ENVIRONMENTAL IMPACT STATEMENT

AIRLY MINE

Airly Mine Extension Project

State Significant Development 5581

Volume 1: Report

SEPTEMBER 2014

Centennial Coal

STATEMENT OF VALIDITY

Submission of Environmental Impact Statement prepared under Part 4 of the *Environmental Planning and Assessment Act 1979.*

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In respect of:	Airly Mine Extension Project, Environmental Impact Statement	

Applicant name:	Centennial Airly Pty Limited
Applicant address:	319 Glen Davis Road, CAPERTEE, NSW 2846
Proposed development:	Airly Mine Extension Project
Land to be developed:	Refer to attached schedule of land (Appendix C).
Environmental Assessment:	An Environmental Impact Statement is attached, which addresses all matters in accordance with *Part 4 of the Environmental Planning and Assessment Act 1979.*
Preparation:	This Environmental Impact Statement has been prepared by Golder Associates Pty Ltd on behalf of Centennial Airly Pty Limited. In preparing the Environmental Impact Statement, Golder Associates has relied upon data, designs and plans and other information provided by Centennial Airly Pty Limited and other individuals and organisations referenced herein.

Declaration: Pursuant to clause 6(f), Part 3, Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*, I declare that this Environmental Impact Statement:

a. has been prepared in accordance with the requirements of the *Environmental Planning and Assessment Act 1979*, *Environmental Planning and Assessment Regulation 2000*, and the Director General's Requirements (SSD_5581) dated 4 February 2014.
b. contains all available information that is relevant to the environmental assessment of the proposed development to which the document relates; and
c. is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Signature:

Date: 16 April 2014 — Report No. 137623024_061_R_Rev1_Ch1-12

Amendment Declaration: I declare that the amendments made to this Environmental Impact Statement and to the best of my knowledge the information contained is neither false nor misleading.

Signature: T Robinson

Date: 10 September 2014 — Report No. 137623024_061_R_Rev2_Ch1-12

EXECUTIVE SUMMARY

Introduction and Overview

Airly Mine is an existing underground coal mine located in the Western Coalfields, within the Sydney Basin, approximately 40 kilometres (km) north-northwest of Lithgow and approximately 171 km northwest of Sydney. The mine's current consent allows extraction of 1.8 million tonnes of coal per annum for supply to both domestic and international markets by rail. Centennial Airly Pty Limited (Centennial Airly) is the operator of Airly Mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited (Centennial Coal).

Airly Mine's development consent (DA 162/91) was granted on 14 April 1993 pursuant to Section 101 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and has been subject to two modifications since. This development consent (DA 162/91) will expire in October 2014. Development consent is required to ensure Airly Mine is approved for operations beyond this date.

The Airly Mine Extension Project (The Project) is a State Significant Development (SSD) in accordance with Clause 8 and Schedule 1 (Item 5) of *State Environmental Planning Policy (State and Regional Development) 2011*. Centennial Airly, as the Applicant of the Project, is seeking approval of the Project in accordance with the provisions of Part 4 Division 4.1 of the EP&A Act.

Director General's Requirements (DGRs) for the Project (SSD_5581) were initially issued on 6 November 2012 (DP&I 2012). As the Project had the potential to impact on matters of environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act), an EPBC referral was submitted to the Commonwealth Department of the Environment (the former Department of Sustainability, Environment, Water, Population and Communities (SEWPAC)) in December 2013 (EPBC Act referral 2013/7076). The Project was subsequently declared a controlled action on 24 December 2013 and DGRs re-issued on 4 February 2014 with Department of the Environment's requirements. The Project will be assessed under the bilateral agreement with New South Wales in accordance with the Part 5 of the EPBC Act.

This Environment Impact Statement (EIS) has been prepared in support of the development application for the Project. It is informed by a wide range of technical assessments determined using a risk based approach. The technical assessments identify, assess, and provide management and mitigation measures for potential environmental impacts associated with the Project. The technical assessments and the EIS have been prepared to meet the DGRs and the environmental assessment requirements of other Government agencies.

Project Description

The overall objective of the Project is to obtain approval for the continuation of mining at Airly Mine to produce coal from the Lithgow Seam. The Project will not significantly alter the nature of the existing operations at Airly Mine and will use existing and currently approved operations and infrastructure.

The Project is seeking continuation of coal extraction at the rate of 1.8 million tonnes per annum using partial extraction techniques and will extend the mining operations to the east. The proposed mining methods will vary from those currently approved in order to reduce subsidence impacts by limiting subsidence to 125 mm in previously unmined areas, and minimise further potential subsidence in areas where the historical New Hartley Shale Mine has already impacted the environment. . Coal will continue to be despatched off site by rail for domestic and overseas markets.

The Project will build and operate new supporting infrastructure to complement existing facilities. Proposed infrastructure at the pit top comprises construction of a coal preparation plant, for the beneficiation of the run of mine (ROM) coal, the establishment of the associated ROM Coal Stockpile and a life of mine reject emplacement area (REA). Progressive rehabilitation of the REA will be undertaken, and on cessation of mining all disturbed areas will be rehabilitated to create a final landform commensurate with the surrounding areas.

The Project will continue to operate 24 hours per day and seven days per week for up to 52 weeks per year. It will provide employment to a full time workforce of up to 135 full time employees and 20 contractors. The Project will have a life of 25 years with rehabilitation to be undertaken within this period.

Mine Design and Minimisation of Impacts to Sensitive Features

The mine design has been carefully formulated to minimise impacts to sensitive surface features. It is based on extensive and long term monitoring of subsidence and related consequences to groundwater, surface water, biodiversity, cliffs and pagodas, at mines with similar mine design criteria, for example, Centennial Coal's Clarence Colliery. The design is supported by detailed geological and geotechnical monitoring and analysis over many years of mining at Clarence Colliery. The mine design proposed in this EIS has defined a range of mining zones with an associated range of extraction void widths to limit subsidence to prevent impact to natural, built and socially sensitive features within Project Application Area.

The current development consent permits full extraction mining resulting in up to 1800 mm of subsidence, strains up to 42.5 mm/m, tilts of 85 mm/m and expected fracturing throughout the mining area where full extraction techniques are permitted. The mine design proposed by the Project, over most of the mining area, would result in vertical subsidence not exceeding 125 mm, strains up to 2 mm/m, tilts up to 3.0 mm/m and no surface fracturing. In the New Hartley Shale Mine Potential Interaction Zone, which is already significantly impacted by previous oil shale mining, additional subsidence is predicted to be up to 500 mm vertical subsidence, up to 8.3 mm/m strains, up to 16.7 mm/m tilts. There is potential for additional surface fracturing in this zone. However, mining in the New Hartley Shale Mine Potential Interaction Zone will not generate significant additional impacts beyond those already existing.

The Project mine design allows an economic return at Airly Mine, while minimising environmental and social impacts. It will result in significantly less subsidence than the currently approved mine design.

Project Benefits

A range of positive benefits will accompany the Project at a local, regional and state level. Notable benefits are the following.

- The Project proposes sustainable mining of coal whilst keeping adverse environmental impacts to a minimum. Mine design technologies and engineering methodologies (i.e. narrow void widths and variable mine design zones) will minimise subsidence effects, impacts and environmental consequences.
- The Project will secure employment for up to 155 full time equivalents with associated flow on effects for the life of the Project.
- Airly Mine will continue to invite community participation and provide support. This helps in strengthening the social fabric of the region.
- The Project will result in improved understanding of heritage significance of the area through field surveying.
- The mine will continue to supply ROM coal for domestic use and product coal for export.
- The Project will result in an injection of approximately $259 million (net present value) into the local, regional, state and national economies over the life of the Project. This expenditure is likely to generate additional economic activity and flow on effects, providing further employment opportunities.

Based upon the predicted minimal environmental effects and the ability of Centennial Airly to manage these effects, the Project presents a minimal residual consequence on implementation of the Statement of Commitments.

Consultation

Centennial Airly maintains an open two-way communication with the local community, consent authorities and other government agencies. A dedicated Stakeholder Engagement Plan was established for the Project and numerous opportunities for input into the EIS development process were provided to all stakeholders identified. Issues raised by stakeholders have been addressed in the EIS and consultation will be ongoing in accordance with the Stakeholder Engagement Plan. The Centennial Coal website will provide updates on the Project for all stakeholders while the internal stakeholders (Airly Mine and other Centennial Coal employees) will also be given updates on the Project via information sessions and meetings.

Key Environmental Issues and Assessment

Potential environmental issues associated with the Project were identified through a Broad-Brush Risk Assessment for the EIS, completed in May 2012, which was supplemented by a subsidence constraints risk assessment in September 2013 attended by a team of specialist consultants. The subsidence constraints analysis identified and prioritised mine characteristics and sensitive features that were potentially at risk of impact due to subsidence.

The table below presents an overview of the key environmental outcomes of the technical assessments undertaken for the EIS.

Summary of Environmental Impacts

Environmental Issue	Overview of Key Findings
Cliffs	▪ It is expected that between nil and 5% of the area of the majority of cliffs will experience mining related impacts. This is expected to manifest itself, at worst, as isolated, individual rockfalls, which in accordance with the ACARP (2002) cliff failure methodology is defined as insignificant. ▪ For six specific cliffs, nil to 10% of cliff area will experience mining related impacts. Similarly, at worst, it is expected to manifest as isolated, individual rockfalls. ▪ No surface cracking is expected to be generated.
Pagodas	▪ The very narrow void width combined with large stable chain pillars is designed to limit subsidence such that surface cracking of pagodas is not predicted.
Watercourses	▪ No fracturing, ponding or mining-induced scouring is predicted for watercourses.
Conservation Areas	▪ The values of the Mugii Murum-ban State Conservation Area will remain unchanged. ▪ No measurable changes to water quantity or quality are predicted for streams in the World Heritage Area. ▪ No effects on ecological systems are predicted in the Greater Blue Mountains World Heritage Area.
Groundwater	▪ There will be a maximum 3.5 m drawdown of a 200 m length of the Gap Creek alluvial aquifer. All other sections of Gap Creek will remain unaffected. ▪ There will be a 1.1 m drawdown of a 100 m length of the Genowlan Creek alluvial aquifer. All other sections of Genowlan Creek will remain unaffected. ▪ There will be no drawdown inThe Oasis or The Grotto areas. ▪ Flows from the Village Spring are likely to cease. ▪ There will be no effect on the regional groundwater system east of the Project Application Area that supplies the registered groundwater users in that area. ▪ Existing beneficial use categories will remain for all groundwater users. ▪ There are no cumulative impacts with other industries or operations in the region.
Surface Water	▪ Increased discharges through the existing LDP001 are expected during prolonged wet weather. ▪ Discharges from LDP001 are predicted to be within relevant water quality criteria. ▪ Subsidence has been minimised and therefore there will be insignificant impacts to waterway hydraulics or geomorphology. ▪ All surface water flow in the Project Application Area is classed as ephemeral. ▪ There will be a maximum 5% reduction in total stream flow at the confluence of Gap and Genowlan Creeks. Stream flow at this point is ephemeral under current natural conditions. ▪ Airly Creek is predicted to experience a maximum cumulative increase of 14.5% in flow. ▪ There will be no cumulative impacts with other industries or operations in the region.

Environmental Issue	Overview of Key Findings
Ecology	▪ No significant impacts are predicted on aquatic habitats, aquatic flora or aquatic fauna and or stygofauna. ▪ The Project is unlikely to have a significant effect on EECs, threatened species or their habitats.
Aboriginal Heritage	▪ Nine Aboriginal sites will be undermined, however the low levels of subsidence and tilt as a result of mining does not pose a risk of harm to these sites. ▪ Impacts due to mining are not expected to adversely affect Aboriginal heritage sites.
Historical Heritage	▪ Mining has been limited in the area of the Airly Village component of the Airly shale mining complex to prevent impacts to historic heritage sites. The sites at the Torbane processing site will not be undermined. ▪ Mining under components of Airly Village are not predicted to cause any subsidence-induced damage.
Traffic	▪ No changes to road infrastructure are required as a result of the project ▪ Traffic management will be required during construction.
Socio-Economic	▪ The Project will enable mining to continue over a period of approximately 20 years. This will secure ongoing employment opportunities and socio-economic flow on benefits over this time for the local community and up to 135 full time employees and up to 20 contractor positions. ▪ The net economic benefit of the Project for the State and regional communities is positive, at a net present value of $259 million over the Project forecast period to 2041.
Noise	▪ Noise will be below the project specific criteria at all privately owned residences and the Airly Campground under all meteorological conditions, including temperature inversions. ▪ Operations will meet the relevant sleep disturbance criteria. ▪ Noise from construction will be within relevant criteria. ▪ Noise levels from trains will not change due to the Project.
Air Quality	▪ Dust levels from the Project are predicted to meet relevant air quality criteria for TSP, PM_{10}, $PM_{2.5}$ and dust deposition.
Greenhouse Gas Emissions	▪ There will be a negligible increase in the annual direct (Scope 1) emissions and the Project represents approximately 0.07% of NSW GHG emissions and 0.02% of Australia's total GHG emissions.
Soils and Land Capability / Agricultural Suitability/ Recreational Use	▪ There will be no land permanently removed from agriculture as a result of the Project, either due to mining or ancillary infrastructure. The Project will only have a minimal impact due to land that will be temporarily removed from agriculture. ▪ The predominant soils within the Project Application Area have extremely low agricultural capability and the Project will have negligible to minimal impacts on soil, land and agricultural resources. ▪ The Project will have negligible impact on surface and groundwater resources relied upon by agriculture. ▪ No impact on the recreational use of the area, including Mugii Murrum-ban SCA, is predicted.
Visual	▪ Minimal impacts on the visual character and amenity of the Project Application Area are predicted. Post-mining, the pit top area will be rehabilitated to grazing land and so reduce existing visual impacts.
Waste Management	▪ No change to the annualised (non-coal) waste materials volumes will occur due to the Project.
Hazards Management	▪ No increased environmental or safety risk from hazardous materials, spontaneous combustion, bushfire or public safety will occur due to the Project.

Environmental Management System

Centennial Airly will continue to implement its well established Environmental Management System (EMS) developed in accordance with the Centennial Coal's EMS Framework. The EMS ensures the effective management of environmental issues and compliance with all regulatory requirements. The EMS incorporates a large number of Environmental Management Plans (EMPs) designed to assist in meeting community expectations and regulatory conditions, including the conditions of the Environment Protection Licence for Airly Mine.

These EMPs will be reviewed and updated for the Project, as appropriate, and will take into consideration the environmental assessments undertaken as part of this EIS, the commitments made in the EIS and all relevant consent conditions.

Justification and Conclusion

Centennial Airly has a long history in the area, with well-established community relationships. Due to knowledge gained from historical operations at Airly Mine and other mines, Centennial Airly has an excellent understanding of mine design principles and requirements for the protection of surface features, and management of potential environmental impacts.

The potential environmental impacts of the Project have and will be minimised through the following measures.

- Obtaining a detailed understanding of the key environmental issues with the potential to be impacted by the Project. The multi-disciplinary assessment and consultation has been to a level of detail commensurate with the scale of the Project, industry standards and the legislative framework under which the Project is considered.
- Formulating a mine design with a successful and proven history in previously mined areas and in other similar operations under similar surface topography and features, of elimination or minimisation of surface subsidence impacts, and one that is safe for the underground workforce and visitors to the surface. Conservative measures in mine design are:
  - consideration of sensitive surface features such as, cliffs, pagodas, groundwater systems, watercourses, ecology and sites of historical and Aboriginal significance that overlie the proposed mining areas;
  - minimisation of subsidence impact through mine design by narrowing voids to highly sub-critical widths. Narrower void widths are tested and proven to minimise subsidence, eliminate surface fracturing and reduce sub–surface fracturing; and
  - application of a series of mining zones to provide specific mining methods for given areas that minimise subsidence impacts while providing for an economically feasible mine.
- Development of a robust numerical groundwater model that predicts mine inflows and potential groundwater impacts with a high level of certainty.
- Continued implementation of the existing proactive strategies and up to date management plans employed at Airly Mine to avoid, minimise, mitigate, offset or manage potential impacts.
- Centennial Airly's commitment for the ongoing review and the further development of the existing environmental management plans where required, and the development of new plans as the need arises.
- Implementation of the Statement of Commitments.

Centennial Airly has shown a commitment to the principles of Ecologically Sustainable Development (ESD) and understands that social, economic and environmental objectives are interdependent. Centennial Airly acknowledges that a well-designed, safe and effectively managed operation will avoid significant and/or costly environmental impact or degradation. The Project design and the suite of existing EMPs have been developed on a risk-basis to appropriately identify, mitigate and manage environmental risk. These demonstrate environmental due diligence and provide procedures for on-going management and monitoring of the operation in-line with the objectives of ESD.

The socio-economic impact of the Project, particularly in terms of direct and indirect employment and flow-on benefits, is anticipated to make a positive contribution to the Lithgow Local Government Area and the surrounding region, and as a continuing operation, the Project will not significantly influence social and community infrastructure requirements.

Accordingly, it is considered that the Project will meet environmental performance and socio-economic benefit requirements.

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GLOSSARY OF TERMS

Term	Definition
20 mm subsidence	The 20 mm subsidence contour is an industry defined limit and represents the practical measurable limit of subsidence.
Air compressor station	Surface building which houses several compressor units which take in air at atmospheric pressure and deliver it at a higher pressure underground as 'compressed air'. This compressed air is used for an array of underground services such as water pumping infrastructure.
Air dispersion model	A computer-based software programme 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.
Alkaline	Alkaline water's pH is over 7 on the pH scale.
Ambient	Pertaining to the surrounding environment or prevailing conditions.
Angle of draw	The angle measured from the vertical, connecting the edge of the mining void to the surface expression of the lateral limit of subsidence (usually defined as less than 20 mm/m).
Aquifer	Underground water storage within either disturbed or undisturbed strata.
Aquitard / Aquiclude	Less permeable strata, not permeable enough to yield economic quantities of water.
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 force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere.
Background	The condition (e.g. noise levels) already present in an area before the commencement of a specific activity.
Baseflow	The discharge of sub-surface water into a stream (i.e. groundwater seepages).
Baseline monitoring	Monitoring conducted over time to collect a body of information to define specific characteristics of an area (e.g. species occurrence or noise levels prior to commencement of a specific activity.
Biological diversity	The diversity of different species of plants, animals and micro-organisms, including the genes they contain, in the ecosystem of which they are part.
Bord and pillar mining	Method of underground coal mining where the coal seam is divided into regular block array (pillars) by driving headings and cut-throughs. In some cases, the pillars are removed in a concurrent or later operation.
Bore dewatering facility	A facility with a number of boreholes drilled from the surface to the coal seam and fitted with submersible pumps that enable the under groundwater to be transferred to the surface. .
Bore	A borehole that is drilled from the surface to a source of underground water that enables the under groundwater to be transferred to the surface either naturally or through artificial means.
Brackish water	Water that has more salinity than fresh water, but not as much as seawater. Typically containing between 0.5 and 30 grams of dissolved salt per litre of water or 0.05 to 3% dissolved salt concentration.
Caving	A collapse of the overburden or strata overlying the coal seam and occurs when the coal is extracted resulted in a goaf.
Catchment	The entire land area from which water rainfall runoff drains to a specific watercourse or water body.
Chain pillar	A block of coal left unmined between two panels. The chain pillar holds up the roof between panels while regular cut throughs allows the passage of air, materials and staff
Clean water	Water that has not come into physical contact with disturbed areas coal or mined carbonaceous material.

Term	Definition
Cliff line	Refers to sub-vertical rock slopes with heights >20 m in. They are also usually longer than their height.
Climatological	The science dealing with climate and climatic phenomena.
Closure	The subsidence-induced reduction in distance between two valley sides
Coal Handling and Preparation Plant (CHPP)	A facility comprising a Coal Preparation Plant for the beneficiation of coal, and a conveyor system for the preparation and transport of product coal off-site.
Coal Handling Plan (CHP)	A facility where coal is screened and prepared for transport off-site.
Coal Preparation Plant (CPP)	A facility where coal is beneficiated (washed) to improve coal quality and prepared for transport off-site.
Continuous miner	The electric powered cutting machine used to form underground roadways by removing coal from the working face.
Conventional movements	Those smooth subsidence movements that can be explained and predicted by expected caving mechanisms in areas of consistent geology and topography
Conveyor	Fixed mechanical apparatus consisting of a continuous moving belt used to transport coal from one place to another.
Critical width	Removal of a small area of coal will form a small void, into which the roof will rarely fracture sufficiently to subside the surface. This is commonly evident in bord and pillar mines, but is also the case if panels were sufficiently narrow. As these panels widen, they reach a critical width, which is when goafing is sufficient to cause maximum possible surface subsidence. A sub-critical width panel is one which did not allow maximum subsidence. However, should two or more adjacent sub-critical panels be mined, their total subsidence may reach critical levels.
Cross-section	A two-dimensional diagram of an object presented as if the object had been cut along its length.
Curvature	The difference in slope of two sections of land surface divided by half the sum of their lengths, usually measured as the inverse of the radius of curvature in 1 over kilometres. Curvature can be convex (hogging) or concave (sagging). Hogging causes compression of surface materials while sagging causes tension. The larger the radius or curvature (or the smaller the inverse), the smaller the potential for damage to rigid natural or built structures.
Depth of cover	The vertical thickness of rock and soil above the mining area.
Design Angle of Draw	The 'practical' angle of draw used to define minimum or allowable distances from the sides and ends of an extracted panel to sensitive surface features. A design angle of draw of 26.5 degrees is common in NSW coalfields.
Dewatering	Transfer of water from underground workings to the surface by a pump.
Development	The extraction of coal to produce underground roadways and headings, enabling access to future extraction areas. Mains development extraction is undertaken using continuous miner units, which simultaneously bolt and dust the face (two major components of development) whilst cutting coal.
Development Consent Area	Shown on Figure 3.1 and includes the Surface Facilities Area.
Development access headings	Underground roadways formed using continuous miners (development activities) to generate access roads from the mains headings to panels. Such access headings can be configured as air intakes or air returns (exhaust). Cut throughs occur at regular intervals to allow access between the development access headings.
Dirty water	Water that has come into physical contact with coal, mined carbonaceous materials or otherwise contains an elevated sediment load.
Down dip	A direction that is downwards and parallel to the dip direction of the strata.
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.

Term	Definition
Ecologically Sustainable Development (ESD)	Using, conserving and enhancing resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased.
Ecosystem	An interacting system of animals, plants, other organisms and non-living parts of the environment.
Electrical Conductivity	A measure of concentration of dissolved salts in water.
Emission	The discharge of a substance into the environment.
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.
Emission inventory	A database that lists, by source, the amount of air pollutants discharged into the atmosphere from a facility over a set period of raw material consumed.
Evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces.
Far-field movements	The measured horizontal movements due to mine-induced subsidence in areas above solid, un-mined coal.
Fresh water	Water with less than 0.5 grams of dissolved salt per litre of water or <0.05% dissolved salt concentration.
Fossil fuel	A fuel such as coal, diesel oil or gas, formed in the geological past from the remains of living populations.
Fugitive emissions	Pollutants which escape from an industrial process due to leakage, materials handling, transfer, or storage.
Goaf	The area of fractured rock above the mined out void. The process is referred to as goafing.
Greenhouse Gases	Gases with the potential to cause climate change (e.g. methane, carbon dioxide and other as listed in the *National Greenhouse and Energy Reporting Act 2007*). and expressed in terms of carbon dioxide equivalent.
Groundwater	All waters occurring below the land surface derived from aquifers.
Hard water (water hardness)	A measure of the concentration of multivalent metallic cations in water, primarily calcium and magnesium, and derived largely from contact with the soil and rock formations. ANZECC/ARMCANZ (2000) defines soft water as hardness concentration 0 – 59 mg/L as $CaCO_3$, moderate hardness as 60 – 119 mg/L as $CaCO_3$, hard water as 120 – 179 mg/L as $CaCO_3$, very hard water as 180 – 240 mg/L as $CaCO_3$, and extremely hard water as over 400 mg/L as $CaCO_3$.
Hydrogeology	The area of geology that deals with the distribution and movement of groundwater in soils and rocks.
Infiltration	Natural flow of surface water through ground surfaces as a result of rainfall events.
Inbye	An underground coal mining term pertaining to the direction towards the coal face. Specifically it is used to describe the relative position of some feature or location in the mine that is closer to the coal face than the reference location.
Irreversible	Referring to the visual nature of impact. Visual impact will be considered irreversible (for example proposed alteration to landforms associated with the REA will be both permanent and irreversible).
Licensed Discharge Point	A location where water is discharged in accordance with conditions stipulated within the respective EPL issued under the NSW *Protection of the Environment Operations Act 1997.*
Long term stable	A standard of geotechnical and engineering design which results in negligible subsidence and long term stability.
Non-conventional movements	Are irregular subsidence movements often associated with shallow depth of cover, abrupt changes in geology, steep topography or in valleys.
Perennial	A watercourse or part of a watercourse that has continuous flow throughout the year.

Term	Definition
Permian Age	The youngest geological period of the Palaeozoic era, covering a span between approximately 290-250 million years.
Pillar failure	In most cases, the chain pillars will partially crush and deform but remain substantially intact and so support the strata above. In some cases, usually due to poor mine design, the chain pillars may totally fail, and in even rarer cases, adjacent chain pillars may sequentially fail.
Pollutant	A substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource.
Process Pond	An open pond where the tailings generated by the blind bore process are managed and stored temporarily.
Project	Extension of underground coal mining and associated activities at Airly Mine with the Project Application Area.
Project Application Area	The site area for the project as bounded by the red line in Figure??
Qualitative assessment	An assessment of impacts based on a subjective, non-statistical oriented analysis.
Quantitative assessment	An assessment of impacts based on estimates of emissions rates and air dispersion modelling techniques to provide estimate values of ground level pollutant concentrations.
Rehabilitation	The restoration of a landscape and especially the vegetation following its disturbance.
Reversible	Referring to the visual nature of impact. Visual impact will be considered reversible (for example constructed elements may be removed at the decommissioning and rehabilitation stage)
Rock formations	Individual rock features >5 m and <20 m high which are not cliff lines. They include sandstone pagodas or micro-buttes and these are usually higher than their width.
Run of Mine coal (ROM)	Raw or unprocessed coal.
Sedimentation Pond	An open pond designed to treat surface runoff water which contains solids attributable to sedimentation. The water is held within the pond and most of the solids drop out of suspension.
Sensitive Receptor	A sensitive receptor is defined by DECCW as location where a person (may or does) work or reside, including residential, hospitals, hotels, shopping centres, play grounds, recreational centres or similar.
Strain	The changing tension or compression in rocks and soil. Strain is measured by the change in the horizontal distance between two points divided by the original horizontal distance between the points. If this distance increases, it shows tensile strain. If the distance decreases, it shows compressive strain. Strain can be estimated by multiplying predicted curvature by 10.
Subsidence	The difference between the pre-mining surface level and the post-mining surface level at a point
Tilt	The change in ground slope measured by the difference in height of two points divided by their distance apart, usually measured in mm/m. Positive tilt is defined as being tilt towards the direction of measurement.
Threatened species	Includes all species with legislative protection under state and federal Acts, including threatened, vulnerable, endangered and critically endangered species under the *Fisheries Management Act 1994*, *Threatened Species and Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*.
Underground roadways	Headings, roadways and cut-throughs mined using continuous miners (development activities) which are designed to be long term stable from a subsidence perspective. The surface subsidence from forming underground roadways is typically undetectable.
Up dip	A direction that is upwards and parallel to the dip direction of the strata.
Ventilation shaft	A vertical passageway from the mine workings to the surface which conveys fresh airflow into the mine or expels used air from the mine.

Term	Definition
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.

ACRONYMS

Acronyms	Definition
%	percent
%ile	Percentile
^{o}C	Degrees Celsius
AADT	Annual average daily traffic
ABS	Australian Bureau of Statistics
AEMR	Annual Environmental Management Report
AGL	Above Ground Level
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
ANZECC	Australian and New Zealand Environment Conservation Council
AWS	Automatic Weather Station
BOD	Biochemical Oxygen Demand
BOM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land
CCC	Community Consultative Community
CCL	Consolidated Coal Lease
CEMP	Construction Environmental Management Plan
CHMHS Act	Coal Mine Health and Safety Act 2002
CHP	Coal Handling Plant
CL	Coal Lease
cm	centimetre
CMA	Catchment Management Authority
CO	Carbon Monoxide
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation

Acronyms	Definition
dB	decibel
dB(A)	Decibel, A weighted (a filter has been applied to the measured result to mimic the human response to noise)
DoE	Federal Department of the Environment (formerly SEWPaC)
DEC	Department of Environment and Conservation (NSW)
DECC	Department of Environment and Climate Change (NSW)
DECCW	(Former) Department of Environment, Climate Change and Water (NSW) (now known as Office of Environment and Heritage (OEH))
DEUS	Department of Energy Utilities and Sustainability (USA)
DGRs	Director General's Requirements
DoE	Commonwealth Department of the Environment
DoP	(Former) NSW Department of Planning
DRE	Division of Resources and Energy (within DTIRIS)
DTIRIS	Department of Trade & Investment, Regional Infrastructure and Services (NSW)
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EL	Exploration Licence
EMS	Environmental Management System
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	Environment Protection Authority
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FM Act	*Fisheries Management Act 1994* (NSW)
FMA Act	*Fisheries Management Amendment Act 1997* (NSW)
g	gram
g/m^2/month	grams per square metre per month
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
GJ	Gigajoule
GHG	Greenhouse Gas
GPS	Geographic Positioning System
GNTCG	Gundungurra Native Title Claim Group
GSSE	GSS Environmental

Acronyms	**Definition**
ha	Hectare
HMCMA	Hunter Central Rivers Catchment Management Authority
hr	hour
INP	NSW Industrial Noise Policy (EPA, 2000)
IPCC	International Panel on Climate Change
kg	kilogram
kL	kilolitre
km	kilometre
km^2	square kilometre
LCC	Lithgow City Council
LDP	Licensed Discharge Point
LEP	Local Environmental Plan
LGA	Local Government Area
m	metre
M	million
m/s	Metres per second
m^2	Square metre
m^3	Cubic metre
min	minute
mg/L	Milligram per litre
ML	Megalitre
MLA	Mining Lease Application
MNES	Matter of National Environmental Significance
mm	millimetre
mm/m	millimetre per metre
MOP	Mining Operations Plan
Mt	Million tonnes
Mtpa	Million tonnes per annum
NES	National Environmental Significance
NEPM	National Environment Protection Measure
NGA	National Greenhouse Account
NGER Act	*National Greenhouse and Energy Reporting Act 2007*
NPI	National Pollutant Inventory (Australia)
NoW	NSW Office of Water
NPW Act	*National Parks and Wildlife Act 1974*
NO_2	Nitrogen dioxide

Acronyms	Definition
N_2O	Nitrous oxide
NPI	National Pollution Inventory
NPV	Net Present Value
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NSW P&E	Department of Planning and Environment (NSW)
NSW P&I	(Former) Department of Planning and Infrastructure (NSW)
OEH	NSW Office of Environment and Heritage
Pa	Pascal – a unit of pressure
PM_{10}	Particulate matter less than 10 microns
$PM_{2.5}$	Particulate matter with an equivalence aerodynamic diameter of 10 microns or less
POEO Act	*Protection of the Environment Operations Act 1997*
RBL	Rated Background Level
REMP	Rehabilitation and Environmental Management Plan
RMS	NSW Roads and Maritime Services (former RTA))
ROM	Run of Mine (coal output)
RTA	NSW Roads and Traffic Authority (now part of RMS)
SAL	Strategic Agricultural Land
SEP	Stakeholder Engagement Plan
SEPP	State Environmental Planning Policy
SEWPaC (now DoE)	The former Department of Sustainability, Environment, Water, Population and Communities (Commonwealth), now Department of the Environment
SF_6	Sulfur hexafluoride
SoC	Statement of Commitments
SMP	Subsidence Management Plan
sp.	species
subsp.	sub-species
SPL	Sound Power Level
SWMP	Site Water Management Plan
t	Tonne
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
TEOM	Tapered element oscillating microbalance
tpa	Tonnes per annum

Acronyms	**Definition**
TSC	Total Suspended Solids
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total Suspended Particulates
TSS	Total Suspended Particulates
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
WM Act	*Water Management Act 2000*
µg	Microgram
$\mu g/m^3$	Microgram per cubic metre
µm	Micrometre or micron

CHAPTER 1.0

Introduction

1.0 INTRODUCTION

This chapter provides an introduction to Airly Mine, an overview of the Airly Mine Extension Project (the Project) and the associated approval process. The purpose and content of the Environmental Impact Statement (EIS) prepared in support of the development application for the Project is also presented.

1.1 Background

Airly Mine is an underground coal mine located in the Western Coalfields (Figure 1.1), within the Sydney Basin, approximately 40 kilometres (km) north-northwest of Lithgow and approximately 171 km northwest of Sydney. The Mine's current consent allows extraction of 1.8 million tonnes of coal per annum for supply to both domestic and international markets by rail. Centennial Airly Pty Limited (Centennial Airly) is the operator of Airly Mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited.

Airly Mine's development consent (DA 162/91) was granted on 14 April 1993 pursuant to Section 101 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). DA 162/91 remains in force and authorises the extraction of up to 1.8 Mpta of run-of-mine (ROM) coal within the existing mining lease area, Mining Lease (ML) 1331 (Figure 1.2). DA 162/91 allowed for a limited scale trial mine for a period of 12 months with transport of 300,000 tonnes of ROM coal by road to the Mount Piper Power Station.

Two subsequent modifications to DA 162/91 were approved and allowed an increased amount of trial mining coal throughput of up to 500,000 tonnes per annum for 2 years to be transported to Mount Piper Station by road (MOD 1), and for the construction and operation of a 66 kV power line to the pit top (MOD 2).

The main components of Airly Mine's existing operations are an underground mine and the surface facilities area or the "pit top". The underground part of the mine is accessed via the pit top. Mine access is off Glen Davis Road, approximately 3 km northeast of Capertee.

