 Mtpa extraction, plus APCVFP (baseline operations), and the proposed operations are presented in **Table 44**. Emissions relating to emissions in the 2011/2012 NGER reporting period (3.7 Mtpa ROM production) are also presented for comparison.

Table 44 Summary of Scope 1, 2 and 3 GHG Emissions (tonnes CO_2-e per annum)

Source	2011/2012 NGER Reporting Period	Baseline Operations	Proposed Operations	Increase from Baseline to Proposed
Scope 1				
Fugitive Emissions	41,507	41,507	41,507	0
Diesel Combustion	526	748	748	0
SF_6 Combustion	0.9	1.8	2.7	0.9
Oil and Grease Consumption	214	214	214	0
Sub Total	*42,248*	*42,472*	*42,473*	*1*
Scope 2				
Electricity Consumption	35,844	50,770	60,529	9,759
Sub Total	*35,844*	*50,770*	*60,529*	*9,759*
Scope 3				
Product Coal Combustion	879,679	943,920	943,920	0
Diesel Combustion	52	70	80	10
Oil and Grease Consumption	41	41	41	0
Electricity Consumption	7,828	11,088	13,219	2,131
Waste Disposal	614	614	614	0
Employee Travel	149	149	149	0
Sub Total	*888,363*	*955,881*	*958,022*	*2,141*
TOTAL	**966,455**	**1,048,939**	**1,061,024**	**11,091**

9.5.1 Scope 1 Emissions Estimations

Direct (Scope 1) GHG emissions (CO_2-e) resulting from modified Project operations are estimated to be 42,473 t per annum, an increase of approximately 1 tonne per annum on approved operations. It is noted that no net increase in coal seam methane generation is anticipated as a result of the proposed Project.

9.5.2 Scope 2 Emissions Estimations

Indirect (Scope 2) GHG emissions (CO_2-e) resulting from modified Project operations are estimated to be 60,529 tonnes per annum, an increase of approximately 9,759 tonnes per annum on approved operations.

9.5.3 Scope 3 Emissions Estimations

Indirect (Scope 3) GHG emissions (CO_2-e) resulting from modified Project operations are estimated to be 958,022 tonnes per annum, an increase of approximately 2,141 tonnes per annum on approved operations. The increased emissions are due to increases in diesel and electricity consumption and combustion associated with the APMEP.

9.6 Comparison with National and State GHG Emissions

The estimated annual emissions associated with the modified Project are presented in **Table 45**.

Table 45 GHG Emissions Estimated to Result from Modified Project Operation

Emission Scope	Estimated Emissions (t CO_2-e/annum)
1	42,473
2	60,529
3	958,022
TOTAL	**1,061,024**

Emissions of GHG in NSW were reported to be 157.4 Mt in 2010, 28% of the Australian total GHG emissions of 560.8 Mt. Comparison of the emissions attributable to the Project with NSW and Australia emission totals is presented in **Table 46**.

Table 46 Comparison of Modified Project GHG Emissions with State and National Totals 2007

Emission Scope	Estimated Emissions (tCO_2-e/annum)	Percentage of NSW 2009 GHG Emission Total	Percentage of Australian 2009 GHG Emission Total
Scope 1	42,473	0.03	0.01
TOTAL (1,2 and 3)	1,061,024	0.7	0.2

9.7 Potential Impacts of Greenhouse Gas Emissions on the Environment

Increased emissions of GHG are widely accepted to exert a warming influence on climate. Increasing concentrations of the long-lived GHG's (CO_2, CH_4, N_2O, halocarbons and SF_6 (LLGHGs) have led to a combined radiative forcing (RF) of +2.63 [±0.26] Watts per square metre (W m^{-2}). A 9% increase in this RF since the publication of the Third Assessment Report of the IPCC (IPCC, 2001) is the result of concentration changes since 1998 (IPCC, 2007). The IPCC state that it is very likely that there has been a substantial anthropogenic (man-made) contribution to surface temperature increases in every continent except Antarctica since the middle of the 20th Century, although difficulties exist in the attribution of temperature changes on smaller than continental scales and on timescales of less than 50 years.

Scientists at the 2005 conference, 'Avoiding Dangerous Climate Change: Symposium on Stabilisation of Greenhouse Gases' concluded that at the level of 550 parts per million (ppm) CO_2 concentration, a 2°C increase in global mean temperature above present levels would be experienced, and that stabilisation at a concentration of 400 ppm would be necessary to avoid a 2°C warming. IPCC reports (IPCC, 2007) have suggested that stabilising concentrations at 450 ppm by 2020 would only result in a 50% likelihood of limiting global warming to 2°C.

The linkages between emissions of CO_2 from an individual project, resulting global CO_2 concentrations and climate warming is not possible due to a host of uncertainties and a lag in the climate system. However, action by National Governments aimed at reducing GHG emissions by sector and national totals will result in mitigation of climate change, and accurate quantification of GHG emissions will aid the ongoing assessment of climate impacts and will reduce the impact on global climate warming influenced by all countries.

9.8 Greenhouse Gas Mitigation Measures

Angus Place is currently implementing a number of measures to minimise to the greatest extent practicable GHG emissions from the Colliery. Relevant measures are described below:

- Maximising energy efficiency as a key consideration in the development of the mine plan. For example, significant savings of greenhouse gas emissions (through increased energy efficiency) are achieved by mine planning decisions.
- The Project Site has developed and implemented an Energy and Greenhouse Management System and monitors and reports energy usage at the Colliery. KPI's including energy demand and GHG emissions per tonne of ROM coal produced are tracked.

Additional measures that Angus Place are striving to achieve include:

- Identify and implement cost effective measures to improve energy efficiency;
- Regular maintenance of plant and equipment to minimise fuel consumption; and
- Consideration of energy efficiency in plant and equipment selection/phase.

Traffic management during APMEP construction operations will also result in the minimisation of fuel use, given the recommended speed restrictions, defined hours of construction and onsite operating practices.

No particular design measures can be incorporated into the Project to avoid impacts associated with GHG emissions..

Centennial Coal is currently investigating at a corporate level the measures which may be taken to offset Scope 1 emissions from their operations. This work is ongoing, but measures may include (but not limited to) alignment with biodiversity offsets, purchase of greenpower and switching to biodiesel fuel if considered feasible. These measures are being investigated and all measures taken to offset GHG emissions associated with the Project will be in alignment with the highest standards, such as the National Carbon Offset Standard [NCOS]).

10 CONCLUSIONS

SLR Consulting was commissioned by Centennial Angus Place Pty Ltd to undertake an Air Quality Impact Assessment and Greenhouse Gas Assessment for the proposed Angus Place Mine Extension Project.

The surface operations at the APMEP include receipt and processing of coal from the underground mine. It is noted that transferring the crushed coal to Springvale Coal Services Washery, or Mt Piper or Wallerawang Power stations via haul roads has not been included in this assessment. The coal is currently being crushed using a rotary breaker at the crushing plant located onsite and is handled using bulldozers.

Potential dust emissions from the APMEP operation were estimated based on published emission factors and measured data from the existing Angus Place Ventilation Shaft. Dispersion modelling was performed for construction and operation of the proposed SMEP to predict the future incremental and cumulative impacts from the APMEP operation. An estimation of emissions and corresponding air quality impacts due to Project Application Area rehabilitation was also performed within this assessment.

Ambient air quality monitoring data from the OEH operated Bathurst monitoring station were used as background to assess the cumulative impact from the APMEP.

Based on the modelling results, it is concluded that the potential increment of TSP, PM_{10}, $PM_{2.5}$ concentrations from the proposed APMEP project and rehabilitation activities at surrounding areas is minimal. The proposed operation or site rehabilitation is unlikely to cause an exceedence of the relevant ambient air quality criteria at any identified surrounding sensitive receptors.

The assessment also considers emissions of Greenhouse Gases (CH_4, CO_2 and SF_6) from the APMEP and includes estimates of direct and indirect GHG emissions.

The total lifetime direct (Scope 1) emissions from the Project are estimated to be approximately 42,473 CO_2-e in any one year.

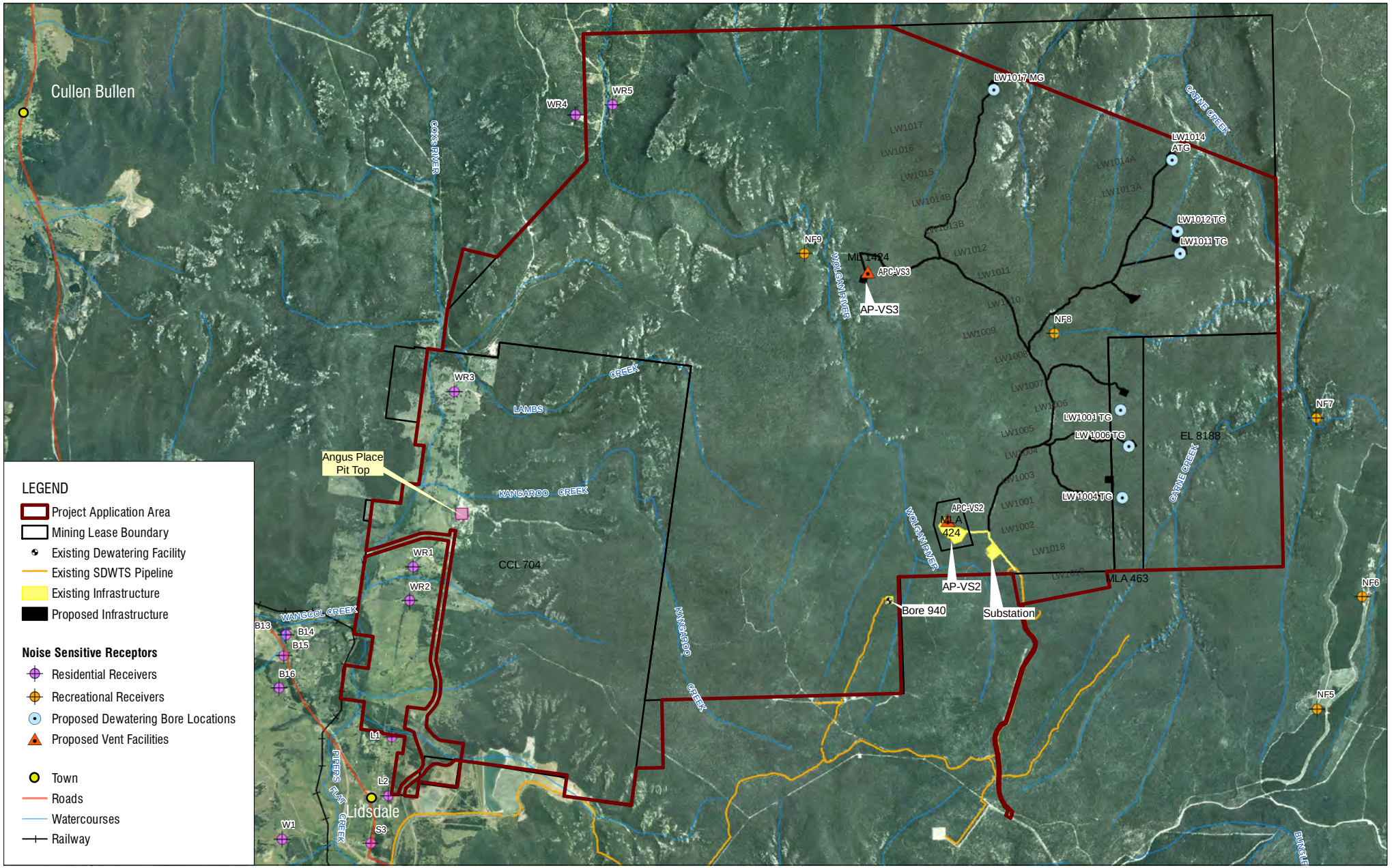
Indirect (Scope 2 and 3) emissions would be released in the process of mining coal, and through the transport and end use of the coal. The total lifetime indirect emissions (Scope 2 and 3) from mining coal and end use of the coal are estimated to be 1,018,551 t CO_2-e, per annum.

Comparison of Project emissions with State and National GHG emission totals indicates that the APMEP is likely to represent approximately 0.03% of NSW GHG emissions when compared to the latest available emissions data (2010) (Scope 1) and 0.01% of Australian GHG emissions (Scope 1).

11 REFERENCES

- Centennial Coal Company (2012) "Greenhouse Gas Assessment, Centennial Guidance Notes", March 2012
- Centennial Coal Company (2010) "Climate Change Response Policy", February 2010
- Commonwealth of Australia Department of Climate Change (2008) "Australia's National Greenhouse Accounts", The Australian Government's Initial Report under the Kyoto Protocol.
- Commonwealth of Australia Department of Climate Change (2012) "Australia's National Greenhouse Accounts, State and Territory Greenhouse Gas Inventories".
- Department of Climate Change and Energy Efficiency (2013) "National Greenhouse Accounts (NGA) Factors Workbook".
- DSEWPC 2012, The *National Pollutant Inventory Emission Estimation Technique Manual for Mining v3.1*, published by Department of Sustainability, Environment, Water, Population and Communities, January 2012.
- Intergovernmental Panel on Climate Change (IPCC) (1996) "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories".
- IPCC Fourth Assessment Report (2007): Working Group III Report "Mitigation of Climate Change", Intergovernmental Panel on Climate Change, 2007
- Katestone 2011, *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, Katestone Environmental Pty Ltd, January 2011.
- MRI 2006, *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors*, prepared by: Midwest Research Institute, prepared for: Western Governors Association – Western Regional Air Partnership (WRAP), MRI Project number 110397, dated: 1 November 2006.
- OEH, 2005, *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, Office of Environment and Heritage, 2005.
- Scire et al 2011, *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'*, Atmospheric Studies Group, TRC Environmental Corporation, March 2011.
- SKM (2007) "Western Coal Unloader Environmental Assessment" April 2007
- SKM (2009) "Mt Piper Power Station Extension Environmental Assessment" September 2009
- SKM (2010) "Mt Piper Power Station Ash Placement Project" August 2010
- SLR Consulting Australia Pty Ltd (2011) "Air Quality Impact Assessment and Greenhouse Gas Assessment, Pine Dale Coal Mine Extension Project"
- SLR Consulting Australia Pty Ltd (2012a) "Air Quality Impact Assessment and Greenhouse Gas Assessment, Angus Place Ventilation Facility Project"
- SLR Consulting Australia Pty Ltd (2012b) "Air Quality Impact Assessment and Greenhouse Gas Assessment, Springvale Mine Dewatering Project"
- USEPA (1997 and updates) AP42 Compilation of Air Pollutant Emission Factors, Fifth Edition

ESA Areas, Proposed Infrastructure and Sensitive Receptor Locations



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SLR
10 KINGS ROAD
NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
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www.slrconsulting.com

Project No.:	630.10123.01030
Date:	22/01/2014
Drawn by:	LH
Scale:	1:75,000
Sheet Size:	A4
Projection:	GDA 1994 MGA Zone 56

Centennial Angus Place Pty Ltd

ANGUS PLACE EXTENSION NOISE

Noise Sensitive Receptors

APPENDIX A

Test Report 610.12201.00000

1 CLIENT DETAILS

Organisation:	Centennial Coal Angus Place
Company Contact:	Iain Hornshaw
Site Address:	Wolgan Road, Wallerawang, NSW 2845
Postal Address:	PO Box 198, Wallerawang NSW 2845
Telephone Number:	02 6354 8738
Email Address:	Iain.hornshaw@centennialcoal.com.au

2 PROJECT DETAILS & SCOPE OF WORK REQUESTED

Project Number:	610.12201.00000
Project Name:	Particulate Testing
Project Manager:	Sandra Lonergan
Monitoring Date:	5 February 2013
Production/Operational Conditions:	Normal
Parameters requested:	Flow, temperature, moisture, molecular weight, dry gas density, oxygen, particulate matter less than 10 microns, particulate matter less than 2.5 microns and total solid particulates
Sample Locations:	Ventilation Shaft
Sample Identification Numbers:	Refer to Appendix A

Signatory

Michael Brecko

Issue Date: 7 March 2013

Accredited for Compliance with ISO/IEC 17025.
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

Test Report 610.12201.00000

3 PROCESS EMISSIONS MONITORING - PARAMETER, SAMPLING AND ANALYSIS METHOD AND ANALYSIS LABORATORY

3.1 Test Methods and Analysis References

All sampling and monitoring was performed by SLR Consulting Australia Pty Ltd (SLR Consulting) unless otherwise specified. The following table outlines for each parameter requested to be tested, the relevant test method for sampling and analysis and the NATA Accredited Laboratory that completed the analysis.