Schedule 2, Condition 2 of the development consent DA 162/91 conditions states:

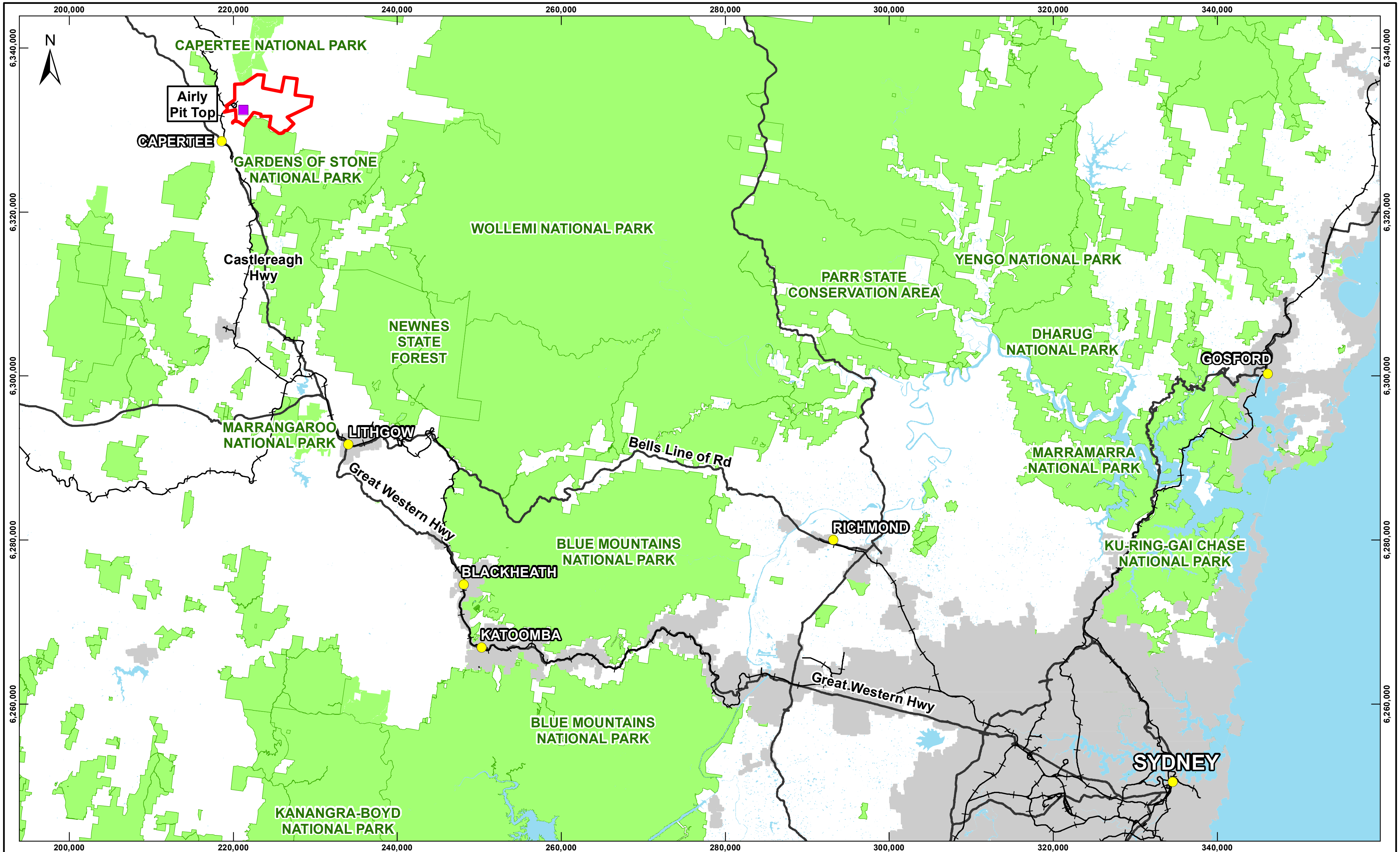
'The duration of this consent is limited to twenty-one (21) years from the granting of the Mining Lease.'

The relevant 'mine lease' being referred to in DA 162/91 is Mining Lease (ML) 1331, which was issued on 12 October 1993 and expires on 12 October 2014. Development consent is therefore required to ensure Airly Mine is approved for operations after 12 October 2014.

The Project is to be assessed as a State Significant Development (SSD) in accordance with Clause 8 and Schedule 1 (Item 5) of *State Environmental Planning Policy (State and Regional Development) 2011*. Centennial Airly Pty Limited, as the Applicant of the Project, is seeking approval of the Project in accordance with the provisions of Part 4 Division 4.1 of the EP&A Act.

Director General's Requirements (DGRs) from the NSW Department of Planning and Infrastructure (DP&I 2012) for the Project (SSD_5581) were initially issued on 6 November 2012. As the Project had the potential to impact on matters of environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), an EPBC Act referral was submitted to the Commonwealth Department of the Environment (the former Department of Sustainability, Environment, Water, Population and Communities (SEWPAC)) in December 2013 (EPBC Act referral 2013/7076). The Project was subsequently declared a controlled action on 24 December 2013 and DGRs re-issued on 4 February 2014 with Department of the Environment's requirements. The Project will be assessed under the bilateral agreement with New South Wales in accordance with Part 5 of the EPBC Act.

The Project Application Area comprises ML1331 and Authorisation A232 boundaries (Figure 1.3).



LEGEND

- Project Application Area
- Town
- Rail
- Main Road
- Urban Area
- Waterbody
- State Forest / Reserve / Park

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:600,000

0 5 10 15 20 25 km

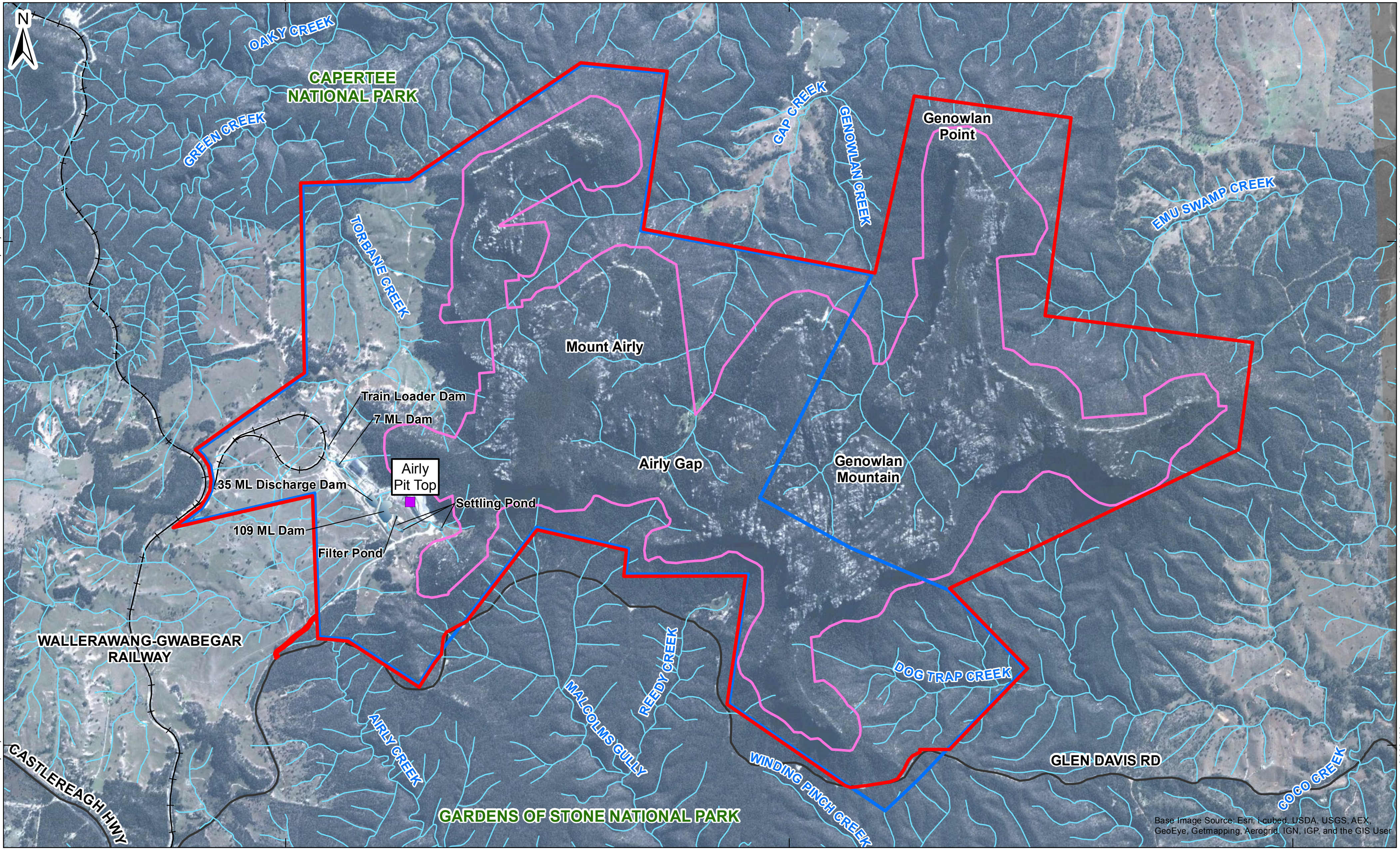
Figure 1.1: Regional Location Plan

PLOTFILE No.

Centennial Coal
Airly

DRG No. 1-1.1

A4



LEGEND

- Project Application Area
- ML1331 Current Development Consent Area (Offset for Clarity)
- Dam
- Limit of Mining in Current Development Consent Area
- Watercourse
- Rail
- Main Road

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 1.2: Development Consent Area and Project Application Area

0 500 1,000 1,500 2,000 Metres

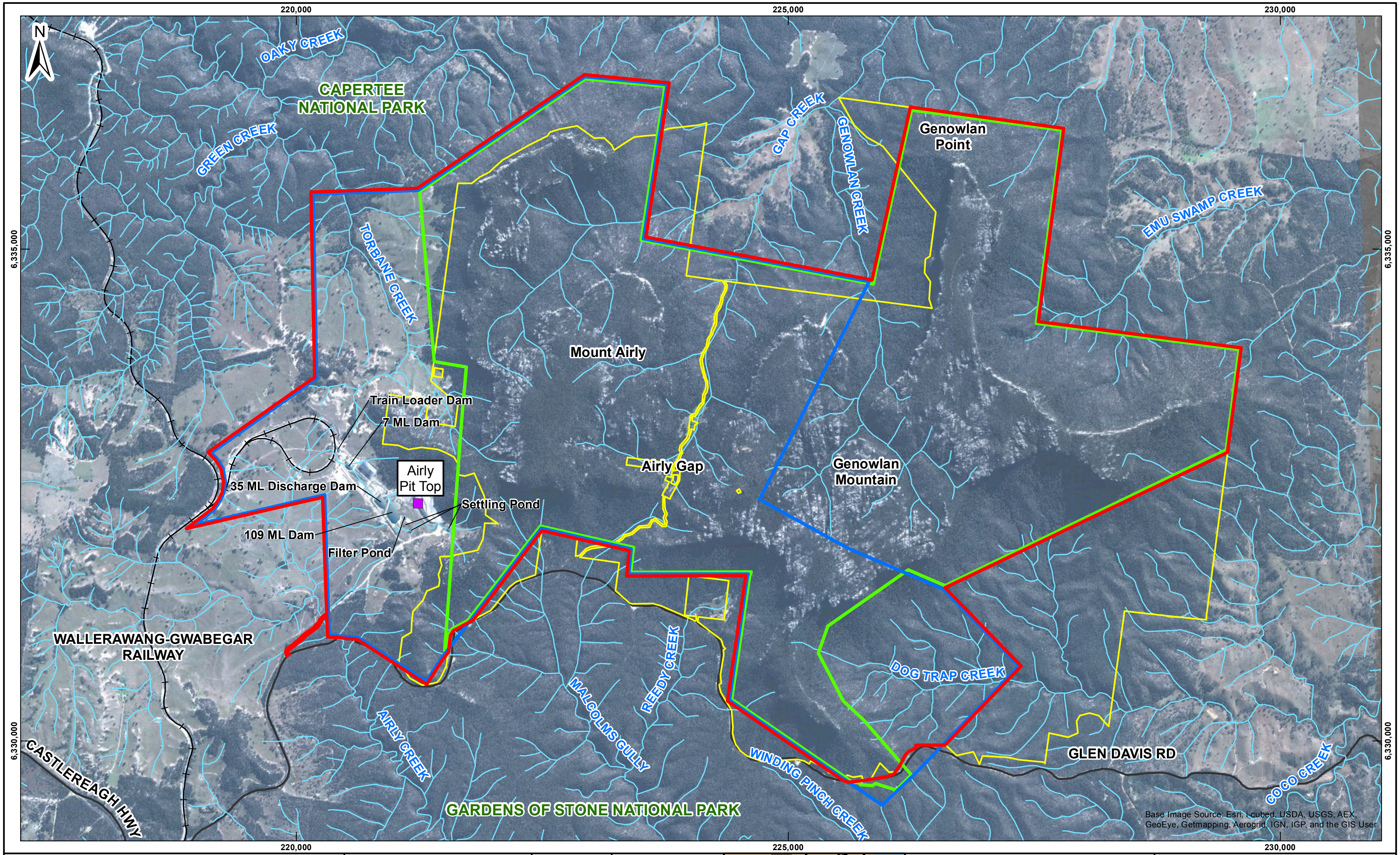
PLOTFILE No.

Centennial Coal

Airly

DRG No. 1-1.2

A4



LEGEND

- Project Application Area
- A232 Authorisation Boundary (Offset for Clarity)
- ML1331 Current Lease Boundary (Offset for Clarity)
- Mugii Murum-ban State Conservation Area
- Watercourse
- Rail
- Main Road
- Dam

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 1.3: Project Application Area and Mining Tenements

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 1-1.3

A4

1.2 The Applicant

Centennial Airly Pty Limited (Centennial Airly) is the Applicant for the Project and is a wholly owned subsidiary of Centennial Coal Company Pty Limited (Centennial Coal). The postal address is:

Centennial Airly Pty Limited
Level 18
BT Tower, 1 Market St
Sydney NSW 2000.

1.3 The Applicant's Environmental Record

A checklist of details for Centennial Airly's environmental history is provided in Table 1.1.

Details of the Applicant's environmental policy and planning framework can be found on Centennial Coal's website, www.centennialcoal.com.au

Mr. Stephen John Burgess is the person making the application on behalf of Centennial Airly.

Table 1.1: Centennial Airly Pty Limited's Environmental Record

Question	Answer	Y/N
Does the party taking the action have a satisfactory record of responsible environmental management?	Centennial Airly values its role in sustainable development and manages all aspects of its activities with due consideration of environmental, economic and social benefits. Airly Mine is committed to its operations and to the continual improvement in health, safety, environment and community management and performance.	Y
Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application- ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?		N
If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?	Centennial Coal's Environment and Community Policy forms part of a broader Environmental Management Strategy. This Strategy has been developed to ensure that Centennial Coal's strategic outlook for environmental management is more clearly and concisely articulated. The Strategy includes objectives to assist Centennial Coal's operations in meeting the principles within the Environment and Community Policy. Underpinning the Strategy, Centennial Coal's Environmental Management System reflects the objectives and principles of the strategy and policy.	Y
Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?	Construction of a Rail Loop at the Airly Mine (2009/4838).	Y

1.4 Document Purpose

The EIS has been prepared by Golder Associates Pty Ltd on behalf of Centennial Airly to support a development application for the continuation of underground mining at Airly Mine beyond the current development consent (DA 162/91) expiry of 12 October 2014.

The EIS has been prepared in accordance with Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*, as well as the DGRs for the Project, issued on 6 November and subsequently revised on 4 February 2014, and the Department of the Environment's Requirements in relation to referral EPBC 2013/7076, issued on 4 February 2014.

The EIS has been prepared using a risk-based assessment approach to identify and evaluate environmental, social and economic aspects relevant to the Project. This has been achieved through a process of ongoing consultation with stakeholders from government agencies, industry, and the surrounding community, risk assessments, robust specialist technical assessments, and mitigation and management measures.

The EIS is supported by a wide range of technical assessments (Section 1.5 and Chapter 10). The EIS and the technical impact assessments consider three separate scenarios: the approved operations (scenario 1), existing operations (scenario 2) and the proposed operations (scenario 3) as described below.

- **Existing Airly Mine Operations** (scenario 1) – considers the potential impacts of infrastructure and operations as constructed and undertaken to date, as described in Chapter 3.0.
- **Approved Airly Mine Operations** (scenario 2) – considers the potential impacts of infrastructure and operations approved in DA 162/91. The approved infrastructure and operations are described in Chapter 3.0.
- **Proposed Airly Mine Operations** (scenario 3) – considers the potential impacts of infrastructure and operations proposed in the Project, and as described in Chapter 4.0. This scenario includes both the construction and operational phases of the Project.

1.5 Document Structure

The EIS is provided in two volumes. Volume 1 sets out the Project in the context of the existing environment, planning considerations, key environmental issues, potential impacts, mitigation measures and residual impacts. It is informed by the technical assessments contained in Volume 2 and provides a concise summary of these assessments. Volume 2 provides the technical assessment reports in full.

The structure of the EIS is summarised in Table 1.2.

Table 1.2: Structure of the Environmental Impact Statement

Chapter	Description
Volume 1 EIS	
Preliminary	▪ Statement of Validation ▪ Executive Summary ▪ Glossary of Terms ▪ Acronyms
Chapter 1.0: Introduction	▪ Discusses the background to the Project. ▪ Introduces the Project and the Applicant. ▪ Provides the document structure. ▪ Overviews the approval process.
Chapter 2.0: Site Description	▪ Describes the Project Application Area and surrounds, proposed and existing mining areas. ▪ Identifies the main natural features and climatic conditions, land ownership and use in the vicinity of the Project Application Area.

Chapter	Description
Chapter 3.0: Existing Operations	▪ Details the existing mine operations. ▪ Identifies the relevant licences and approvals and mining processes. ▪ Outlines the history and extent of the existing operations, the supporting surface infrastructure including coal handling and transport, and water management. ▪ Environmental management procedures currently employed by Airly and current employment.
Chapter 4.0: Project Description	▪ Describes the Project and aspects of the existing mining operations that will continue. ▪ Compares the Project with the existing operation and approved activities. ▪ Provides an overview of mine closure and the nominated end land use.
Chapter 5.0: Planning Considerations	▪ Discusses relevant local, State and Commonwealth planning considerations.
Chapter 6.0: Socio-Economic Analysis	▪ Discusses the social and economic assessment methodology. ▪ Provides and analyses the findings of the social and economic costs and benefits of the Project.
Chapter 7.0: Stakeholder Engagement	▪ Discusses the engagement strategies of the existing operation and the Project. ▪ Details the outcomes of consultation and how issues raised during consultation have been addressed in the EIS.
Chapter 8.0: Mine Design and Subsidence	▪ Discusses the development of the mine plan. ▪ Describes the design philosophy and mine constraints that have influenced the existing mine layout and the Project mine design principles. ▪ Discusses subsidence predictions and controls.
Chapter 9.0: Identification of Key Environmental Issues	▪ Discusses the key environmental impacts and the risk rating for each environmental aspect resulting from risk assessments.
Chapter 10.0: Assessment and Management of Key Environmental Issues	▪ Assesses key environmental issues, the potential impact of the Project and the consequence of the relevant impact. ▪ Describes the management measures proposed to mitigate and reduce environmental risk of the Project and/or offset any unavoidable impacts.
Chapter 11.0: Statement of Commitments	▪ Provides a Statement of Commitments regarding the Project's construction, operation, maintenance, closure and rehabilitation.
Chapter 12.0: Justification and Conclusion	▪ Discusses justification of the Project with regard to environmental, social and economic considerations. ▪ Provides an overall balance of impacts and benefits. ▪ Sets out the alternatives considered. ▪ Summarises how the objectives of Ecological Sustainable Development have been achieved.
References	▪ Contains source references used throughout this EIS.
Volume 2 Appendices	
Appendix A	Director General's Requirements SSD_5581 and Department of the Environment Requirements
Appendix B	State Significant Development Application Form and Political Donations Disclosure Statement

Chapter	Description
Appendix C	Schedule of Lands
Appendix D	Subsidence Predictions and Impact Assessment for Airly Mine, Golder Associates, July 2014 (
Appendix E	Groundwater Impact Assessment, GHD, August 2014
Appendix F	Surface Water Impact Assessment, GHD, July 2014
Appendix G	Aquatic Ecology and Stygofauna Assessment: Airly Mine Extension, Cardno Pty Ltd, August 2014
Appendix H	Flora and Fauna Impact Assessment, RPS, August 2014
Appendix I	Traffic & Rail Impact Assessment, Barnson, April 2014
Appendix J	Cultural Heritage Impact Assessment, RPS, August 2014
Appendix K	Noise Impact Assessment, SLR Consulting Australia Pty Ltd, March 2014
Appendix L	Air Quality and Greenhouse Gas Assessment, SLR Consulting Australia Pty Ltd, April 2014
Appendix M	Social Impact Assessment, James Marshall & Co, August 2014
Appendix N	Economic Assessment, Aigis Group, August 2014
Appendix O	Decommissioning and Rehabilitation Strategy , SLR Consulting Australia, July 2014
Appendix P	Visual Impact Assessment, Green Bean Design, August 2014
Appendix Q	Agricultural and Land Use Impact Assessment, SLR Consulting Australia, July 2014
Appendix R	Airly Mine Reject Emplacement Options Feasibility Study, April 2014
Appendix S	Reject Emplacement Area Concept Design Report, June 2013 Reject Emplacement Area Concept Design Report Addendum - Response to EIS Adequacy Review, August 2014

1.6 Overview of the Project

The overall objective of the Project is to obtain approval for the continuation of mining at Airly Mine to produce coal from the Lithgow Seam. The Project will not significantly alter the nature of the existing operations at Airly Mine and will use existing and currently approved operations. Mining methods will vary from those currently approved in order to reduce subsidence impacts to not exceed 125 mm in previously unmined areas, and minimise further potential subsidence in areas where the historical New Hartley Shale Mine has already impacted the environment. . The Project will extend the mining operations to the east and build and operate new supporting infrastructure to complement existing facilities.

The Project will:

- in general, include all currently approved operations, facilities and infrastructure of Airly Mine
- continue to extract up to 1.8 Mtpa of ROM coal from the Lithgow seam underlying the Project Application Area using underground mining techniques
- extend the life of mine by 25 years from the date of consent (including rehabilitation)
- continue to extract coal using partial extraction methods within the ML1331, and extend the mining area to the east of the existing workings into the A232 area
- develop underground access roadways from the current mining area to the east to allow access to the proposed mining areas

- use various partial extraction mining methods that will manage subsidence not to exceed 125 mm in previously unmined areas and minimise further potential subsidence impacts in areas where the historical New Hartley Shale Mine has already impacted the environment
- continue to operate and maintain the existing ancillary surface infrastructure for mine access, underground ventilation, electricity, water, materials supply, and communications at the pit top, and upgrade this infrastructure as required for mining operations
- continue to handle ROM coal through a crushing and screening plant at the pit top for transfer to the existing and proposed stockpiles as required to meet market demands
- complete the construction of the coal handling and preparation plant (CHPP) through construction of a Coal Preparation Plant (CPP) and associated overland conveyors, required for the beneficiation of ROM coal
- use the existing and new overland conveyor systems for the transfer of ROM and product coal from the underground to the CPP and coal stockpiles prior to despatch to offsite locations
- construct a life of mine reject emplacement area (REA) for the co-disposal of reject materials from the CPP
- continue to use the existing water storage dams at the pit top to meet operational water demands
- construct an appropriately sized new water management dam for the proposed life of mine REA
- continue to manage non-production waste in accordance with the Airly Mine’s Mining Operations plan 2013-2020
- despatch ROM and product coal off site using the existing rail load out facilities for the export and domestic markets
- continue exploration, predominantly borehole drilling, to further refine the existing geological model
- continue to undertake environmental monitoring
- review and update existing environmental management plans as required
- operate 24 hours per day and seven days per week for 52 weeks per year
- provide employment to a full time workforce of up to 135 full time employees and 20 contractors
- progressively rehabilitate exploration boreholes and disturbed areas at the pit top no longer required
- undertake life-of-mine rehabilitation at the pit top disturbance areas to create final landforms commensurate with the surrounding areas.

1.7 Director General’s Requirements

The revised DGRs for the Project were provided by the Director General of the then NSW P&I on 4 February 2014 (NSW P&I (2014)). These included the requirements of the Commonwealth Minister of the Environment made in the decision (section 75 of the EPBC Act) pertaining to the Airly Mine Extension Project referral EPBC 2013/7076. Table 1.3 lists the DGRs and references the relevant chapter and/or section of the EIS where they have been addressed. Table 1.4 outlines the Commonwealth Department of the Environment’s (DoE) Requirements.

The DGRs for the Project are provided in full in Appendix A.

Table 1.3: Summary of Director General's Requirements SSD 5581

Requirements	EIS Chapter Reference
General Requirements The Environmental Impact Statement for the development must meet the form and content requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*. In addition, the EIS must include:	
■ A detailed description of the development, including: ▪ need for the proposed development ▪ likely staging of the development - including construction, operational stage/s and rehabilitation ▪ likely interactions between the development and any approved and proposed mining operations, including detailed assessments of any required modifications to the approvals for these operations ▪ likely interactions with other approved developments/projects at the site ▪ plans of any proposed building works.	Chapter 3.0: Existing Operations Chapter 4.0: Project Description Chapter 10.0: Assessment and Management of Key Environmental Issues Chapter 12.0: Justification and Conclusion
■ Consideration of all relevant environmental planning instruments, including identification and justification of any inconsistencies with these instruments.	Chapter 5.0: Planning Considerations
■ A risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment.	Chapter 9.0: Identification of Key Environmental Issues
■ A detailed assessment of the key issues specified below, and any other significant issues identified in this risk assessment, which includes: ▪ a description of the existing environment, <u>using sufficient baseline data</u> ▪ an assessment of the potential impacts of all stages of the development, including any cumulative impacts, taking into consideration relevant guidelines, policies, plans and statutes ▪ a description of the measures that would be implemented to avoid, minimise and, if necessary, offset the potential impacts of the development, including proposals for adaptive management and/or contingency plans to manage any significant risks to the environment.	Chapter 10.0: Assessment and Management of Key Environmental Issues
■ A consolidated summary of all the proposed environmental management and monitoring measures, highlighting commitments included in the EIS.	Chapter 11.0: Statement of Commitments
■ The EIS must be accompanied by a report from a qualified quantity surveyor providing: ▪ a detailed calculation of the capital investment value (as defined in clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the proposal, including details of all the assumptions and components from which the calculation is derived ▪ a close estimate of the jobs that will be created by the development during the construction and operational phases of the development ▪ certification that the information provided is accurate at the date of preparation.	Provided with State Significant Development Application
Key Issues The EIS must address the following specific issues:	
■ **Subsidence** – including a detailed quantitative and qualitative assessment of the potential conventional and non-conventional subsidence impacts of the development that includes: ▪ the identification of the natural and built features (both surface and sub-surface) within the area that could be affected by subsidence, and an assessment of the respective values of these ▪ accurate predictions of the potential subsidence effects and impacts of the development, including a robust sensitivity analysis of these predictions	Chapter 8.0: Mine Design Chapter 10.0: Assessment and Management of Key Environmental Issues

Requirements	EIS Chapter Reference
▪ a detailed assessment of the potential environmental consequences of these effects and impacts on both the natural and built environment, paying particular attention to those features that are considered to have significant economic, social, cultural or environmental values ▪ consideration of potential cumulative impacts and consequences in those areas previously mined for oil shale ▪ a detailed description of the measures to avoid, minimise, remediate and/or offset subsidence impacts and environmental consequences (including adaptive management and proposed performance measures).	

■ **Water Resources** – including:
▪ detailed assessment of potential impacts on the quality and quantity of existing surface water and groundwater resources in accordance with the NSW Aquifer Interference Policy, including:
  ▪ impacts on affected licensed water users and basic landholder rights
  ▪ impacts on riparian, ecological, geomorphological and hydrological values of watercourses, including GDEs and environmental flows.
▪ a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures
▪ identification of any licensing requirements, including existing or future Environment Protection Licences (EPLs) or Pollution Reduction Programs (PRPs), and approvals under the *Water Act 1912* and/or *Water Management Act 2000*
▪ demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP)
▪ a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo
▪ a detailed description of the proposed water management system (including sewerage), water monitoring regime, beneficial water re-use program and all other proposed measures to mitigate surface water and groundwater impacts.
	Section 10.1: Water Resources

■ **Biodiversity** – including: ▪ accurate estimates of direct vegetation impacts, such as clearing and subsidence and indirect impacts such as 'edge effects' a detailed assessment of potential impacts of the development on any terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities, groundwater dependent ecosystems, regionally significant remnant vegetation, or vegetation corridors ▪ a detailed assessment of the impact of the project on the Mugii Murum-ban State Conservation Area (SCA), with reference to the issues identified in the Draft Plan of Management for the SCA and how subsidence monitoring is proposed to be undertaken with minimal impacts in the SCA ▪ measures to avoid, reduce or mitigate impacts on biodiversity ▪ an offset strategy, which is clearly quantified, to ensure that the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term.	Section 10.2: Ecology

■ **Heritage** – including:
▪ an Aboriginal cultural heritage assessment (including both cultural and archaeological significance) which must:
  ▪ demonstrate effective consultation with the Aboriginal community in determining and assessing impacts, and developing and selecting mitigation measures
  ▪ outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures).
	Section 10.3: Heritage

Requirements	EIS Chapter Reference
▪ an Historic heritage assessment (including archaeology) which must: ▪ include a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items ▪ outline any proposed mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures).	
■ **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 ▪ an investigation of methods to control dust lift-off from coal wagons ▪ reasonable and feasible mitigation measures to minimise dust emissions, including evidence that there are no such other available measures ▪ monitoring and best practice management measures, in particular real-time air quality monitoring.	Section 10.6: Air Quality Management
■ **Consultation Requirements**– During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, community groups and affected landowners. In particular you must consult with the: ▪ Commonwealth Department of Environment ▪ Office of Environment and Heritage (including the National Parks and Wildlife Service and Heritage Branch) ▪ Environment Protection Authority ▪ Division of Resources and Energy within the Department of Trade and Investment, Regional Infrastructure and Services ▪ Department of Primary Industries (including the NSW Office of Water, NSW Agriculture, Fisheries NSW and Catchments and Lands (Crown Lands Division)) ▪ Roads and Maritime Services ▪ NSW Health ▪ Hawkesbury-Nepean Catchment Management Authority ▪ Lithgow City Council ▪ Delta Electricity ▪ relevant Aboriginal stakeholders. ■ The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, justification should be provided.	Chapter 7.0: Stakeholder Engagement
■ **Traffic & Transport** – including: ▪ an assessment of potential traffic impacts on the capacity, efficiency and safety of the road network ▪ a description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road network in the surrounding area over the life of the development.	Section 10.4: Traffic and Transport
■ **Land Resources** – including a detailed assessment of impacts to: ▪ soils and land capability (including erosion and land contamination) ▪ landforms and topography, including 'the Grotto', cliffs, rock formations, steep slopes, etc. ▪ land use, including agricultural, forestry, conservation and recreational use.	Section 10.8: Soils, Land Capability and Agricultural Suitability
■ **Rehabilitation** – including the proposed rehabilitation strategy for the site, having regard to the key principles in *Strategic Framework for Mine Closure*, including: ▪ rehabilitation objectives, methodology, monitoring programs, performance	Section 10.9: Decommissioning and Rehabilitation Strategy

Requirements	EIS Chapter Reference
standards and proposed completion criteria ▪ nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies ▪ a conceptual final landform design, including a detailed figure depicting relevant site features ▪ the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.	
■ **Greenhouse Gases** – including: ▪ a quantitative assessment of potential Scope 1, 2 and 3 greenhouse gas emissions ▪ a qualitative assessment of the potential impacts of these emissions on the environment ▪ an assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency.	Section 10.7: Greenhouse Gas
■ **Visual – including:** ▪ a detailed assessment of the potential visual impacts of the development on private landowners in the surrounding area as well as from key vantage points in the public domain in particular, those available to recreational users from State forests, State conservation areas and national parks ▪ a detailed description of the measures that would be implemented to minimise the visual impacts of the development.	Section 10.10: Visual Amenity
■ **Hazards** – Paying particular attention to public safety, including bushfires.	Section 10.12: Hazards Management
■ **Noise** – including a quantitative assessment of potential: ▪ construction, operational and off-site transport noise impacts ▪ reasonable and feasible mitigation measures, including evidence that there are no such other available measures ▪ monitoring and management measures, in particular real-time and attended noise monitoring.	Section 10.5: Noise Management
■ **Waste** – including: ▪ accurate estimates of the quantity and nature of the potential waste streams of the development, including tailings and coarse reject ▪ a tailings and coarse reject disposal strategy, including an adequate justification of the chosen strategy over other alternative disposal options, including underground stowage ▪ a description of measures that would be implemented to minimise production of other waste, and ensure that that waste is appropriately managed.	Section 10.11 Waste Management
■ **Social & Economic** – including an assessment of the: ▪ potential direct and indirect economic benefits of the development for local and regional communities and the State ▪ potential impacts on local and regional communities, including: – any increased demand for local and regional infrastructure and services (such as housing, childcare, health, education and emergency services) – impacts on social amenity, particularly impacts on local residents of and other nearby landowners and residents. ▪ a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the development, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism ▪ a detailed assessment of the costs and benefits of the development as a whole,	Chapter 6.0: Socio-Economic Analysis

Requirements	EIS Chapter Reference
and whether it would result in a net benefit for the NSW community.	
Plans and Documents	
■ The EIS must include all relevant plans, architectural drawings, diagrams and relevant documentation required under Schedule 1 of the *EP&A Regulation 2000*. These documents should be included as part of the EIS rather than as separate documents.	As relevant throughout the EIS

Table 1.4: Commonwealth Department of the Environment Requirements

Director General Requirements	EIS Chapter and Appendix Reference
■ **General Information:** 1. The background of the action, including: a) the title of the action b) the full name and postal address of the designated proponent c) a clear outline of the objective of the action d) the location of the action e) the background to the development of the action f) how the action related to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action g) the current status of the action h) the consequences of not proceeding with the action.	a) Section 1.1 b) Section 1.2 c) Section 1.3 and Chapter 4.0 d) Section 2.1 e) Section 1.1 f) Chapter 12.0 g) Section 1.5 h) Section 12.1
■ **Description of the controlled action** 2. A description of the action, including: a) all the components of the action b) the precise location (including coordinates) of any works to be undertaken, structures to be built or elements of the action that may have relevant impacts c) how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts d) the timing and duration of the works to be undertaken e) to the extent reasonably practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact, including: i) if relevant, the alternative of taking no action ii) a comparative description of the impacts of each alternative on the matters protected by the controlling provision for the action iii) sufficient detail to clarify why any alternative is preferred to another. Short, medium and long- term advantages and disadvantages of the options should be discussed.	a) to d) Chapter 4.0 e) Chapter 12.0

Director General Requirements	EIS Chapter and Appendix Reference
■ **Description of the existing environment** 3. A description of the existing environment of the proposal location and the surrounding areas that may be affected by the action, including but not limited to: a) a detailed description of the methodology, timing, effort and results of all targeted surveys undertaken for all relevant matters, undertaken using accepted methodology for targeting listed threatened species, ecological communities and their respective habitat, including but not limited to OEH's Survey and assessment guidelines (2009), and the Department of the Environment's species-specific survey guidelines for nationally threatened species, and a description of any limitations and constraints of the surveys undertaken. Please note that surveys should be undertaken within the site and in surrounding areas that may provide habitat for threatened species and ecological communities and that may be directly or indirectly impacted by the proposal b) a description of the nature, location and extent of all vegetation types occurring on-site and immediately adjacent to the site(s) that are likely to provide suitable habitat for threatened species and ecological communities c) a description and map of the nature, location and extent of likely suitable habitat, and the distribution, abundance and records for threatened species and ecological communities (including breeding, foraging, roosting habitat, habitat critical to the survival of the relevant species and ecological communities, movement corridors and migration paths) within the site and in surrounding areas that may be impacted by the proposal d) the regional distribution and abundance of suitable and potential habitat for threatened species and ecological communities surrounding the site e) a description of the habitat parameters for relevant areas that support listed threatened species and ecological communities, including but not limited to ecological, geological and hydrological conditions for these areas f) details of relevant baseline conditions to be used to assess the impacts of the action and the performance and effectiveness of proposed mitigation measures, including habitat parameters for relevant areas that support listed threatened species and ecological communities, or g) details of the monitoring programs to be implemented before, during and after construction to determine these baseline conditions and measure the effectiveness of proposed mitigation measures h) a description of the important water resources within the site and in surrounding areas, which is consistent with the most recent version of the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development's *Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources* i) a description of water related assets that are dependent on any important water resources, including an estimation of the water requirements of those assets (i.e. regional water use) j) a description of World Heritage values and National Heritage values of the Greater Blue Mountains World Heritage property and National Heritage place, including but not limited to the riparian, stream/waterbody and aquatic flora and fauna values of Airly and Coco Creeks and The Capertee River.	a) Section 10.2.2 b) Section 10.2.3 c) Section 10.2.3 and 10.2.4 d) Section 10.2.3 and 10.2.4 e) Section 10.2.3 and 10.3.4 f) Section 10.2.2 and 10.2.3 g) Section 10.2.7 h) Section 10.1 i) Section 10.1 j) Section 10.1.5
■ **Description of the relevant impacts of the controlled action** 4. An assessment of all relevant impacts with reference to the EPBC Act Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance (2009) and species specific guidelines as relevant at www.environment.gov.au/epbc/guidelines-policies.html that the controlled action has, will have or is likely to have. Information must include: a) a description of the relevant impacts of the action on matters of national environmental significance b) a detailed assessment of the nature and extent of the likely short term and long	Section 10.2.3, 10.2.4, 10.2.5, Section 10.3, Appendix H and Appendix F

Director General Requirements	EIS Chapter and Appendix Reference
term relevant impacts c) a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible d) analysis of the significance of the relevant impacts e) any technical data and other information used or needed to make a detailed assessment of the relevant impacts. 5. A description of the relevant impacts on EPBC Act listed species or ecological communities should include, inter alia, direct, indirect, cumulative and facilitative impacts on the: f) population of the species at the site g) are of occupancy of the species h) habitat critical to the survival of the species i) breeding cycle of the population j) availability or quality of habitat for the species If the conclusion is made that a threatened species or ecological community present or likely to be present onsite will not be impacted by the proposed action, sufficient justification must be provided. 6. In addition to requirements 4 and 5, additional information about potential impacts to the *Pultenaea* sp. Genowlan Point should include a detailed description of the potential and likely hydrological and subsidence related changes that may occur as a result from the proposed action. Direct and indirect impacts must be included. Cumulative and facilitative impacts should also be included. Please include impacts to the: k) ecological, geological and hydrological conditions specific to habitat critical to the survival of the species (Genowlan Point Allocasuarina nana Heathland) l) quality or integrity of the Pultenaea sp. Genowlan Point population including, but not limited to, assisting invasive species that are harmful to the ecological community to become established m) abiotic (non-living) factors (such as water, nutrients or soil) necessary for the survival of the species. For example, subsidence related impacts (such as surface and subsurface cracking, slumping, tilt, and strain), altering groundwater levels, soil disturbance or substantial alteration of surface water drainage patterns (such as dewatering, pending). These impacts should be described for the construction, operational and decommissioning phases of the controlled action. 7. Where there is a potential habitat for EPBC Act listed species, surveys must be undertaken. These surveys must be timed appropriately and undertaken for a suitable period of time by a qualified person. A subsequent description of the relevant impacts on such EPBC Act listed species should include, inter alia, direct, indirect, cumulative and facilitative impacts on the: n) ecological and geological conditions specific to habitat critical to the survival of the species o) abiotic (non-living) factors (such as geological formations, water) necessary for	

Director General Requirements	EIS Chapter and Appendix Reference
the survival of the species, for example subsidence related impacts to habitat, interference with maternity and other roosts, or substantial alteration of hydrology. These impacts should be described for the construction, operational and decommissioning phases of the controlled action. 8. An assessment of all relevant impacts to the World and Nationally listed Greater Blue Mountains World Heritage Area (GBMWHA), including but not limited to riparian, stream/waterbody and aquatic flora and faunal values of Airly and Coco Creeks and The Capertee River inter alia. The assessment must include, but not be limited to: p) A detailed description of the potential and likely hydrological modification, including changes to water and sediment quality and quantity entering the heritage area, that may occur as a result of the proposed. Direct and indirect impact must be included. Cumulative and facilitative impacts should also be included q) A detailed assessment of any other potential and likely impacts on World and National Heritage 9. The documentation provided must include information addressing all relevant impacts on water resources and water related values. This must include, but not be limited to, potential impacts to Matters of National Environmental Significance. The information must be consistent with the most recent version of the Independent Expert Scientific Committee on Coal Seam Fas and Large Coal Mining Development's Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources.	
■ **Proposed avoidance, safeguards and mitigation measures** 10. A description of feasible mitigation measures, changes to the action or procedures, which have been proposed by the proponent or suggested in public submissions, and which are intended to prevent or minimize relevant impacts on matters of national environmental significance. Information must include: a) description of how the action has been designed to avoid impacts to, threatened species and ecological communities, world and national heritage values and water resources b) a description of the mitigation measures that will be undertaken to prevent or minimise the relevant impacts of the action. These mitigation measures should be justified and based on best available practices c) an assessment of the expected and predicted effectiveness of the mitigation measures including the effect on abundance and condition of species, suitable habitat and ecological communities, world and national heritage values and water resources d) any statutory of policy basis for the mitigation measures e) the cost of the mitigation measures f) an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs (including any relevant thresholds for corrective actions) for the relevant impacts of the action. Include the person or agency responsible for implementing these programs and the effectiveness of all mitigation measure, including any provisions for independent environmental auditing g) the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program h) identification of mitigation measures proposed to be undertaken by State governments, local governments or the proponent i) any changes to the action which prevent relevant impacts on listed threatened species and communities.	Section 10.2.7

Director General Requirements	EIS Chapter and Appendix Reference
■ **Offsets** Where impacts cannot be avoided or mitigated, an offset package to compensate for any predicted or potential residual significant impacts on matters of national environmental significance. Offsets should demonstrate consistency with the Commonwealth EPBC Act Environmental Offsets Policy (October 2012, or subsequent version). Available at www.environment.gov.au/epbc/publications/environmental-offsets-policy.html Information must include: a) How the offset compensates for the residual impacts, when the offset will be delivered and how the offset will be managed b) An assessment of the impact of the offsets on other matters of environmental, economic, or social significance c) An analysis of cost, both financial and other, related to offsets, and d) The information requirements provided at Appendix B of the DGRs	NA
■ **Other approvals and conditions** 11. Any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action. Information must include: a) Details of any local or State government planning scheme, or plan or policy under any local or State government planning system that deals with the proposed action, including: i. What environmental assessment of the proposed action has been, or is being, carried out under the scheme, plan or policy, and ii. How the scheme provides for the prevention, minimisation and management of any relevant impacts. b) A description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the EPBC Act), including any conditions that apply to the action c) A statement identifying any additional approval that is required d) A description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.	Chapter 5.0
■ **Economic and social matters** 12. A description of the short-term and long-term social and economic implications and/or impacts of the Project. 13. A description of the capital investment and ongoing employment and economic value of the project.	Chapter 6.0
■ **Environmental record of person proposing to take the action** 14. Details of any proceeding under a Commonwealth, State or Territory law for the protection of the environment or the conversation and sustainable use of natural resources against: a) The proponent b) For an action for which a person has applied for a permit, the person making the application. 15. Details of the proponent's environmental policy and planning framework.	Section 1.3
■ **Information sources** 16. For information given in an environment assessment, the draft must state: a) The source of the information b) How recent the information is c) How the reliability of the information was tested, and d) What uncertainties (if any) are in the information.	References
■ **Consultation** 17. Any consultation about the action, including: a) Any consultation that has already taken place b) Proposed consultation about relevant impacts of the actions, and c) If there has been consultation about the proposed action – any documented	Chapter 7.0

Director General Requirements	EIS Chapter and Appendix Reference
response to, or result of, the consultation. 18. Identification of affected parties, including a statement mentioning any communities that may be affected and a description of their views.	

Table 1.5 lists the relevant requirements of the Independent Expert Scientific Committee (IESC 2014) and where they are addressed in the EIS.

Table 1.5: Independent Expert Scientific Committee Checklist Table as Relevant to the Project

Background Data and Modelling	
Identification of the water related assets (aquatic ecosystems, terrestrial ecosystems, drinking water supply, irrigation water supply, surface infrastructure, industry, regional communities, hydrogeological units) including fauna, flora and species habitat surveys as they relate to the dependence on each identified water resource.	Appendix F Sections 1.6 and 3; Appendix E Sections 1.5 and 3; Appendix G Sections 4 and 5 Appendix H Sections 4 and 5 EIS Chapter 2.0
Identification of the hydrogeological unitto which GDEs are connected and an estimate of the ecological water requirements of GDEs. GDEs should be identified in accordance with the methodology outlined in Eamus et al, 2006. A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation, *Australian Journal of Botany,* 2006, 54: 97-114	Appendix E Section 3.7; Appendix H Section 3 EIS Chapter 2.0
A site-specific water balance complemented by a regional water balance that includes the lateral extent of influence of underground mining.	Appendix F Sub-appendices B and D
A description of the water resources of the site and region (including current standing water levels and any records of seasonal and historical annual variations in level, quality), including variation in rainfall, evaporation, groundwater and surface water quality and quantity. Includes hydrographs and logs and identifies the dates, locations, flow conditions and elevations of data points.	Appendix E Sections 3 and 4, Sub appendix B and C; Appendix F Sections 3.3, 4.6, 5.3, 5.6 and Sub-appendices B and C
Description of the hydrological regime, including drainage patterns, watercourse hydrographs, spatial and temporal and seasonal trends in streamflow and/or standing water levels, water quality data (including turbidity, acidity, salinity, organic chemistry, metals, metalloids, radionuclides, other potentially harmful chemicals), geomorphology of all watercourses.	Appendix E Sections 3 and 4, Sub appendix B and C; Appendix F Sections 3 and 5 and Sub-appendices B andC EIS Chapter 2.0
Description of existing flood regime including flood volumes, depth, duration, extent and velocity for a range of annual exceedance probabilities; maps identifying peal flood extent, depth and velocity	Not assessed based on site topography and very low predicted subsidence.
A description of the geology and hydrogeology at a local and regional level, including definition of the geological sequence, name of formations from youngest to oldest, surface geology and cross-sections.	Appendix E Section 3 and Sub-appendix B EIS Chapter 2.0
A description of the hydraulic characteristics (hydraulic connectivity and storage characteristics) for each hydrogeological unit.	Appendix E Section 3.5 and Sub-appendix B
A definition of any geological structures and outlines of the influence of the structures on groundwater, in particular groundwater flow and recharge.	Appendix E Section 3.4
The depth to hydrogeological unit s and standing water levels, hydro-chemical characteristics, potentiometric heads.	Appendix E Section 3.5 and 4
A description of the likely recharge sources for each hydrogeological unit, details of discharges from each hydrogeological unit, direction of groundwater flow and contours of groundwater elevations for all hydrogeological units; discharge pathways for the hydrogeological unit likely to be impacted.	Appendix E Section 3.5 and Sub-appendix B

Assessment of the extent (frequency, volume and direction) of hydrological interactions between water sources, including surface-groundwater connectivity, inter-hydrogeological unit connectivity.	Appendix F Section 5.3, 6.4 and 6.10; Appendix E Section 3.5 and Sub-appendix B
Surface water assessment and model, including hydrology and water quality parameters.	Appendix F Section 4 and 5
Groundwater assessment and numeric model (calibrated to baseline conditions), including hydrology and water quality parameters: • Enables a probabilistic evaluation of potential future scenarios. • Includes the model conceptualisation of hydrogeological unit, key assumptions and limitations. • Represents each hydrogeological unit, storage, flow characteristics of each, linkages between each, existing recharge/discharge pathways of each hydrogeological unit and changes predicted to occur when the project commences. • Incorporates the various stages of the proposed project and predicts water level/pressure declines in each hydrogeological unit for the life of the project and beyond, including pre and post development water level or potentiometric surface contours for each hydrogeological unit. • Captures solute transport modelling. • Provides information on the time to maximum drawdown and the time for drawdown equilibrium to be reached. • Identifies the volumes predicted to be dewatered on an annual basis, with an indication of the proportion supplied from each hydrogeological unit. • Provides information on water level recovery rates and timeframes in each hydrogeological unit for the life of the project and beyond. • Considers a variety of boundary conditions across the model domain, including constant or general head, river cells or drains. • Includes a sensitivity analysis of boundary conditions and justificiation for the conditions applied. • Be undertaken in accordance with the Australian Groundwater Modelling Guidelines, and has been peer reviewed • Includes recommendations and a program to review and update the model as more information becomes available.	Appendix E Section 5 and 6and Sub-appendix B
Relevant information to describe the existing state of water related ecosystems and processes at a regional scale.	EIS Section 10.2.3.2-4 ; Appendix G Sectons 4 and 5
An assessment of the quality of and risks inherent in the data used in the background data and modelling.	Appendix F Sub-appendix B
Water and Salt Balance	
This section must include a site specific water balance and a site specific salt balance, complemented by a regional balance of both water and salt covering the larger area of potential impact.	Appendix F and Sub-appendix B and D
This should include the set of water and salt stores within the system boundary and the flow of water and salts between these stores. The assessment should include any change to the store or flow of water and salts as a result of the project.	Appendix F and Sub-appendix B and D
This section needs to include an assessment of the changes to any water storage or flow of water in the system as a result of the project, including changes to salt loads. The water balance needs to include consideration of water quality parameters and the water treatment options to be considered by the project.	Appendix F and Sub-appendix B and D
The assessment needs to include any changes to the hydrogeological unit storage properties and groundwater flows and pressures resulting from the depressurisation of the target coal measures as well as an estimation of the flow/exchange of water between overlying and/or underlying hydrogeological units and the target coal measure for all major hydrogeological units over the project area.	Appendix F and Sub-appendix B and D
The water balance must also identify water deficits and the proposed strategy to manage these.	Appendix F and Sub-appendix B and D

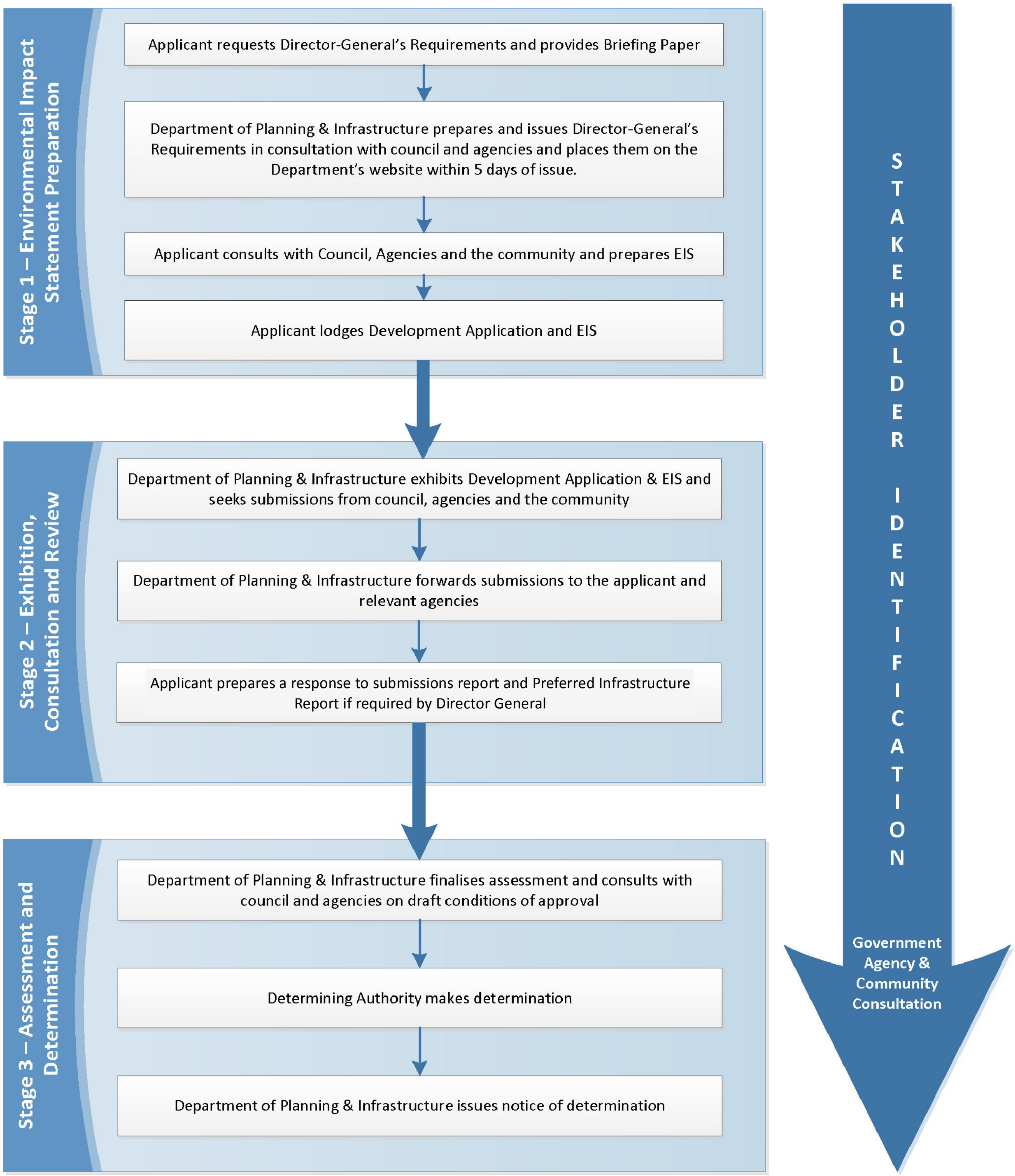
The water balance must include consideration of each hydrogeological unit recharge/discharge, surface water seepage/recharge, rainfall interception, evaporation and the interactions and flows between and within.	Appendix F and Sub-appendix B and D
Hydrogeological unit storage properties and groundwater flows, pressures relating for depressurization and/or dewatering.	Appendix F and Sub-appendix B and D
Water infiltration from surface storages.	
Estimate of flow of water between overlying and/or underlying hydrogeological units and the target coal measure(s).	Appendix F and Sub-appendix B and D
Waste water from the proposal, including proposed treatment, disposal, volumes and timing.	Appendix F and Sub-appendix B and D
Volumes and quality of water intended for injection.	Appendix F and Sub-appendix B and D
Volumes and quality used during mining and associated activities (eg processing).	Appendix F and Sub-appendix B and D
Volumes, quality and sources of water not available from within the water balance that must be imported from elsewhere.	Appendix F and Sub-appendix B and D
Existing interactions and flows that are part of the baseline water flows for the system.	Appendix F and Sub-appendix B and D
Estimates of water use in transpiration and predicted changes to vegetation water use as a result of the project.	Appendix F and Sub-appendix B and D
Assessment of the Impacts on Water Resources and Water-related Assets	
Consideration of the State based policies and guidelines developed by the Department of Planning, the Office of Environment and Heritage and the Office of Water.	Appendix E Section 2 and Appendix F Section 2 EIS Chapter 5.0 and Section 10.1
How the project will change both local and regional water balances.	Appendix F Sub-appendices B and D EIS Chapter 10.1
Predictions of subsidence and the effects from dewatering and depressurisation (including lateral effects) on surface topography, groundwater and water movement, and fracturing of confining layers.	Appendix D Sections 6 and 7 and Appendix E Section 6 and Sub-appendix B EIS Chapter 8.0 and 10.1
The hydrogeological units that will be directly impacted, including the coal seam.	Appendix E Sub-appendix B
The hydrogeological units that will be dewatered or indirectly impacted by dewatering in connected hydrogeological units.	Appendix E Sub-appendix B
The extent of impact on hydrological interactions between water sources, including surface/groundwater connectivity, inter- hydrogeological units connectivity.	Appendix F Section 6 and Appendix E Sub-appendix B
Impacts associated with surface water diversions (where relevant).	Appendix F Section 6; Appendix E Section 6
Assessment of direct and indirect impacts on water related assets, including ecological assets. .	Appendix F Section 6 EIS Sections 10.1 and 10.2
Impacts on the hydraulic properties of hydrogeological units including potential for physical transmission of water within and between formations, effects of depressurisation changes in storage and an estimate of the likely leakage.	Appendix E Sub-appendix B EIS Section 10.1
Estimates of the quantity and quality of operational discharges of water, including emergency discharges.	Appendix F Sub-appendix B EIS Section 10.1
Consideration of the impacts of water management infrastructure on the biodiversity assets (e.g. roads, pipelines, habitat fragmentation).	;Appendix H Section 7.1 EIS Section 10.2
Assessment of the cumulative impact of the project with past, present and known future projects.	Appendix F Section 6 and Sub-appendix D EIS Section 10.1

Assessment of long term impacts of post mining landforms	Appendix D Section 7; Appendix Q Section 4.2 EIS Section 10.8
Measures to avoid and minimize impacts to water resources and water related assets	Appendix E Section 7 amd Appendix F Section 7 EIS Sections 8.0 and 10.1
Proposed mitigation measures for each identified impact.	Appendix E Section 7 amd Appendix F Section 7 EIS Section 10.1
Assessment of Cumulative Impacts	
The cumulative impact assessment needs to consider all past, present and known future projects (including non-Centennial) and should be undertaking with regard to the regional water balance and hydrogeological modelling outcomes. The cumulative impact assessment should include:	Appendix E Section 6 and Appendix F Section 6.10 and Sub-appendix D EIS Section 10.1
Catchment and regional scale information	Appendix E Section 6 and Appendix F Section 6.10 and Sub-appendix D EIS Section 10.1
Total existing and planning licensed and extracted water for consumptive, industrial and agricultural purposes in the surface catchment and groundwater system	Appendix E Section 6 and Appendix F Section 6.9 and 6.10 and Sub-appendix D EIS Section 10.1
Existing water quality guidelines, targets, environmental flow objectives and requirements for the ecosystems of the surface and groundwater systems	Appendix E Section 6 and Appendix F Section 6.10 and Sub-appendix D EIS Section 10.1
The proportional increase in water resource use and impacts as a consequence of the proposal	Appendix E Section 6 and Appendix F Section 6.10 and Sub-appendix D EIS Section 10.1
The overall level of risk to water related assets that combine probability of occurrence with severity of impact of all past, present and known future projects	Appendix E Section 6 and Appendix F Section 6.10 and Sub-appendix D EIS Section 10.1

1.8 Approval Process and Indicative Timeline

The Project is to be assessed as a State Significant Development (SSD) in accordance with Clause 8 and Schedule 1 (Item 5) of *State Environmental Planning Policy (State and Regional Development) 2011*. This EIS has been prepared to accompany a development application by Centennial Airly for the Project in accordance with the provisions of Part 4 Division 4.1 of the EP&A Act and the DGRs issued by the then NSW P&I (formerly Department of Planning). Chapter 5.0 details the key aspects of the Project that trigger the requirement for State Significant Development approval under the EP&A Act.

The Project is a controlled action (EPBC 2013/7076) and will be assessed under the EPBC Act through the bilateral agreement with NSW, accrediting the EP&A Act (SSD process). The bilateral agreement between the Commonwealth of Australia and the State of New South Wales relating to environmental assessment (the bilateral agreement), allows the Commonwealth Minister for the Environment to rely on specified environmental impact assessment processes of the State of New South Wales in assessing actions under the EPBC Act. A summary of the SSD assessment pathway is provided in Figure 1.4.



CENTENNIAL AIRLY PTY. LTD.

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	127623060-R Rev 0
SCALE	NOT TO SCALE

Figure 1.4: State Significant Development Assessment and Approval Pathway

PLOTFILE No.

Centennial Coal
Airly

DRG No. 1-1.4

A4

CHAPTER 2.0

Site Description

2.0 SITE DESCRIPTION

2.1 Site Location

The existing underground Airly Mine is located 5 km northeast of the village of Capertee in the Lithgow Local Government Area (Lithgow LGA). It is 40 km north- northwest of Lithgow and 171 km northwest of Sydney (Figure 1.1). The Project is on the northern fringe of the Western Coalfields.

The Gardens of Stone National Park and Ben Bullen State Forest lie almost immediately to the south of the Project Application Area, whilst Wollemi National Park is approximately 35 km to the east. The Gardens of Stone National Park is part the Greater Blue Mountains World Heritage Area. The Capertee National Park lies immediately to the north of the Project Application Area, while most of the Project Application Area is within the Mugii Murrum-ban State Conservation Area (Mugii Murrum-ban SCA).

The Mugii Murrum-ban State Conservation Area was gazetted on 4 March 2011. The SCA is characterised by two mesas (Mount Airly and Genowlan Mountain), pagodas, cliffs and dissected sandstone gorges. The SCA boundary is shown in Figure 1.3 and has an area of 3,650 ha. The reserve has significant natural and cultural heritage values and also contains significant mineral resources. As a state conservation area, Mugii Murum-ban SCA is reserved to protect environmental and cultural heritage values while permitting mining and exploration.

The Castlereagh Highway is the major arterial road in the region and Glen Davis Road links the Mine Access Road with the Castlereagh Highway.

2.2 Project Application Area

The Project Application Area includes Mining Lease ML1331 and Authorisation 232 (A232) with areas of 2,744 ha and 3,096 ha respectively, and is shown in Figure 1.3. The Project Application Area encompasses an area of 3,982 ha and is characterised by environmental features such as rock outcrops, sandstone cliffs and deep valleys. Approximately 3,090 ha or approximately 78% of the Project Application Area is within the 3,650 ha Mugii Murrum-ban State Conservation Area.

2.3 Landscape Features

2.3.1 Topography

The Project Application Area is characterised by a steep and rugged topography with large areas of cliffs and significant rock outcrops, including ‘The Grotto’. The topography is dominated by Mount Airly and Genowlan Mountain (Photograph 2.1). Site elevation varies from in excess of 1000 m on Mount Airly and Genowlan Mountain to 700 m to the west of Mount Airly and less than 400 m to the southeast of the pit top. Slopes surrounding Mount Airly and Genowlan Mountain exceed 50% grade. There are small areas of flatter land on plateaus. To the west of Mount Airly there are undulating areas within the Project Application Area with slopes typically between 3-20%.

Mount Airly and Genowlan Mountain are surrounded by steep and rugged topography with large areas characterised by cliffs and significant rock outcrops (Photograph 2.1). There are small areas of flatter land on plateaus. To the west of Mount Airly there are undulating areas within the Project Application Area.

Mount Airly and Genowlan Mountain form an irregular starfish-shaped mesa complex dissected by a low saddle or valley known as Airly Gap (Photograph 2.2), through which Gap Creek flows north beyond the outlier to join Genowlan Creek, which rises in Genowlan Mountain and eventually flows into the Capertee River. The perimeter of the mesas is characterized by intermittent sheer and benched cliffs abutted by talus slopes.

Topography within the mesas varies from gently undulating to steep sided valleys, major cliff lines and gorges. There are a number of rock formations including ‘pagodas’ (Photograph 2.2) which are formed by differential erosion of the overlying strata forming dome shaped rock structures, sometimes referred to as 'beehives'. The 'pagodas' are mainly smooth surfaced, although some are benched (platy pagodas), which occur when harder layers such as leached ironstone is present within the structure.

The Project Application Area sits more broadly within the landscape of the Capertee Valley. This valley is a large, broad-floored canyon measuring over 30 km from north to south and east to west. The valley is surrounded by sandstone cliffs and steep talus slopes (Photograph 2.3) similar to those found on Mount Airly and Genowlan Mountain and these mountains sit as a one of three distinct mesa complexes within the Capertee Valley. Both Mount Airly and Genowlan Mountain are clearly visible for tens of kilometres in all directions.

Much of the Capertee Valley has been cleared for agricultural use. The more rugged western and south-western portion of the valley is less cleared and there remain significant portions of forested land. The Project Application Area is almost entirely covered by forest with only the western and north western portions being cleared land, owned by Centennial Airly Pty Limited.

2.3.2 Geology and Soils

2.3.2.1 Geology

Airly Mine lies within and at the northern edge of the Western Coalfields where the high sandstone terrain characteristic of the Blue Mountains, breaks up into separate mesas and sandstone ridges.

Airly Mine is located in a region that is comprised of deeply incised gorges with, cliffs and pagodas, narrow incised valleys and sandstone and conglomerate rocks. The coal deposit underlying the Project Application Area is contained entirely within the Mount Airly-Genowlan Mountain mesa that is a Permo-Triassic outlier of coal bearing strata capped by approximately 200 m of Narrabeen Group cliff forming sandstones (mostly the Grose Sandstone).

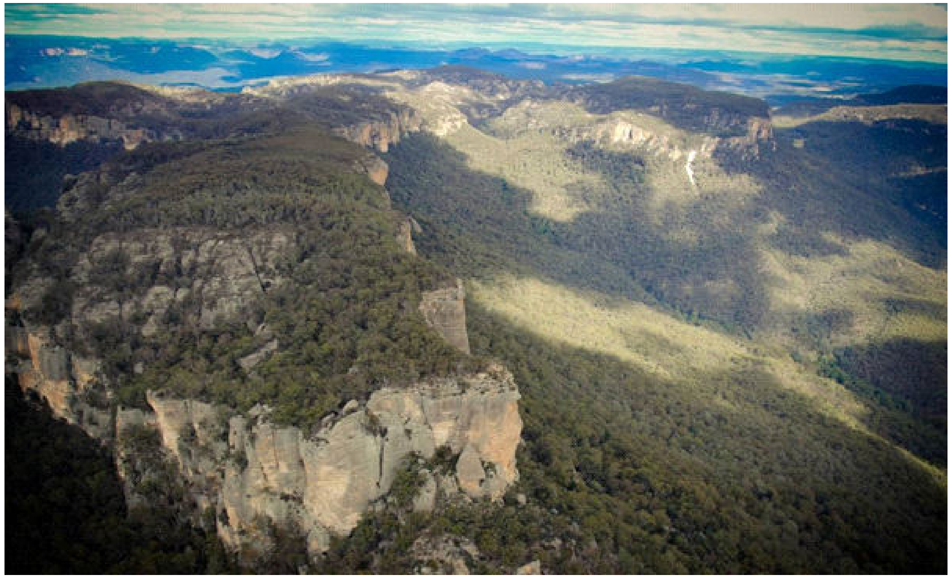
Underlying the Narrabeen Group is the Permian Illawarra Coal Measures which contain a number of coal seams including the Irondale, Lidsdale and Lithgow listed in Table 2.1 and shown schematically in Figure 2.1. Lithology consists of a mixture of sandstone, claystone, mudstone and conglomerate. Regionally, the coal measures dip 0.5 degrees to 1 degree to the east and northeast.

Triassic Narrabeen Group strata cover most of the upper half of the plateau and form rugged escarpments Table 2.1 summarises the relevant stratigraphic units. Small isolated outliers of Tertiary basalt cap the highest points of the plateau.

Rocks of the Narrabeen Group located near the surface belong to the Grose Sub-group and include the Banks Wall Sandstone, which is the uppermost stratigraphic unit.

As illustrated in Figure 2.1 the Illawarra Coal Measures are underlain by the Shoalhaven Group which consists of siltstone and lithic sandstone conglomerate, which overlies the Devonian metamorphic strata containing shale, sandstone and limestone. The underlying Permian Illawarra Coal Measures outcrop around the perimeter of the plateau. The Illawarra Coal Measures contain the coal seams proposed to be mined in the Project. The only coal seam deemed to be of any significant economic importance is the Lithgow Seam, which is located in the lower part of the Illawarra Coal Measures. All of the existing and proposed workings at Airly Mine are located in the Lithgow Seam. The Illawarra Coal Measures and underlying Shoalhaven Group lie unconformably on Lower Devonian shales, tuffs and limestones.

Genowlan Point



Mount Airly

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 2.1: Genowlan Point and Mount Airly

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.1

A4

Pagodas on Mount Airly

Cliff Features from Airly Gap

DATE	14/08/2014
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REFERENCE	137623024-R Rev 0
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Photograph 2.2: Pagodas on Mount Airly and Cliff Features from Airly Gap

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.2

A4

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Photograph 2.3: Typical Cliff Lines from Project Application Area

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.3

A4

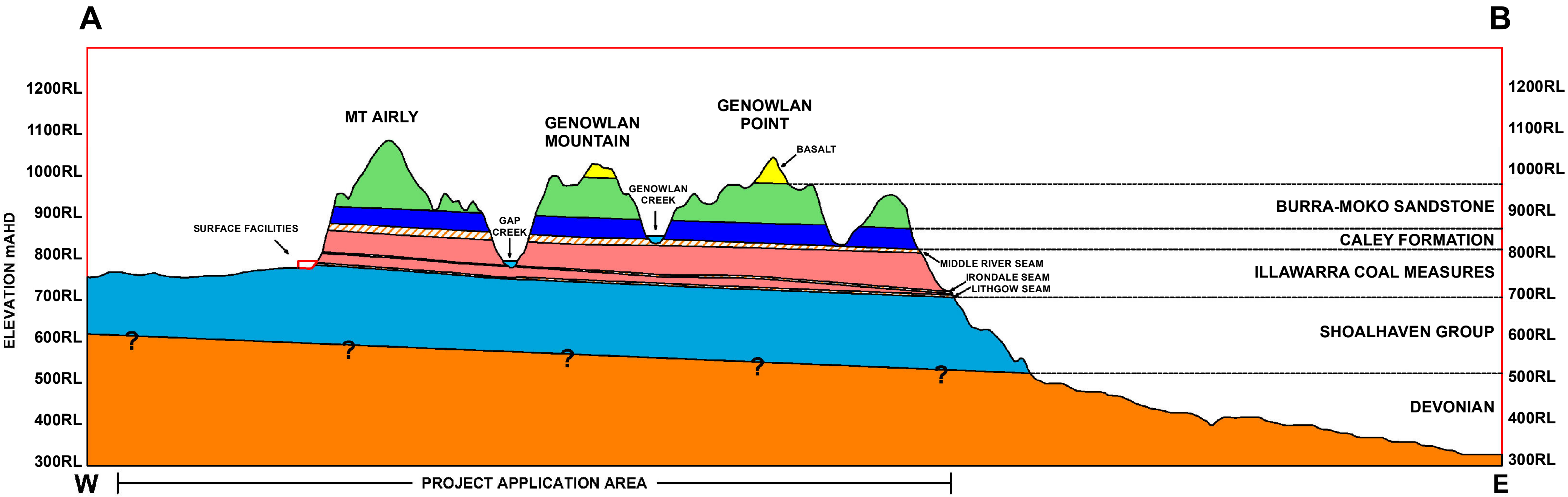
The geological and geotechnical environment play an important part in determining the appropriate mining methods to be employed. Significant geological factors that influence mining method selection at Airly Mine are:

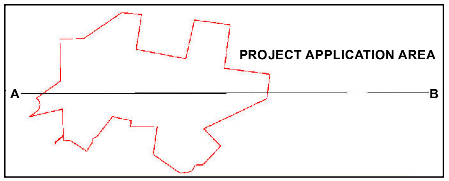
- depth of cover (ranging from 0 m at the outcrop to 300 m)
- relatively weak roof strata in the Lithgow seam
- geological structure
- large scale regional geological features
- strength of the overburden
- stress environment.

Depth of cover in particular influences mining method selection. Methods that are suitable at shallower depths are not suitable at greater depth. Due to the irregular and discontinuous nature of the Mount Airly–Genowlan Mountain complex, some methods, such as longwall mining, are precluded. When the above-noted factors are combined with the need to preserve sensitive surface features as well as surface and groundwater systems, it is necessary to develop mining methods to suit each specific part of the deposit. This is discussed in detail in Chapter 8.0.