All associated NATA endorsed Test Reports/Certificates of Analysis are provided separately in Appendix A.

3.1.1 Point Source Emissions

Parameter		Test Method Number for Sampling and Analysis	NATA Laboratory Analysis By: NATA Accreditation No. & Report No.
Sampling Location	NSW	NSW TM-1, AS4323.1	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Velocity	NSW	TM-2, USEPA M2A, 2C	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Duct Temperature	NSW	TM-2, USEPA M2, 2C	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Volumetric Flow Rate	NSW	TM-2, USEPA M2A, 2C	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Duct Pressure	NSW	TM-2, USEPA M2, 2C	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Dry Gas Density	NSW	TM-23, USEPA M3	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Moisture	NSW	TM-22, USEPA M4	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Molecular Weight of Stack Gases	NSW	TM-23, USEPA M3	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Oxygen	NSW	TM-25, USEPA M3A	SLR Consulting Australia Pty Ltd, Accreditation No.3130, Report No. 610.12201.00000
Total Solid Particulate Matter	NSW	NSW TM-15, AS4323.2	ALS, Accreditation No. 825, Report No. EN1300531
Particulate Matter less than 10 microns	NSW	OM-5, USEPA 201A	ALS, Accreditation No. 825, Report No. EN1300531
Particulate Matter less than 2.5 microns	NA	NSW TM-15 and particle sizer	University of New South Wales, Arc Centre of Excellence for Functional Nanomaterials, School of Chemical Sciences and Engineering

Test Report 610.12201.00000

3.2 Deviations from Test Methods

There were deviations to the specified test reference methodologies and these are specified below:

- The sample position does not meet ideal sampling plane position criteria of two duct diameters upstream from a flow disturbance and six duct diameters downstream from a flow disturbance. The sample plane position also does not meet the minimum distances specified in Table 1 of AS4323.1. Additional sampling points were adopted in accordance with AS4323.1 to improve the accuracy of the measurement.
- The sample position also does not meet the minimum number of access holes available in a suitable section of the stack or duct. A minimum of six access holes along the height side of the duct is required or 5 access holes along the width side of the duct. Additional sampling points were adopted in accordance with AS4323.1 to improve the accuracy of the measurements.

3.3 Sampling Times

As per the relevant test reference method or State requirement.

3.4 Reference Conditions

As per relevant test reference method, State requirement, or Environment Protection Licence or equivalent.

3.5 Identification

All samples are individually labelled with reference number, location, sampling date and times.

3.6 Sampling Plane Details

Test Report 610.12201.00000

Ideal sampling positions; In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 7-8 diameters downstream and 2-3 diameters upstream from a flow disturbance. However, in most cases, a suitable sampling plane will be a position fitting the minimum criteria specified in Table 1 of AS4323.1.

Non Ideal sampling position; If measurements near a bend is unavoidable, the sampling position shall be greater than one duct diameter upstream of the bend or greater than two duct diameters downstream of the bend. When the criteria in Table 1 of AS4323.1 cannot be met, a greater number of sampling points shall be used in order to retain as much accuracy as is practicable.

Monitoring Location: Ventilation Shaft	
Duct Diameter (m)	3.80m * 5.30m (Width * Height)
Equivalent Duct Diameter (m)	4.43m

Parameter	**Upstream**	**Downstream**
Type of Disturbance	Exit / Exhaust	Bend (Reducer)
Distance to Disturbance (m)	0	3.3
No. of Duct Diameters	0	0.7
Ideal Minimum Distance Criteria	2D	6D
Diameters less than Ideal Criteria	2	5.3
Sampling Factor	1.15	1.20

Number of sampling points for manual isokinetic sampling	**Criteria**	**Comments**
Minimum No. of Sampling Traverses	6 per height or 5 per width	Nil traverses available – SLR adopted traverse measurements from the open exhaust face.
Minimum No. of Access Holes	6 per height or 5 per width	Nil access holes available – SLR adopted traverse measurements from the open exhaust face.
Minimum No. of Sampling Points per Traverse	6 * 5 = 30 points	--
Combined Sampling Factor	1.38	--
Total No. of Sampling Points	42 per height (7 points per traverse by 6 traverse) 45 per width (9 points per traverse by 5 traverse)	SLR adopted a total of 42 points (6 points per traverse by 7 traverses across the stack height dimensions). 7 traverses were chosen to enable measurements to be conducted across each baffle section as shown in the sample location photograph.

Test Report 610.12201.00000

3.7 Average Results

Results are presented at standard conditions (0^{o}C and 1 atmosphere) unless otherwise stated. Where measured values have been corrected to reference conditions (i.e. 'normalised') the measured values are reported prefixed with an "N" (e.g. Nm^3).

Location:	Ventilation Shaft
Date Tested:	5 February 2013

Parameter	Unit	Average Measured Value
Duct Diameter	m	3.80 x 5.30
Duct Cross Sectional Area	m^2	20.140
Temperature	^{o}C	25.4
Velocity	m/s	12.1
Volumetric Flow	m^3/s	244.45
Volumetric Flow	N m^3/s	221.06
Gas Density	kg/m^3	1.29
Molecular Weight Dry Stack Gas	g/g mole	28.8
Total Stack Pressure	kPa	101.79
Moisture	%	1.6
Oxygen	%	20.7
Total Solid Particulates	mg/m^3	0.6
Particulate matter less than 10 microns	mg/m^3	< 0.04
Particulate matter less than 2.5 microns	mg/m^3	0.03*

* denotes not part of our NATA scope of accreditation.

Key:

^{o}C	=	degrees Celsius
%	=	percentage
kg/m^3	=	kilograms per cubic metre of air
kPa	=	kilopascals
g/g mole	=	grams per gram mole
m^3/s	=	cubic metre of air per second
m/s	=	metres per second
mg/m^3	=	milligrams per cubic metre of air

Test Report 610.12201.00000

3.8 Measurement Uncertainty – Process Emission Monitoring

Parameter	Associated Test Method	Uncertainty
Velocity	TM-2, AS 4323.1, USEPA M2A, 2C	± 5%
Temperature	TM-2, USEPA M2C	±2°C
Moisture	TM-22, USEPA M4	± 25%
Oxygen	TM-25, USEPA M3	± 15%
Particulate (as TSP)	TM-15, AS 4323.2, USEPA M5	± 15% (greater than 20 mg/m^3) ± 50% (less than 20 mg/m^3)
Particulate (as PM_{10})	OM-5, USEPA M201A	± 50%

Test Report 610.12201.00000

APPENDIX A CERTIFICATES OF ANALYSIS

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EN1300531**	Page	: 1 of 4
Client	: **SLR Consulting Australia Pty Ltd**	Laboratory	: Environmental Division Newcastle
Contact	: MR MICHAEL BRECKO	Contact	: Peter Keyte
Address	: PO BOX 176 2/2 LINCOLN ST LANECOVE NSW, AUSTRALIA 1595	Address	: 5 Rosegum Road Warabrook NSW Australia 2304
E-mail	: mbrecko@slrconsulting.com	E-mail	: peter.keyte@als.com.au
Telephone	: +61 02 9428 8134	Telephone	: 61-2-4968-9433
Facsimile	: +61 02 9427 8200	Facsimile	: +61-2-4968 0349
Project	: 610 12201	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 14123		
C-O-C number	: ----	Date Samples Received	: 07-FEB-2013
Sampler	: ----	Issue Date	: 13-FEB-2013
Site	: ----		
		No. of samples received	: 4
Quote number	: ----	No. of samples analysed	: 4

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **EA143LV - Results may be biased low due to filter damage observed upon sample receipt. Light deposit visible on samples.**

Analytical Results

Sub-Matrix: **AIR** (Matrix: **AIR**)			Client sample ID	**1778 - SLR4**	**1779 - SLR5**	----	----	----
			Client sampling date / time	05-FEB-2013 15:00	05-FEB-2013 15:00	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EN1300531-001**	**EN1300531-002**	**----**	**----**	**----**
EA143B: Total Particulate Matter - Stack Tests								
Particulate Matter	----	0.0001	g	**0.0010**	**0.0020**	----	----	----

Analytical Results

Sub-Matrix: FILTER (Matrix: AIR)			Client sample ID	1780 - SLR-QF-1	1781 - SLR-QF-2	----	----	----
			Client sampling date / time	05-FEB-2013 15:00	05-FEB-2013 15:00	----	----	----
Compound	CAS Number	LOR	Unit	EN1300531-003	EN1300531-004	----	----	----
EA143: Total Suspended Particulates								
PM10 (mass per filter)	----	100	µg/filter	<100	<100	----	----	----

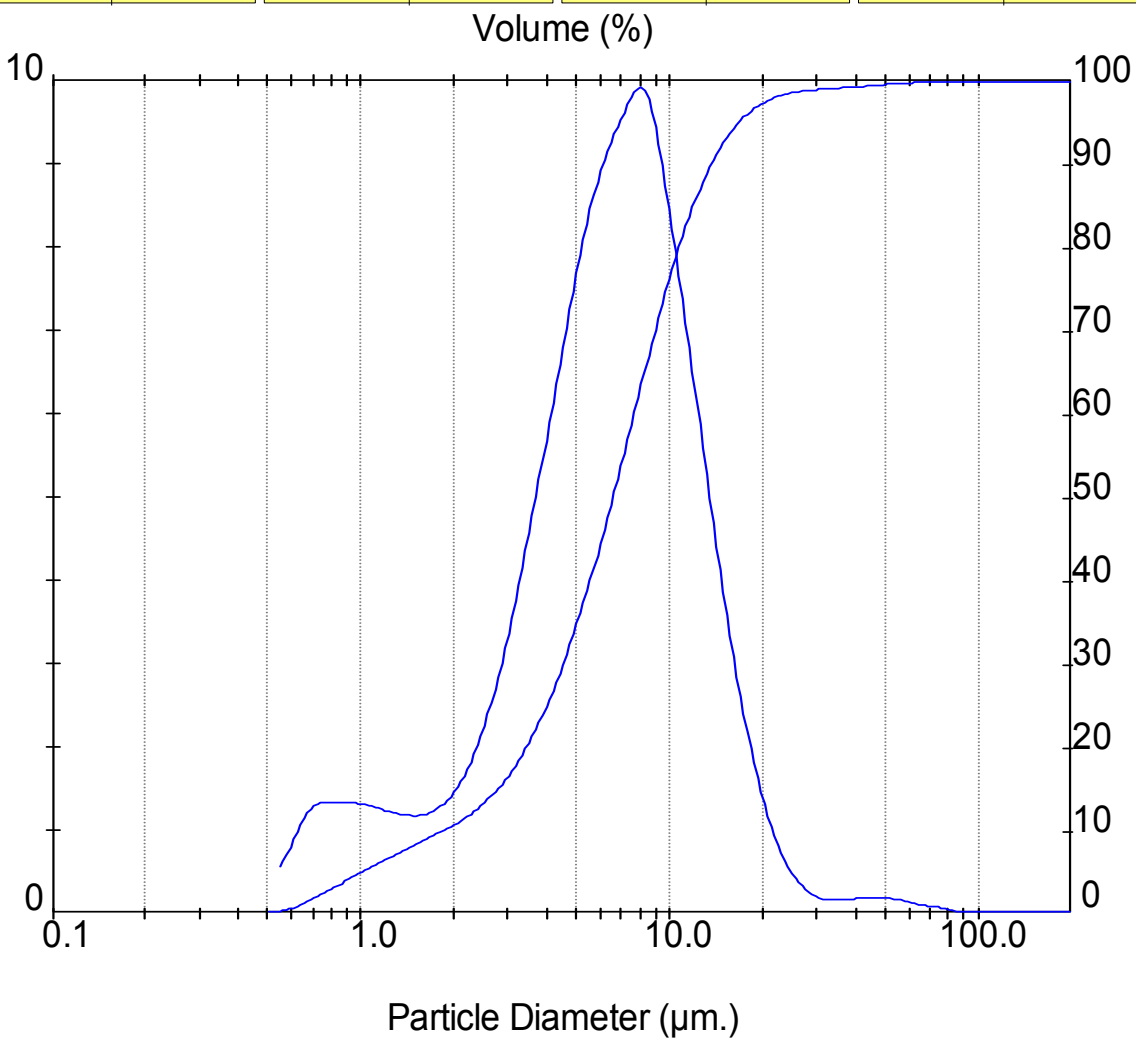
Result: Analysis Table

ID: 1409	Run No: 11	Measured: 9/25/2012 10:18AM
File: THIMBLE	Rec. No: 11	Analysed: 9/25/2012 10:18AM
Path: C:\DOCUME~1\JOHN\MYDOCU~1\TJ\SLRCON~1\		Source: Analysed