Table 2.1: Generalised Stratigraphic Column within the Project Application Area

Period		Group	Sub-group	Formation
Tertiary				Flood basalt
Triassic		Narrabeen	Grose	Burra-Moko Head Sandstone
				Caley Formation
Permian	Late	Illawarra Coal Measures	Wallerawang	Middle River Seam
			Charbon	Moolarben Seam
				Baal Bone Formation
				Upper Irondale Seam
				Irondale Seam
				Long Swamp Formation
			Cullen Bullen	Lidsdale Seam
				Lithgow Seam
				Marangaroo Conglomerate
			Nile	Gundangaroo Formation
				Coorongooba Creek Sandstone
				Mount Marsden Claystone
		Shoalhaven		Berry Siltstone
	Early			Snapper Point Formation
Lower Devonian				Shales, tuffs and limestones





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REFERENCE	137623024-R Rev 0
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Figure 2.1: Typical Stratigraphy at Airly Mine

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-2.1

A4

2.3.2.2 Soils

Soil landscapes have recognisable and specific topographies and soils, and can be presented on maps and described by concise statements. The soil landscapes within the Project Application Area have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of the Department of Primary Industries), at the scale of 1:100,000 (Soil Landscape of the Wallerawang; King, 1993) and 1:250,000 (Soil Landscapes of the Bathurst; Kovac et al, 1989).

The majority of the Project Application Area comprises the Hassans Walls Soil Landscape. Descriptions of all 11 Soil Landscapes within the Project Application Area are identified in Section 10.8. The dominant soil types are shown in (Figure 10.39).

The Hassans Walls Soil Landscape consists of cliffs derived from Narrabeen Group sandstones and steep colluvial talus sideslopes developed over the Illawarra Coal Measures and the Shoalhaven Group. Open forest and open woodland is associated with this landscape.

This Soil Landscape is susceptible to erosion given its sandy basis and is generally unsuitable for cultivation or grazing due to severe limitations; however some gentler slopes and narrow drainage flats are capable of light grazing.

Eleven Soil Landscapes were identified within the Project Application Area and are identified in Table 2.2 and Figure 10.38.

Table 2.2: Soil Landscapes

Soil Landscape	Project Application Area	
	ha	%
Canobla Gap	118	2.9
Capertee	97	2.4
Coco	86	2.2
Cullen Bullen	23	0.6
Glen Alice	279	7.0
Hassans Walls	2,176	54.7
Medlow Bath	72	1.8
Mount Tomah	64	1.6
Rowans Hole	158	4.0
Warragamba	625	15.7
Wollangambe	285	7.1
Total	**3,983**	**100.0**

The majority of the Project Application Area comprises soils with low to moderately low inherent fertility. The one exception is the Mount Tomah Soil Landscape with moderately high inherent fertility; however, this Soil Landscape has limitations associated with steep slopes and mass movement, and covers a very small proportion of the Project Application Area.

2.3.3 Natural Features and Man Made Features

2.3.3.1 Cliffs

For the purposes of this EIS, the term “cliff” has been defined as a sub-vertical rock slope with a height >20 m. Cliffs are also usually longer than their height. Typical cliffs are shown in Photograph 2.3.

The relatively high strength of the Narrabeen sandstone units, combined with the presence of near vertical jointing of the rock mass, leads to the formation of sizeable cliffs. The mechanism by which these cliffs form is partly structural and partly erosional. Tectonic forces and mountain uplift cause fracturing of the sandstone units and result in sub-vertical jointing that can penetrate the full depth of the sandstone unit. Subsequent erosion of the underlying Permian strata to form the surrounding valleys by rivers and streams has caused a removal of support from the overlying sandstone. Over time the continuing removal of support destabilizes the sandstone causing it to break off on the pre-existing joints and fall onto the lower talus slopes. The result is a vertical or near vertical rock face that can reach well over 100 m tall in the Project Application Area.

As mentioned in Section 2.3.2.1, the sandstone cliffs sit atop the Permian talus slopes and form an external boundary to the upper portion of Mount Airly and Genowlan Mountain. Within the mountain complex itself, the action of wind and water erosion has formed deeply incised gorges that partly penetrate the sandstone units to form cliffs. Although these internal cliffs are smaller than those found on the exterior of the mountains, they nevertheless reach heights of over 50 m in places.

Cliff stability is affected by a number of factors. These include:

- cliff height
- rock unit strength
- degree of preexisting fracturing
- exposure to wind and water erosive forces
- amount of undermining due to erosion and downs slope movement of the underlying talus material.

It is estimated that the natural frequency of large scale cliff falls in the Project Application Area is once every four years. Falls of isolated rocks occur more frequently, but are not noticeable at any great distance.

As a result of the above factors, the cliffs within the Project Application Area were assessed to be sensitive to the impacts of mining related subsidence. The impact of full extraction systems on the sandstone cliffs in the Blue Mountains is well documented. Cliffs have already been impacted around the part of Mount Airly undermined by the previous New Hartley Shale Mine. This has resulted in large scale collapse and significant fracturing as is typical with full extraction under these features.

Chapter 8.0 describes the means by which these features will be managed in relation to subsidence impact.

2.3.3.2 Pagodas

Washington and Wray (2011) describe pagodas as conical rock structures caused by differential erosion of the surrounding sandstone. These features occur in the Banks Wall and Burra Moko Head sandstones. Pagodas can broadly be described as two main types namely, smooth and platy. Platy pagodas occur more typically in the Banks Wall sandstone, whereas the smooth pagodas tend to occur more in the Burra Moko Head sandstone unit.

Smooth pagodas of the type found in the Project Application Area are similar to features found elsewhere in Australia and internationally. They have very steep sides that are often formed along preexisting joints and rounded tops. Heights of smooth pagodas within the Project Application Area can reach to around 20 m.

Platy pagodas differ in that they tend to be more conical in structure and Washington and Wray (2011) state that:

"*Platy pagodas however commonly have regular ironstone banding every 20 cm to a metre that can extend up to 60 metres in height. This banding is generally 2-5 cm in thickness and can, because of erosion of the surrounding friable sandstone, often project 20-40 cm from the sandstone (and in exceptional cases can project up to a metre). This ironstone plays a major protective role, and smooth pagodas appear to be eroding far more quickly than platy pagodas (we estimate at least 10 times faster, though this needs further research)"*

Washington and Wray (2011) also state that the platy pagodas are distinct features that are not replicated elsewhere outside the Blue Mountains region of New South Wales.

Within the Project Application Area, pagodas tend to occur mainly at the top of external and internal cliffs and around deeply incised gorges and canyons. Some do occur as isolated rock outcrops within larger plateau landscapes, but these are very minor in comparison to the numbers found around cliffs and gorges.

Pagodas tend to be the most resilient part of the rock mass remaining after erosion and are often bounded on pre-existing joint lines. The behavior of pagodas when subjected to subsidence differs from sandstone cliffs. Inspection of pagodas impacted by the full extraction techniques in the previous New Hartley Shale Mine operation under Mount Airly show that the pagodas will typically crack, but total or even partial collapse is not present (Photograph 2.2). This mechanism is also typical when viewing similar features in other parts of the Western Coalfield such as previous longwall mining areas at Baal Bone and Clarence Collieries.

The pagodas within the Project Application Area are regarded as sensitive surface features.

2.3.3.3 Steep Slopes

The term "steep slope" is potentially quite broad. Within the context of the Project Application Area, a steep slope refers to the scree and rubble covered talus slopes below the sandstone cliffs. These slopes geologically correspond to the Permian strata below the Narrabeen Sandstone. The Permian strata consists highly laminated mudstones, siltstones, sand stones and coal. As valley erosion occurs, these slopes are prone to weathering and slippage of that weathered portion down slope. This process causes reduction of support to the overlying sandstone and results in cliff collapse. The weathered Permian material is mixed with the debris from the collapse of the sandstone cliffs above to form the steep talus slopes below the cliffs so typical of the Blue Mountains region.

The talus slopes within the Project Application Area are thickly vegetated. Vegetation communities on these slopes tend to be hardy as they must endure constant change and are not particularly well watered. As a result the vegetation on these slopes is not susceptible to impact from mining related subsidence.

The steep slopes are only likely to be impacted due to full extraction techniques. Impacts would likely be manifested as surface cracking, slope slippage and formation of sink holes where full extraction of coal takes place at lower depth of cover.

2.3.3.4 Deeply Incised Gorges

Section 2.3.3.1 describes the formation of the sandstone cliffs in the Project Application Area. The internal cliffs are mostly formed along joints and other fractures in the rock mass. In some places these cliffs are only separated by a few metres to tens of metres and may be over 50 m in height. These narrow, deeply incised gorges or canyons are quite common throughout the Blue Mountains region and are typified at Airly Mine by features such as the Grotto. The location of The Grotto is shown Figure 3.5 and Photograph 2.4 shows the typical landscape of a narrow deeply incised gorge in the form of The Grotto. It is noted The Grotto forms a tributary of the Genowlan Creek.

The narrow deeply incised gorges and canyons often have a rocky base and shallow soils. Surface water fed from upstream may flow through these features and streams are ephemeral. Monitoring by Airly Mine has shown the water flow in The Grotto to be ephemeral and rainfall dependent. The sheltered environment along with moisture from surface water and seepage of water from the surrounding sandstones promotes the growth of water loving plants such as tree ferns.

In areas where there is a greater source of sediments, the gorges become wider and allow the accumulation of deeper soil profiles. In these areas, more regular surface water flow encourages the growth of taller moist forest communities. This type of gorge is typified by The Oasis, also known as Jurassic Park, which is located on the lower portion of Genowlan Creek within Genowlan Mountain. The location of The Oasis is shown in Figure 3.5 and Photograph 2.5 shows the typical landscape of a wider deeply incised gorge in the form of The Oasis.

The Subsidence Impact Assessment (Appendix D) discusses the potential impacts of subsidence due to full extraction on deeply incised gorges such as those found on Mount Airly and Genowlan Mountain. The two main mechanisms of potential impact on deeply incised forges are valley closure and valley floor uplift.

Valley closure occurs due to the compressional curvature of the surface during mining causing the two sides of a deeply incised gorge to move together. This can cause fracturing and possible failure of the canyon walls similar to the failure of cliffs due to subsidence.

Valley floor uplift occurs when the compression forces generated by subsidence concentrate at the base of a valley causing a buckling type failure. Both mechanisms can be eliminated by reducing subsidence to very low levels as will be described in Chapter 8.0. The susceptibility of deeply incised gorges to subsidence impact makes them a sensitive feature requiring further management to avoid adverse impact.

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	REFERENCE	137623024-R Rev 0	
	SCALE	NOT TO SCALE	

Photograph 2.4: The Grotto

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.4

A4

DATE	17/04/2014
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Photograph 2.5: The Oasis

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.5

A4

2.3.3.5 Aboriginal Heritage

The Heritage Impact Assessment (Appendix J) conducted for the Project identified 19 new sites within the Project Application Area in addition to the three sites identified from a search Aboriginal Heritage Information Management System (AHIMS) database. The sites included the following types:

- isolated find
- artefact scatter
- scarred tree
- shelter with deposit
- shelter with artefact
- art site.

The location of the identified Aboriginal heritage sites is shown in Figure 10.9.

Significant camp sites have been located in areas adjacent to the Project Application Area, and the Capertee Valley is recognised as journey route for the local Aboriginal people. Small to medium sized groups used the lower and flatter areas near drainage lines as camp sites. Airly Gap was identified as a travel route.

The presence of art work on Genowlan Mountain combined with a lack of water and food sources suggests ceremonial and ritual uses of the area only. Mount Airly appears to have been largely unoccupied.

The scientific significance of the sites within the Project Application Area was assessed in accordance with the criteria in the Burra charter. The sites ranks range from high local significance (an art site) to low local significance (artefact scatters). Further details are presented in Section 10.3.

The registered Aboriginal parties involved in the Cultural Heritage Impact Assessment (Appendix J) were given the opportunity to consider the sites in terms of the following values:

- social values (spiritual, political and cultural aspects of the site)
- aesthetic values (visual aspect of the site)
- historic values (aesthetic and social value combined).

Feedback from the registered Aboriginal parties noted that all sites in the Project Area were considered to have moderate to high significance in terms of social, aesthetic and historic values. The registered Aboriginal parties chose not to rank sites individually. Further details are presented in Section 10.3.

2.3.3.6 Historical Heritage

The area that is now Mugii Murum-ban SCA has long been valued for its mineral resources, including coal, oil shale (torbanite), gold and diamonds. Oil shale was mined beneath the north western extent of Mount Airly between the 1880s and 1912, from the former New Hartley and Genowlan Mines. These are collectively referred to as the New Hartley Shale Mine in the EIS. Early operation focussed on exporting the oil shale without any further processing at site. The shale was mined at the northern end of Airly Gap and initially transported to the southern end of Airly Gap by horse drawn tramway. From there, a series of powered steel wire rope skip haulages transported the shale to the base of the mountain and thence overland to a loading facility located on the Wallerawang-Gwabegar railway for export.

Later operations saw the oil shale transported westwards from the mines through a tunnel driven beneath Mount Airly using powered rope skipways. The shale was processed at the Torbane works located about 1 km north of the Airly pit top. The shale was heated in large brick lined retorts to produce crude oil for export to domestic and international markets. Coal from the Lithgow Seam was mined at the Torbane Colliery located within the western portion of the Project Application Area and was used to provide heating to the oil shale retorts. Photograph 2.6 and Photograph 2.7 show some of the mining and oil shale processing activities during the period of operation.

The oil shale operation on Mount Airly and Torbane Village formed a part of a series of oil shale mining and processing ventures that were concentrated in the Wolgan and Capertee Valleys. The operation was purchased by the same company that founded the Newnes oil shale operation in the neighbouring Wolgan Valley. When mineable reserves were exhausted at Mount Airly, workers and operations transitioned over to the Newnes operation until its closure in 1932. This in turn was superseded by the oil shale mining and processing operation at Glen Davis on the Eastern edge of the Capertee Valley.

There are a number of ruins in Airly Gap associated with the oil shale mining activities and nearby Airly Village**.** Photograph 2.9 and Photograph 2.10 show some of the ruins in Airly Gap. Remains of the feed retorts used for the processing of oil shale to produce crude oil at the Torbane processing site also remain (Photograph 2.11). The Airly Village and the Torbane processing site are collectively known as the Airly shale mining complex in this EIS and the Cultural Heritage Impact Assessment (Appendix J).

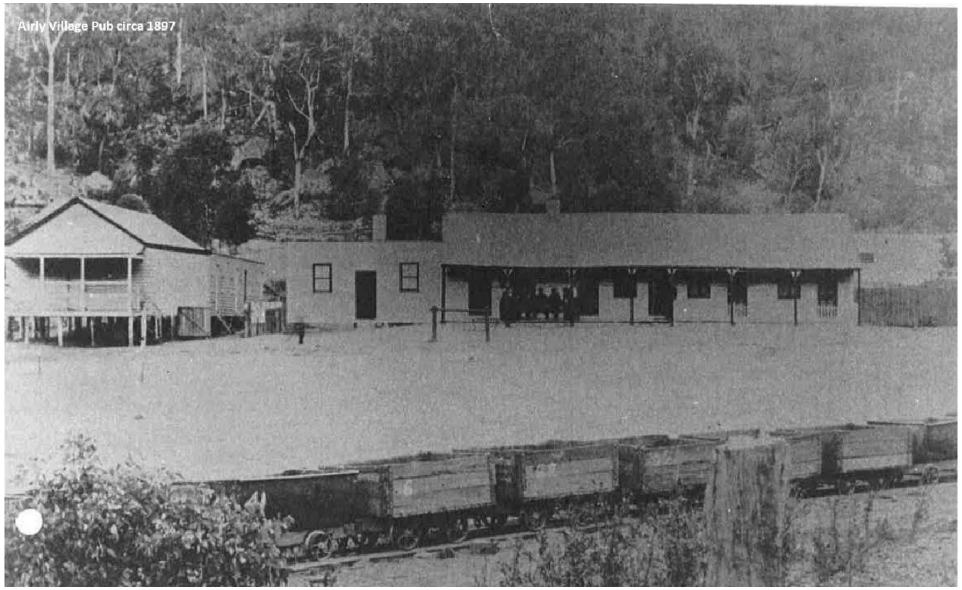
As identified within the Cultural Heritage Impact Assessment (Appendix J), the following assessment in relation to Airly shale mining complex has been made:

"The wider Airly shale mining complex is considered to be a cultural landscape embodying historical values.It is illustrative of mining practices and the accompanying community life associated with extensive shale mining activities in a remote location dating from the late 19th Century. Although relatively short-lived (shale mining activities were concentrated between the 1880s and c1912 with some activity in the 1940s), the landscape has been dramatically influenced with evidence of working practices and technologies, habitation and living conditions remaining today.

The site has high aesthetic value as a result of the highly scenic and dramatic nature of the surrounding landscape. Furthermore, the interactions between the component parts, many of which are picturesque ruins, with this stunning backdrop create attractive views and vistas. Technical achievement is considered to be embodied by the remains of transportation and processing systems at the site as well as the ingenuity of creating working and living places in what would have been a very remote and harsh environment.

The interest in the site shown by local historical societies and special interest groups is considered to signify that the site has social value at a local level."

Diamonds and gold were mined on a small scale from both surface and underground operations located on the western part of Genowlan Mountain in the period from the 1960s to the 1980s. Very little remains of this operation and it has been assessed as having only local historic significance.



Airly Village Pub 1897

Torbane Village Works

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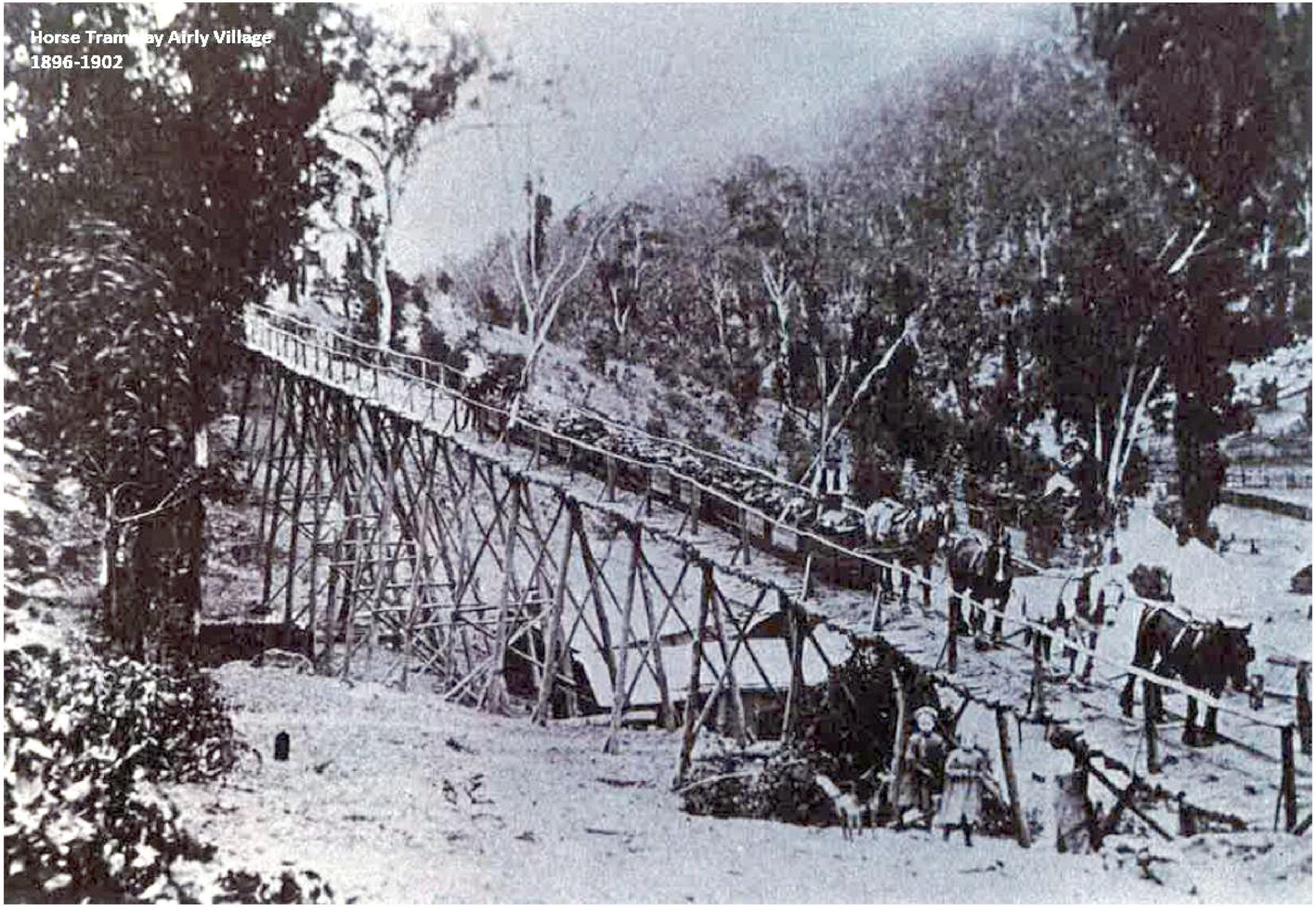
Photograph 2.6: Airly Village Pub 1897 and Torbane Village Works

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.6

A4



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Photograph 2.7:
Horse Tram Way
Airly Village 1896 - 1902

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.7

A4

2.3.3.7 Other Man Made Features

There are several other man made features of note in the Project Application Area that are proposed to be undermined. These are:

- a single state survey mark at Genowlan Trig Station
- the emergency services communications tower on Genowlan Mountain
- private residence (stone cottage at Airly Gap and Nissen Hut at the old diamond mine on Genowlan Mountain)
- a single buried telephone cable in Airly Gap
- public unsealed road in Airly Gap and numerous four wheel drive tracks.

A state survey mark exists at the Genowlan Trig Station site (Figure 8.2). This site is overgrown and no longer maintained by the State. Permission would be sought to undermine this from the Department of Lands (Land and Property Information Division) prior mining taking place.

An emergency services communications tower and associated structures are located on Genowlan Mountain (Figure 8.2). The tower, made of bolted steel construction, is bolted to three piers and is approximately 20 m high. Solar panels are mounted on the adjacent concrete block shed and cabling connects the shed to the tower. There are also two small sheds associated with the tower. One shed is a 3 m x 4 m prefabricated steel structure bolted to four concrete pier foundations. The second shed is a 2 m x 2 m concrete block structure on a concrete slab.

A military style Nissen Hut and small out-building are on the Airly Gap side of Genowlan Mountain (Figure 8.2)**.** Members of the Ribbaux family have permissive occupancy rights within the Nissen Hut during their lifetime. The Nissen Hut is 11 m x 5 m and of bolted steel construction with timbered ends. The entire structure is resting on timber posts. These posts vary in length from 0.2 to 1.2 m in height and are generally in poor condition. There is a 2.5 x 5 m out building adjacent to the Nissen Hut that is also of bolted steel construction with a rough timber frame resting on a poor quality concrete slab. Subsidence is not likely to cause collapse of these structures. As these structures are in poor state of repair it is proposed to conduct a dilapidation survey prior to undermining them. Consultation with the owner (NPWS) and the occupier will be undertaken to develop an appropriate management plan for these structures.

“Rock Bottom” is a Centennial Airly owned cottage within the Airly village site, adjacent to Gap Creek. There is also a Stone Cottage at the southern end of Airly Gap. This cottage is a single room structure and of rough stone construction.

A copper telecommunication cable is laid along the route of the old southern tramway leading up into the southern end of Airly Gap and then through to the “Rock Bottom” cottage owned by Centennial Airly. This is the only subscriber to the service in the Project Application Area. The line does not proceed past the cottage.

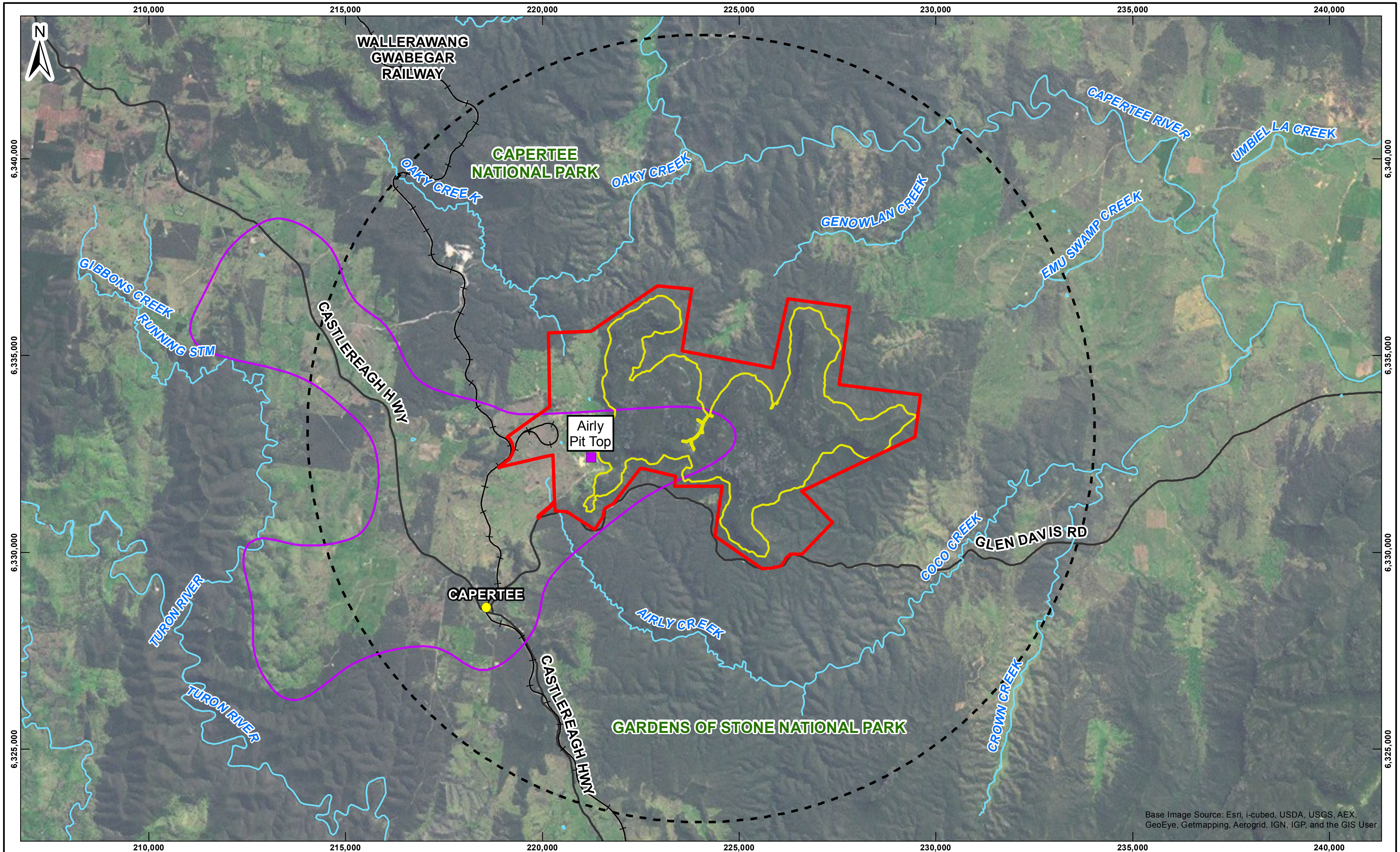
Numerous unsealed roads have been constructed in the Project Application Area. The most significant of these is the road servicing Airly Gap and a number of properties beyond that point that are outside the Project Application Area. The road is classified as a vehicular track on the Glen Alice 1:25000 map and is currently only maintained by Airly Mine for mining related activity access. The remaining roads in the Project Application Area are classified as four wheel drive tracks.

2.4 Study Areas

The study area for the majority of the technical assessments undertaken for the Project is the Project Application Area with the exception of air, noise and visual impact assessments. For these technical assessments, the study areas are defined as follows.

- Groundwater and Surface Water Impact Assessment (Section 10.1): the Project Application Area plus the area of surrounding environmental and human water users.
- Ecological Impact Assessment (Section 10.2): the Project Application Area plus an area 10 km outside for database searches.
- Heritage Impact Assessment (Section 10.3): the Project Application Area.
- Transport Impact Assessment (Section 10.4): the Project Application Area plus roads and railways used by the Project.
- Noise Impact Assessment (Section 10.5): the Project Application Area and adjoining potentially affected receptors.
- Air Quality and Greenhouse Gas Impact Assessment (Section 10.6 and Section 10.7): the Project Application Area and adjoining potentially affected receptors.
- Soils, Land Capability and Agricultural Impact Assessment (Section 10.8): the Project Application Area.
- Decommissioning and Rehabilitation (Section 10.9): the Project Application Area.
- Visual Impact Assessment (Section 10.10): the Project Application Area and adjoining potentially affected receptors.
- Subsidence Impact Assessment (Chapter 8.0): 26.5 degrees angle for draw from all workings.

Figure 2.2 shows the boundaries of the study areas for the Project.



LEGEND

- Project Application Area
- Limit of Mining
- Visual Study Area
- Ecology Database Search Area
- Town
- Watercourse
- Rail
- Main Road

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:125,000

Figure 2.2: Project Study Areas

0 1 2 3 4 5 km

PLOTFILE No.

Centennial Coal

Airly

DRG No. 2-2.2

A4

2.5 Land Use and Ownership

2.5.1 Land Use

2.5.1.1 Land use in the vicinity

Land use in the vicinity of the Airly Mine consists of rural residential, grazing, underground coal mining, coal handling infrastructure, transport infrastructure, commercial forestry, recreation (including tourism) and nature conservation within the Mugii Murum-ban SCA and nearby National Parks (Capertee National Park and Gardens of Stone National Park. Excelsior Limestone Mine is operated by Sibelco Australia 5 km northwest of the Airly pit top. Centennial Coal owns a property known as 'Bernina' which extends from the Wallerawang-Gwabegar rail line in the east to the Castlereagh Highway in the west. The property is mostly cleared and used for cattle grazing.

The majority of the Project Application Area consists of rugged unpopulated bush land including the Mugii-Murum-ban SCA.

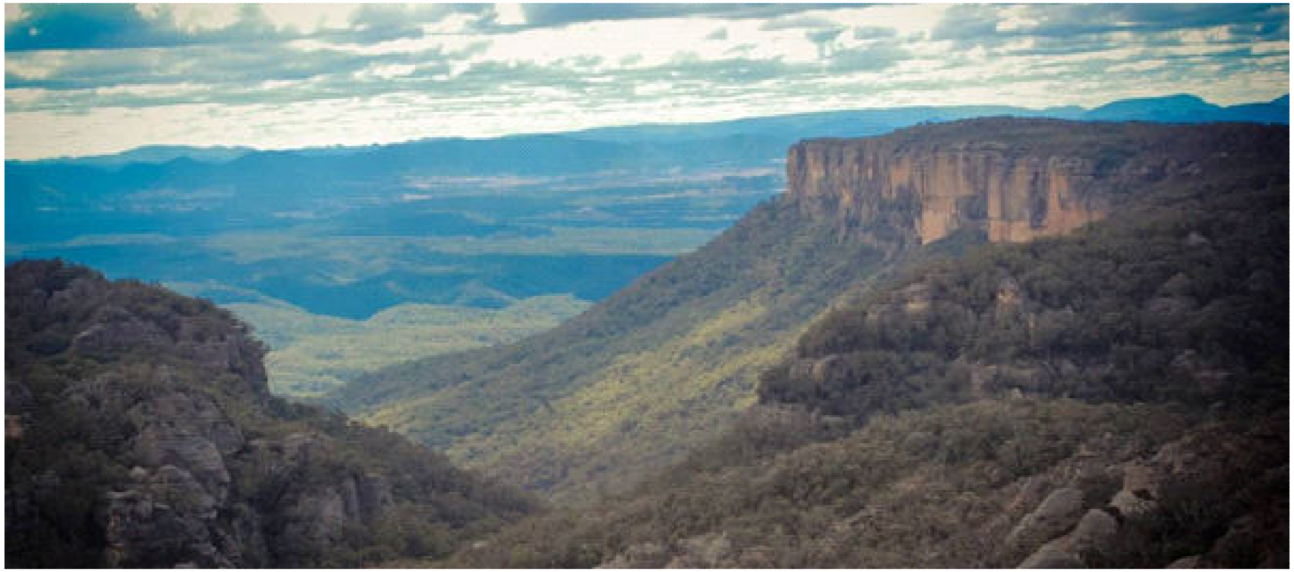
Airly Mine pit top is 5 km northeast of Capertee and is within Capertee Valley. The Capertee Royal Hotel (Photograph 2.8) and service station are features that create an underlying character to the village. There is an active progress association (Capertee and District Progress Association) and other localised tourist operators and businesses. The disused railway station, cottages and hotel are a reminder of its historical significance as part of the expansion of the rail network. Its character is also defined by its role as a focal point for the surrounding rural areas.

The Capertee Valley is known to have significant natural and historic heritage value. It is the world's second largest canyon being one kilometre longer than the Grand Canyon, but not quite as deep. Visitors come to the area for environmental tourism (eg. bird watching), four wheel driving, camping, bushwalking, photography. Bird watching in particular is an important attraction to the Capertee Valley. The valley is blessed with a remarkable diversity of birds, especially species that can be difficult to find in other areas. It's a stronghold for declining woodland birds, those species which have suffered most as a result of extensive clearing for agriculture throughout inland south-eastern Australia e.g. Regent Honeyeater. The bmbirding.com.au website states the Capertee Valley is home to more species of birds, than anywhere else in the Southern Hemisphere.

The nearest large urban centre is Lithgow, within the Lithgow LGA, which has a population of 20,161. The majority of the population lives in Lithgow urban area (11,143 people), Wallerawang (1,855 people) and Portland (1,829 people). The remainder of the population (approximately 26%), live across the smaller villages and rural localities within the Lithgow LGA. Lithgow meets the higher order retail, commercial and professional service needs of the area. Lithgow was established on coal mining, however, steel manufacturing, copper refining and other industrial enterprises have also been carried out historically in the region. Electricity generation is significant industry in the Lithgow region along with forestry. Tourism and recreation is a growing sector in the region and is particularly focused on the more scenic parts of the LGA. Agriculture accounts for 31% of land use of the total area within the Lithgow region.

Historically oil shale mining and associated petroleum production was an important land use in the vicinity, with large mining and industrial complexes at Glen Davis, Glen Alice and Newnes. The historical remains of these mines and works are significant tourist attractions.

Royal Hotel, Capertee



Views within the Capertee Valley

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 2.8: Royal Hotel, Capertee and Views within the Capertee Valley

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.8

A4

2.5.1.2 Land use in the Project Application Area

The land use within the Project Application Area is dominated by the Mugii Murum-ban SCA, which covers 3,062 ha and is used for recreational and conservation. A portion of the Project Application Area (480 ha) is cleared of native vegetation and forms sections of grazing properties owned by Centennial Airly. Due to slope and soil type constraints, the areas cleared of native vegetation within the Project Application Area are not suited to cultivation; the current use of cattle grazing is the most suitable.