Range: 300 mm	Beam: 14.30 mm	Sampler: MS7	Obs': 23.9 %
Presentation: 3OHD		Analysis: Polydisperse	Residual: 0.427 %
Modifications: None			

Conc. = 0.0025 %Vol	Density = 1.000 g/cm^3	S.S.A.= 1.5352 m^2/g
Distribution: Volume	D[4, 3] = 7.68 um	D[3, 2] = 3.91 um
D(v, 0.1) = 1.85 um	D(v, 0.5) = 6.56 um	D(v, 0.9) = 13.68 um
Span = 1.804E+00	Uniformity = 5.984E-01	

Size (um)	Volume In %	Size (um)	Volume In %	Size (um)	Volume In %	Size (um)	Volume In %
0.49	0.54	3.60	5.43	26.20	0.26	190.80	0.00
0.58	0.99	4.19	6.79	30.53	0.17	222.28	0.00
0.67	1.32	4.88	8.07	35.56	0.18	258.95	0.00
0.78	1.34	5.69	9.03	41.43	0.20	301.68	0.00
0.91	1.33	6.63	9.59	48.27	0.19	351.46	0.00
1.06	1.27	7.72	9.85	56.23	0.14	409.45	0.00
1.24	1.20	9.00	8.72	65.51	0.10	477.01	0.00
1.44	1.19	10.48	7.08	76.32	0.05	555.71	0.00
1.68	1.29	12.21	5.28	88.91	0.00	647.41	0.00
1.95	1.58	14.22	3.58	103.58	0.00	754.23	0.00
2.28	2.14	16.57	2.19	120.67	0.00	878.67	
2.65	3.01	19.31	1.18	140.58	0.00		
3.09	4.14	22.49	0.56	163.77	0.00		
3.60		26.20		190.80			



Result: Analysis Table

ID: 1409	Run No: 12	Measured: 9/25/2012 10:18AM
File: THIMBLE	Rec. No: 12	Analysed: 9/25/2012 10:18AM
Path: C:\DOCUME~1\JOHN\MYDOCU~1\TJ\SLRCON~1\		Source: Analysed

Range: 300 mm	Beam: 14.30 mm	Sampler: MS7	Obs': 23.9 %
Presentation: 3OHD		Analysis: Polydisperse	Residual: 0.420 %
Modifications: None			

Conc. = 0.0025 %Vol	Density = 1.000 g/cm^3	S.S.A.= 1.5402 m^2/g
Distribution: Volume	D[4, 3] = 7.56 um	D[3, 2] = 3.90 um
D(v, 0.1) = 1.84 um	D(v, 0.5) = 6.56 um	D(v, 0.9) = 13.58 um
Span = 1.790E+00	Uniformity = 5.801E-01	

Size (um)	Volume In %	Size (um)	Volume In %	Size (um)	Volume In %	Size (um)	Volume In %
0.49	0.54	3.60	5.41	26.20	0.24	190.80	0.00
0.58	1.00	4.19	6.78	30.53	0.14	222.28	0.00
0.67	1.33	4.88	8.08	35.56	0.15	258.95	0.00
0.78	1.36	5.69	9.06	41.43	0.16	301.68	0.00
0.91	1.34	6.63	9.64	48.27	0.15	351.46	0.00
1.06	1.28	7.72	9.92	56.23	0.11	409.45	0.00
1.24	1.21	9.00	8.78	65.51	0.06	477.01	0.00
1.44	1.19	10.48	7.13	76.32	0.00	555.71	0.00
1.68	1.29	12.21	5.31	88.91	0.00	647.41	0.00
1.95	1.58	14.22	3.60	103.58	0.00	754.23	0.00
2.28	2.12	16.57	2.20	120.67	0.00	878.67	
2.65	2.98	19.31	1.18	140.58	0.00		
3.09	4.12	22.49	0.55	163.77	0.00		
3.60		26.20		190.80			

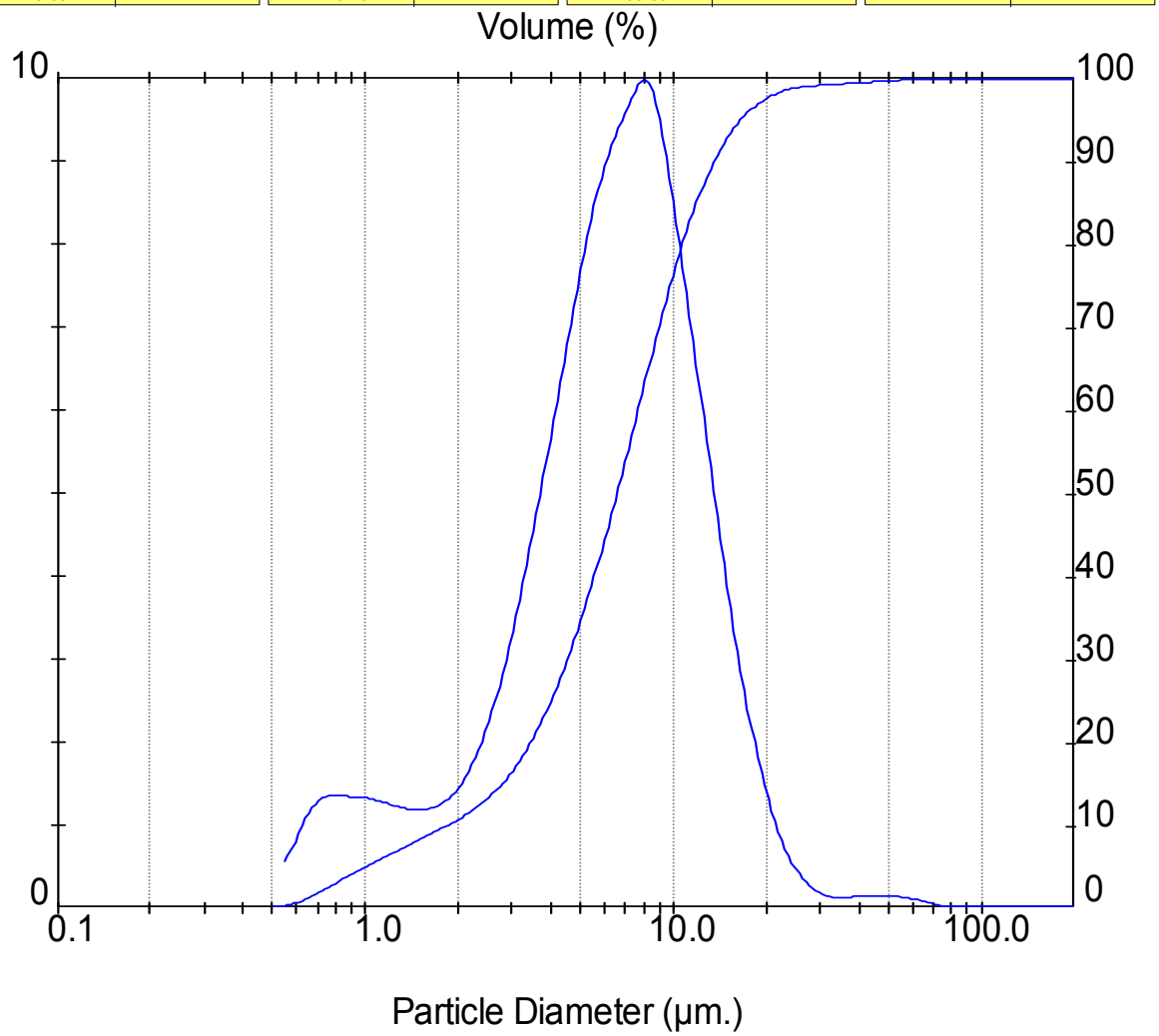


Table C-1 Emission Estimation

Activity	Intensity		Emission Factor				Variables		Ref
	Value	Units	TSP	PM_{10}	$PM_{2.5}$	Units	Parameter	Value	
Conveyor transfer points	12,000,000	tpa	0.0003	0.0001	0.00002	kg/t	Wind speed factor [1]	2.23	AP42
							Moisture content	10%	
							Control efficiency	40%	
Crushing	4,000,000	tpa	0.0100	0.0040	0.00040	kg/t	Control efficiency	70%	AP42
Dozers	2,334	hr/yr	12.3	2.8	0.27	kg/h	Silt content	5%	AP42
							Moisture content	10%	
Loading coal to trucks	4,000,000	tpa	0.0004	0.0002	0.00001	Kg/t			Katestone (2011)
Wind erosion - Exposed areas	1.56	ha	0.40	0.20	0.06	kg/ha/hr	Hours per year	8,760 hours	NPI
							Control efficiency	50%	
Ventilation fan	221.1	m^3/s	0.60	0.04	0.03	mg/m^3			

Note: Wind Speed Factor = average of $(\text{wind speed}/2.2)^{1.3}$

Figure D-1 Annual and Seasonal Windroses (2009)

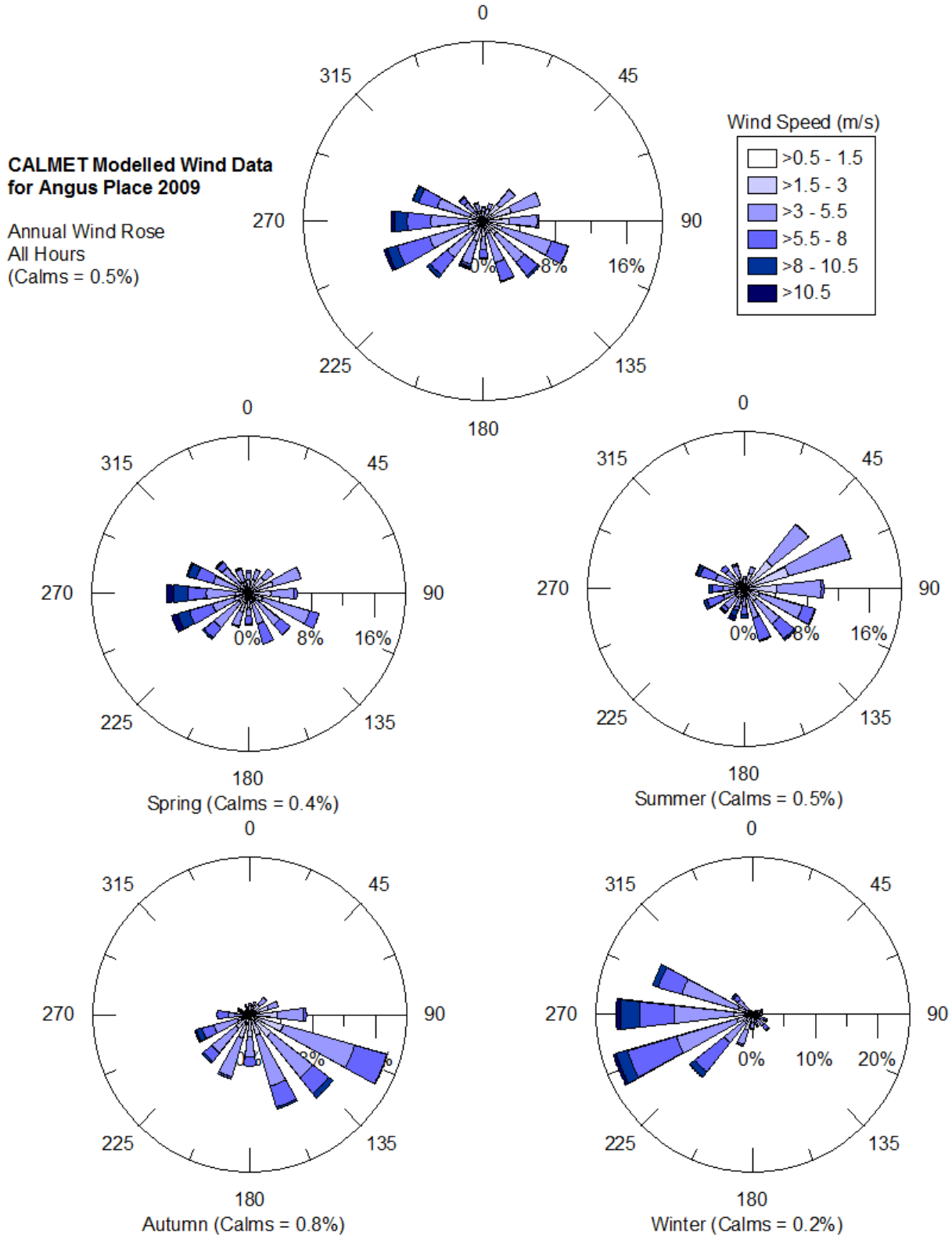
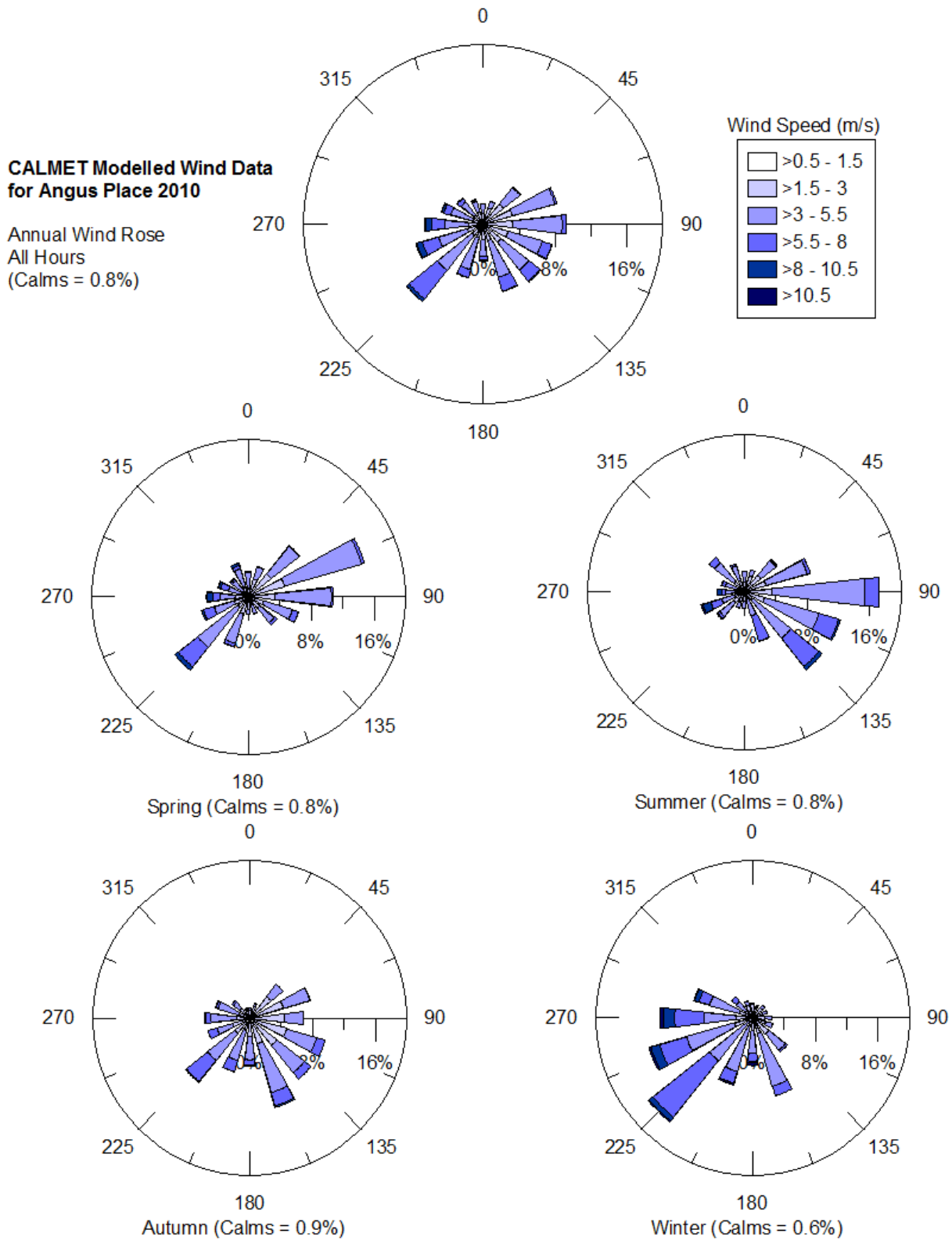


Figure D-2 Annual and Seasonal Windroses 2010



Appendix E

Pollutant Isopleth Plots

Figure 1 Predicted Annual Average Dust Deposition Rate – Construction

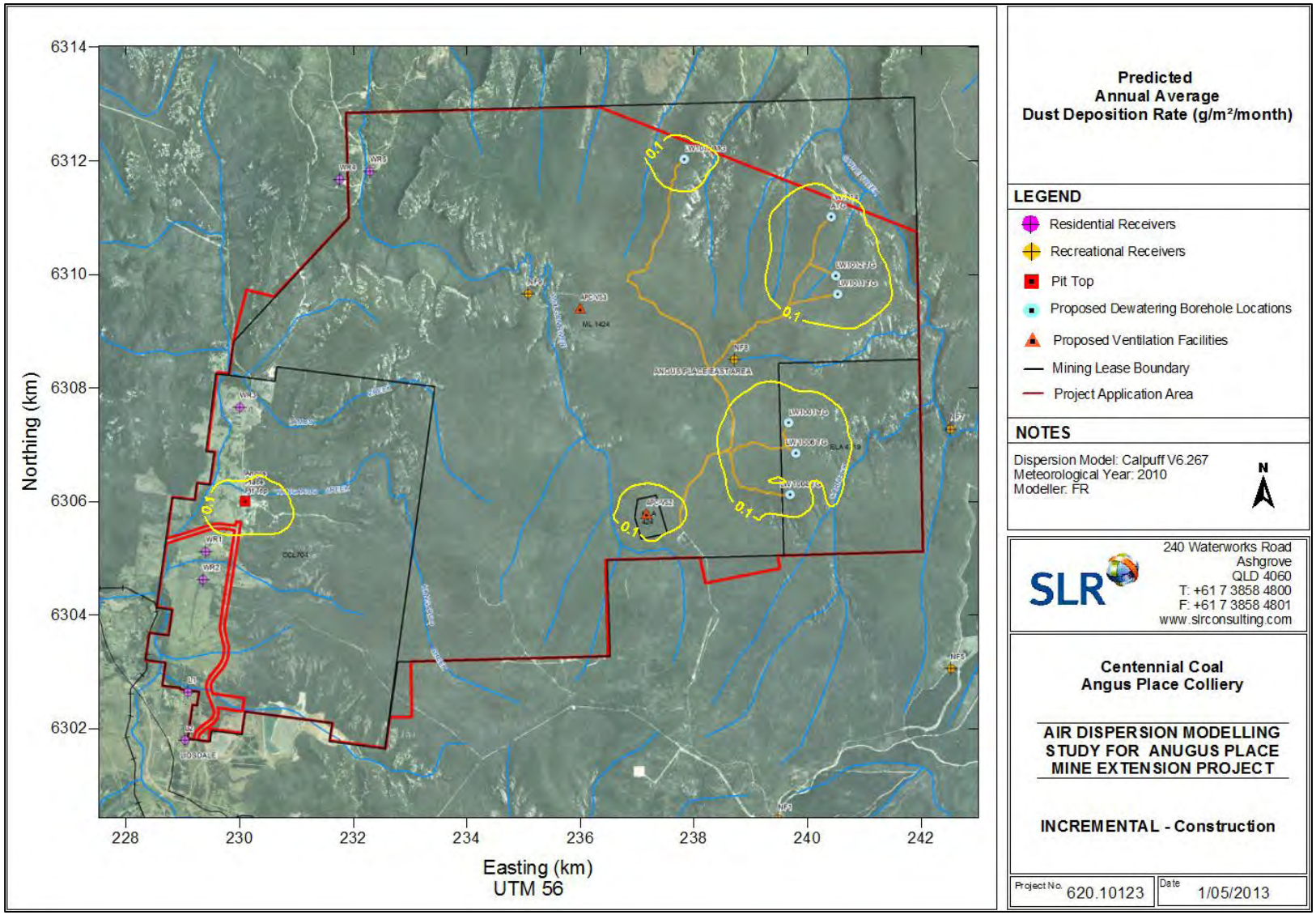


Figure 2 Predicted Annual Average Incremental TSP Concentrations – Construction

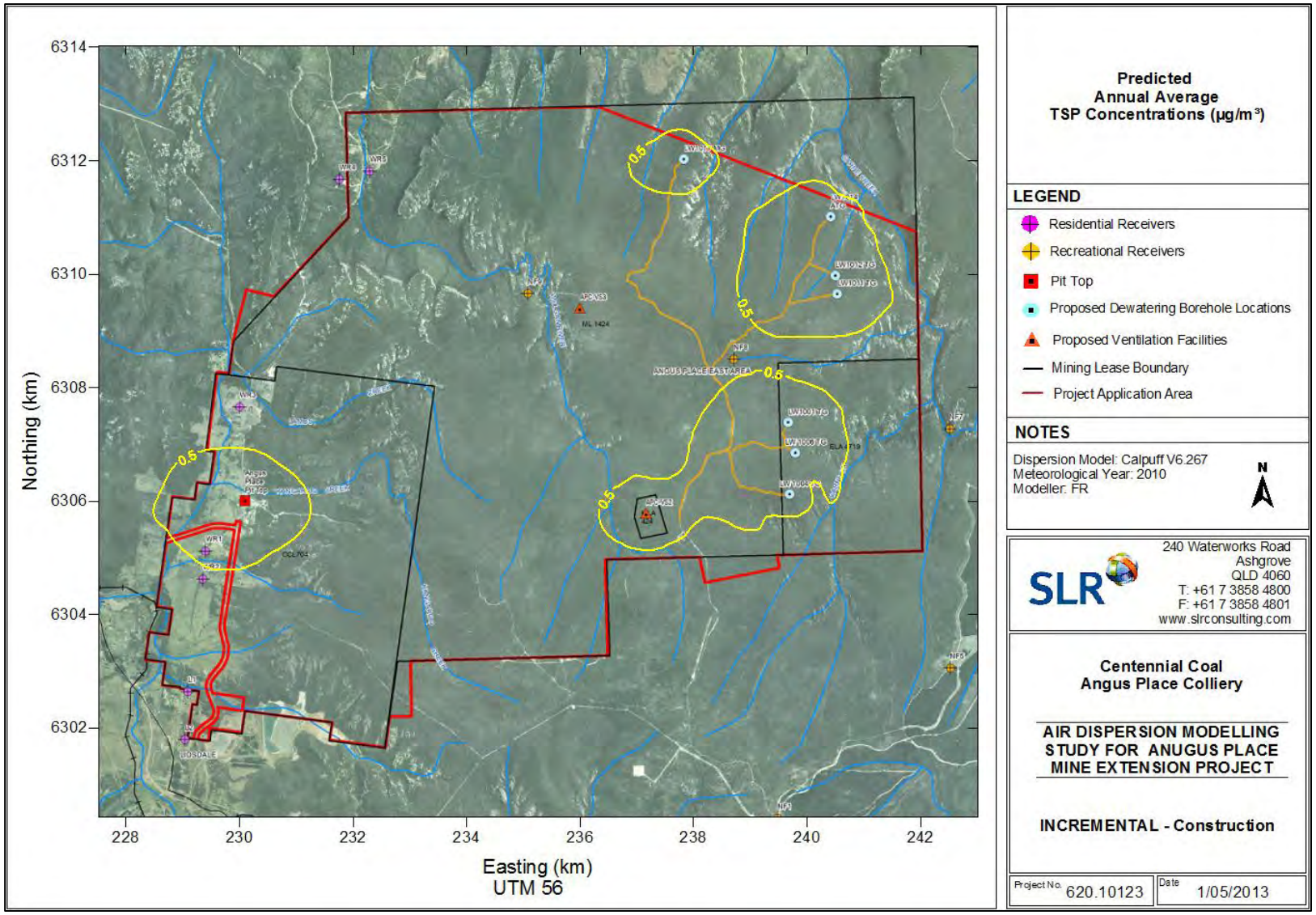


Figure 3 Predicted Annual Average Incremental PM_{10} Concentrations – Construction

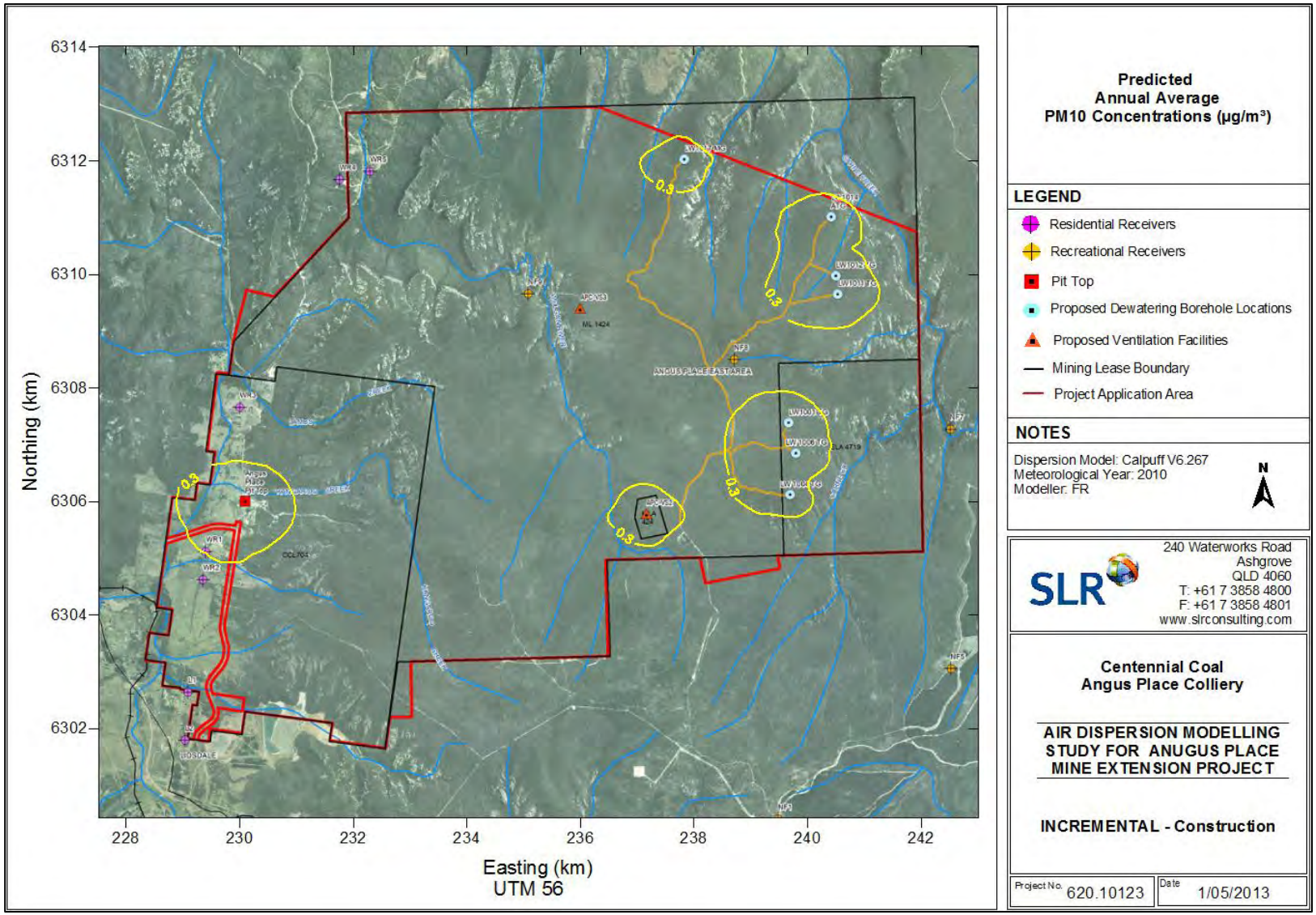


Figure 4 Maximum Predicted 24-Hour Average Incremental PM_{10} Concentrations – Construction