The area around Airly Gap (Figure 8.2) was an important oil shale mining and processing district from around 1893 to 1913, with several oil shale or torbanite mines feeding the oil shale retorts at the nearby (now long abandoned) village of Torbane. Oil shale was mined beneath the Mugii Murum-ban SCA from the former New Hartley and Genowlan Mines. These are collectively referred to as the New Hartley Oil Shale Mine in the EIS and are located under Mount Airly. The oil shale was transported via horse drawn or powered rope slipways either direct to export or for processing at Torbane. Coal from the Lithgow Seam was mined at the Torbane Colliery located within the western portion of the proposed Project Application Area and was used to provide heating to the oil shale retorts.

Photograph 2.9, Photograph 2.10 and Photograph 2.11 show a series of historical photos of the Airly shale mining complex, noting particularly the historical rockfalls (presumably caused by shale extraction) and the degree of clearing for the industrial complex.

Diamonds and gold were mined on a small scale from both surface and underground operations located on the western part of Genowlan Mountain in the period from the 1960s to the 1980s.

There are three properties owned by Centennial Coal that are located in the Project Application Area. ‘Carinya’, located to the north of the surface facilities area, includes areas of cleared land used for cattle grazing although areas in the north of the property still predominantly contain native vegetation with high connectivity values. ‘Airly’ which is the property that encompasses the surface facilities area includes mostly cleared land and is also used for cattle grazing. ‘Bernina’ forms the western buffer to the surface facilities area and extends from the Wallerawang-Gwabegar rail line to the Castlereagh Highway.

2.5.2 Land Ownership

Land ownership within and surrounding the Project Application Area consists of Crown Land, land owned by Centennial Coal, privately owned land and land owned and managed by the National Parks and Wildlife Service NSW. The land ownership is shown in Figure 2.3.

A schedule of land within Project Application Area is provided in Appendix C.

Most land in the Project Application Area (the SCA) is owned by the National Parks and Wildlife Service NSW and most of the remainder is owned by Centennial Airly. There are two freehold private properties in the Project Application Area, one being the Parr property on the southern fringe of the Project Application Area, and the second being the Wilkinson property in Airly Gap.

Most of the Parr property is south of the Project Application Area as is the house (R1 on Figure 2.6). The Wilkinson property contains a small recreational stone cottage (R6), which is within the Project Application Area and the mining area.

The Ribbaux family have a permissive occupancy from National Parks and Wildlife Service for the old Nissen Hut (R18) on top of Genowlan Mountain. The Nissen Hut is within the Project Application Area and the proposed mining area.

Centennial Coal owns three properties that neighbor the surface facilities area at the pit top. ‘Carinya’ is located to the north of the surface facilities area and provides a large buffer between the mine site and privately owned land to the north and west of the Wallerawang-Gwabegar rail line. Photograph 2.12 shows the view of the western portion of the Project Application Area buffer area. ‘Airly’ is the main property which encompasses the surface facilities area and rail loop. It is adjoined to the east by parcels of Crown land and to the south by the Glen Davis Road. ‘Bernina’ forms the western buffer to the surface facilities area and extends from the Wallerawang-Gwabegar rail line to the Castlereagh Highway.

2.5.3 Land Zoning

The Project Application Area falls under the *Lithgow City Local Environmnetal Plan 1994* (Lithgow LEP 1994) and *Rylstone Local Environmental Plan 1996* (Rylstone LEP 1996)

Majority of the land within the Project Application Area is zoned as 1(a) Rural (General) under the Lithgow LEP 1994 while the remainder of the land, located on the northeast portion of the Project Application Area, is zoned Zone (a) Rural (General) under Rylstone LEP 1996 (Figure 2.4).

Lithgow City Council has recently developed a *Draft Lithgow Local Environmental Plan 2013* (Draft Lithgow LEP 2013), which concluded its exhibition period on the 6 August 2013. Submissions are currently being reviewed. Under the Draft Lithgow LEP 2013, zones are renamed with additional objectives and land uses to better reflect the characteristics of the Lithgow LGA and commensurate with the *Lithgow Land Use Strategy 2010-2030*. Figure 2.5 shows the land zoning of the Project Application Area in accordance with the Draft Lithgow LEP 2013.

Table 2.3 provides a summary comparison of the existing (Lithgow LEP 1994) proposed (Draft Lithgow LEP 2013) zones as relevant to the Project Application Area.

Table 2.3: Zonings

Lithgow City Local Environmental Plan 1994 ***Rylstone Local Environmental Plan 1996***	**Draft Lithgow Local Environmental Plan 2013**
Zones 1(a) Rural (General)	RU1 Primary Production* RU2 Rural Landscape E3 Environmental Management E4 Environmental Living
Zone 1 (e) Outer Rural	RU1 Primary Production
Zone 1 (f) Rural (Forestry)	RU3 Forestry
Zones 1 (c) Rural (Small Holdings)	R5 Large Lot Residential
Zone 2(v) Village	RU5 Village

*Primary Production covers land used for most kinds of commercial primary industry production including extensive and intensive agriculture, private forestry, mining and extractive industries.
Source: http://www.lithgow.com/lep/factSheets/Fact%20Sheet%20Rural%20Zones.pdf

Boiler and winding gear platform

Whitewash cave house

Cowie house

Single room cave house

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Photograph 2.9: Relics from Airly Village

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.9

A4

CENTENNIAL AIRLY PTY. LTD.	DATE	17/04/2014	**Photograph 2.10: Rock Fall Airly Village 1911**	PLOTFILE No.	
	SEAM	LITHGOW		Centennial Coal Airly	
	REFERENCE	127623060-R Rev 0			
	SCALE	NOT TO SCALE		DRG No. 2-P2.10	A4

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 2.11: Torbane Processing Plant Remains

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.11

A4

CENTENNIAL AIRLY PTY. LTD.	DATE	14/08/2014		
THIS DRAWING IS COPYRIGHT	SEAM	LITHGOW		
NO PART OF IT IN ANY FORM OR BY ANY MEANS (ELECTRONIC, MECHANICAL, MICRO-COPYING, PHOTOCOPYING OR OTHERWISE) BE REPRODUCED, STORED IN A RETRIEVAL SYSTEM OR TRANSMITTED WITHOUT PRIOR WRITTEN PERMISSION	REFERENCE	137623024-R Rev 0		
	SCALE	NOT TO SCALE		

Photograph 2.12: View of Western Portion of the Project Application Area

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-P2.12

A4

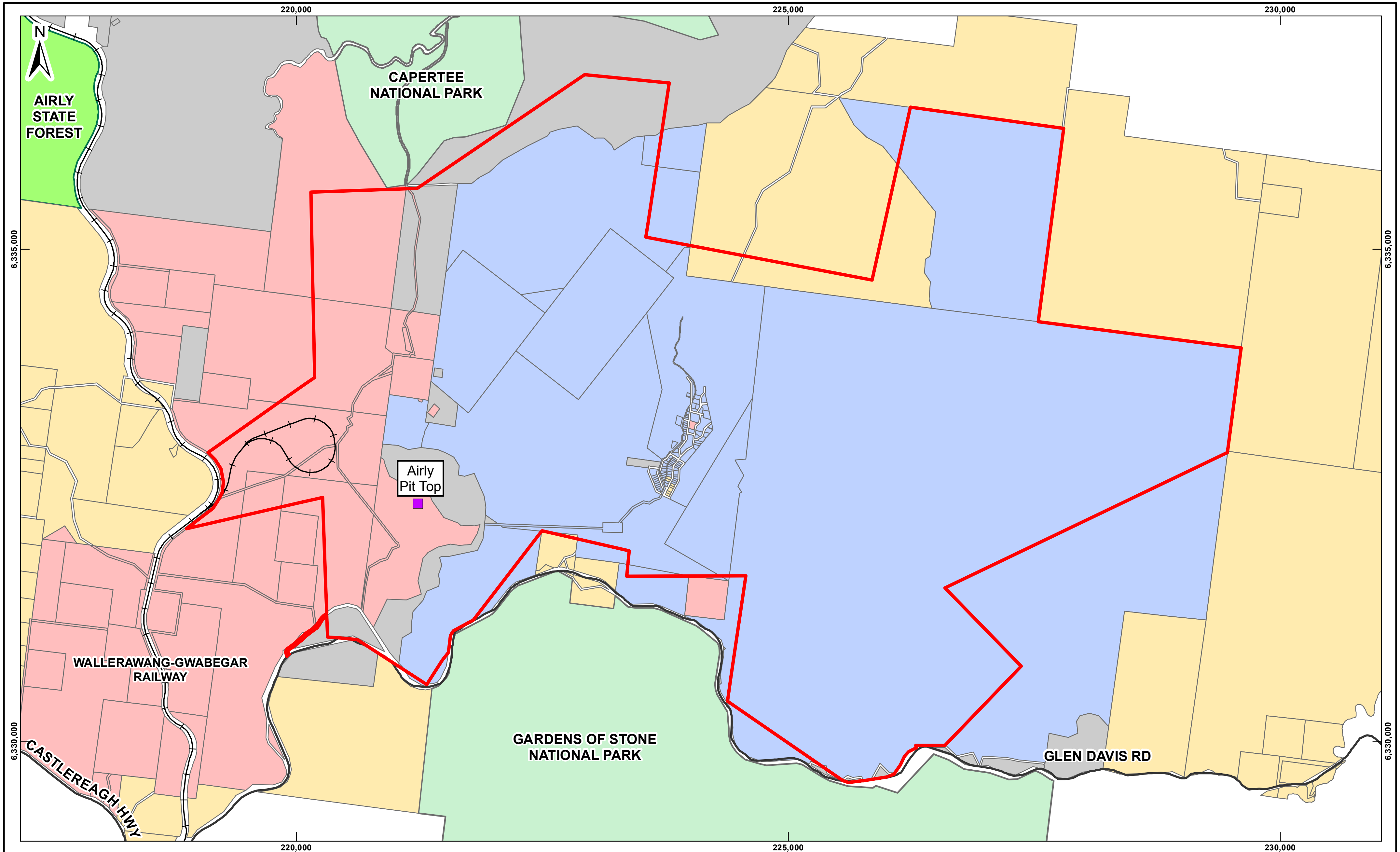
2.5.4 Nearest Sensitive Receptors

There are a number of sensitive residential and recreational receptors in the vicinity of the Project (Figure 2.6). A list of these receptors is provided in Table 2.4.

Table 2.4: Sensitive Receptors

Residential Receptor	Receptor Type/Description
R1	Residential Dwelling (Private Residential)
R2	Residential Dwelling (Private Residential)
R3	Residential Dwelling (Private Residential)
R4	Residential Dwelling (Private Residential)
R5	Residential Dwelling (Private Residential)
R6	Stone Cottage Airly Gap (Private)
R7	Residential Dwelling (Private Residential)
R8	Residential Dwelling (Private Residential)
R9	Residential Dwelling (Private Residential)
R10	Residential Dwelling (Private Residential)
R11	Residential Dwelling (Private Residential)
R12	Residential Dwelling (Private Residential)
R13	Residential Dwelling (Private Residential)
R14	Residential Dwelling (Private Residential)
R15	Residential Dwelling (Private Residential)
R16	Residential Dwelling (Private Residential)
R17	Camp Ground Airly Gap (Passive recreational)
R18	Nissen Hut Genowlan Mountain (Permissive Occupancy)

Potential impacts of the Project upon the sensitive receptors identified in Table 2.4 have been assessed within the noise, air quality, visual and social impact specialist assessments.



LEGEND
- Project Application Area
- Rail
- Main Road
- State Forest
- National Park
- Centennial Land
- Crown Land
- Mugii Murum-Ban SCA
- Private Freehold Land

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

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REFERENCE	137623024-R Rev 0
SCALE	1:50,000

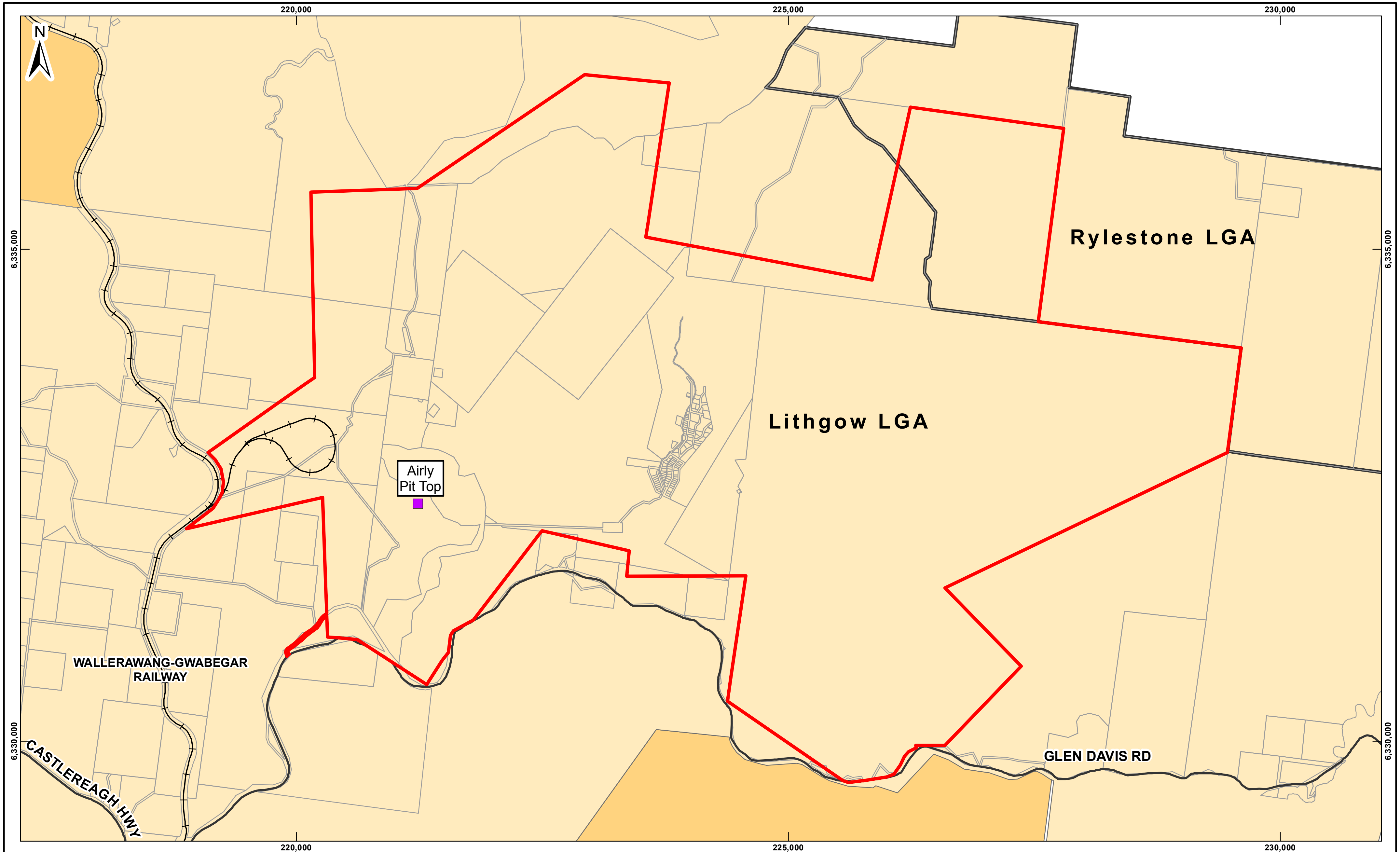
Figure 2.3: Land Ownership

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-2.3

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- Cadastral Boundary
- Rural (General) 1(a)
- Rural (Forestry) 1(f)
- Rural (General) 1(a) (Rylestone LEP)

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	15/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

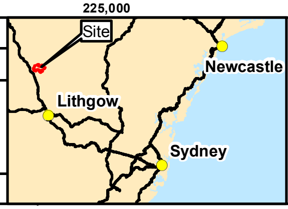


Figure 2.4: Land Zoning (Lithgow LEP 1994 and Rylestone LEP 1996)

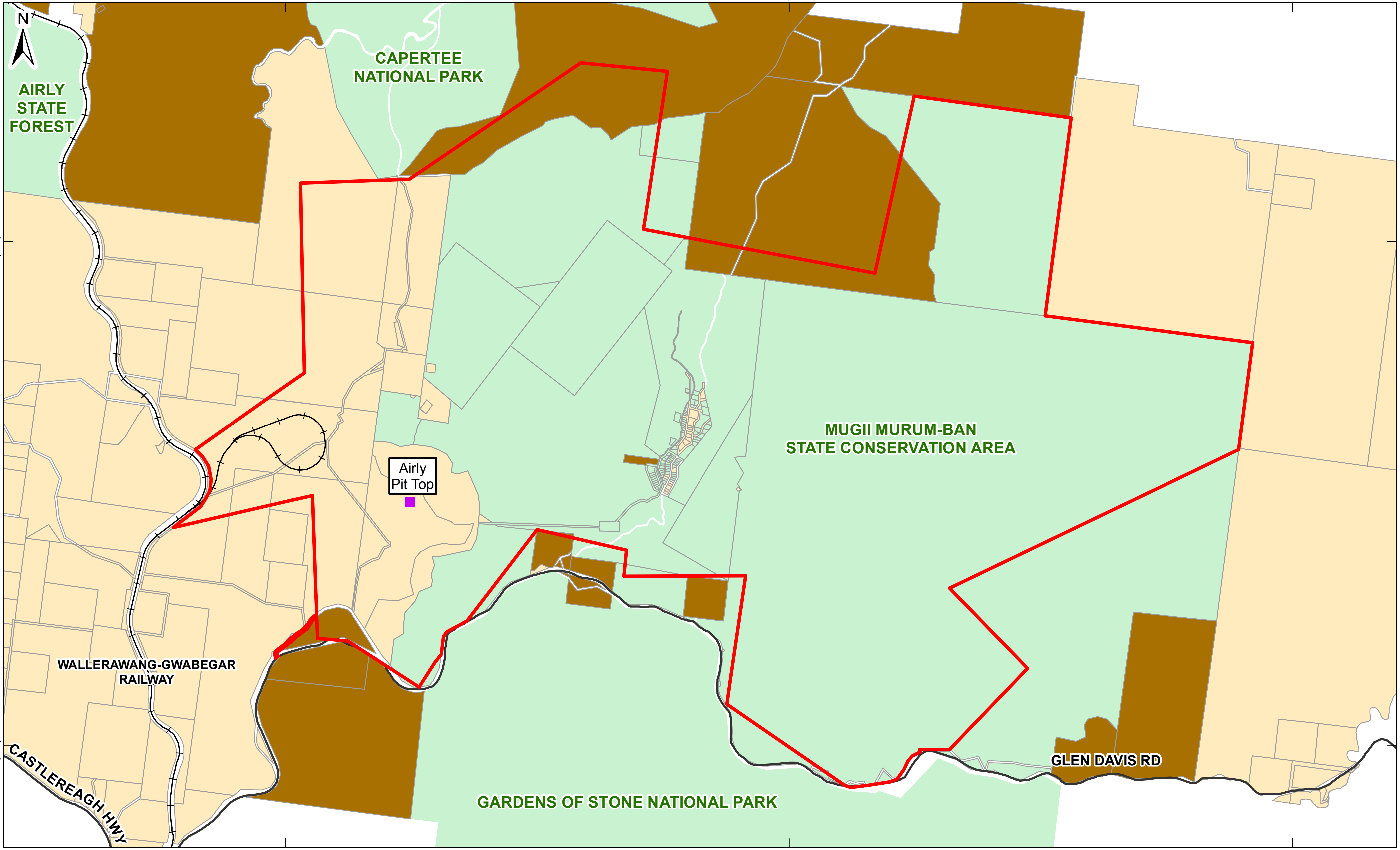
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-2.4

A4



LEGEND

- Project Application Area
- RU1 - Primary Production
- RU2 - Rural Landscape
- E1 - National Parks and Nature Reserves
- Cadastral Boundary
- Rail
- Main Road

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 2.5: Land Zoning (Draft Lithgow LEP 2013)

0 500 1,000 1,500 2,000 Metres

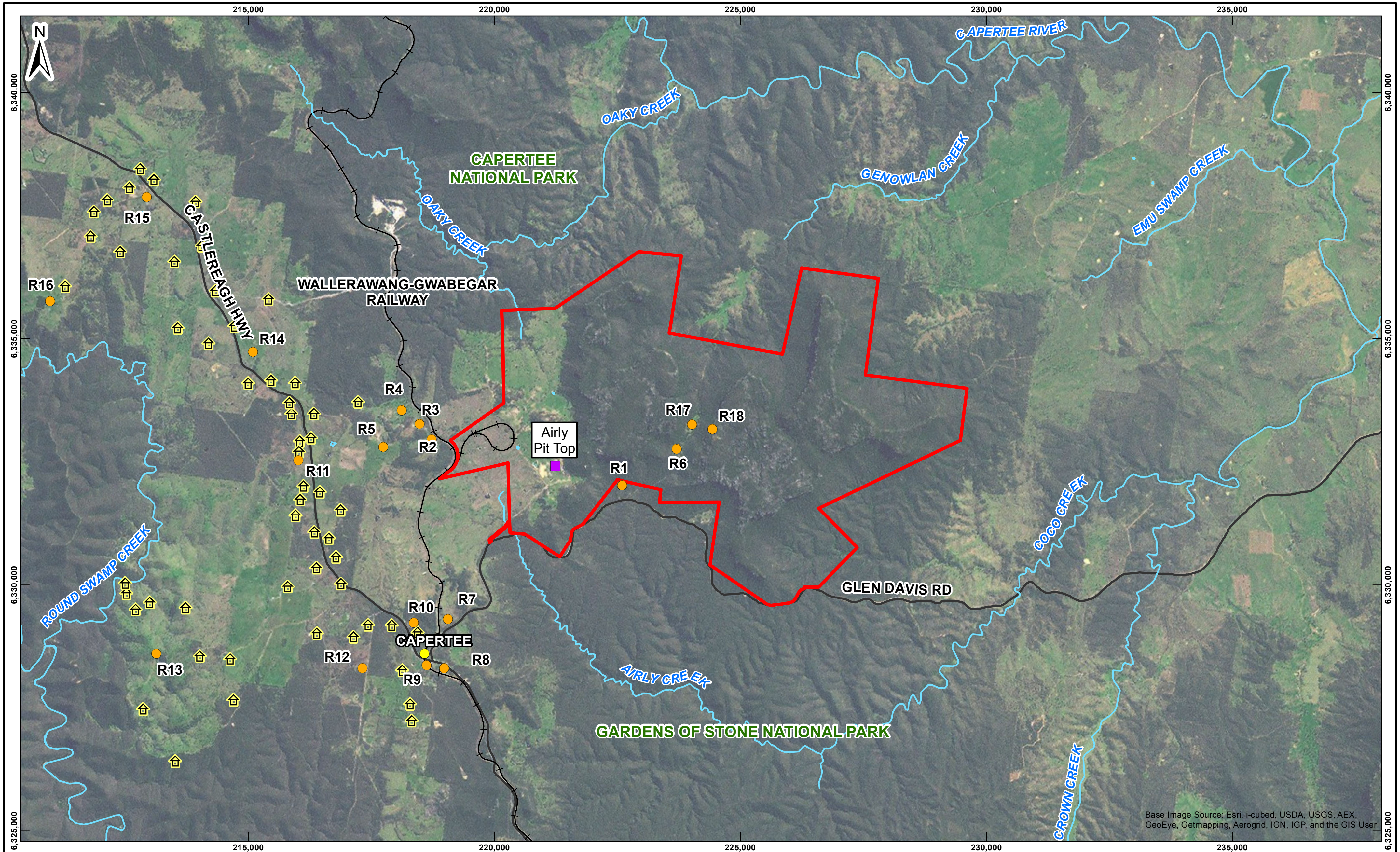
PLOTFILE No.

Centennial Coal

Airly

DRG No. 2-2.5

A4



LEGEND

- Project Application Area
- Town
- Sensitive Receptor
- Private Residential Dwelling
- Watercourse
- Rail
- Main Road

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:100,000

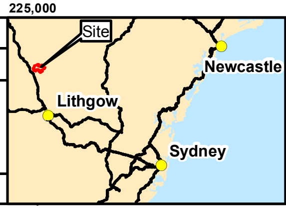


Figure 2.6: Sensitive Receptor Locations

0 1 2 3 4 km

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-2.6

A4

2.6 Hydrology

2.6.1 Surface Water

Watercourses within the Project Application Area include four sub-catchments as follows:

- The Torbane - Oaky Creek sub-catchment
- The Airly - Coco Creek sub-catchment
- The Gap - Genowlan Creek sub-catchment
- The Emu Swamp Creek sub-catchment

These watercourses as well as sub-catchment boundaries are show in Figure 2.7. All sub-catchments drain into the Capertee River, which flows in a south-easterly direction and is a tributary of the Colo River, which ultimately flows into the Hawkesbury River and Broken Bay.

The northwest section of the Project Application Area is drained by the Torbane-Oaky Creek system. Torbane Creek joins Oaky Creek approximately 2 km downstream of the Project Application Area boundary. Approximately 518 ha of the Torbane Creek catchment and 71 ha of the upper Oaky Creek catchment lie inside the Project Application Area.

The Airly-Coco Creek system drains the southern sector of the Project Application Area. The headwaters of the Coco Creek are located in the south of the area. Airly Creek rises in the south western section of the Project Application Area. This system enters the Capertee River approximately 12 km upstream of Glen Davis. Approximately 1,400 ha of the Project Application Area drain into Airly-Coco Creek. Centennial Airly is currently licensed under the Environment Protection Licence (EPL) 12374 to discharge water to Airly Creek. Based on water quality sampling data, Airly Creek is generally brackish and slightly alkaline in the vicinity of the Airly Mine surface facilities area. Median electrical conductivity (EC) is in the range 2,365 – 2740 µS/cm at surface water sampling locations, an order of magnitude higher than the ANZECC/ARMCANZ (2000) default trigger value for upland rivers. The water quality of Airly Creek is closely related to the natural geology of the catchment.

Surface flows in the north eastern sector flow eastwards via a series of drainage lines into Emu Swamp Creek, which drain into the Capertee River approximately 10 km downstream of the Project Application Area. Approximately 355 ha of the Project Application Area drains into Emu Swamp Creek catchment.

Surface runoff from the northern section of the Project Application Area drains into Gap Creek and Genowlan Creek. The two creeks, which are groundwater fed in parts, drain northward approximately 2 kilometres before converging into the greater Genowlan Creek. Genowlan Creek continues to drain in a north easterly direction until its confluence with the Capertee River approximately 8 km downstream. The Gap-Genowlan Creek sub-catchment occupies the largest portion of the Project Application Area with 1,558 ha draining to the creek system. Based on water quality sampling data, these creeks are generally fresh and slightly acidic.

All creeks within the Project Application Area are ephemeral and do not have surface water flow for the entire year. Generally, these watercourses flow for relatively brief period following significant rainfall events. Flows within Airly, Oaky, Coco and Genowlan Creeks become perennial outside the Project Application Area.

2.6.2 Groundwater

Within the Project Application Area five main sources of groundwater have been identified. Figure 2.8 provides a cross-section through the Project Application Area and adjacent areas showing conceptual groundwater flows. Stratigraphically, aquifers occur in the following strata (located in vertically descending order):

- alluvium
- Triassic sandstone strata
- Permian strata
- Shoalhaven strata
- Lower Devonian metamorphic strata.

The alluvium, Triassic and Permian aquifer systems are defined as localised sources of groundwater because they are isolated from the surrounding land by virtue of being elevated above the valley floor in the Mount Airly and Genowlan Mountain structures. The Shoalhaven and Devonian aquifers are defined as regional groundwater sources due to them being connected to the broader land mass of the valley floor.

Local groundwater sources within the Project Application Area have been classified as 'less productive' according to the NSW Aquifer Interference Policy (NSW Office of Water, 2012) since the yields are typically less than 5 L/s and/or the groundwater salinity exceeds 1,500 mg/L. These sources are less productive due to low yield rather than high salt levels.

The regional groundwater source in the Shoalhaven unit is classified as less productive due to high salinity exceeding 2500 mg/L. By contrast the Devonian groundwater source is classified as highly productive due to high yield and salinity of less than 1500 mg/L.

Given the highly differing water qualities between the various aquifers, the amount of interconnectedness between aquifers is limited.

The NSW Groundwater Bore Database lists 36 bores within 5 km of the Project Application Area. 35 of these are registered for domestic, irrigation and/or stock use and are located outside the Project Application Area. Bore locations are shown in Figure 2.9. The 36th registered bore is Centennial Airly's production bore (GW068640).

The registered domestic and stock bores primarily extract groundwater from the lower regional groundwater source (sandstone and conglomerate formations) to the east of the Project Application Area, with yields generally less than 2.5 L/s. Some registered bores are also located within Genowlan Creek alluvium to the north-east.

Alluvium Groundwater Sources

Alluvium is the soil and loose rock material that is located at the surface and overlies the rock mass below. This material dates in the Quaternary period from 2.5 million years ago to the present. The alluvium throughout the Project Application Area forms an unconfined shallow aquifer with groundwater ranging in depth from less than 1 m to over 5 m below ground level (bgl), and aquifer thickness generally less than 12 m.

The alluvium associated with Gap Creek and Genowlan Creek is generally a silty sand material and recharged from rainfall as well as seepage from adjacent (primarily Permian) strata.

A falling head test indicated a hydraulic conductivity of 0.11 m/day for alluvium at Gap Creek (test conducted at Airly Mine monitoring borehole ARP05). Based on water sampling undertaken at the site, the alluvium is fresh and slightly acidic.

Areas of Genowlan Creek and Gap Creek are fed relatively consistently by rainfall based flows which emerge from the Quaternary colluvium and alluvium. Although the source for this recharge is rainfall based, anecdotal evidence infers that these rainfall based flows are held in the Quaternary strata and released slowly into the upper reaches of Genowlan Creek above the “Grotto” and the “Oasis” areas (Figure 3.5), as well as in certain reaches of Gap Creek. Flows in the “Grotto” and Gap Creek vary with rainfall seasonality (as indicated by existing flow gauges) whereas anecdotally the flows through the “Oasis” are more persistent, varying from approximately 2.2 L/s in average conditions to 1 L/s during drought.

There are no human users of this groundwater source within the Project Application Area.

Narrabeen Sandstone and Permian Groundwater Sources

The local porous and fractured rock groundwater sources include the Narrabeen Sandstone and coal seams of the Illawarra Coal Measures. These sources are recharged by rainfall via fractures within overlaying strata, and seep out of the side of the mountains or directly into watercourses.

Packer testing and falling head testing reported by RPS (2014a) indicate the following hydraulic conductivities for these groundwater sources.

- Narrabeen Sandstone: 0.002 – 0.15 m/day (based on two packer tests at ARP01, one packer test at ARP02A and one falling head test at ARP03A).
- Lithgow Seam: 0.02 – 0.08 m/day (based on packer tests at ARP01 and ARP04 and falling head tests at ARP02A and APR03A).

These aquifers also provide baseflow to the surface stream systems on Mount Airly and Genowlan Mountain and are the major contributor to baseflow compared to the baseflow derived from the alluvium. The Narrabeen Sandstone is a greater contributor to baseflow in the streams than the Permian strata due to the relatively higher permeability of the rock mass.

There are no human users of this groundwater system either within or external to the Project Application Area. A single registered surface water licence exists downstream of the Project Application Area on Genowlan Creek.

Shoalhaven Groundwater Source

The upper regional groundwater source occurs within siltstone and sandstone of the Shoalhaven Group that underlies the Permian strata. This stratum lies approximately 5 m below the floor of the Lithgow Seam and is generally 100 – 150 m thick. According to the Western Coalfield (Southern Part) Regional Geology 1:100,000 map, this rock formation was deposited in a marine environment and therefore the groundwater is highly brackish to saline with salt content in excess of 2500 mg/L. This groundwater source is classified as less productive as a result. The existing production bore at the Airly Mine surface facilities area is installed within this groundwater source. The recharge area is predominantly to the west of the Project Application Area where the Shoalhaven Group outcrops. Groundwater flow is generally to the east.

Packer testing for the Shoalhaven Group indicates a low hydraulic conductivity in the order of 0.0003 m/day at monitoring borehole APR04 (i.e. 570 m AHD). However, pumping tests undertaken at the production bore in 2009 indicate a much higher hydraulic conductivity in the order of 0.3 m/day (at an elevation of approximately 700 m AHD). There are no users of this groundwater system within the Project Application Area other than Airly Mine.

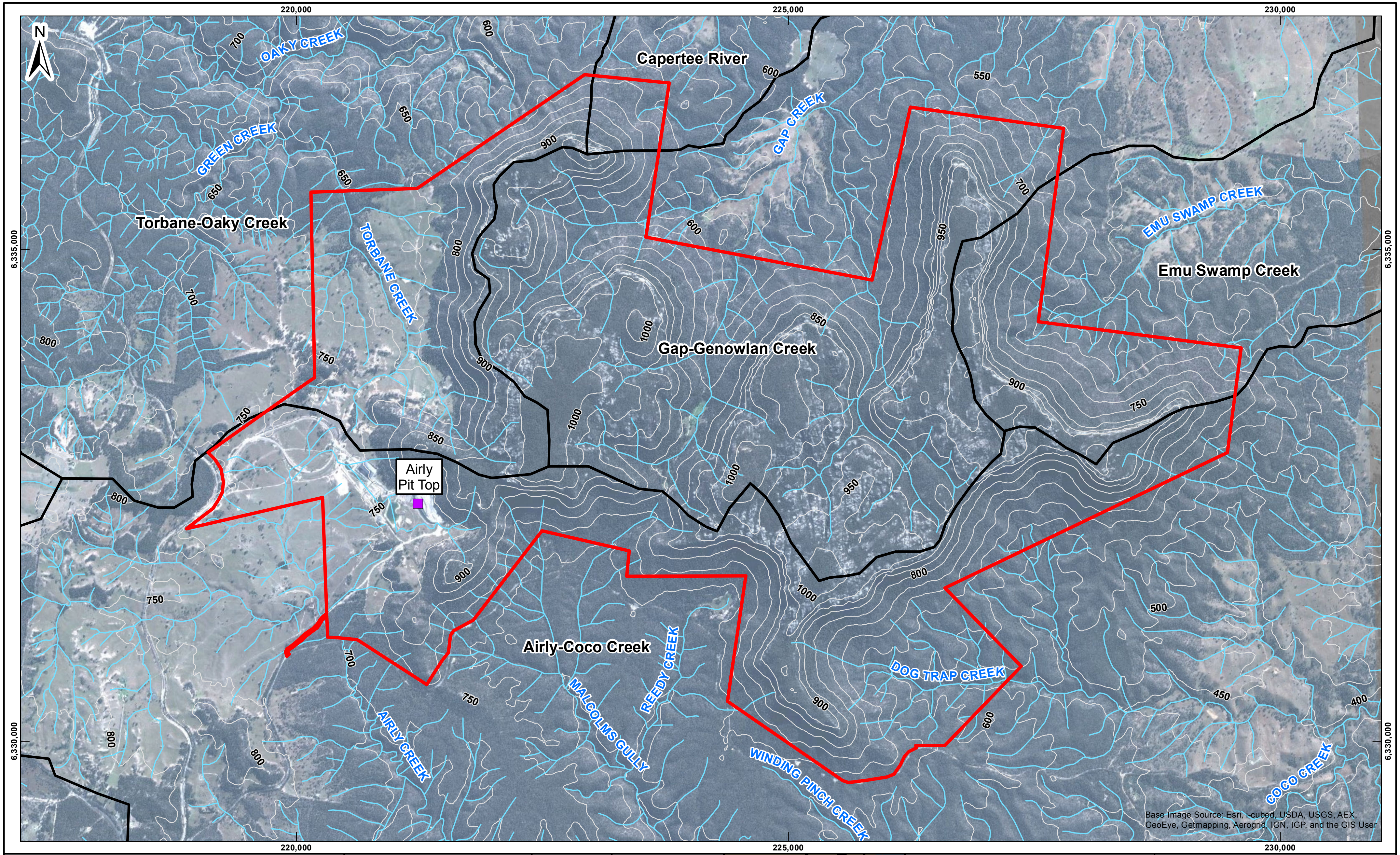
Devonian Groundwater Source

Below the Shoalhaven Strata lies a ‘highly productive’ groundwater source within Devonian metamorphic strata containing shale, sandstone and limestone. Recharge areas occur to the north, south and east of the Project Application Area and groundwater flow is generally to the east.