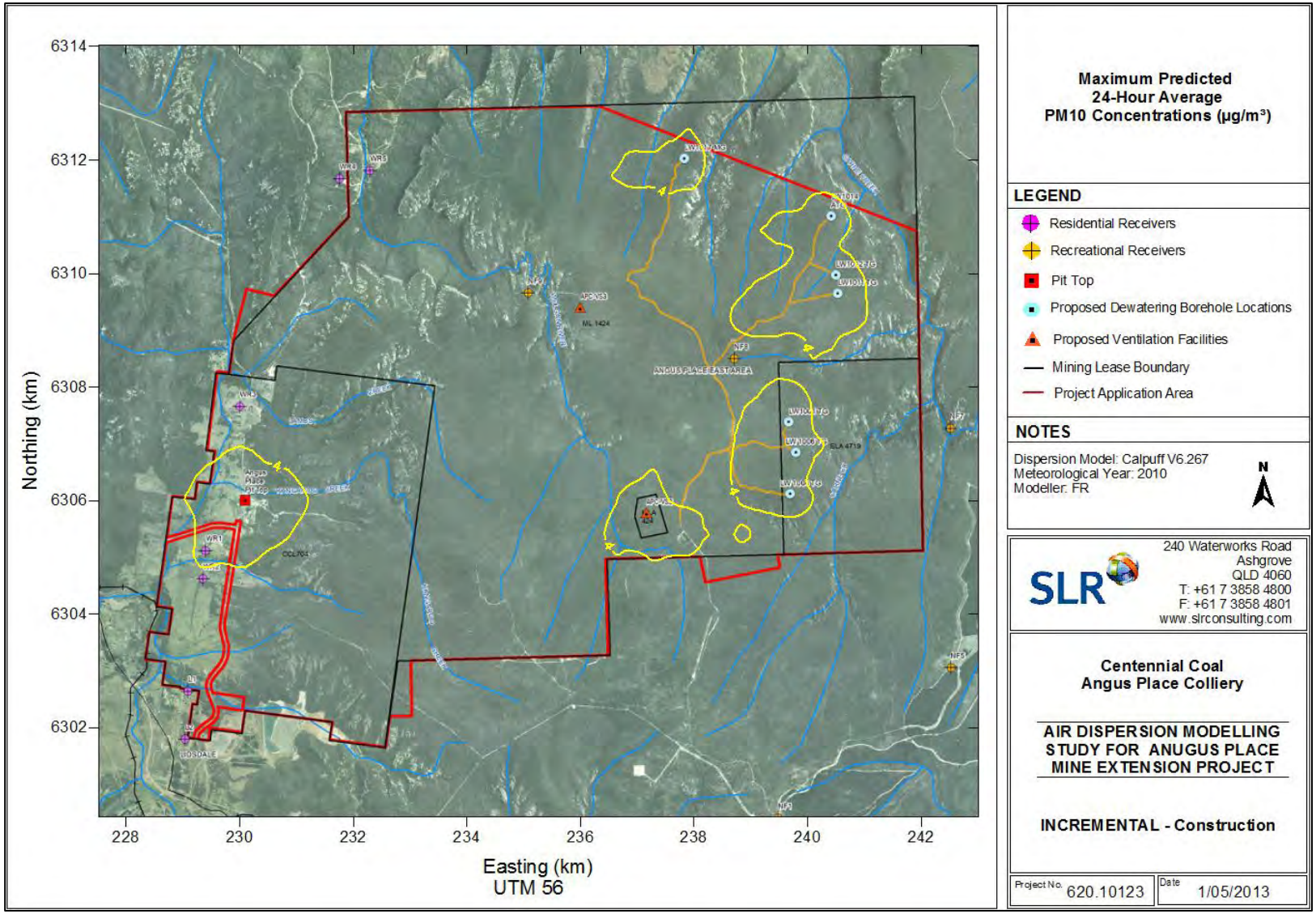


Figure 5 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations – Construction

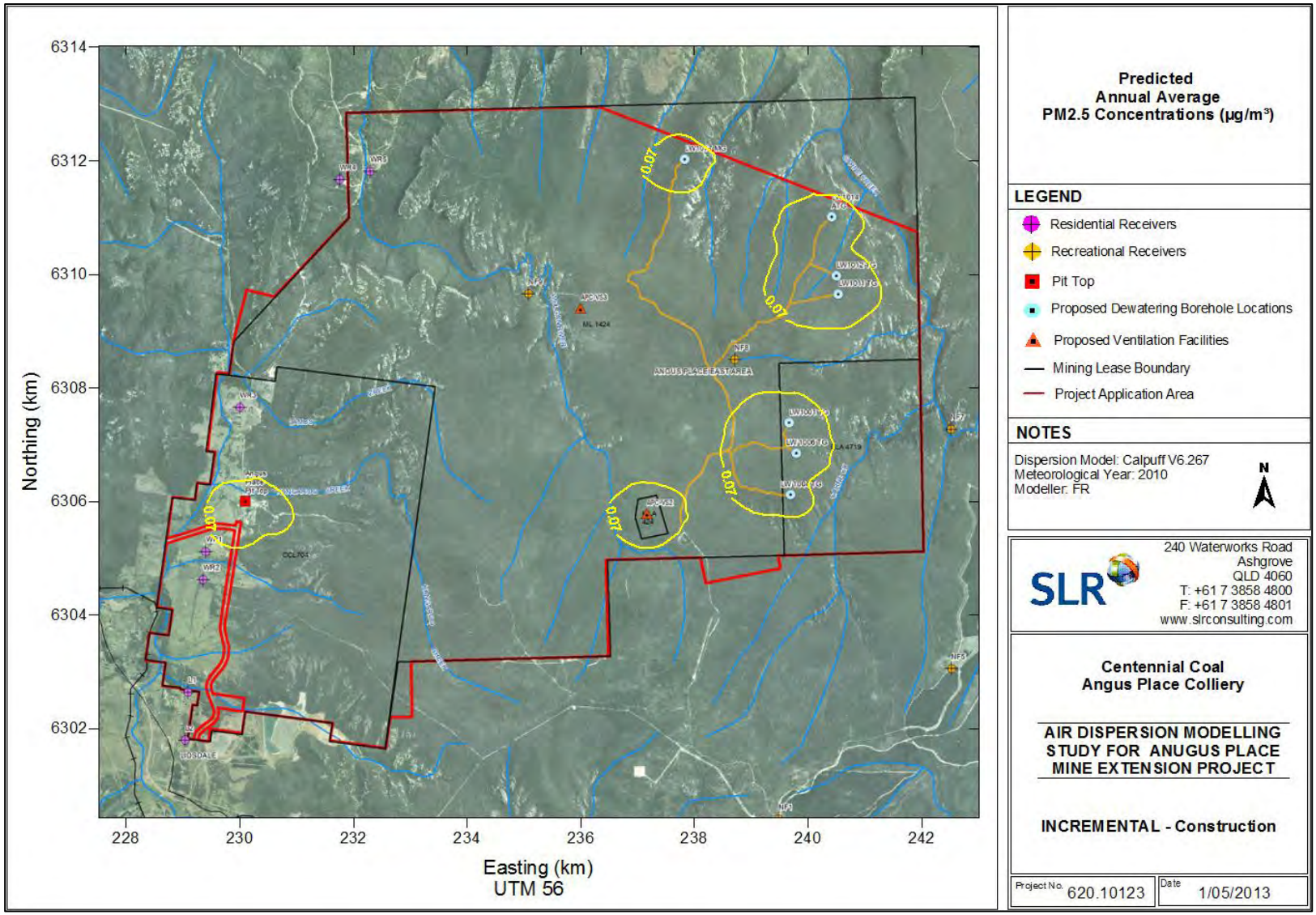


Figure 6 Maximum Predicted 24-Hour Average Incremental $PM_{2.5}$ Concentrations – Construction

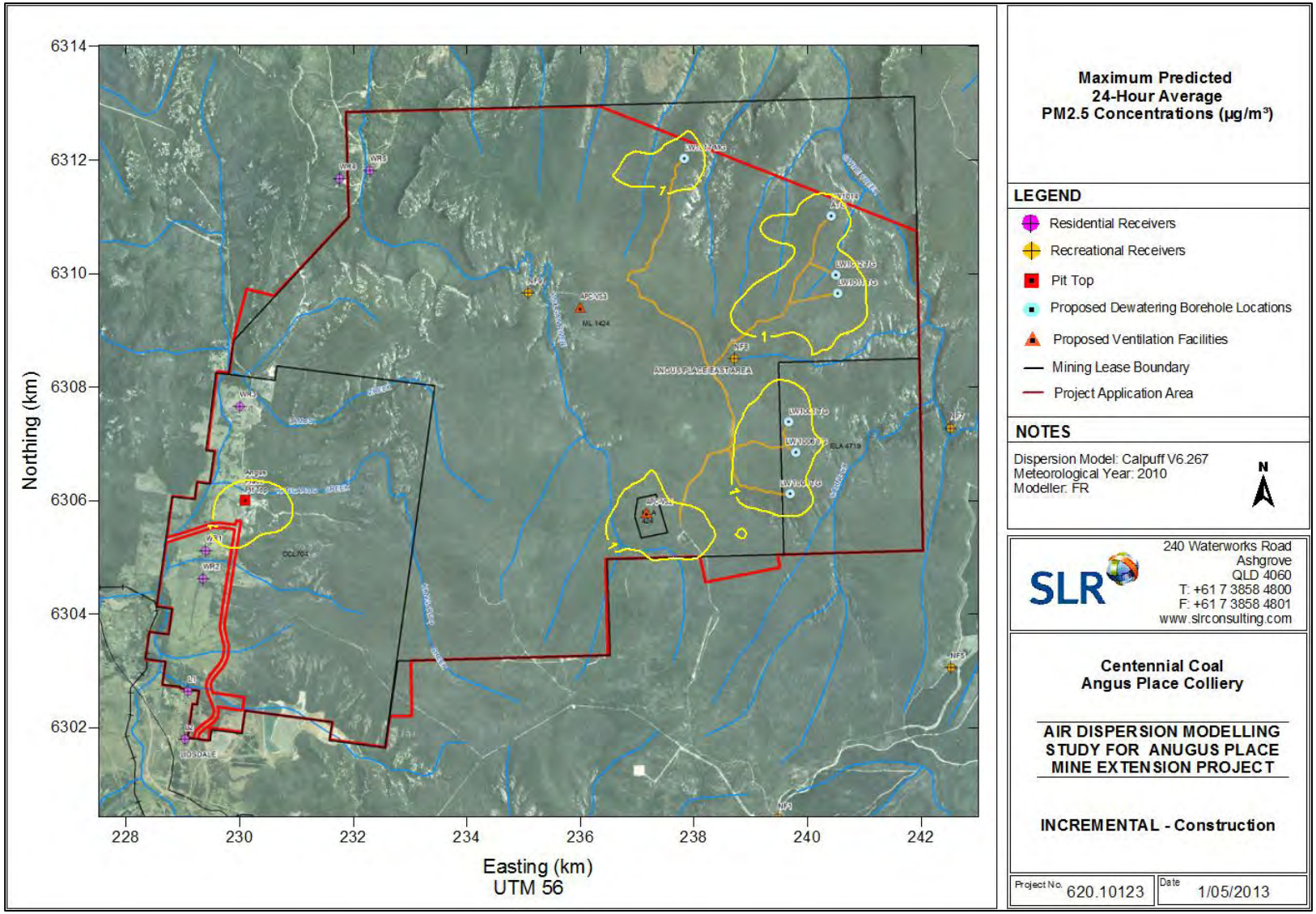


Figure 7 Predicted Annual Average Dust Deposition Rate – Operation

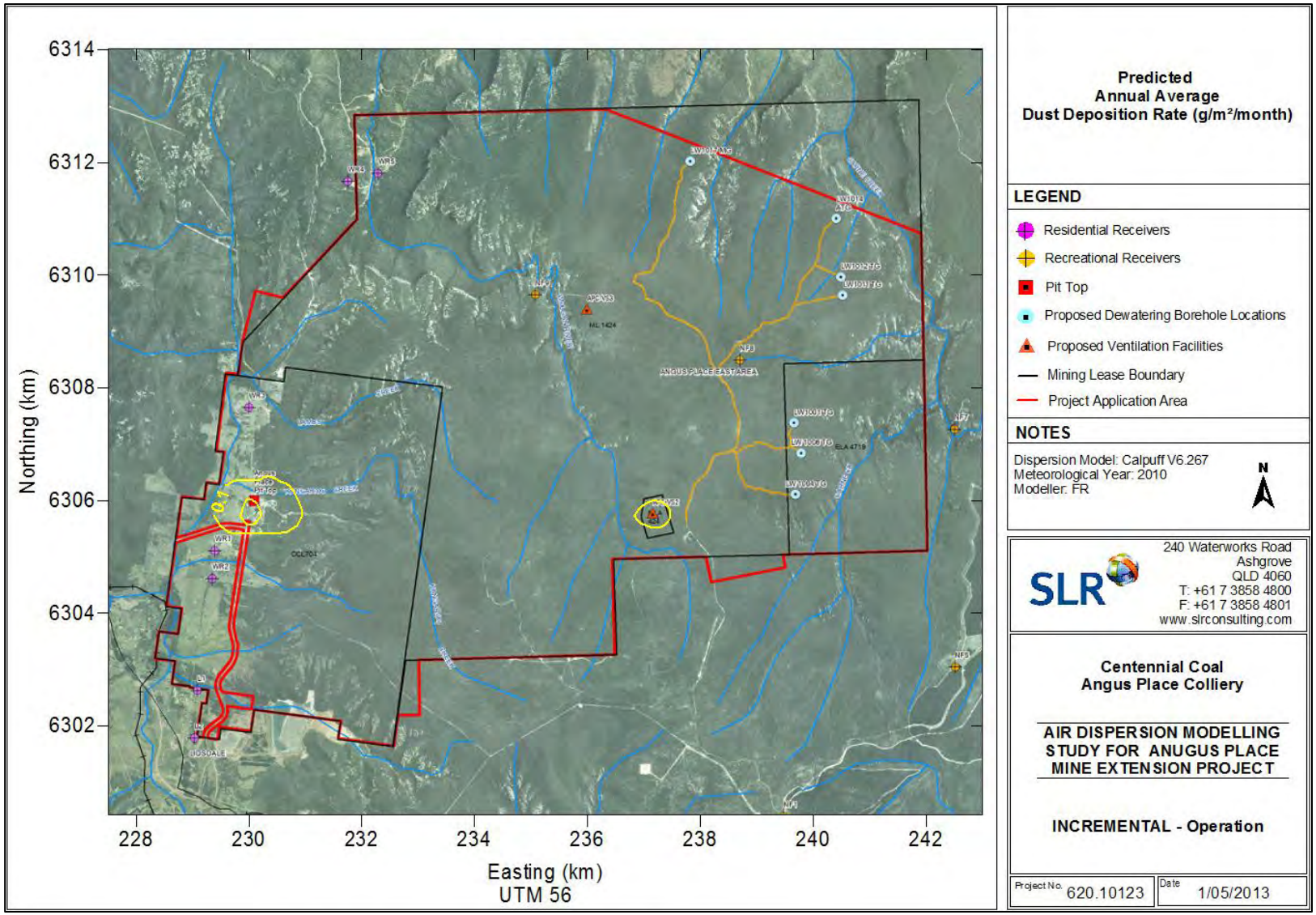


Figure 8 Predicted Annual Average Incremental TSP Concentrations – Operation

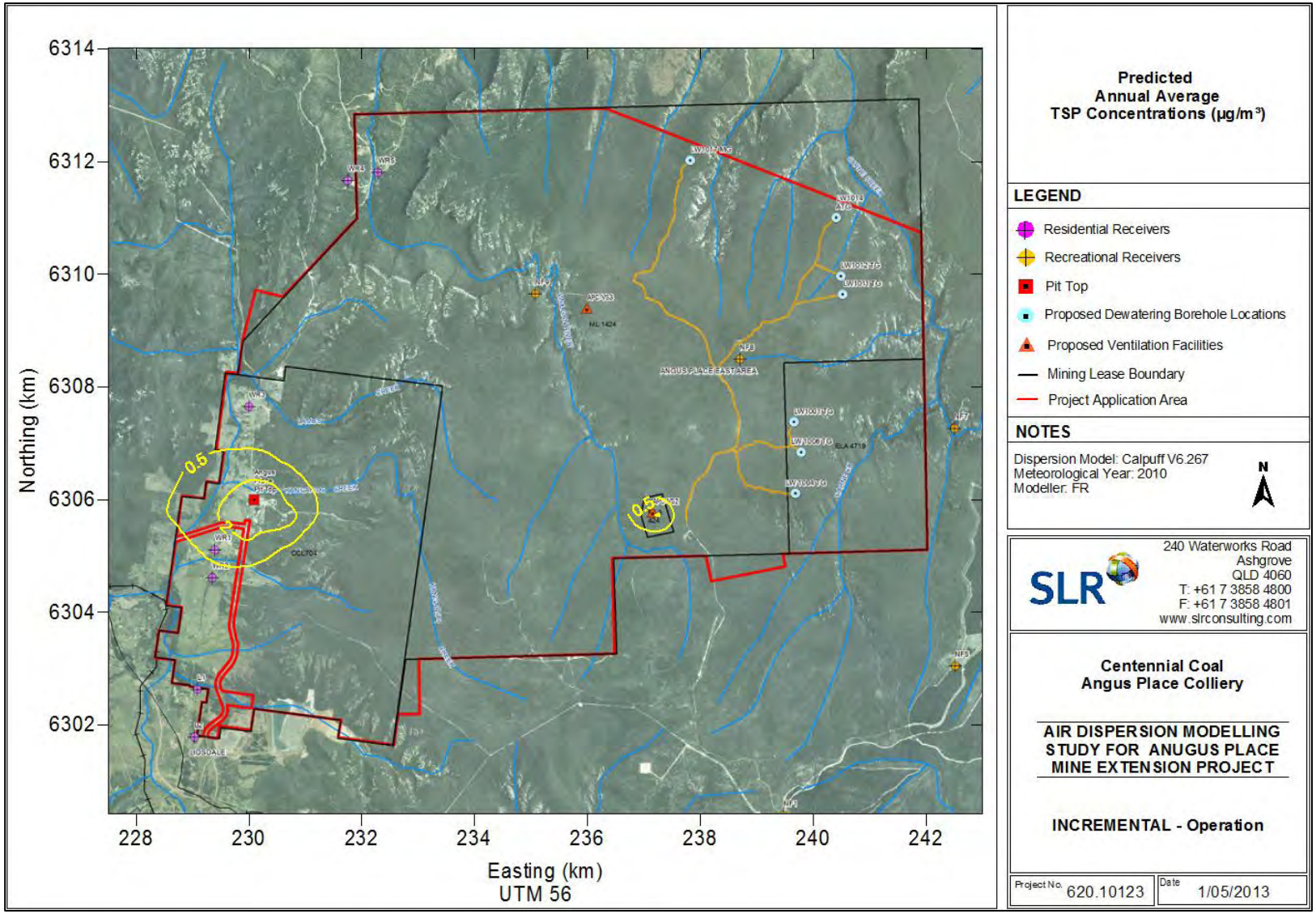


Figure 9 Predicted Annual Average Incremental PM_{10} Concentrations – Operation

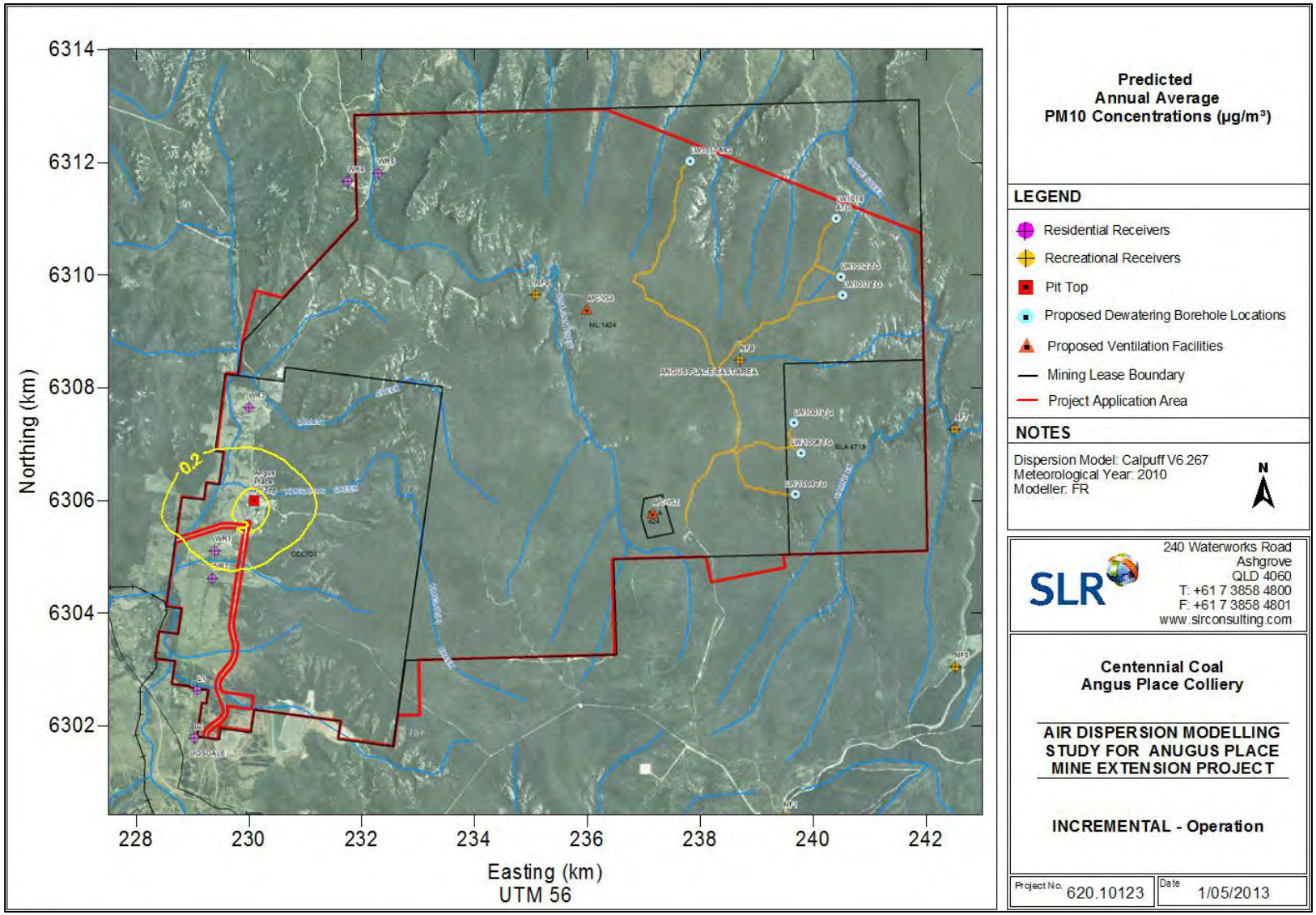


Figure 10 Maximum Predicted 24-Hour Average Incremental PM_{10} Concentrations – Operation

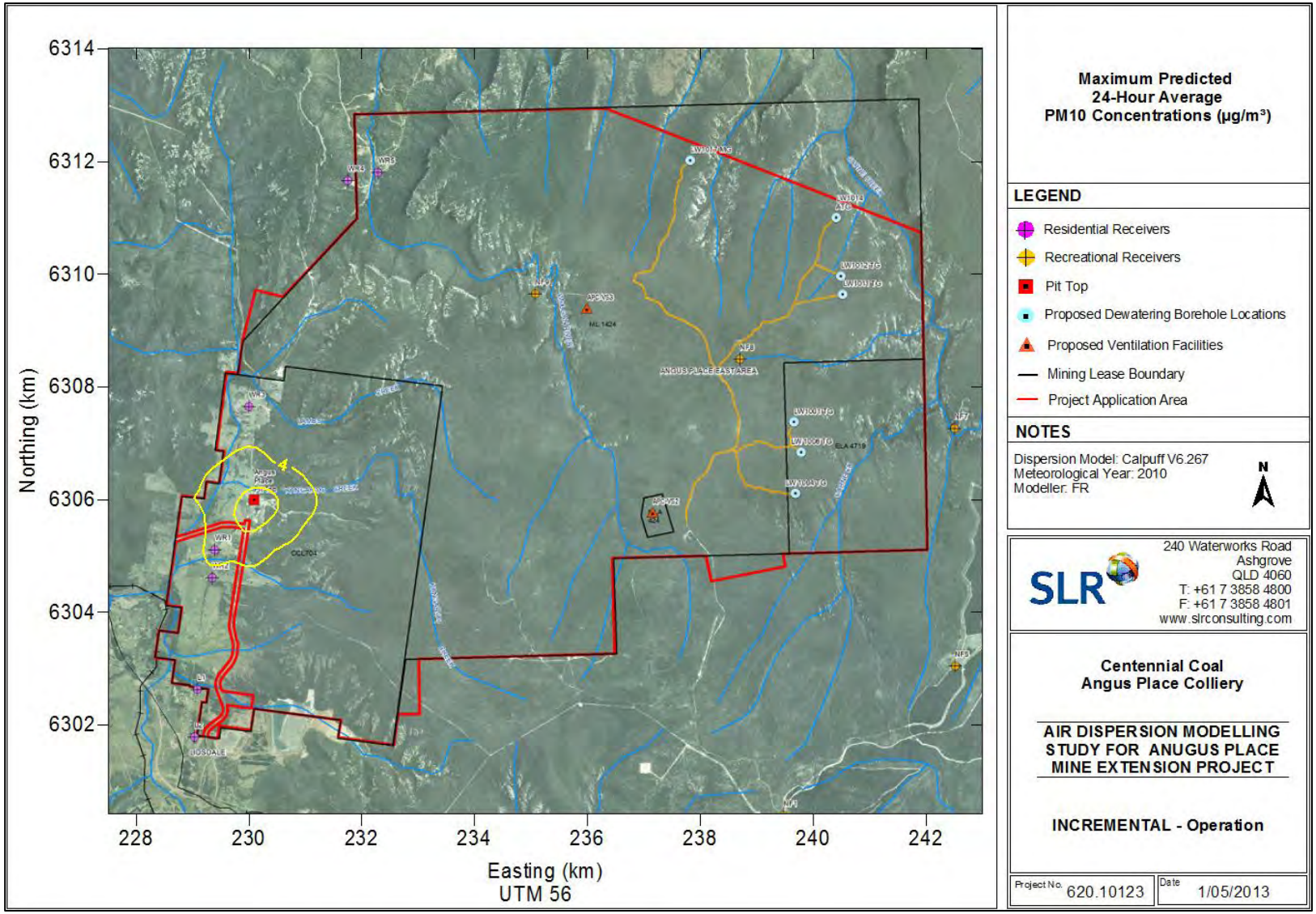


Figure 11 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations – Operation

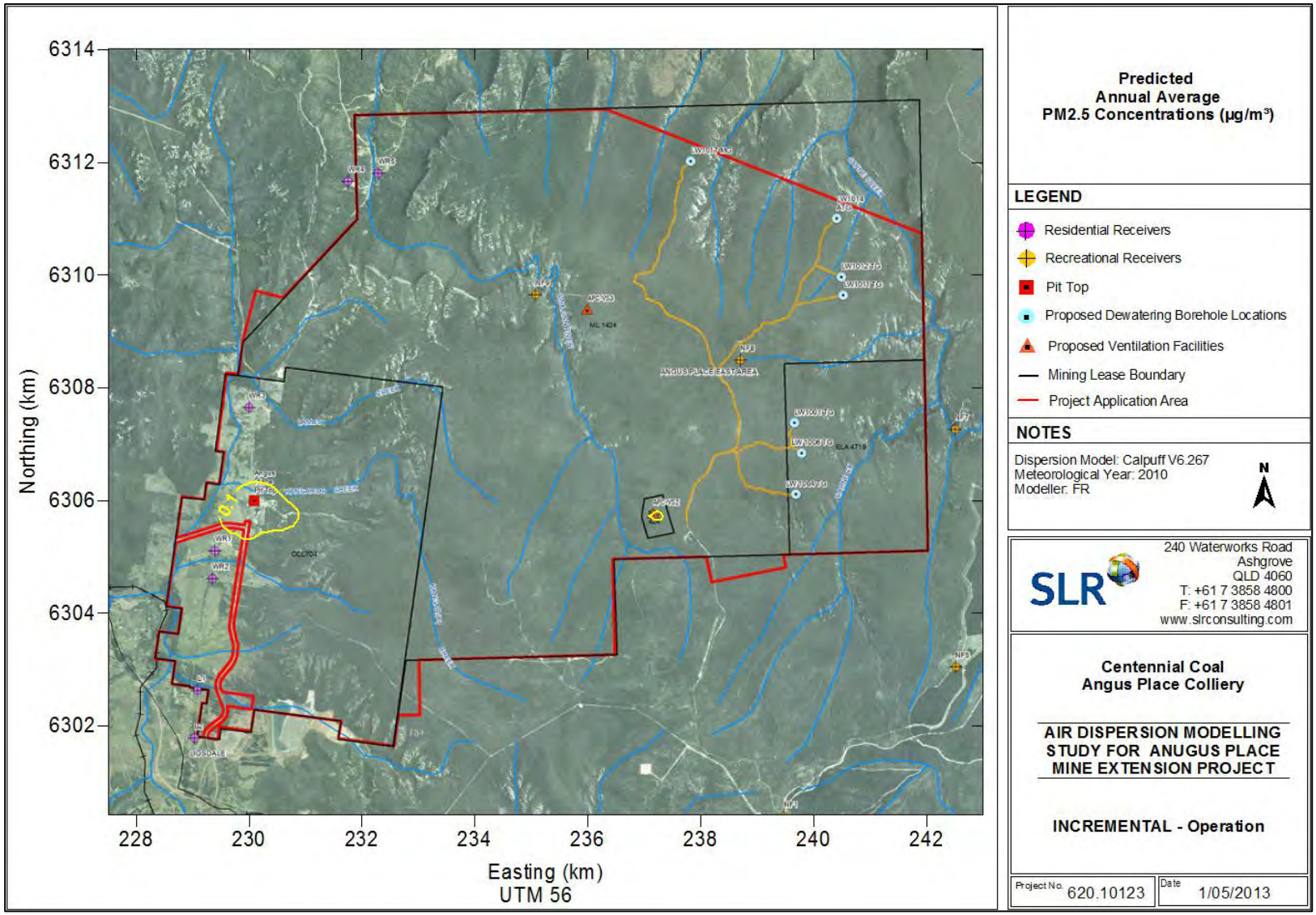


Figure 12 Maximum Predicted 24-Hour Average Incremental $PM_{2.5}$ Concentrations – Operation