Groundwater Users

A search of the NSW Groundwater Bore Database was undertaken to identify registered bores within a 5 km radius of the Project Application Area. The search identified 36 bores, with the majority (35) being registered for domestic, irrigation and / or stock use and one registered as a test bore. Bore locations are shown in Figure 2.9.

The registered domestic and stock bores that were identified primarily extract groundwater from the lower regional groundwater source (sandstone and conglomerate formations) to the east of the Project Application Area, with yields generally less than 2.5 L/s. Some registered bores are also located within Genowlan Creek alluvium to the northeast. The closest registered bores are at least 1 km from the Project Application Area.



LEGEND

- Project Application Area
- Catchment Boundary
- Watercourse
- Contour - 50m Interval

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	17/04/2014
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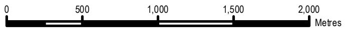
Figure 2.7: Sub Catchment Areas



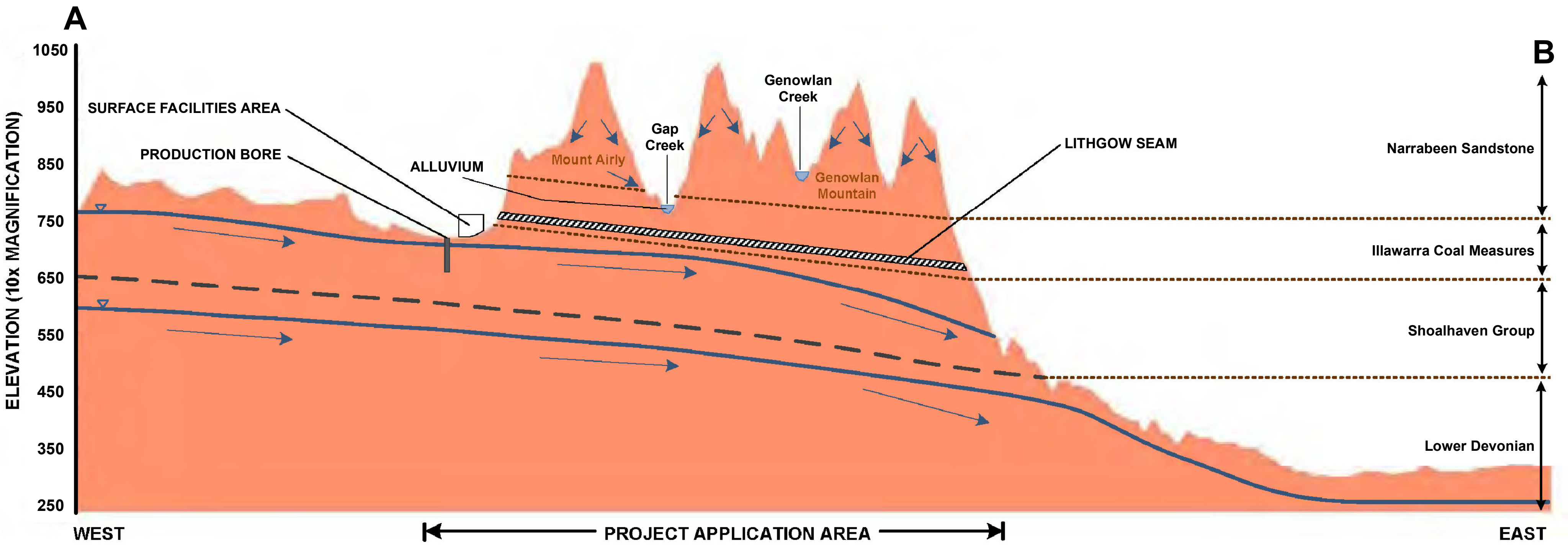
PLOTFILE No.

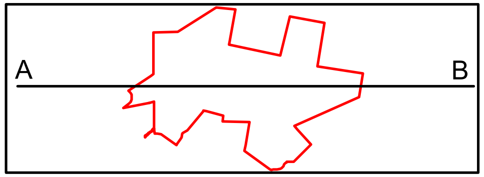
Centennial Coal

Airly

DRG No. 2-2.7

A4





DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

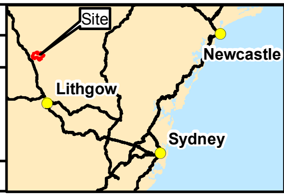


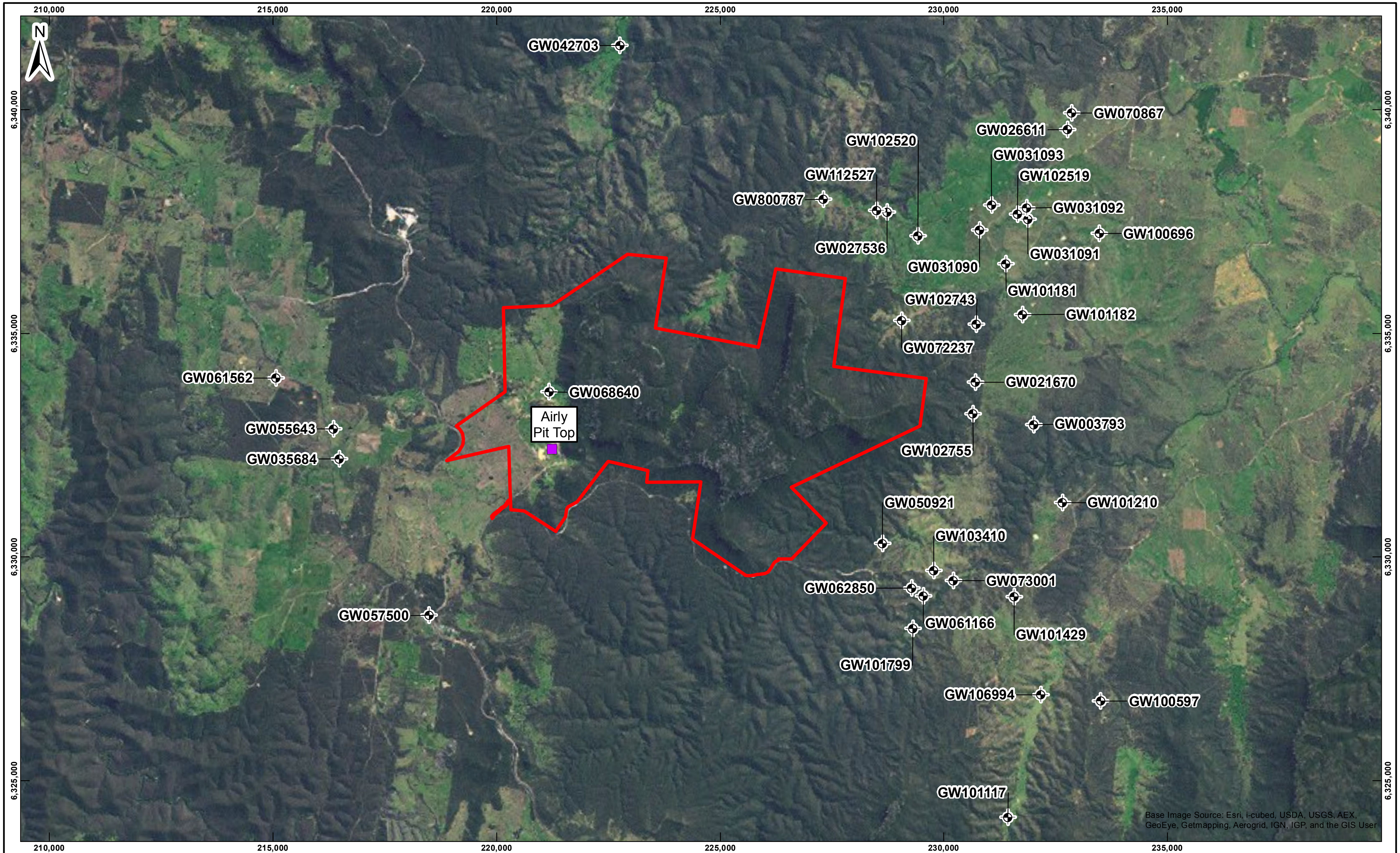
Figure 2.8: Local and Regional Groundwater Flow

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-2.8

A4



LEGEND

Project Application Area

Registered Groundwater Bore

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:110,000

Figure 2.9: Registered Groundwater Bore Locations

0 1,000 2,000 3,000 4,000 Metres

PLOTFILE No.

Centennial Coal

Airly

DRG No. 2-2.9

A4

2.7 Ecology

2.7.1 Vegetation Communities

Thick native vegetation dominates the upper regions of the Project Application Area. Vegetation communities were mapped using desktop analysis and vegetation surveys to define and map vegetation communities and to search for threatened flora species. The vegetation mapping is consistent with DEC (2006). The following vegetation communities were recorded within the Project Application Area:

- MU2 Mountain Gully Grey Myrtle Dry Rainforest
- MU3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum – Broad-leaved Hickory Moist Forest
- MU4 Sheltered Gully Brown Barrel Ferny Forest
- MU10 Capertee Residual Basalt Brittle Gum - Stringybark Layered Open Forest
- MU13 Tableland Gully Ribbon Gum - Blackwood - Apple Box Forest
- MU20 Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands
- MU21 Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest
- MU27 Mount Airly Sydney Peppermint - Narrow-leaved Stringy - Grey Gum Shrubby Open Forest
- MU29 Sandstone Slopes Sydney Peppermint Shrubby Forest
- MU32 Tableland Scribbly Gum -Narrow-leaved Stringybark- Shrubby Open Forest
- MU38 Capertee Grey Gum - Narrow-leaved Stringybark - Scribbly Gum - Callitris - Ironbark Shrubby Open Forest
- MU40 Capertee Slopes Red Ironbark - Red Stringybark - Narrow-leaved Stringybark Shrubby Woodland
- MU42 Capertee Hills White Box - Tumbledown Redgum - Ironbark - Callitris Shrubby Woodland
- MU43 Pagoda Rock Sparse Shrubland
- MU44 Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath
- MU47 Genowlan Point Dwarf Sheoak Heathland
- MU54 Capertee - Wolgan Riparian Rough-barked Apple - River Oak Open Forest
- MU58- Acacia Thicket
- MU62 Cleared and Severely Disturbed Lands.

Two EECs were also recorded within the Project Application Area, as listed below:

- Genowlan Point *Allocasuarina nana* Heathland (TSC Act)
- White Box – Yellow Box – Blakely’s Red Gum Woodland (TSC Act), and White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).

2.7.2 Threatened Flora and Fauna

Literature reviews and database searches including OEH's Atlas of NSW Wildlife (TSC Act) and EPBC Act (Protected Matters Search Tool) reveal 25 threatened flora species and 55 threatened fauna species within 10 km of the Project Application Area that are listed under the TSC Act and/or the EPBC Act. Listed species and their distribution across the Project Application Area are provided in Section 10.2.

Threatened Flora Species

Those threatened plant species identified from literature reviews, field surveys and database searches that have been assessed on the likelihood of occurrence of potentially occurring within the defined Project Application Area based on suitability of habitat are listed in Section 10.2.3. Three threatened flora species were observed within the Project Application Area during field surveys and include:

- *Eucalyptus cannonii*; (Capertee Stringybark)
- *Prostanthera stricta;* (Mount Vincent Mint Bush)
- *Pultenaea* sp. Genowlan (Genowlan Point Pultenaea).

Eucalyptus cannonii and *Prostanthera stricta* are listed as Vulnerable under both the TSC Act and EPBC Act, whereas *Pultenaea* sp. Genowlan Point is listed as Critically Endangered under both the TSC Act and EPBC Act. All three species occur above the proposed mining area.

Threatened Fauna Species

Fauna species identified from literature reviews, database searches (both TSC Act and EPBC Act listed species) and field surveys that are known to occur within the Project Application Area, based on suitability of habitat include the following:

- *Varanus rosenbergi (*Rosenberg's Goanna)
- *Anthochaera Phrygia* (Regent Honeyeater)
- *Callocephalon fimbriatum (*Gang-gang Cockatoo)
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo)
- *Chthonicola sagittata* (Speckled Warbler)
- *Climacteris picumnus victoriae (*Brown Treecreeper (eastern subspecies))
- *Daphoenositta chrysoptera (*Varied Sittella)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Grantiella picta* (Painted Honeyeater)
- *Melithreptus gularis gularis* (Black-chinned Honeyeater eastern subspecies)
- *Ninox strenua (*Powerful Owl)
- *Pachycephala inornata (*Gilbert's Whistler)
- *Petroica boodang (*Scarlet Robin)
- *Petroica phoenicea (*Flame Robin)
- *Pomatostomus temporalis temporalis (*Grey-crowned Babbler (eastern subspecies))

- *Stagonopleura guttata (*Diamond Firetail)
- *Tyto tenebricosa* (Sooty Owl)
- *Tyto novaehollandiae* (Masked Owl)
- *Chalinolobus dwyeri (*Large-eared Pied Bat)
- *Dasyurus maculatus maculatus* (Spotted-tailed Quoll)
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Myotis macropus* (Southern Myotis).

Listed species and their distribution across the Project Application Area are provided in Chapter 10.0, Section 10.2.

2.8 Climate

The climate in the region is typical of a cool temperate mountain climate, characterised by cold winters and warm summers. The highest temperatures occur throughout December, January and February, with the coolest temperatures occurring in July. Snow and/or sleet are common in winter months.

2.8.1 Data Sources

Daily rainfall data was obtained as SILO Patched Point Data from Queensland Climate Change Centre of Excellence has been used in the EIS to consider the long-term wet and dry conditions of the Project. SILO Patched Point Data is based on historical data from a particular Bureau of Meteorology (BoM) station with missing data 'patched in' by interpolating with data from nearby stations. For this assessment, SILO data was obtained from BoM Ilford (Warrangunyah) Station (station number 62031), which is located approximately 29 km northwest of Airly Mine. This station was chosen based on the length and quality of the data recorded and proximity to the Project.

CALMET modelling was conducted to obtain air data (wind speed and direction). Hourly surface meteorological data from the BoM stations located at Nullo Mountain AWS, Mudgee Airport AWS, Bathurst Airport (BoM 2013) AWS and Mount Boyce AWS were incorporated in the CALMET model.

Representative temperature data for the area has been obtained from the BoM weather station located at Lithgow Newnes Forest Centre (Station 0630621). Data shows that the Project Application Area experiences a warm summer/cold winter temperature pattern with an average rainfall of an average maximum temperature range of 9.4 degrees Celsius (°C) in July to 23.5°C in February.

2.8.2 Temperature and Rainfall

The region has a cool temperate mountain climate, which is characterised by cold winters and warm summers. The warmest month of the year is January with a mean maximum temperature of 28.5°C and a mean minimum of 13.6°C. The coolest monthly is July with a mean maximum temperature of 11.8°C and a mean minimum temperature of 0.9°C.

The period of rainfall data used for this assessment extended from January 1901 to December 2012 and is summarised as annual totals in Figure 2.10. The statistics for the rainfall dataset are:

- minimum annual rainfall - 277 mm in 1982
- average annual rainfall - 672 mm
- median annual rainfall - 659 mm
- maximum annual rainfall - 1513 mm in 1950.

The monthly rainfall averages ranged from a low of approximately 45 mm in May to a high of approximately 67 mm in January, averaged over the period of 112 years. Figure 2.11 shows a significant variation in the maximum recorded monthly rainfall with the maximum monthly value being approximately 304 mm in August and the lowest monthly value being approximately 150 mm in May.

Figure 2.10 Annual Rainfall Recorded at Ilford (Warrangunyah Station)

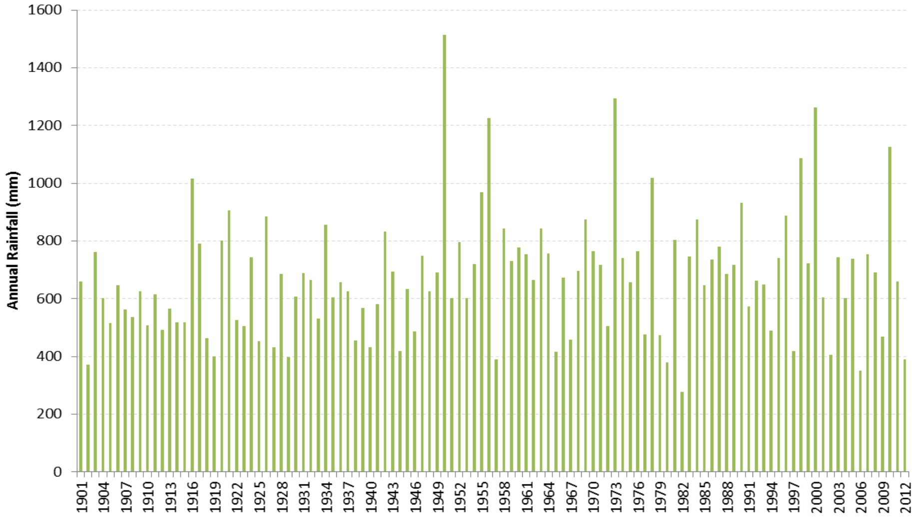
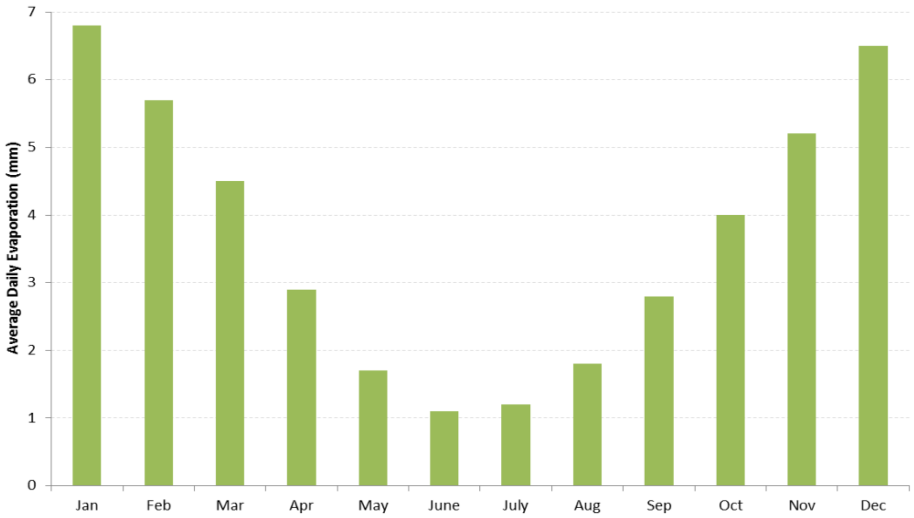


Figure 2.11 Monthly Rainfall Statistics for Ilford (Warrangunyah Station)



2.8.3 Wind

A summary of the annual wind behaviour predicted for the site by CALMET is presented in Figure 2.12, as Predicted by CALMET (2010). The frequency of the wind speed variation is presented in Figure 2.13.

Figure 2.12 and Figure 2.13 indicate that the site experiences predominately light to moderate winds (between 1.5 m/s and 8 m/s), with the prevailing wind direction from the south west quadrants. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur approximately 9% of the time during the year 2010.

The seasonal wind roses indicate that:

- in summer, the winds are light to moderate (1.5 m/s to 8 m/s) from the southern, eastern and west north western quadrant
- in autumn, winds are light to moderate (1.5 m/s to 8 m/s) from the southern and south western quadrant
- in winter, winds are light to high (1.5 m/s to 10.5 m/s) and are predominantly from the south western quadrant
- in spring, winds are light to moderate (1.5 m/s to 8 m/s) from the west southwest and west north western quadrants.

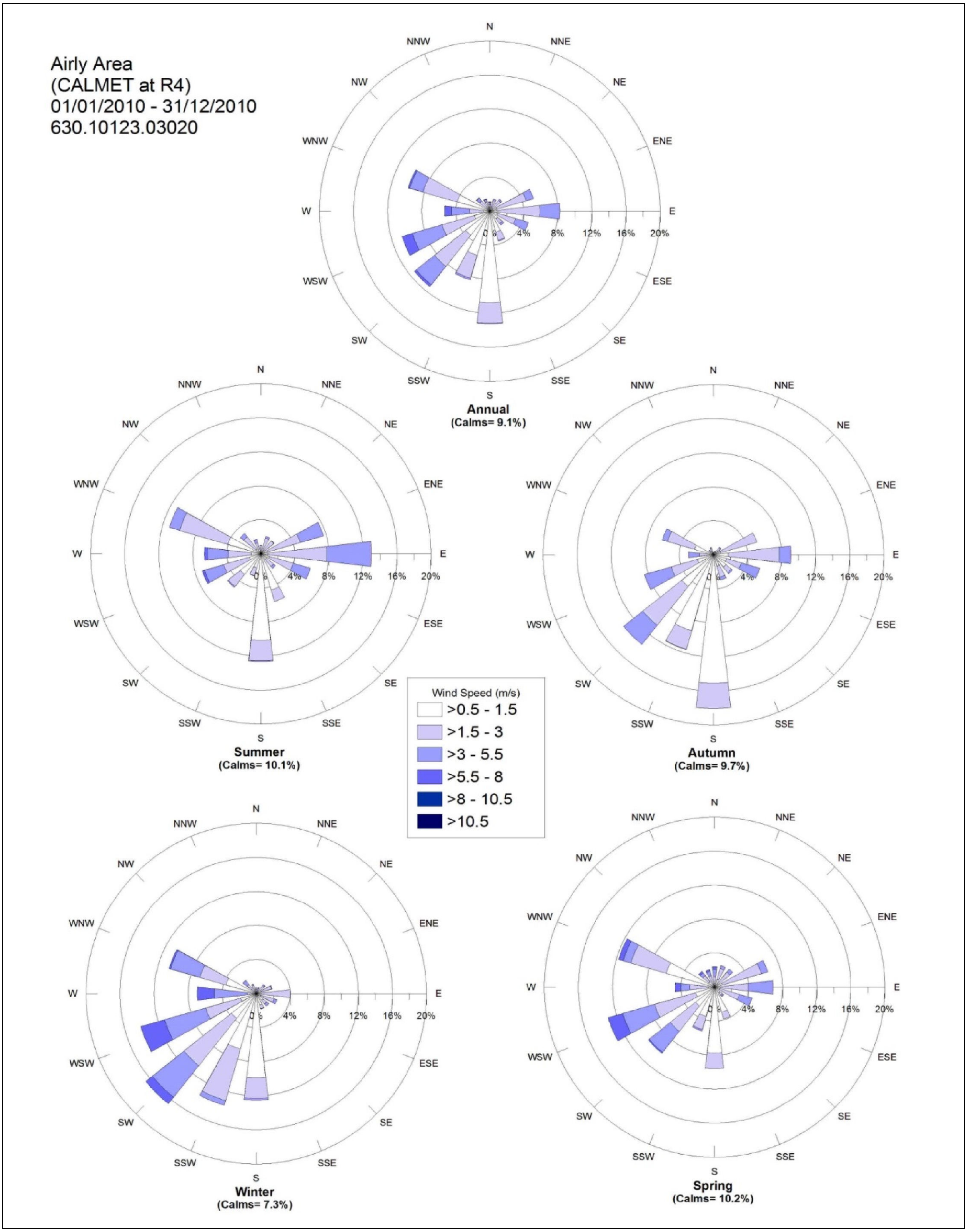
2.8.4 Atmospheric Stability Classes and Temperature Inversion

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 (Table 2.5). These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models.

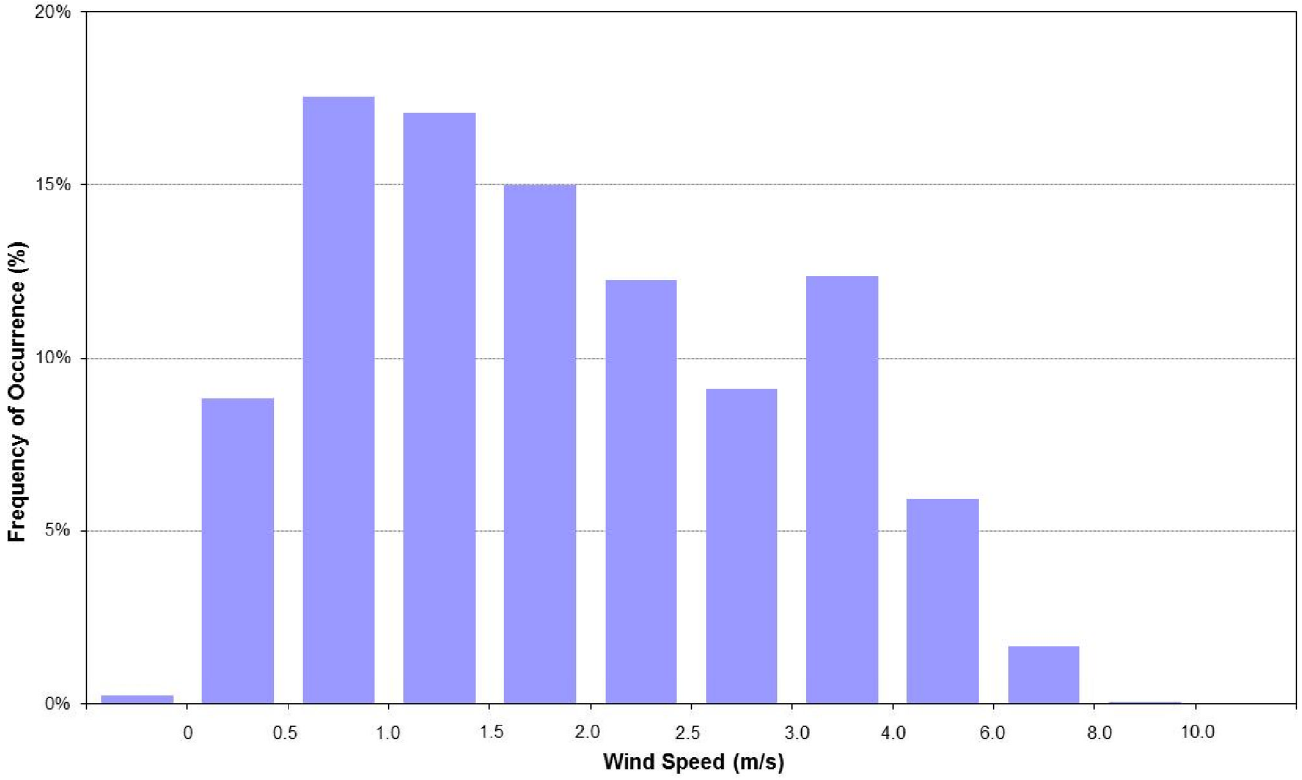
Table 2.5: Atmospheric Stability Classes

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

The Project Application Area has a high frequency Stability Class F, which is indicative of very stable night time conditions, conducive to a low level of pollutant dispersion due to mechanical mixing resulting in higher pollutant concentrations.



CENTENNIAL AIRLY PTY. LTD.	DATE	17/04/2014	**Figure 2.12: Wind Rose for the Project Site as Predicted by CALMET (2010)**	PLOTFILE No.	
THIS DRAWING IS COPYRIGHT	SEAM	LITHGOW		Centennial Coal Airly	
NO PART OF IT IN ANY FORM OR BY ANY MEANS (ELECTRONIC, MECHANICAL, MICRO-COPYING, PHOTOCOPYING OR OTHERWISE) BE REPRODUCED, STORED IN A RETRIEVAL SYSTEM OR TRANSMITTED WITHOUT PRIOR WRITTEN PERMISSION	REFERENCE	127623060-R Rev 0			
	SCALE	NOT TO SCALE		DRG No. 2-2.12	A4



DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Figure 2.13: Wind Speed Distribution Predicted by CALMET (2010) for the Project Site

PLOTFILE No.

Centennial Coal
Airly

DRG No. 2-2.13

A4

CHAPTER 3.0

Existing Mine Operations

3.0 EXISTING AND APPROVED MINE OPERATIONS

3.1 History of Coal Exploration and Mining at Airly Mine

A coal exploration program was commenced at Airly Mine in 1984 by Novacoal Australia Pty Limited consisting of 24 boreholes and field surveys of the old Torbane Colliery workings. The program established the economic significance and the extent of the coal resource in the region.

In 1987, a bulk sample operation was established near the existing pit top area to verify the initial exploration data and to determine appropriate underground mining sections and methods. This bulk sampling was completed over six months and produced 26,000 tonne of coal. All coal was loaded onto trucks and transported to the former Western Main Colliery at Blackmans Flat (now the Springvale Coal Services Site, operated by Springvale Coal Pty Limited) where it was tested for quality and washability.

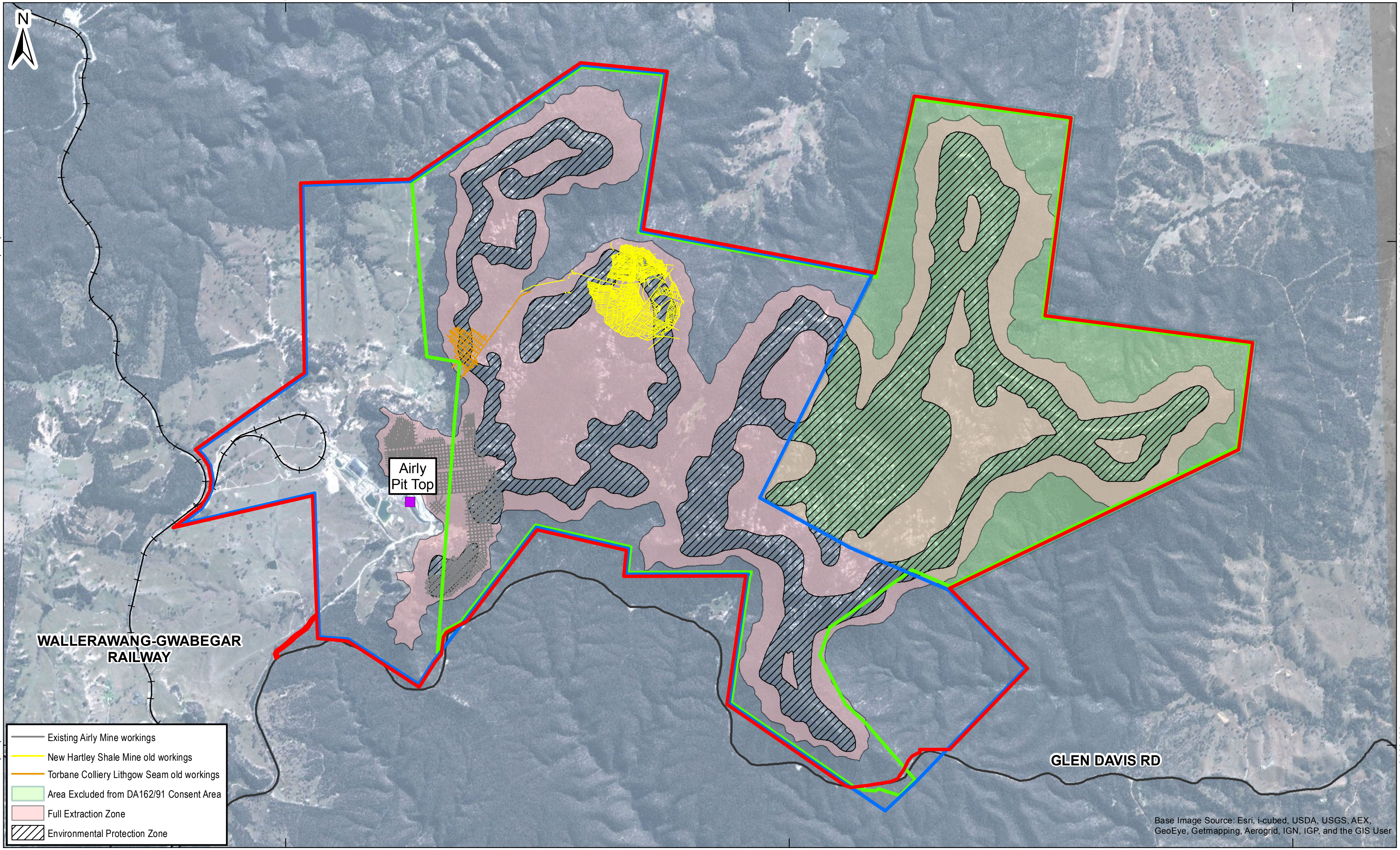
As a result of the initial exploration work and bulk sample program, an *Environmental Impact Statement* in support for a development application for the Airly Coal Project was prepared and submitted to the then Department of Planning on 28 October 1991 by Novacoal Australia Pty Limited (Novacoal 1991). On 15 September 1992 the then Minister of Planning, the Hon Robert Webster MP, established a Commission of Inquiry to examine and make recommendation in respect of the Airly Coal Project development application. An addendum, titled *Supplementary Report to Environmental Impact Statement* (Novacoal 1992) was prepared during the Commission of Inquiry proceedings. Following the Commission of Inquiry, development consent for the Airly Coal Project was granted by the then Minister for Planning on 14 April 1993. However, as part of the Commission of Inquiry process, the eastern part of the proposed mining area for the Airly Coal Project (that would have extended mining beyond 21 years) was removed from the development consent area. This area was identified as being the subject of a potential future separate development application post the 21 year consent expiry. This eastern area is shown in Figure 3.1.

The development consent (DA 162/91) permitted a 1.8 Mtpa production underground mine with transport of coal from the full production mine by rail. It also allowed trial mining at the mine with approval to transport 300,000 tonne of ROM coal by road to the Mount Piper Power Station for twelve months. Centennial Coal purchased the Airly Coal Project in late 1997 and commenced construction on 3 March 1998. In May 1998, the main pollution control ponds, access road, Airly Creek crossing and culverts and the initial pit top facilities were completed. The approved trial mining operation was developed in 1998 and the coal was transported to Mount Piper Station in December 1998. In 1999, the development consent was modified to allow up to 500,000 tonne of coal to be transported by road to Mount Piper Station for a period of two years after which the mine was then placed on care and maintenance.

In mid-2008, Centennial Coal commenced detailed planning for the future development and operation of the mine. In February 2009, the construction of the rail loop and permanent infrastructure to support the mine into its full operational phase commenced. The constructions works, undertaken within the approved footprint, took into consideration contemporary environmental standards.

The first full scale coal production occurred on the 14 December 2009, with the first train load of coal leaving Airly on 22 April 2010 destined for export via Port Kembla. Production gradually increased during 2011 with the construction of mine infrastructure, ventilation fans and the underground to surface trunk conveyor.

Coal production continued to increase during 2012 with Airly Mine passing the first million tonnes of coal mined in June 2012. Total production during the 2012 Annual Environmental Management Reporting period was 731,250 tonne (Centennial 2012c). Construction works at Airly Mine has been ongoing. Construction during 2012 included the completion of the pit top bathhouse and administration buildings, and the effluent treatment facility. Figure 3.1 displays the current development consent area and the proposed Project Application Area for the Project.



LEGEND

- Project Application Area
- ML1331 Current Lease Boundary (Offset for Clarity)
- A232 Authorisation Boundary (Offset for Clarity)
- Rail
- Main Road

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 3.1: Approved (DA162/91) Mining Zones

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 3-3.1

A4

3.2 Existing Approvals

The approvals, authorities and licences under which Airly Mine operates are outlined in Table 3.1. The existing infrastructure at the pit top is shown in Figure 3.1.

Table 3.1: Airly Mine Approvals, Authorities and Licences

Title	Description	Issue/Consent Date	Expiry Date
Lease			
Authorisation No. 232	Covers an area of approximately 3,054 ha and allows for prospecting activities with depth restriction from surface to 900 m below AHD where it is not underlain by ML1331.	1980 Renewed 03/06/10	20/10/14
Mining Lease ML1331	Covers approximately 2,744 ha and generally excludes the surface down to 20 m, but includes the surface down to unlimited depth in the areas where surface infrastructure is present or has been approved.	12/10/93	12/10/14
Consents			
Development Consent (DA 162/91)	The Development Consent DA162/91 as granted, allows for the following activities: ■ the construction and operation of an underground coal mine ■ development of a twelve month Trial Mine to demonstrate new technologies and prove that economic production rates can be achieved ■ full scale mine development following the Trial Mine phase at the rate of 1.8 Mtpa ROM coal from the Lithgow Seam beneath both Mount Airly and Genowlan Mountain ■ extraction of coal by both partial and full extraction techniques beneath defined areas ■ all product coal haulage by rail, except for 300,000 tonnes of which is to be transported via road from the trial mining to Mount Piper Power Station. ■ construction and operation of coal handling and transport systems comprising the pit top area and rail loading facilities as follows: ▪ a rail loop linking to the Wallerawang-Gwabegar rail line ▪ construction of a coal preparation plant (washery) and the associated coal transfer and storage infrastructure including conveyors, stockpile areas, rail loading bin ▪ reject material management facilities on site comprising a tailings dam and the associated settling ponds for fine reject materials and a course Reject Emplacement Area. ■ construction of associated surface buildings and services ■ modifications to facilities at Wallerawang Colliery Siding, by upgrading to a rail loop with unloading facilities ■ establishment of mine access	14/04/93	Limited to 21 years from the granting of the Mining Lease (ML 1331) Expires 12/10/14

Title	Description	Issue/Consent Date	Expiry Date
	■ at the pit top, a rail loop linking to the Wallerawang-Gwabegar rail line ■ construction of a coal handling and preparation plant, a tailings dam and associated settling pond and a coarse rejects emplacement area. A condition of the consent was to establish the Special Monitoring Committee comprising representatives nominated by: ■ Lithgow City Council (Chair) ■ Department of Trade & Investment, Regional Infrastructure & Services ■ Office of Environment and Heritage (National Parks and Wildlife Service) ■ Capertee & District Progress Association ■ Colong Foundation for Wilderness ■ Colo Committee ■ Capertee Valley Alliance Inc. ■ Capertee Valley Environmental Group Inc. ■ Airly Mine Environmental Officer.		
Consent (DA162/91) MOD 1	The first modification allowed for the following: ■ extension of the Trial Mine phase from twelve months to two years ■ increased road haulage of ROM coal from 300,000 tonnes to 500,000 tonnes of ROM coal per year to Mount Piper Station for a maximum period of two years ■ minor additional modifications in relation to establishment of the access road to the pit top.	07/12/99	Expires 01/07/00
Consent (DA162/91) MOD 2	The second modification allowed for the following: ■ establishment of a 15 m wide easement for the full length (approximately 3.85 km) of the proposed power-line route ■ construction of 66 kV power-line with the easement including: ▪ installation of poles and stays, insulators, fittings and conductors ▪ construction of barriers at road crossings ▪ circuit metering yard ▪ connection to the Integral Energy take-off point; ▪ construction of a maintenance track within the easement; ▪ ground disturbance (for excavation of footings, construction, and maintenance track) and tree clearing.	21/08/09	12/10/14
Environmental Protection Licence			
Environmental Protection	Requirements to monitor dust and water discharge quantity/quality from the identified Licensed Discharge Points	Granted on 12/12/05	12/12/08 (review date)

Title	Description	Issue/Consent Date	Expiry Date
Licence (EPL) 12374	(LDPs) LDP001.		
EPL 12374 Variation	The licence was varied to allow for the following: ■ alignment of scheduled and fee based activities ■ updating of conditions to reflect current best practice.	18/08/09	12/12/13
EPL 12374 Variation	The licence was varied for the following reason. ■ The Licensee must conduct a site specific Best Management Practice determination to identify the most practicable means to reduce particle emissions.	19/12/11	19/12/16
EPL 12374 Variation	The licence was varied to allow for the following: ■ Category for Mining for coal increased to >500,000 – 2,000,000 tonne ■ Two new additional licenced discharge points (LDP002 and LDP003) ■ pH range changed at licenced discharge points to 6.5 – 9.0.	31/08/12	31/08/17 due for renewal
Groundwater Monitoring Bore Licences			
Licence No.10BL604518	ARP01	14/02/11	Perpetuity
Licence No.10BL604520	ARP02A & ARP03A	14/02/11	Perpetuity
Licence No.10BL604521	ARP04 & ARP05	14/02/11	Perpetuity
Licence No.10BL605352	ARP06, ARP07, ARP08 & ARP09	28/03/13	Perpetuity
Ground Water Extraction Licences			
Water Access Licence (WAL24386)	Extract 158 ML per annum from Sydney Basin North Water Source	17/02/11	16/02/16
Water Access Licence (WAL36565)	Water Access Licence granted to extract 120 ML per annum in the Sydney Basin North Groundwater Source.	16/10/13	Perpetuity
Other Approvals			
Lithgow City Council (LCC) Building Approval	Covering trial mine construction.		Perpetuity
Consent to Destroy Aboriginal Artefacts	Covering a site discovered on the access road route.	13/03/98	Perpetuity
EPBC Act approval 7 May 2009	This approval covered minor tree removal as part of the construction of the rail loop.		Perpetuity
Installation of Surface Water Monitoring Stations	Approval for surface water monitoring stations located in the Mugii Murum-ban State Conservation Area.	24/09/12	Perpetuity
LCC Building	Occupation Certificate for the Administration and Bathhouse	29/11/12	Perpetuity

Title	Description	Issue/Consent Date	Expiry Date
Approval	buildings.		
Onsite Sewage Management System	Approval to operate the Ecomax effluent treatment system.	18/07/13	18/07/18

Table 3.2 provides an overview and comparison of the existing operations and those approved in the current Development Consent (DA162/91).

Table 3.2: Comparison of Approved and Existing Operations

Key Feature	Approved Operation	Existing Operations
Mine Life	■ Development consent (DA162/91) is limited to 21 years from the granting of ML1331 and expires on 12 October 2014.	As approved.
Hours of Operation	■ The mine operates 24 hours per day, 7 days per week, up to 52 weeks per year.	As approved.
Coal Production	■ Annual extraction limit of 1.8 Mtpa of ROM coal.	As approved.
Site Access	■ Mine Access Road, off Glen Davis Road at approximately 3 km from Capertee village.	As approved.
Mine Method and Design	The development consent: ■ stipulates no mining in the 50 m coal barrier (measured horizontally from the outcrop) ■ allows first workings only where the depth of cover is less than 50m ■ allows partial extraction beneath Environmental Protection Zones and full extraction in areas outside Environmental Protection Zones with supercritical void widths with: ▪ maximum subsidence of 1.8 m ▪ maximum tensile strains of 25.5 mm/m ▪ maximum compressive strains of 42.5 mm/m ▪ maximum tilt of 85 mm/m.	As approved, but only first workings have been undertaken.
Underground Mine Ventilation	■ one upcast shaft (vertical stack) located at the pit top. ■ air intake via surface portals located at the pit top box cut. ■ ventilation facilities approved at the approved Eastern Portal.	As approved, apart from the Eastern Portal that was not constructed.
Underground Mine Access	■ underground mine access is via a series of portals at the pit top box cut. ■ eastern portal.	The approved Eastern Portal was not constructed.
Airly Pit Top Infrastructure	■ bathhouse, office and assembly building ■ wash-down facilities ■ workforce, materials and ventilation portals ■ store building and training centre	As approved mostly with the exceptions of cable store, store building, roof bolt store and fire station which have not been built.

Key Feature	Approved Operation	Existing Operations
	■ bulk storage area ■ cable store ■ store building ■ roof bolt store ■ potable water provision ■ sewage treatment plant ■ hardstand areas, haul roads, car-parking areas and helicopter pad ■ diesel, fuel and oil storage area ■ refueling facilities ■ fire station/ compressor and associated fire-fighting equipment ■ compressor room ■ main ventilation fan ■ water management structures (for surface catchment and separation of clean and dirty water) i.e. sedimentation basins for storm water runoff; ■ electrical distribution network sub-station ■ workshop and service building.	
Employment	■ 120 personnel.	As approved.
Coal destination	■ Domestic power stations and overseas export.	As approved.
Coal Stockpiles	■ A 30,000 tonne ROM emergency stockpile ■ A 200,000 tonne Product Coal Stockpile.	As approved.
Coal Handling and Preparation Plant	■ The system of conveyors for ROM coal handling constructed to operate at 500 tph and used for the transfer of coal for the underground to the stockpile areas. ■ Coal Handling and Preparation Plant (CHPP) (500 tph) was approved.	The CHP part of the CHPP was constructed, but the CPP (500 tph) component with a dedicated ROM stockpile area was not constructed.
Reject Material Management	■ Approved for 4.3 Mt coarse REA and a tailings dam of 740,000 tonne capacity for fine reject materials.	The REA and tailings dam have not been constructed.
Electrical Services	■ 66 kV electricity line, Substation 0 and Substation 1	As approved.
Coal Transport	■ Transport of coal to offsite locations via rail. ■ Train loading facilities approved and constructed comprise: ▪ a rail loop ▪ a train load out station ▪ a rail surge bin.	As approved.
Land Preparation	■ Vegetation clearance and land preparation approved for the establishment of the pit top, REA, tailings dam, and Eastern Portal.	Land preparation not undertaken for the approved REA and tailings dam or the Eastern Portal as they were not constructed.

Key Feature	Approved Operation	Existing Operations
Water Management	■ A system of sediment dams or settling ponds, water storage dams and diversion drains for the separation of clean and dirty water at the pit top. ■ Clean water harvested from the surface run-off used as process water. ■ Process water supplemented from the production bore supply on an as-required basis. ■ Effluent treated on site.	As approved.
Rehabilitation and Final Landform	■ Progressive rehabilitation of disturbed areas no longer required. ■ Creation of a final landform which will be stable, aesthetically consistent with surrounding landforms. ■ Final land form does not preclude possible alternative final land uses.	Progressive rehabilitation as approved, however, life of mine rehabilitation not undertaken as yet.
Exploration activities	■ Exploration activities undertaken within A232 boundary. ■ Activity approval sought under Part 5 of the EP&A Act.	As approved.

3.3 Exploration Program

Airly Mine has an ongoing exploration program used to obtain specific geological information in terms of geotechnical conditions, coal seam quality and thickness, through core sampling. Information obtained is used for the ongoing refinement of the site's existing geological model which then allows detailed mine planning. The exploration program also allows the installation of piezometers in the aquifers of interest for ongoing groundwater monitoring.

All exploration activities are carried out in accordance with the requirements of the *Mining Act 1992.* Approval for the proposed exploration activities is currently sought under Part 5 of EP&A Act from Division of Resources and Energy (DRE) of Department of Trade & Investment, Regional Infrastructure and Services (DTIRIS) following the preparation of Review of Environmental Factors to assess the potential environmental impacts of the proposed activity.

Centennial Airly has developed area-based assessment procedures for the management of exploration activities to ensure that they are conducted in an environmentally responsible manner and with due consideration to the community. This includes a risk-based process for the selection, assessment and environmental management of proposed drillhole sites and access tracks based on environmental, geological, logistical and other operational constraints. The proposed exploration activities, planned outcomes of the program, locations of the drillhole sites and access tracks are reviewed in consultation with the land owner, National Parks and Wildlife Service. Final selection of exploration sites are made after environmental assessments undertaken and relocated to avoid environmental impacts that have been identified as unacceptable during the consultation process with the land owner. Potential impacts considered in the assessment process include:

- Native vegetation with particular focus on threatened or endangered species,
- Fauna species with particular focus on impacts to habitat for threatened or endangered species,
- Indigenous and non-indigenous heritage,
- Access for recreational use of the State Conservation Area,

- Noise from drilling and water delivery operations,
- Access for process water during drilling,
- Removal of waste during and following drilling in
- Ongoing access and monitoring requirements and
- Rehabilitation requirments for sites and access tracks.

Following vegetation clearing at the drillhole site, appropriate erosion and sediment controls are installed and maintained around disturbed areas in accordance with the Blue Book (Landcom, 2004). Felled trees are stockpiled for use in rehabilitation.

A series of above ground tanks are used to allow storage of cuttings and recycling of drilling fluid and process water. The drilling fluid and cuttings are pumped to the largest tank as they emerge from the borehole. Larger cuttings are settled and the drilling fluid cascades into a second tank where finer material is settled. The drilling fluid then cascades into a final container where make up water and additional drilling chemicals are added prior to being recycled down hole. Water required for drilling is sourced from the Airly Mine water management dams or other water storages as permitted by the land holder. Water is transported to the site by either truck or helicopter.

The drilling fluid is continuously pumped to the drill head to facilitate the removal of cuttings, stabilise the borehole, cool the cutting head and lubricate the drill head. All drilling fluid recovered that cannot be recycled is removed from site following OEH's *Waste Classification Guidelines* (DECCW 2009) by a licensed waste transporter to a receiving facility.

Spoils or cuttings generated during drilling are removed from the settling tanks as required and transported by truck to the mine site for storage. The cuttings are tested before being disposed of at a waste facility suitable for the category of material determined from the testing. Sealing of the drill holes is undertaken in accordance with the DTIRIS requirements.

Rehabilitation of the drill site commences soon after completion of drilling activity and follows on from decommissioning of equipment and removal of waste materials. Following re-profiling within the disturbed areas, the stockpiled topsoil is re-spread onto areas requiring rehabilitation, to a minimum depth of 0.1 – 0.3 m, depending on availability. Stockpiled cleared vegetation is spread over the re-profiled areas.

An inspection is conducted with the NPWS following rehabilitation to determine that rehabilitation has been conducted to the satisfaction of the land owner. Further work is carried out as required and land owner sign off is obtained.

3.4 Hours of Operation and Workforce

Airly Mine is approved to operate 24 hours a day, up to seven days per week. The approved workforce at Airly Mine is 120 personnel.

3.5 Site Access

The Airly Mine pit top is accessed via the Mine Access Road, which joins the Glen Davis Road approximately 3 km from the village of Capertee (Photograph 3.1). Glen Davis Road joins Castlereagh Highway in Capertee.

3.6 Land Preparation

Land preparation has been approved at the pit top coarse rejects emplacement area (REA), tailings dam and the eastern portal. All areas required for the construction of the surface facilities at the pit top have been cleared and managed in accordance with the current Airly Mine Mining Operations Plan (Centennial 2012e). The area approved for the REA was used for the construction of the ventilation system for the underground mine while the area approved for the tailings dam and the eastern portal remain uncleared as these components have not been established to date.

Land preparation during construction involved the clearing of vegetation, removal and stockpiling of topsoil, establishment of temporary and permanent water management systems, and temporary rehabilitation and surface stabilisation. Only minor clearing involving individual paddock trees was required for the pit top infrastructure.

The land preparation work was undertaken in accordance with a Contractor's Construction Environmental Management Plan (CEMP). The CEMP contained the following Environmental Management Plans:

- soil and water quality management plan
- flora and fauna Environmental Risk Assessment Plan (ERAP)
- air quality ERAP
- noise management plan
- archaeology and heritage control ERAP.

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	SEAM	LITHGOW	
	REFERENCE	137623024-R Rev 0	
	SCALE	NOT TO SCALE	

Photograph 3.1: Intersection of Mine Access Road and Glen Davis Road

PLOTFILE No.

Centennial Coal
Airly

DRG No. 3-P3.1 | A4

3.7 Mining

3.7.1 Trial Mining

As noted in Section 3.1, trial mining was undertaken at Airly Mine between 1998 and 2002. ROM coal up to 300,000 tonnes was transported via road haulage to Mount Piper Power Station over 12 months and this was followed by transport of 500,000 tonnes of ROM coal over an additional period of two years, again to Mount Piper Power Station.

3.7.2 Approved and Current Mining Method

The development consent DA 162/91 allows for the extraction of up to 1.8 Mtpa of ROM coal with the following conditions:

- no mining within the 50 m coal outcrop barrier (measured horizontally)
- first workings only where the depth of cover is less than 50 m where no measurable subsidence would occur
- partial secondary extraction within designated Environmental Protection Zones shown in Figure 3.1, again where no measurable subsidence would occur
- full extraction in remnant areas within the centres of Mount Airly and Genowlan Mountain (Figure 3.1) and where the subsidence was predicted to reach a maximum of 1.8 m.

Areas approved for full extraction are located generally within the centre of the Mount Airly and Genowlan Mountain mesa and include all areas outside the outcrop barrier and Environmental Protection Zones.

The development consent allows for both partial and full extraction areas to be first developed by continuous miners supported by shuttle cars. To date, only development or first workings have been carried out and only in areas with depth of cover of greater than 20 m and up to 160 m. Headings and roadways are developed to allow access to the coal resource.

Airly Mine currently utilises a combination of place changing and super panel development with continuous miners involving first workings to extract coal. Mining operations are designed and carried out with consideration to a number of mine constraints and in accordance with DA162/91 conditions. The principal constraint relates to the protection of designated 'Environmental Protection Zones' in accordance with Schedule 2, Condition 12 of DA162/91, from subsidence (Figure 3.1).

Prior to the commencement of mining, a geotechnical engineered mine design is developed with an appropriate pillar system factor of safety calculation for minimal subsidence impacts within the mining area. The factor of safety is calculated to be appropriate for long term stability after mining has been completed. Mining operations are then managed in accordance with the design developed to ensure that minimal impact occurs to the surface features.

To date the mining activities have consisted of first workings in shallow (less than 160 m depth of cover). Within the designated Environmental Protection Zones, and in other areas where depth of cover is greater than 160 m, partial extraction has been planned but has not been carried out to date.

Subsidence monitoring to date has consisted of surface inspections only due to the low depth of cover and high factors of safety surrounding the first workings used in the current mining areas. Given that no mining other than first workings has taken place under the designated Environmental Protection Zones, the regular surface inspections undertaken to date over the mined areas have been sufficient. These surface inspections have shown no visible impact on the ground surface such as cracking, sink holes or pressure ridges. There has been no indication of impacts on the existing vegetation over the current mining areas.

3.7.3 Mining Sequence

The general sequence of mining to date has been to progress from the mine entrances at the western edge of Mount Airly in an easterly direction and to the south. The existing workings are shown in Figure 3.1.

3.8 Coal Handling, Processing, Stockpiles and Transport

3.8.1 Coal Handling and Processing

Construction of the approved coal handling and preparation plant (CHPP) at the pit top has commenced and to date Stage 1 (coal handling plant) has been constructed (Photograph 3.2). Stage 1 consists of the coal crushing circuit, coal transport system including the underground and surface conveyors, multiple coal stockpiles, a train load-out and rail loop.

The materials handling system is designed to receive up to 1,800 tonnes per hour (tph) of minus 300 mm maximum lump size ROM coal from the underground coal workings. Coal from continuous miners is deposited into shuttle cars for transport a short distance to a feeder/ breaker unit and thence loaded onto a conveyor belt for transport to the pit top via the trunk conveyor (UC01) (Figure 3.2).

UC01 conveyor deposits coal onto the first of the surface conveyors (CV01) where it is elevated for transfer into the crushing and screening plant. The crushing and screening station sizes the coal to less than 50 mm and stockpiles it on the Product Coal Stockpile via a skyline tripper conveyor (CV02). The locations of the infrastructure are shown in Figure 3.2).

Currently ROM coal is stockpiled within the Product Coal Stockpile (Figure 3.2) prior to transfer to the train loading bin for dispatch off site. Three draw points are provided via a tunnel reclaim system, which comprises three stockpile activators with vibrating feeders to feed onto surface conveyor CV03 connecting to the train loading bin. CV03 has been designed with a capacity of up to 2,000 tph ROM coal while the train loading bin has a 500 tonne capacity.

3.8.2 Coal Stockpiles

The Emergency Stockpile (Figure 3.2) with a capacity of less than 30,000 tonne, has been established immediately to the southwest of the transfer point between the UC01 trunk conveyor and CV01 conveyor (Figure 3.2 and Figure 4.1). In the event of the Product Coal Stockpile becoming full, coal from the underground conveyor system is currently placed on the Emergency Stockpile by truck and front end loader. When the Product Coal Stockpile level falls sufficiently, the diverted coal from the Emergency Stockpile is fed back onto CV01 via the hopper on CV01 using a front-end loader. No facility to divert coal directly from UC01 to the Emergency Stockpile has been built to date.

The Product Coal Stockpile accommodates 160,000 tonne of ROM coal and this capacity can be increased to the approved 200,000 tonne with push out by a dozer.

3.8.3 Coal Reject Material Management

Airly Mine does not currently require a REA or a tailings dam for reject (coarse and fine) material management as no coal beneficiation is currently undertaken at the site.

3.8.4 Coal Transport

All coal is transported from Airly Mine by rail. Coal from the Product Coal Stockpile is reclaimed via a reclaim tunnel onto a conveyor, which transfers coal to the rail bin from which coal is loaded into trains for transport off site to domestic and overseas markets.

Centennial Airly was permitted to road haul a total of 500,000 tonnes of coal from trial mining to the Mount Piper Power Station in compliance with the requirements of the Council and the Roads and Traffic Authority. This condition of approval has lapsed and all coal has since been transported off site via rail.

Airly Mine Pit Top

Airly Coal Handling Infrastructure

DATE	14/08/2014
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SCALE	NOT TO SCALE

Photograph 3.2: Airly Mine Pit Top and Coal Handling Infrastructure

PLOTFILE No.

Centennial Coal
Airly

DRG No. 3-P3.2

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3.9 Plant and Equipment

Airly Mine uses continuous miners for coal extraction and a range of other ancillary equipment both in the underground workings and during operations at the pit top. Typical underground equipment comprises: shuttle cars, load haul dump vehicles, personnel transporters, electrical distribution equipment, and coal conveyors. Mobile underground plant are regularly maintained and repaired at the surface.

Fixed plant used on the surface is described in Section 3.10. Mobile plant used on the surface includes: bulldozer, front end loader, water cart, off highway haul truck, forklift, telehandler, delivery vehicles and light utility vehicles.

3.10 Mine Support Facilities and Underground Access

Existing surface infrastructure at the pit top is illustrated in Figure 3.2 which supports the underground operations at Airly Mine. Table 3.3 lists this existing infrastructure. Underground mine access is from the pit top via in-seam portals.

Table 3.3: Mine Support Facilities

Functions	Existing Surface facility
Underground access and associated infrastructure	▪ mine access is via three in-seam portals ▪ ventilation fans for air exhaust (located within the northern-most adit) ▪ portal for the trunk conveyor (UCCV01) from underground workings; ▪ mine services to the underground workings.
Engineering and services	▪ workshop and service building ▪ electrical distribution network sub-station ▪ water management structures (for surface catchment and separation of clean and dirty water) i.e. sedimentation basins for storm water runoff ▪ dust suppression systems.
Coal handling, preparation and transport infrastructure	▪ trunk conveyor from underground (UCV01) ▪ surface conveyor system comprising CV01, CV02 and CV03 ▪ crushing and screening station ▪ product stockpile with reclaim tunnel and ROM coal stockpile ▪ Coal handling plant ▪ internal haul roads ▪ train loading bin ▪ rail spur leading from the Wallerawang-Gwabegar rail line.
Support services and administration at the Pit Top	▪ potable water provision ▪ sewage treatment facility ▪ septic tanks at the Train Loader ▪ train refuelling station ▪ wash-down facilities(partially built) ▪ workforce and materials portals ▪ bath house, office and assembly building ▪ training centre ▪ hardstand areas, haul roads, car-parking areas and helicopter-pad ▪ diesel, fuel and oil storage (partially built).
Non- mine owned infrastructure	▪ overhead transmission lines ▪ telecommunications network.

LEGEND

- Rail
- Waterbody
- Train Refuelling Station

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:10,000

Figure 3.2: Existing Infrastructure at the Pit Top

0 100 200 300 400 Metres

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Centennial Coal

Airly

DRG No. 3-3.2

A4

The train refuelling on site is currently undertaken using a fit for purpose fuel tanker that comes equipped with emergency stops and drip trays to minimise any spills. The hose connections between the fuel tanker and the train fuel tanks are of the Banlaw type locking fitting that do not permit flow until the connections have been locked in place. Fuel flow is stopped if the connection separates. A concrete sump is located in the vicinity for the containment and management of any spills.

3.11 Water Management

The water management system is comprised of surface, process, potable and effluent management elements operated in accordance with the Airly Water Management Plan (Centennial 2011a).

Figure 3.3 provides an overall schematic of the Airly Mine water management system and which is described below.

3.11.1 Surface Water Management

The water management structures for the separation and storage of clean and dirty water at the pit top and their respective catchments are shown in Figure 3.3.

The clean water diversion drains have been designed to collect and divert clean water around the site and as needed into water storages. Accordingly, while clean water is caught and diverted, it does join dirty water in storages to provide process water. The diversion drains are concrete lined on steep grades, jute mesh lined on lesser grades or unlined on gentle grades. Energy dissipaters are in place at the discharges of concrete lined drains. The diversion drains are designed to pass runoff from a 1 in 100-year 72-hour storm event.

The sediment or settling dam system, in addition to its primary pollution control function, is used to store clean water harvested from the site.

Dirty water from the pit top hard stand area passes through a coarse sediment dam and the 109 ML Dirty Water Dam prior to discharging into the 35 ML Discharge Dam. The 109 ML Dirty Water Dam receives dirty water runoff and wash-down water from the machinery wash-down bay, hardstand areas, oil storage areas, and maintenance and service workshop, along with stormwater runoff from the workshop areas, administration area and car park. The 7 ML Dam receives dirty water runoff and wash-down water from the CHP and Product Coal Stockpile areas. The Train Loader Dam receives dirty water runoff and wash-down water from the train loader and CV03 areas. Post settling, the water from the 7 ML and Train Loader Dams is pumped into the 109 ML Dirty Water Dam.

The design for all dirty water structures is consistent with the requirements of *Managing Urban Stormwater, Soils and Construction Manual (Landcom 2004).*

In summary, the pit top water management structures comprise:

- a series of concrete lined clean and dirty water diversion drains
- small coarse settling pond for trapping coarse sediment located near the car park and in the vicinity of the 109 ML Dirty Water Dam
- dirty water dams comprising the 109 ML Dirty Water Dam and a 7 ML Dam into which overflows from the Product Coal Stockpile and a Train Loader Dam where fine sediments settle out
- a 35 ML Discharge Dam used for the storage of settled water and which overflows via LDP001 into Airly Creek. It receives surface run-off from non-disturbed areas and either overflow or piped water fed by gravity from the 109 ML Dirty Water Dam following de-silting.

Table 3.4 summarises the clean and dirty water dam storage volumes, and the water storage tanks for the storage of rain water.

Table 3.4: Stored Water Volumes

Water Storage	Storage Volume (ML)
Administration Building Tanks	0.24
Header Tanks	0.04
Process Water Tank	0.75
Settling Pond	3
109 ML Dirty Water Dam	109
35 ML Discharge Dam	35
7 ML Dam	7
Train Loader Dam	0.78

3.11.2 Underground Water Management

No significant inflows of groundwater from the coal seam or surrounding strata have been intersected to date during coal extraction, i.e.there have been no significant accumulations of groundwater. Only minor ingress of water has been noted in seam low points and in a few discrete locations. During operations, accumulation of water only occurred around the working areas due to process water use, for example for dust suppression on travelling roadways underground. No water has been discharged from the mine during operations to date.As such, no underground water management is currently required to remove groundwater to the surface.

3.11.3 Process Water

Process water, used to meet operational requirements is obtained in priority order from the following sources:

- 35 ML Discharge Dam which receives settled water from the 109 ML Dirty Water Dam
- Production Bore (Bore Licence Number 10BL603503) currently licensed to pump up to 278 ML per annum (Table 3.1).

Clean water from the 35 ML Discharge Dam is pumped into the process water tank (part of the water management facility) located on the pit top hard stand area. Process water is distributed via pipeline for dust suppression and fire-fighting supply to both underground and surface facility areas.

Water from the production bore is initially pumped to the 109 ML Dirty Water Dam, then by gravity pipeline to the 35 ML Discharge Dam and then pumped to the process water tank within the water management facility.

3.11.4 Drinking Water and Bathhouse Water

Airly Mine is not connected to a municipal water supply. Drinking water, for offices and underground personnel, is supplied by bottled water which is delivered by local suppliers.

Water for showers in the bathhouse is supplied by harvested water from the rooftops of the administration and facilities buildings. Rainwater is stored in the rainwater tanks. Trucked potable water is used to fill up these Administration Buildings Tanks in order to meet bathing water requirements in the bathhouse.

Water for the toilets in the administration buildings is supplied by the Process Water Tank.

3.11.5 Effluent Management

Sewage and grey water from the bathhouse and offices at the pit top area is treated on site by a sewage treatment facility. The mine's effluent system upgrade was completed during June 2012 and the life of mine Ecomax Effluent Treatment System.

Underground sewage is contained by Alfab activated biological toilets. These toilets are discharged into the Effluent Treatment System for treatment.

Septic tanks have been installed at the Train Loader facility to manage sewage from the toilet located at that location. The sewage is transported by a licensed contractor as required to the onsite Ecomax Effluent Treatment System for disposal.

3.11.6 Licensed Discharge Points and Water Monitoring

EPL 12374 defines the volumetric and concentration limits for discharge of water from the three licensed discharge points i.e. LDP001, LDP002 and LDP003, shown in Figure 3.3. Daily flow monitoring is required at LDP001 while water quality monitoring is required monthly during discharge for various parameters at all three LDPs.

The locations of the LDPs are shown in Figure 3.5 and described as follows:

- LDP001 located at the 35 ML Discharge Dam
- LDP002 located at the 7 ML Dam
- LDP003 located at the Train Loader Dam adjacent to the rail loading point.

The EPL 12374 requires all discharge points to be sampled monthly during discharge for the analytes listed in Table 3.5. This table also provides the limits stipulated in EPL12374. Water discharged at LDP001, LDP002 and LDP003 is analysed for pH, total suspended solids (TSS) concentration, conductivity and oil & grease concentration.

Water quality monitoring has also been carried out since January 2009 in addition to that required by the EPL 12374 to verify the effectiveness of pollution control systems on site. These monitoring sites include the Settling Dams, 109 ML Dirty Water Dam, 35 ML Discharge Dam, 7 ML Dam, Airly Creek, and a tributary of Airly Creek. This monitoring is in addition to that required by EPL 12374.

Table 3.5: Water Quality Monitoring Parameters

Analyte or parameter	EPL 1374 Limit
Oil and Grease concentration	10 mg/L
pH	6.5-9.0
TSS concentration	50 mg/L

3.11.7 Site Water Requirements- Existing

A comprehensive site water balance assessment has been conducted to quantify surface and groundwater budgets for existing (and future) operations. The water balance (Appendix F) reviews the site water requirements, available water storage and discharge volumes for Airly Mine. Total site water requirements for the existing operations are illustrated in Table 3.6. The site water requirements for the approved scenario were also modelled and have been included in Table 3.6.

Table 3.6: Annual Site Water Requirements - Existing and Approved Scenarios

	ML/yr	ML/yr
Direct rainfall onto storages and catchment runoff	114.1	194.5
External bathing and potable water supply	0.3	0.3
Groundwater inflows into underground workings	0.0	598.4 (maximum in mining year 16)
Extraction from production bore	132.6	0.0
In situ coal moisture	46.1	46.1
TOTAL INPUTS (rounded)	**293**	**839**
OUTPUTS		
Evaporation	29.7	52.6
Dust suppression	99.8	99.8
Sewage to effluent treatment	1.7	1.7
Discharge through LDP001	5.5	485.9
Discharge through LDP002	0.0	0.0
Discharge through LDP003	0.0	0.0
Discharge through proposed LDP on Reject Settlemt Dam	N/A	0.5
Coal product moisture	156.4	142.3
Rejects moisture		56.5
TOTAL OUTPUTS (rounded)	**293**	**839**
CHANGE IN STORAGE		
Surface water storages	0.0	0.0
TOTAL CHANGE IN STORAGE	**0**	0

Table 3.6 shows the following for existing operations (scenario 1).

- The largest source of water is the production bore to supplement water harvested by the surface water system.
- Coal product moisture is the largest output from the site, accounting for approximately 156 ML/yr, followed by water required for dust suppression and evaporation. No water is lost to rejects as none are produced.
- Discharges through LDP002 and LDP003 are not expected to occur.
- Annual discharge through LDP001 is predicted to be approximately 5.5 ML/yr.

Table 3.6 shows the following for approved operations (scenario 2).

- The largest source of water is from underground workings at 598 ML/yr due to predicted increases in vertical and horizontal hydraulic conductivity resulting from the approved mine design.

- Coal product moisture is the largest output from the site, accounting for approximately 142 ML/yr, followed by dust suppression and evaporation. 56 ML/yr will be lost to rejects.
- Discharges through LDP002 and LDP003 are not expected to occur.
- Annual discharge through LDP001 is predicted to be approximately 486 ML/yr.

Discharges from LDP001-LDP003 contribute to the flow of Airly Creek. Discharges through LDP002 and LDP003 are not expected to occur under existing and approved operations and therefore current operations within the reach of Airly Creek receiving discharge from LDP002 and LDP003 are expected to remain the same.