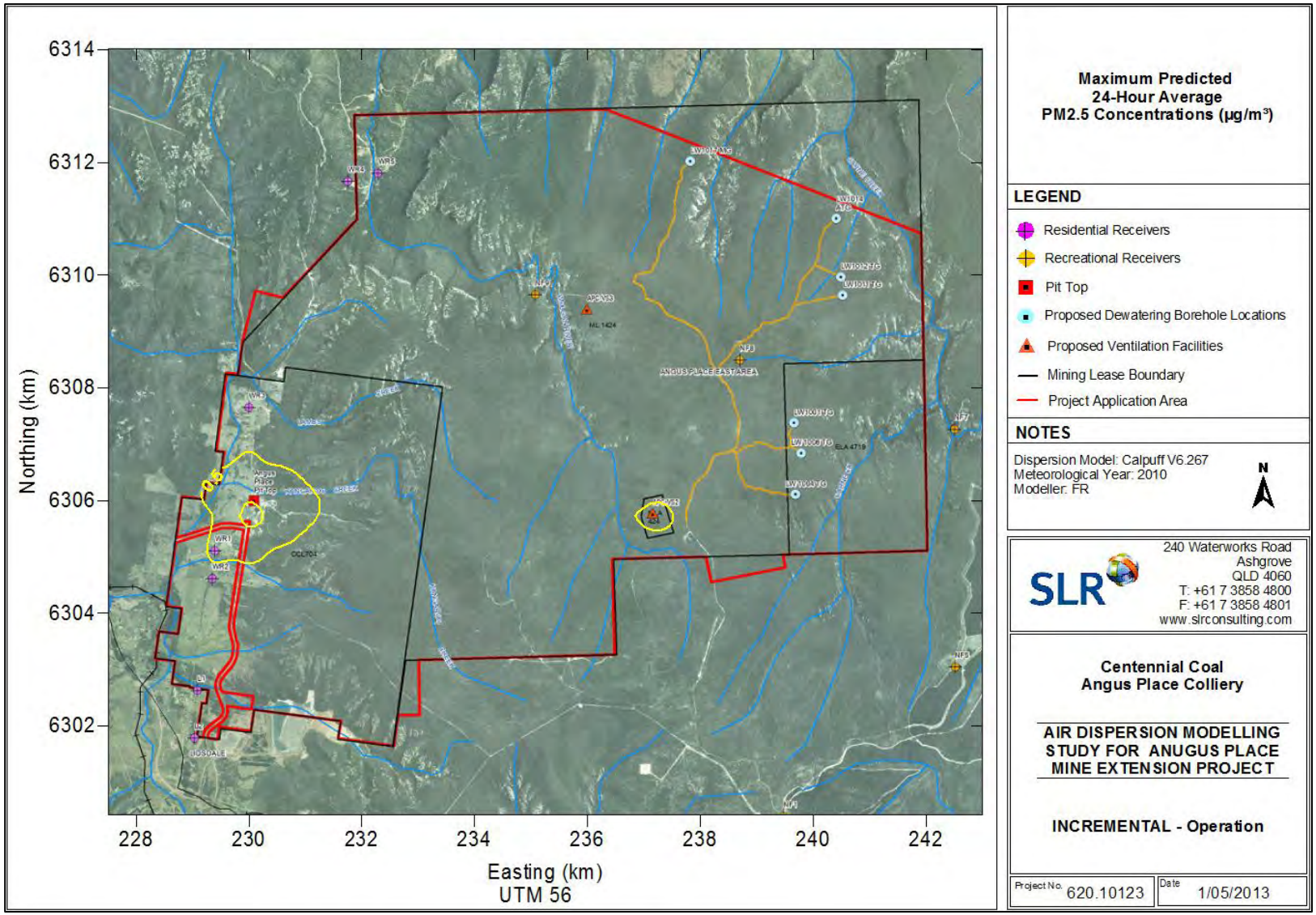


Figure 13 Predicted Annual Average Dust Deposition Rate – Rehabilitation

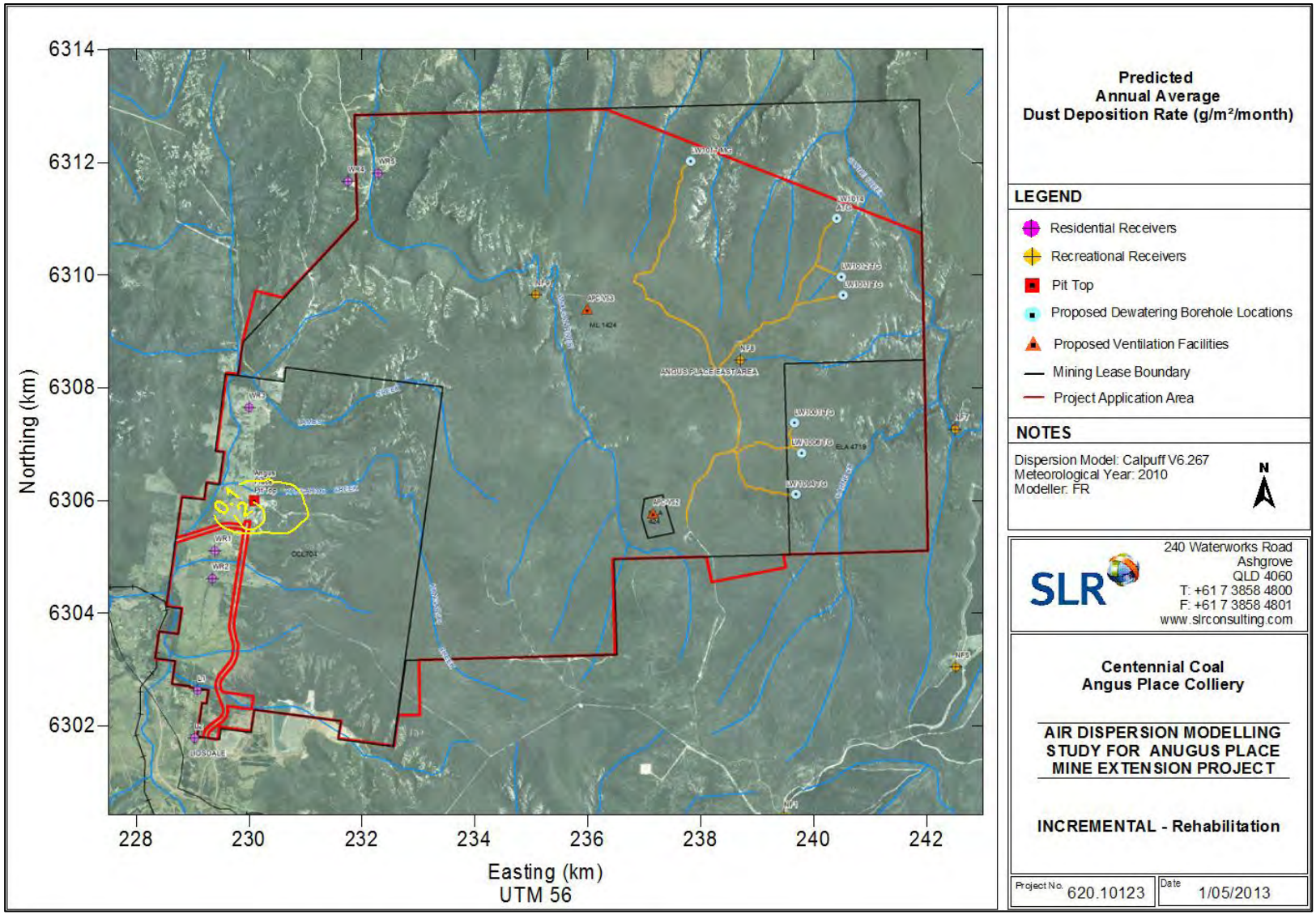


Figure 14 Predicted Annual Average Incremental TSP Concentrations – Rehabilitation

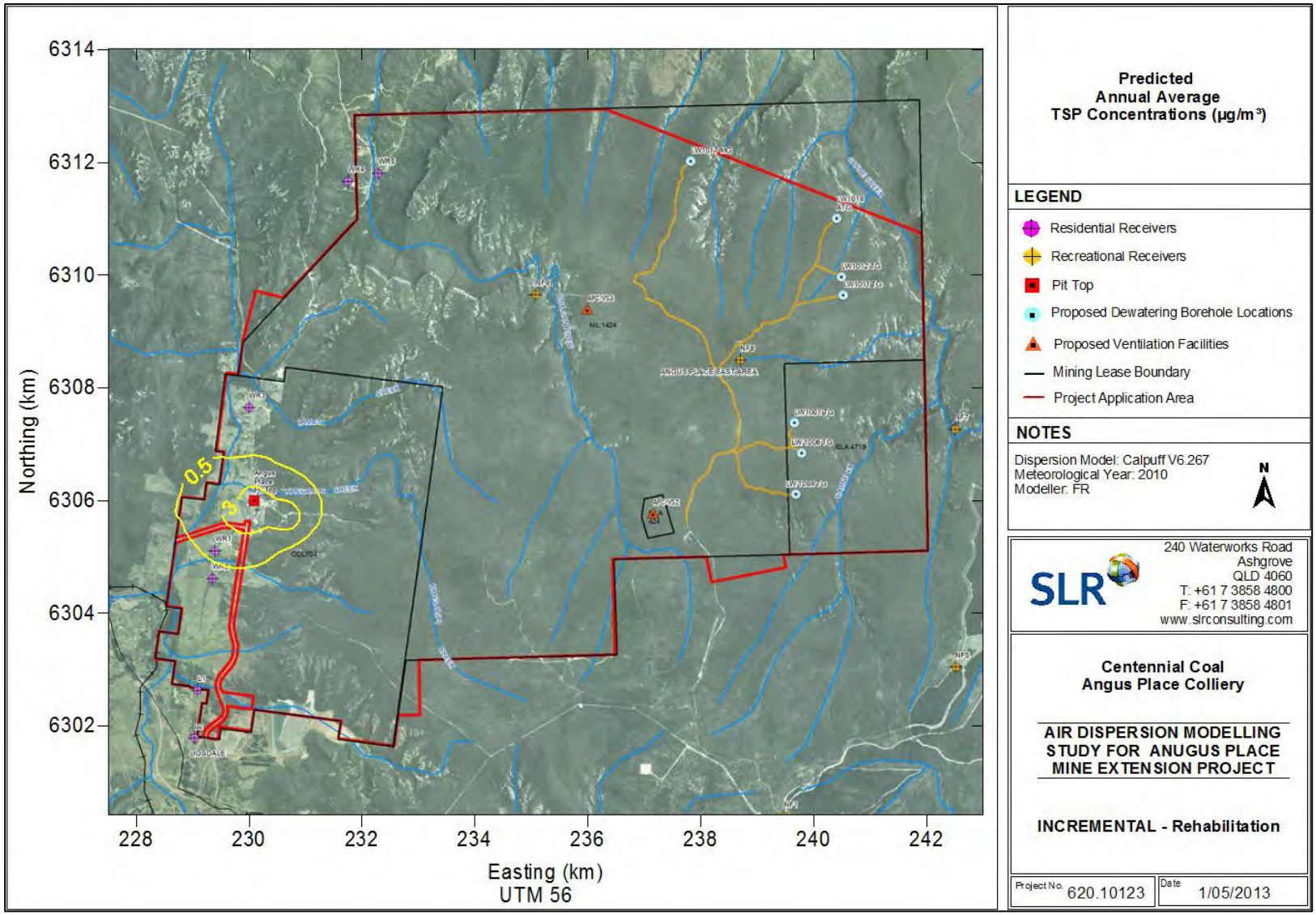


Figure 15 Predicted Annual Average Incremental PM_{10} Concentrations – Rehabilitation

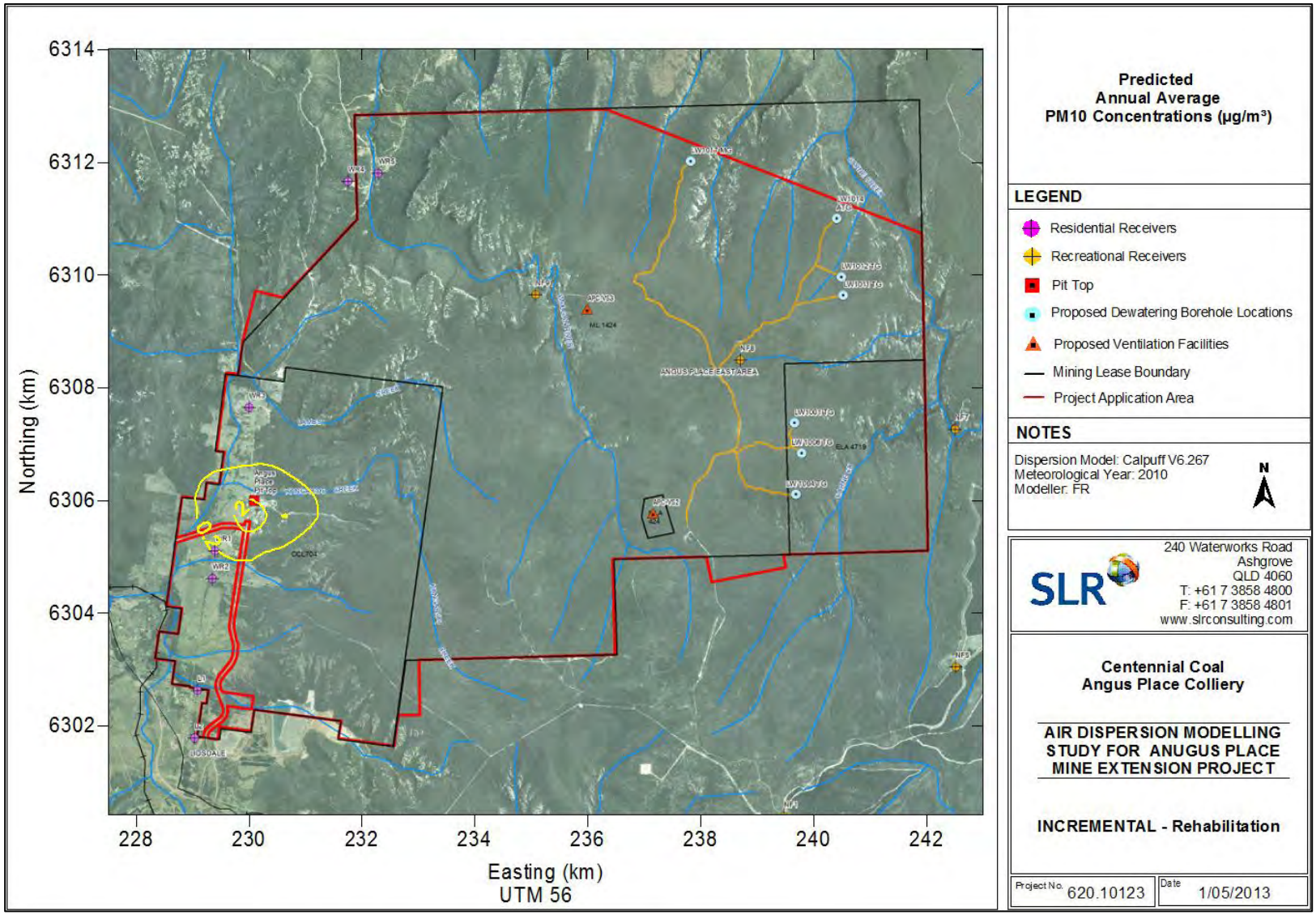


Figure 16 Maximum Predicted 24-Hour Average Incremental PM_{10} Concentrations – Rehabilitation

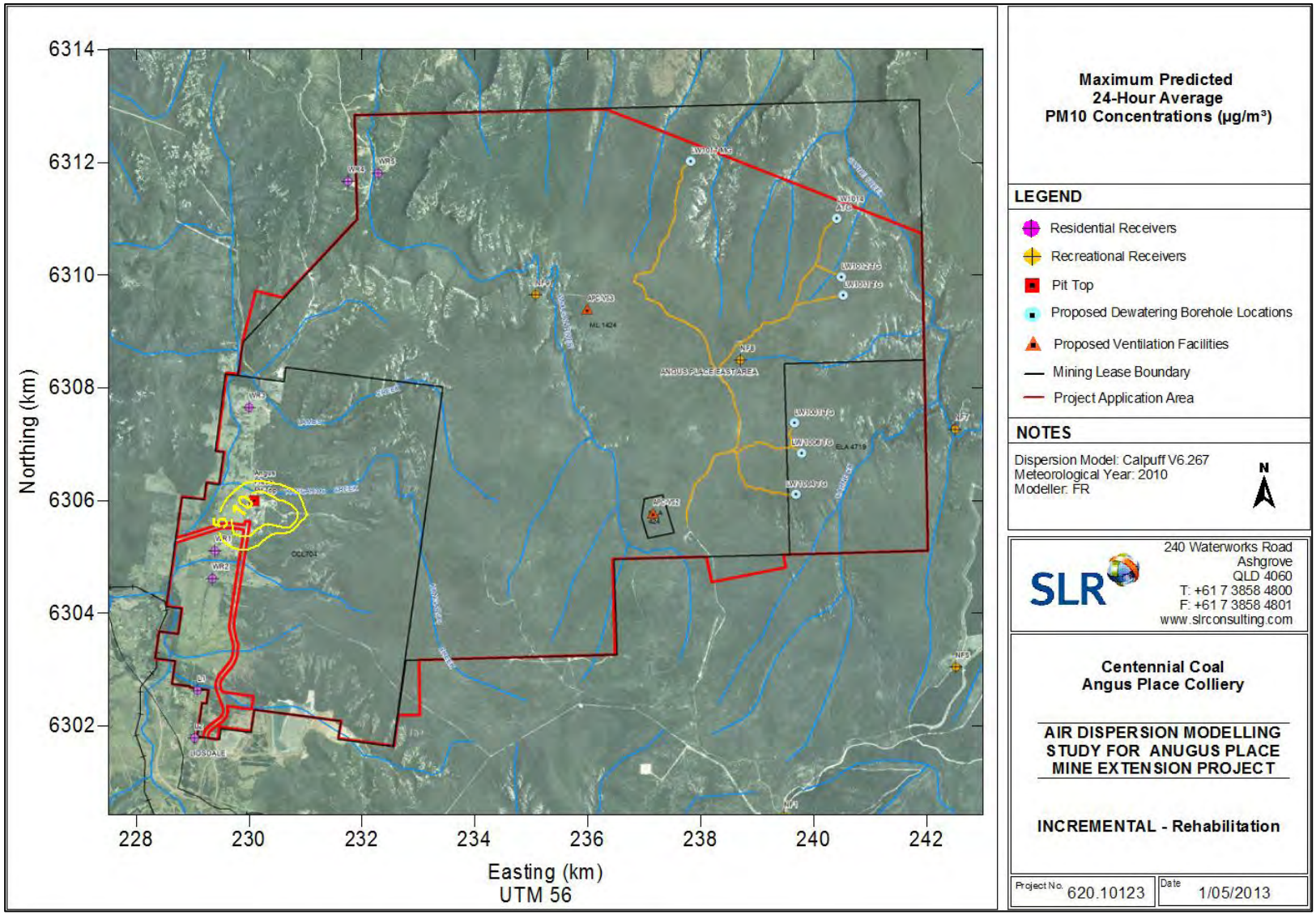


Figure 17 Predicted Annual Average Incremental $PM_{2.5}$ Concentrations – Rehabilitation

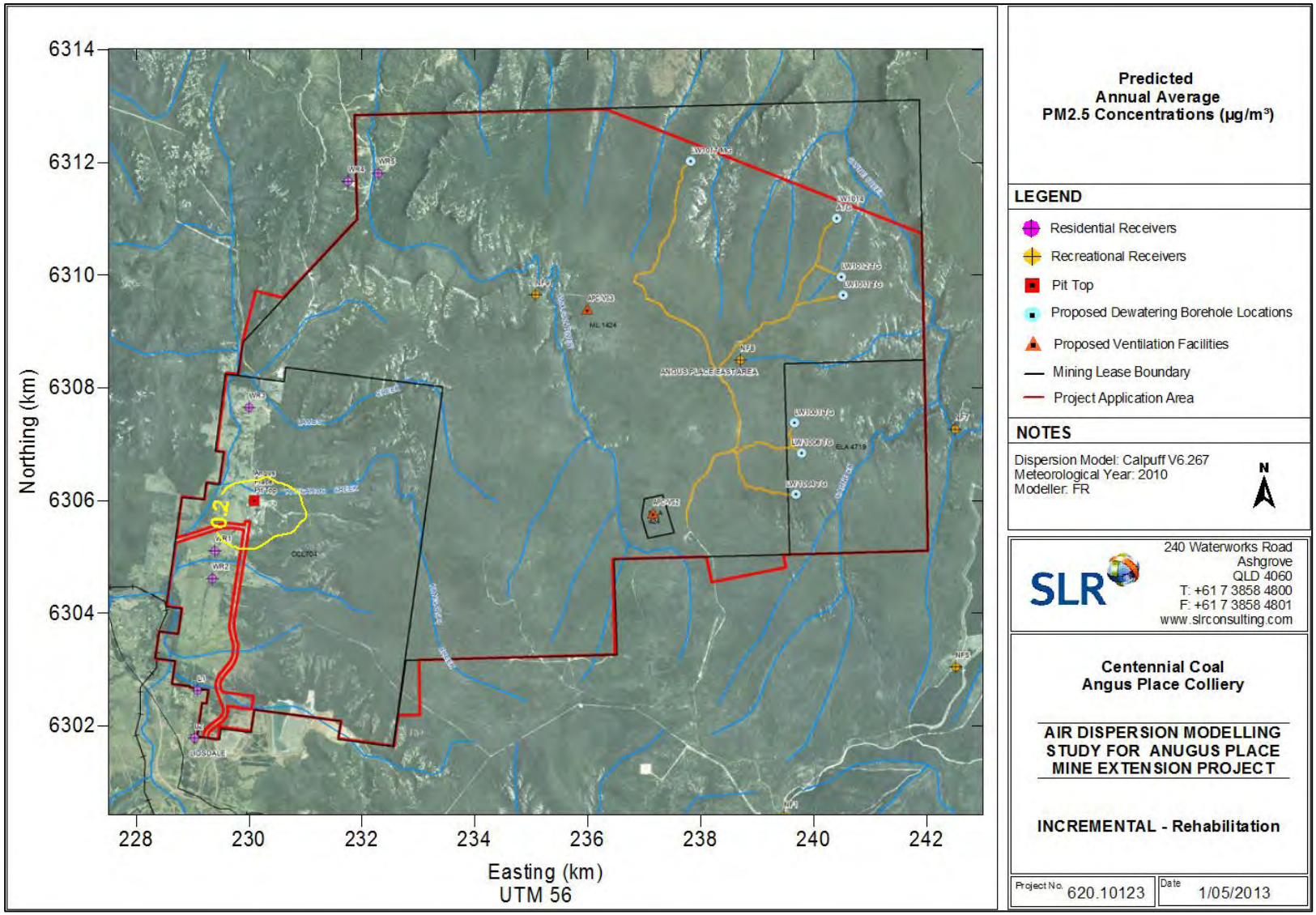
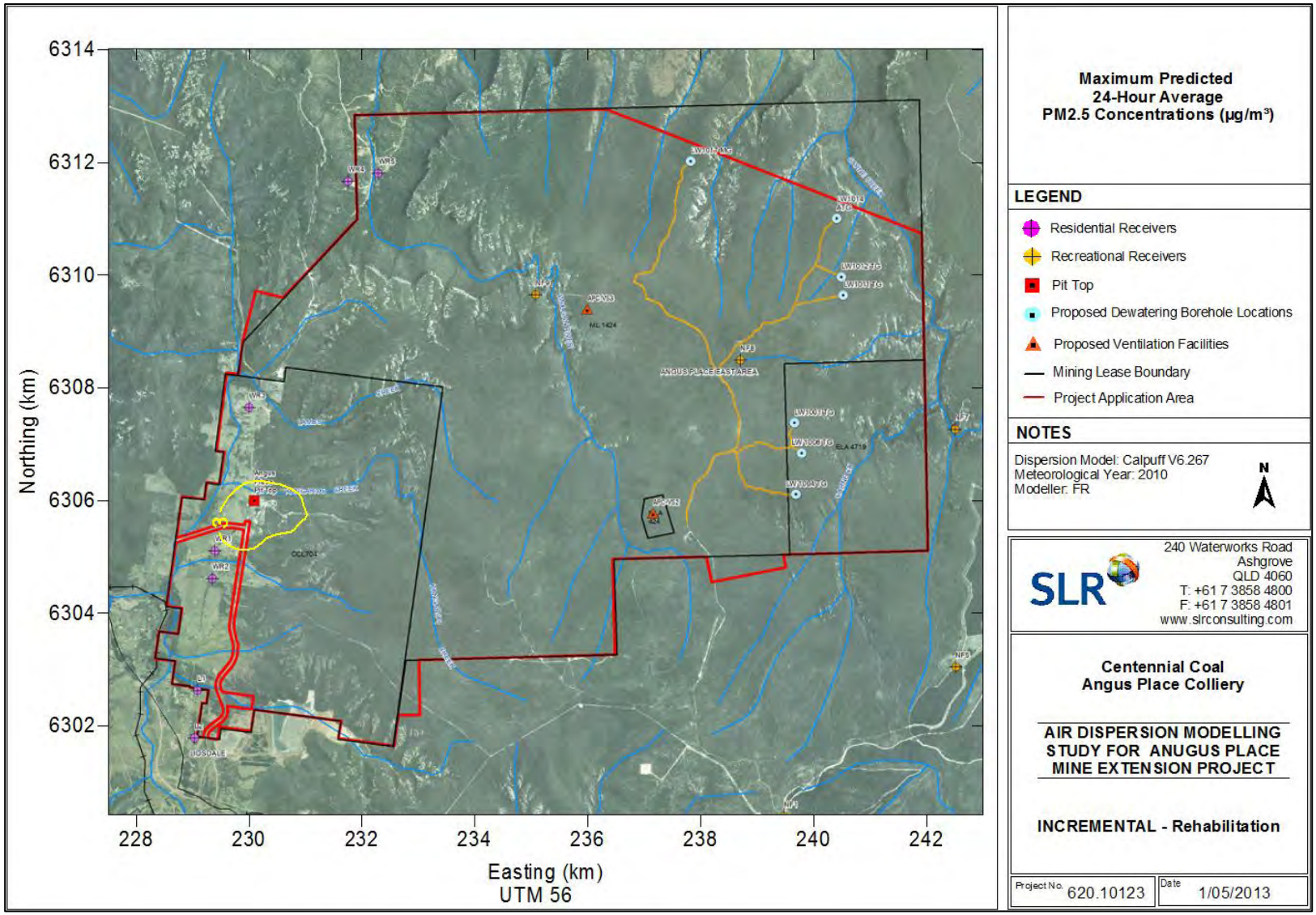


Figure 18 Maximum Predicted 24-Hour Average Incremental $PM_{2.5}$ Concentrations – Rehabilitation



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