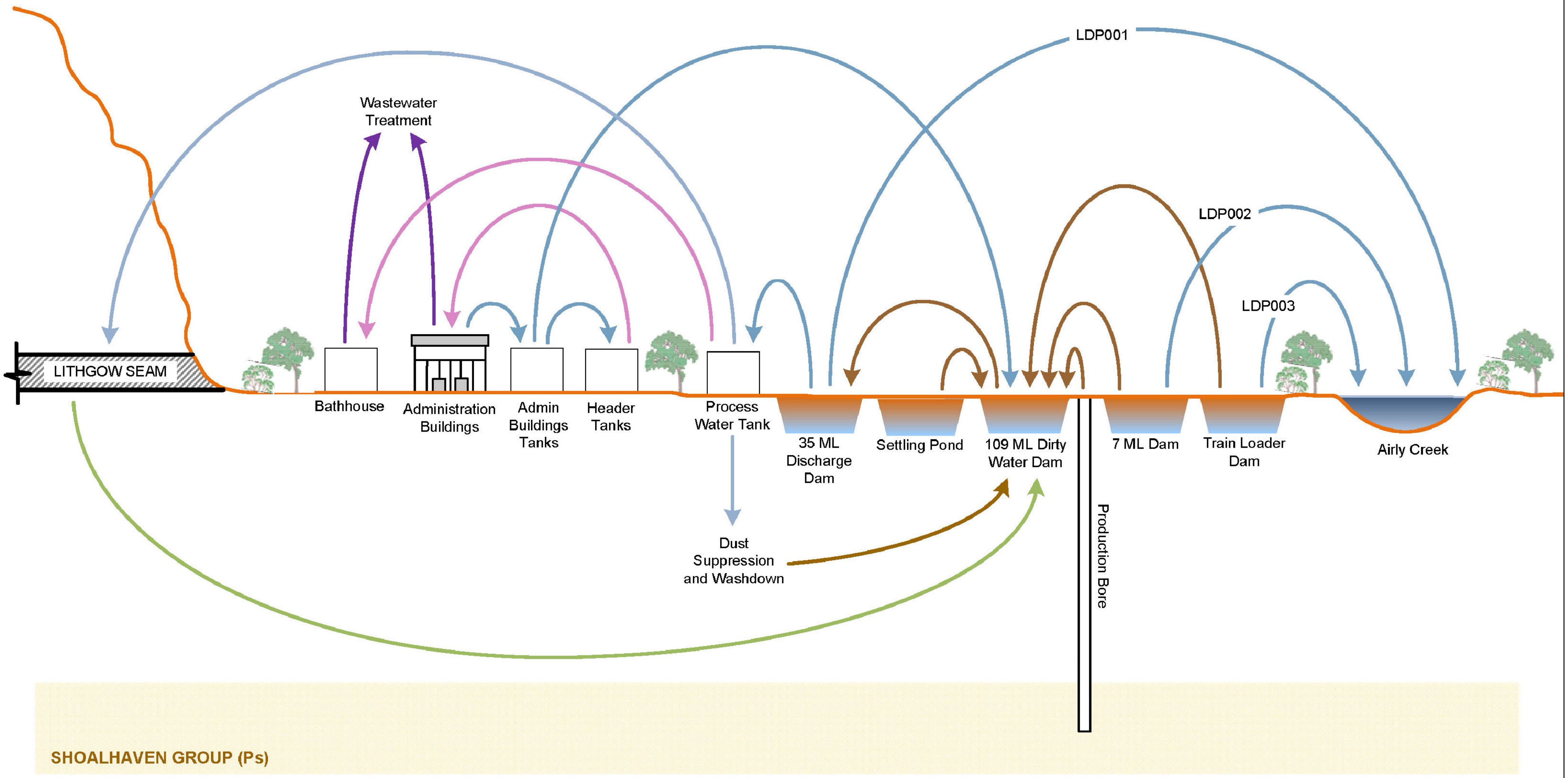
The average annual discharge through LDP001 under existing operations is predicted to be approximately 5.5 ML/yr, which is significantly skewed by high rainfall events and prolonged wet periods. Discharges are predicted to occur under existing conditions on less than 0.3% of days, or approximately 1 day per year. The current EPL 12374 limit of 100 ML/day was not exceeded under the modelled existing conditions.

3.12 Underground Ventilation

All underground coal mines require ventilation, to provide oxygen for personnel and to maintain the atmosphere in a safe condition. For coal mines, the major gases of concern are: methane, which can be explosive within a certain range of methane to oxygen ratio; carbon monoxide, a toxic gas which in excessive concentrations binds preferentially to haemoglobin in lungs thereby causing intoxication of the bloodstream; and carbon dioxide, which in excessive concentration can cause asphyxiation. In NSW, there are statutory requirements for the maintenance of mine atmosphere to remain breathable and non-explosive.

Ventilation is also required to dilute potentially harmful dust concentrations generated from mining activities. In NSW, there are statutory requirements for the maintenance of safe levels of airborne dust in the mine atmosphere. Ventilation also removes heat from mine workings so as to prevent heat stress in persons working underground.

The primary method for managing mine atmosphere is by mechanical ventilation. The main ventilation installation at Airly Mine consists of a two electrically powered centrifugal fans attached to the northern-most access adit at the pit top. These fans are of the exhausting type and draw fresh air from the remaining three access portals, through the workings, and vent the used air to the external atmosphere through the fans.



LEGEND

- Clean Water
- Underground Water
- Dirty Water
- Wastewater
- Amenities and Bathhouse Water

Water Management Schematic provided by GHD

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
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Figure 3.3: Water Management Schematic

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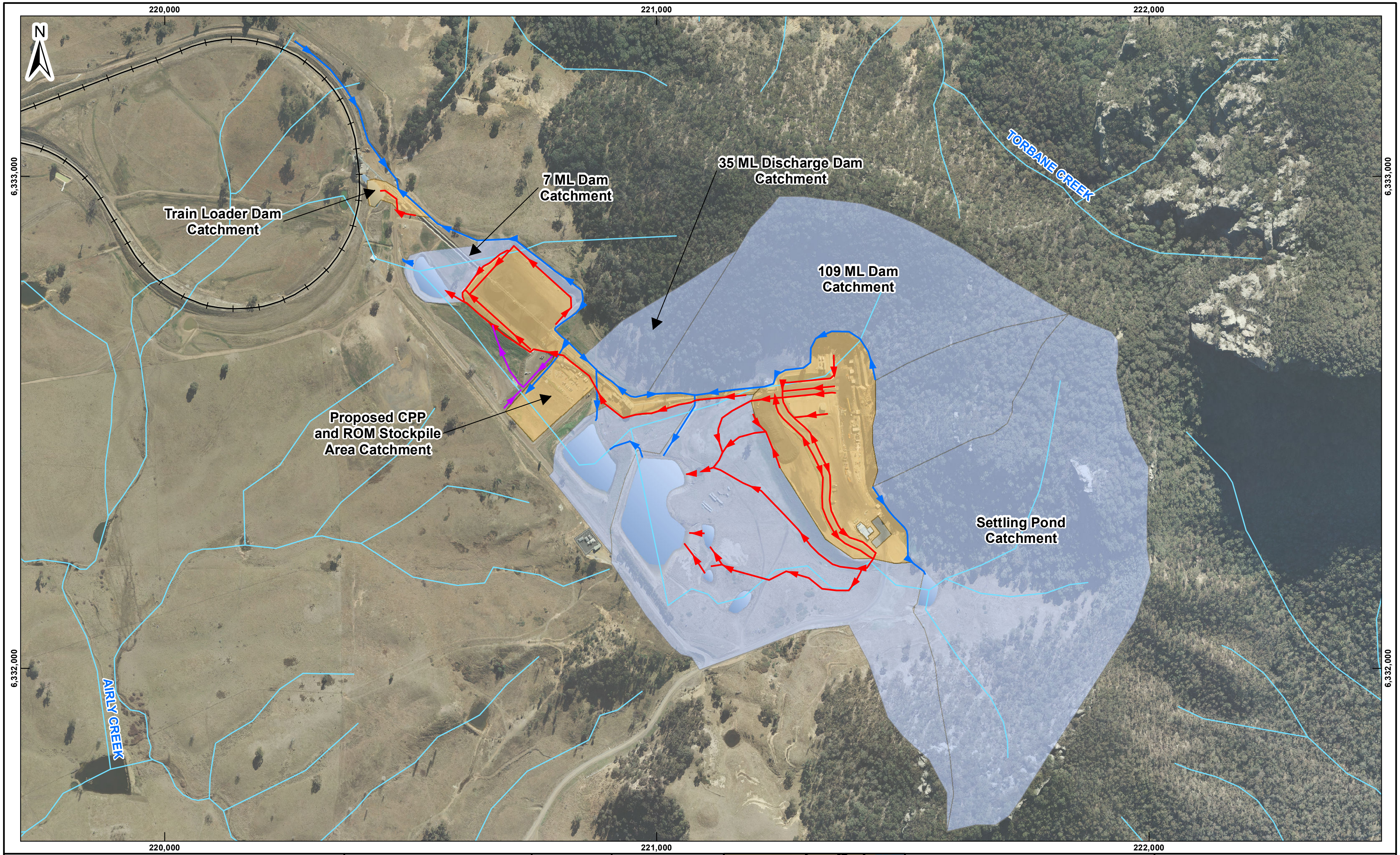

LEGEND

- Clean Water Diversion
- Dirty Water Diversion
- Dirty Water Diversion - Proposed
- Rail
- Watercourse
- Clean Water Catchment
- Dirty Water Catchment

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
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REFERENCE	137623024-R Rev 0
SCALE	1:10,000

Figure 3.4: Water Management at the Pit Top

0 100 200 300 400 Metres

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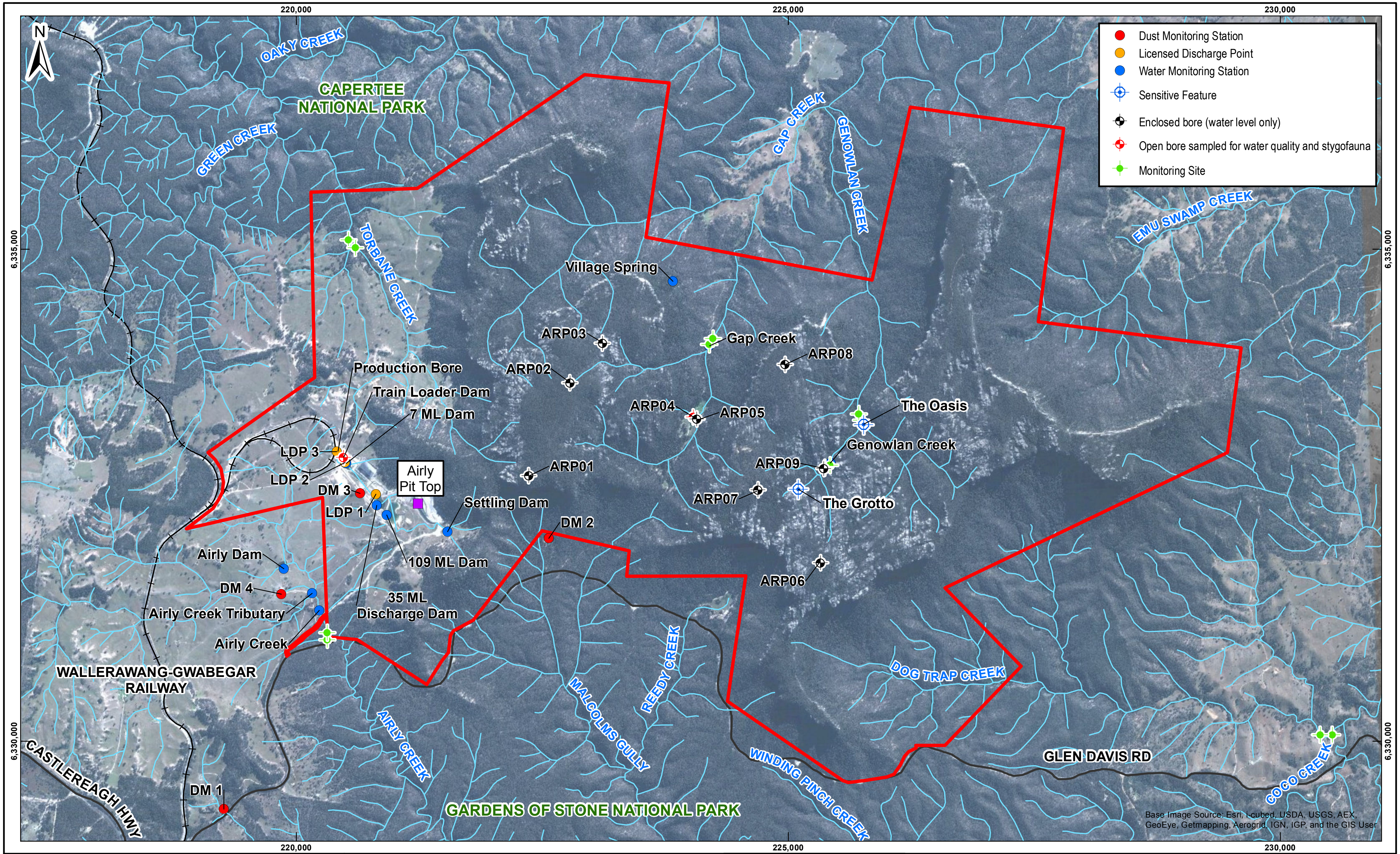
Centennial Coal
Airly

DRG No. 3-3.4

A4



LEGEND
- Project Application Area
- Watercourse
- Rail
- Main Road

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
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REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 3.5: Environmental Monitoring and Discharge Points

0 500 1,000 1,500 2,000 Metres

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Centennial Coal
Airly

DRG No. 3-3.5

A4

3.13 Waste Management

3.13.1 Production Waste

Production waste is not generated at Airly Mine given that no coal beneficiation occurs and no reject materials are produced.

3.13.2 Non-Production Waste

General waste is disposed of to a landfill by a licensed waste contractor. Waste oil collected in the workshop is stored before being removed off site by a licenced recycling contractor. Separate bins for oily rags, oil and diesel filters, damaged chemical anchors and polythene pipe are provided. Expired chemical anchors are taken off site and disposed of by the manufacturer in an approved manner. Waste Management is undertaken in accordance with the existing Airly Mine Mining Operations Plan (Centennial 2012e) with all potentially hazardous material stored and/or bunded appropriately in accordance with relevant application standards. Table 3.7 identifies typical wastes and their disposal destinations.

Table 3.7: Typical Waste Streams and Disposal

Waste Stream	Example Waste	Management/Disposal Method
General Solid Waste		
Mixed Solid Waste	Putrescible wastes and non-putrescible wastes. This also includes waste that meet the classification of *General Solid Waste under DECCW's Waste Classification Guidelines (2009)*	General consumable waste materials are stored in 5 x 3.5 m^3 and 2 x 10 m^3 waste skips and collected regularly by licensed providers for oofsite disposal to landfill.
General Solid Waste (Recyclables)		
Paper and Cardboard	Paper and cardboard	Colour coded recycling containers are placed in identified areas for collection of cardboard and paper products. These, and smaller receptacles in the administration and office areas, are collected regularly by licensed providers.
Scrap Steel/Metals	Scrap Steel/Metals	All scrap steel/metal is placed into a dedicated skip and sold to scrap steel merchants for recycling.
Liquid Waste		
Used oil filters and drums	Waste oils/Grease	Used oil filters are stored in designated bins and are taken to a recycling facility by a registered waste disposal company. At the recycling facility, these are crushed to recover all oil and subsequently, both the oil and metal is recycled. Materials still containing liquid are not disposed of to landfill. These materials are removed by licensed contractors for recycling or disposal and a licensed waste management facility. 20 L drums are drained into waste oil collection (drum drainer) and placed into scrap metal recycling bins. Grease cartridges are placed in sealed drums within the bulk oil store, prior to collection by licensed contractors.
Hydrocarbons/ Hazardous Materials	Oils, diesel fuels,	Hazardous materials including oils and fuels are stored in accordance with Australian Standards. A spill response procedure is in place which addresses clean-up procedures in an event of a spill of these materials . Hazardous materials that need to be disposed of are stored within an allocated area prior to being removed by a licensed hazardous waste contractor.

Waste Stream	Example Waste	Management/Disposal Method
Waste effluent	Sewage	Sewage and grey water from the bathhouse and offices at the pit top area is treated on site by a sewage treatment facility. The mine's effluent system upgrade was completed during June 2012 and the life of mine Ecomax Effluent Treatment System caters for the expected workforce. Underground sewage is contained by Alfab activated biological toilets. Septic tanks have been installed at the Train Loader facility to manage sewage from the toilet located at the Train Loader. The sewage is transported by a licensed contractor to the Ecomax Effluent Treatment System for disposal.

3.14 Environmental Management

3.14.1 Introduction

Centennial Airly is committed to continual improvement in the environmental management of Airly Mine's operations and to developing effective community relationships. Centennial Airly recognises the importance of effectively managing the environmental impacts associated with Airly Mine and has developed an Environment and Community Policy that commits to continual improvement in its environmental management and performance.

3.14.2 Centennial Environmental Policy

Airly Mine has adopted Centennial Coal's Environment and Community Policy forming part of a broader Environmental Management Strategy. The Strategy has been developed to ensure the strategic outlook for environmental management is clearly and concisely articulated. The Environmental Management Strategy contains objectives to assist Centennial Airly's operations at Airly Mine in meeting the principles within the Environment and Community Policy. Underpinning the Environmental Management Strategy, Centennial Airly has an established Environmental Management System (EMS) at Airly Mine that reflects the objectives and principles of the strategy and policy.

3.14.3 Environmental Management System and Management Plans

The EMS has been developed in accordance with *the Centennial Coal Environmental Management System Framework* (Centennial 2011b). The EMS sets down procedures and standards for the management of areas of environmental significance and mechanisms whereby the environmental performance of Airly Mine can be measured and assessed, and appropriate action taken where necessary. The EMS has been developed and implemented in accordance with all regulatory requirements, including the International Standard ISO14001, while providing a means for continued improvement in the environmental performance of the Airly Mine.

As part of the EMS, Centennial Airly maintains a number of Environmental Management Plans (EMPs) and procedures as outlined in Table 3.8.

ML1331 requires the preparation of an Annual Environmental Management Report (AEMR) to address environmental management during the year including reporting on the progress of mining activity and the environmental performance at Airly Mine.

The EMPs are supported by an environmental monitoring network, which consists of monitoring of noise, dust, surface water, and groundwater.

The management plans are supported by an environmental monitoring network, which consists of monitoring of noise, dust, surface water, and groundwater.

Table 3.8: Airly Existing Mine EMPs and Procedures

Management Plan or System	Purpose
Mining Operations Plan	Covers activities at Airly Mine during operations. The document has been prepared in accordance with the *Guidelines to the Mining, Rehabilitation and Environmental Management Process prepared by the NSW Department of Mineral Resources, Updated April 2012.*
Landscape and Rehabilitation Management Plan	To minimise and manage potential landscape and rehabilitation issues and to return the land to a pre-operation state or better, in line with the relevant consent conditions and in consultation with the key stakeholders.
Environmental Monitoring Plan	Provides details of monitoring and reporting of the various management plans.
Stakeholder Engagement Plan	The objectives are to: ■ effectively communicate with relevant stakeholders ■ define responsible parties within Centennial in respect of the communication paths and forums ■ monitor and manage issues from relevant stakeholders ■ maintain a complaints protocol.
Borehole Construction Environmental Management Plan	Project specific plan developed to ensure appropriate environmental management practices are followed during borehole construction.
Pollution Incident Response Management Plan	Covers the key actions to minimise the occurrence of a pollution incident and to manage a pollution incident if one occurs (during and after a pollution incident). The plan has been prepared for managing the impact to human health (employees and nearby neighbours) and the environment (onsite and offsite).
Air Quality Management Plan	Provides for the monitoring and management of air quality.
Noise Management Plan	Sets out procedures for monitoring, assessing and responding to noise impacts.
Water Management Plan	Coordinates the management of water within the Airly Mine lease area in an efficient and sustainable manner.
Waste Minimisation and Management Plan	To achieve waste minimisation through maximising re-use and recycling, to ensure environmentally responsible disposal of waste materials not suitable for re-use or recycling and to ensure environmental protection throughout all stages of waste handling, storage, collection and disposal.
Contractor Management Plan	This plan aims to ensure that all activities carried out on behalf of Airly by external contracted parties comply with legislative requirements, internal and external practices and guidelines.
Fire Management Plan	Sets out the procedures for reporting fire and for the inspection and maintenance of firebreaks and asset protection zones at the pit top.

Management Plan or System	Purpose
Strata Failure Management Plan	In accordance with Clause 28b (ii) of the *Coal Mine Health and Safety Regulation 2006* the objectives of this management system are to ensure as far as reasonably practicable the safety of all persons present at the coal operation with regard to underground strata.
Ventilation Arrangements	In accordance with Clause 21 of the *Coal Mine Health and Safety Regulation 2006,* Airly Mine has implemented Ventilation Arrangements to ensure as far as reasonably practicable the safety of all persons present at the coal operation with regard to mine ventilation.

3.14.4 Monitoring and Reporting

Environmental Monitoring is conducted in accordance with EPL12374, DA 162/91, ML1331, and A232. The EMPs prepared as part of environmental monitoring are consistent with the Centennial Coal's standard *ECMS-006 Monitoring and Evaluation* specifying the environmental sampling standards for all monitoring including collection and analysis.

Compliance against the limits set out in EPL12374 is reviewed monthly and non-compliances documented in the monthly environmental and operations reports. Reporting of non-compliance with EPL12374 licence limits are consistent with the Centennial standard *ECMS-003 Incident Reporting and Investigation*.

The results of the monitoring program described above and identified inTable 3.8 are recorded in the following reports:

- Annual Environmental Management Reports;
- Annual Returns for EPL 12374;
- National Pollutant Inventory reports; and
- Environmental Monitoring Reports.

These reports are supported by an environmental monitoring network, monitoring noise, dust, groundwater, surface water and subsidence. Monitoring locations are illustrated in Figure 3.5. An overview of the monitoring results is provided below and further details of the monitoring results are provided in Chapter 10.0.

An overview of the monitoring undertaken is provided below and further details of the monitoring results are provided in Chapter 10.0. Airly Mine undertakes monitoring of:

- deposited dust
- groundwater – groundwater level and water quality
- surface water – surface flows and water quality
- aquatic ecology and stygofauna
- subsidence.

Deposition Dust Monitoring

Table 3.9 outlines the Dust Monitoring Locations and frequency of monitoring.

Table 3.9: Dust Monitoring Overview

Dust Monitoring Location	Frequency
DM1	Monthly
DM2	Monthly
DM3	Monthly
DM4	Monthly

Groundwater Monitoring

Table 3.10 outlines the groundwater monitoring locations, frequency of monitoring, quality and summary of analytes.

Table 3.10: Groundwater Monitoring Overview

Groundwater Monitoring Location	Frequency	Piezometric Pressure	Quality	Summary of Monitoring Parameters and Analytes
AM2B	Monthly		X	pH, electrical conductivity (EC) Dissolved metals: As, Cr, Cu, Fe, Pb, Mn, Ni, Zn
ARP01	Monthly	X		
ARP02A	Monthly	X		
ARP03A	Monthly	X		
ARP04	Monthly	X		
ARP05	Monthly		X	pH, EC Dissolved metals: As, Cr, Cu, Fe, Pb, Mn, Ni, Zn
ARP06	Monthly	X		
ARP07	Monthly	X		
ARP08	Monthly	X		
ARP09	Monthly		X	pH, EC, Dissolved metals: As, Cr, Cu, Fe, Pb, Mn, Ni, Zn
Village Spring	Monthly		X	pH, EC, Dissolved metals: As, Cr, Cu, Fe, Pb, Mn, Ni, Zn

Surface Water Monitoring

Table 3.11 outlines the surface water monitoring locations, frequency of monitoring, quality and summary of analytes.

Table 3.11: Surface Water Monitoring Overview

Surface Water Monitoring Location	Frequency	Flow	Quality	Summary of Monitoring Parameters and Analytes
LDP001	Quality – Monthly (when discharging) Flow - Continuous	X	X	pH, EC, turbidity TSS, oil and grease, iron (total and dissolved), manganese (total and dissolved) concentrations
LDP002	Monthly (when discharging)		X	pH, EC,turbidity TSS and oil & grease concentrations
LDP003	Monthly (when discharging)		X	pH, EC, turbidity TSS and oil and grease concentrations
Airly Creek	Monthly		X	pH, EC, turbidity TSS, oil and grease, ammonia, total nitrogen, total phosphorus concentrations Total metals : Al, As, Ba, B, Cd, Co, Fe, Pb, Mn, Hg, Ni, Se, Ag, Zn Dissolved metals: Al, Sb, As, Ba, Be, B, Cd, Cr, Cu, Co, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sn, Ti, V, Zn
Airly Creek Tributary	Monthly		X	pH, EC, turbidity TSS, oil and grease, ammonia, total nitrogen, total phosphorus concentrations Total metals: Al, As, Ba, B, Cd, Co, Fe, Pb, Mn, Hg, Ni, Se, Ag, Zn Dissolved metals: Al, Sb, As, Ba, Be, B, Cd, Cr, Cu, Co, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sn, Ti, V, Zn
The Grotto	Monthly		X	pH, EC, turbidity TSS, oil and grease, total nitrogen, total phosphorus concentrations Total metals: Al, Fe Dissolved metals: Al, Fe, As, Cd, Cr, Pb, Mn, Hg, Ni, Zn
Gap Creek	Monthly	X	X	pH, EC, turbidity TSS, oil and grease, total nitrogen, total phosphorus concentrations Total metals: Al, Fe Dissolved metals: Al, Fe, As, Cd, Cr, Pb, Mn, Hg, Ni, Zn
Genowlan Creek	Monthly	X		Flow
Village Spring	Monthly	X		Flow

Aquatic Ecology and Stygofauna Monitoring

Limited aquatic ecology and stygofauna monitoring has been undertaken at the site to date. An initial site visit to assess the availability of permanent aquatic habitat and select sampling sites was completed on 15 April 2013. Twelve monitoring sites were selected based on available surface water, and to achieve an adequate representation of aquatic habitats present. Measurement of temperature, electrical conductivity, salinity, pH, dissolved oxygen and turbidity just below the surface of the water column and at depth where sufficient water was available were monitored.

Stygofauna samples were collected on 21 May 2013, 11 June 2013 and 4 December 2013 from the existing shallow piezometer (ARP05) near Gap Creek, the Production Bore (AM2B-1) near the coal handling facility and the Old Production Bore (AM2B).

Subsidence Monitoring

As noted in Section 3.7.2 subsidence monitoring to date comprises surface inspections given that only first workings are undertaken in the current mining areas. Regular visual inspections of surfaces over the mined areas are undertaken and this method of gauging subsidence impacts has been deemed to be sufficient. These surface inspections have shown no visible impact on the ground surface such as cracking, sink holes or pressure ridges. There has been no indication of impacts on the existing vegetation over the current mining areas.

3.14.5 Audits and Continuous Improvements

Continuous improvement is achieved through monitoring and review; internal and external communication with stakeholders; implementation of corrective and preventative actions; and tracking progress against objectives and targets.

Audits give an assessment of the implementation of the EMS, compliance, policy, objectives and environmental performance. Internal audits are completed periodically to ensure the EMS is operating in accordance with the Centennial EMS Framework with continuous improvement identified and implemented where feasible.

An external consultant was engaged by Centennial Coal during 2012 to carry out an environmental audit at Airly Mine. The audit was commissioned by Centennial Airly to assess the level of compliance of its operations against its approvals, licences, leases and management plans. Included with this objective was a requirement that the audit provide information to Centennial Coal on environmental compliance to enable site management to identify opportunities for improvement.

3.14.6 Pollution Incident Response Plan

In August 2012 a Pollution Incident Response Management Plan (PIRMP) was developed and implemented at Airly Mine to satisfy the requirements of section 153A of the *Protection of the Environment Operations Act 1997* (POEO Act) which requires the preparation, implementation and publication of a PIRMP. The PIRMP for Airly Mine is available on the Centennial Coal website.

3.14.7 Pollution Reduction Program

In 2011, the NSW Environment Protection Authority required, through a Pollution Reduction Program, that Airly Mine provide a Site Specific Particulate Matter Control Best Practice Assessment report which examined in detail the potential measures which could be employed to further reduce particulate emissions from the mine. The report, prepared by SLR Consulting Australia Pty Ltd, was prepared in accordance with the *Coal Mine Particulate Matter Control – Best Practice: Site Specific Determination Guideline* (EPA 2011) to comply with the EPA specifications as stipulated in the Licence Variation Condition U1 of EPL 12374.

3.15 Rehabilitation and Final Landform

The approved MOP details the proposed rehabilitation objectives to ensure the final landform is commensurate with the surrounding topography and relevant zoning requirements of the time.

Airly Mine has adopted a progressive approach to rehabilitation to reduce and mitigate potential environmental impacts where possible. This comprises of a preliminary rehabilitation strategy, which incorporates both temporary and permanent program in order to maximise surface stability during construction works and establishment of the final emplacement landforms. Temporary rehabilitation works run in conjunction with temporary erosion and sedimentation controls.

Permanent rehabilitation works include the outer face of the detention dams, long-term access roads and permanent fill areas. Permanent rehabilitation is also undertaken, in consultation with the National Parks and Wildlife Service, at exploration drillholes areas as described in Section 3.3.

Rehabilitation at the site is undertaken in accordance with the Airly Mine's Mining Operations Plan (Centennial 2012e) Specific objectives and outcomes of the final rehabilitation programs as described in this Plan are as follows:

- ecological diversity and structure to be compatible with the surrounding forest ecosystem
- control of watershed runoff flow velocities to reduce erosion in the long term
- promotion of native flora and fauna conservation
- improvement of visual amenity.

CHAPTER 4.0

Project Description

4.0 PROJECT DESCRIPTION

4.1 Overview of Project

The Project will, in brief, include:

- all currently approved operations, facilities and infrastructure of the Airly Mine, except as otherwise indicated in this EIS (Table 4.1)
- extension and continuation of mining for a further 20 years from the date of consent with rehabilitation to be undertaken after this period
- modifications to existing facilities and infrastructure, and construction and operation of new facilities and infrastructure, within the Project Application Area that are required to support the Project.

The Project will continue to use the existing underground and surface infrastructure at the pit top as described in Chapter 3.0. The Project is proposing to construct and operate both currently approved and new infrastructure, and progressively rehabilitate areas no longer required in the Project.

The Project's mining operations will be carried out using contemporary mining methods including continuous miner development and appropriate mining equipment that will allow either part or full removal of some of the coal remaining after initial development such as partial pillar extraction and panel and pillar style mining methods. The Project's mining methods are further discussed in Chapter 8.0. The Project will not significantly alter the nature of the existing operations at Airly Mine. On cessation of mining activities the Project will rehabilitate all disturbed areas associated with the pit top to create final landforms commensurate with the surrounding areas and land uses.

4.2 Proposed Project and Existing Operations

Table 4.1 provides an overview and comparison of the existing operations approved in the current Development Consent (DA162/91) and the proposed Project.

Figure 4.1 shows the proposed Mining Zones. Figure 4.2 shows the existing and the proposed new infrastructure and elements required to support the Project.

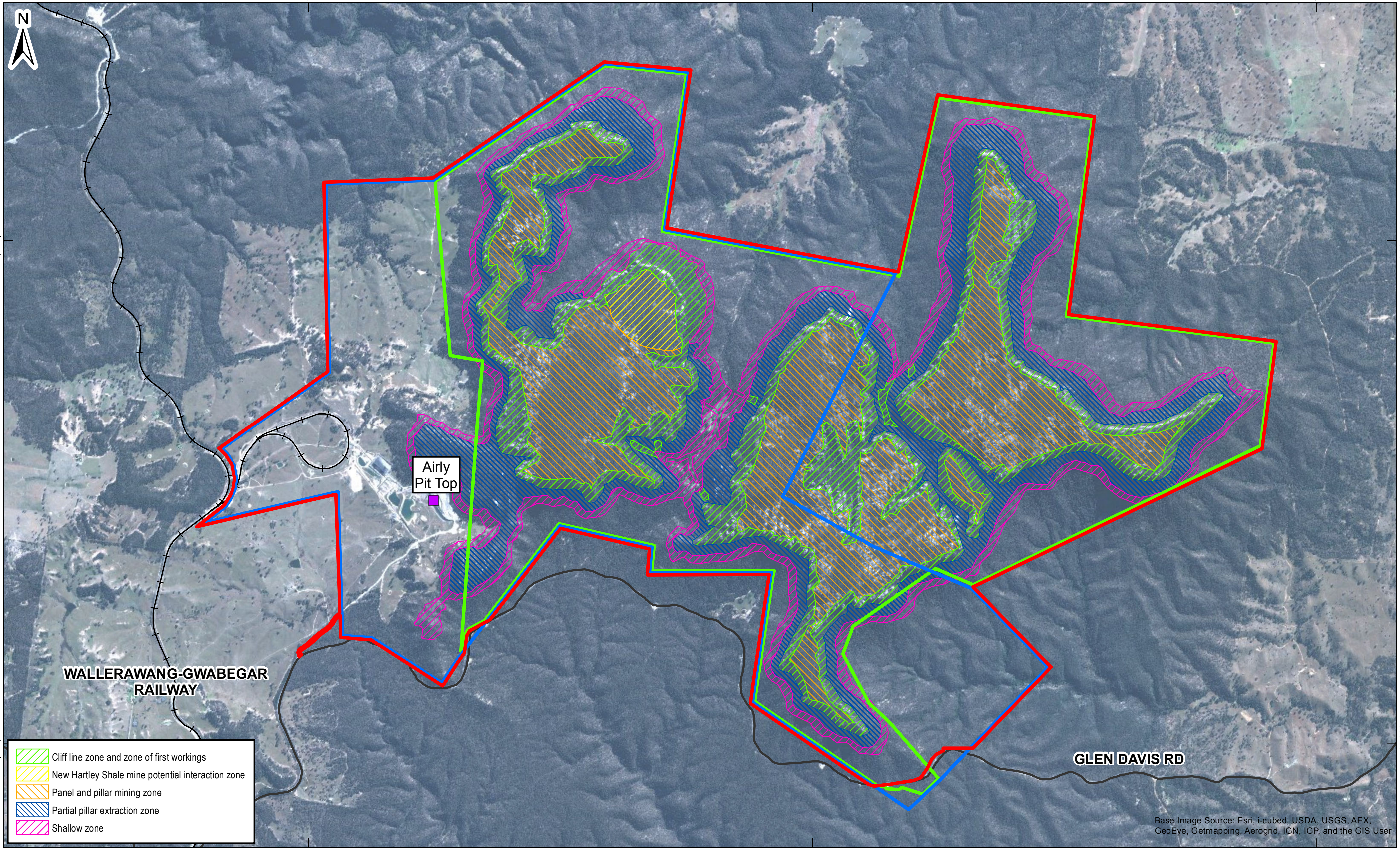
Table 4.1: Comparison of Approved Operations and the Project

Key Feature	Approved Operation	The Project
Mine Life	Development consent (DA162/91) is limited to 21 years from the granting of ML1331 and expires on 12 October 2014.	Seeking approval for continued operations at Airly Mine for 25 years (including rehabilitation) from the date of consent.
Hours of Operation	24 hours per day, 7 days per week, up to 52 weeks per year.	No change.
Coal Production	Annual extraction limit of 1.8 Mtpa of ROM coal.	No change.
Site Access	Mine Access Road, off Glen Davis Road at approximately 3 km from Capertee village.	No change.
Mine Method and Design	The development consent: ■ stipulates no mining in the 50 m coal barrier (measured horizontally from the outcrop) ■ allows first workings only where the depth of cover is less than 50 m ■ allows partial extraction beneath Environmental Protection Zones and full extraction in areas outside Environmental Protection Zones with supercritical void widths with: ▪ maximum subsidence of 1.8 m ▪ maximum tensile strains of 25.5 mm/m ▪ maximum compressive strains of 42.5 mm/m ▪ maximum tilt of 85 mm/m.	■ no mining in the 50 m coal barrier. ■ first workings only where the depth of cover is less than 50 m. ■ the mining area is to be divided into zones of varying mining systems to limit subsidence to 125 mm as follows: ▪ **Panel and Pillar Zone**: Plateau area with cover depths of >160 m. The void width is 61 m and sub-critical, with long term stable pillars left between the voids. ▪ **Cliff Line Zone**: An area of first workings defined by setback from both the crest and toe of the cliffs. ▪ **Partial Pillar Lifting Zone**: A zone extends from the Cliff Line Zone to typically the 100 m depth contour, creating limited spans (15.5 m to 25.5 m) and leaving long-term stable pillars. ▪ **Shallow Zone**: A second zone of first workings between the 100 m and 20 m depth of cover contours. It includes areas of European heritage and involves the formation of long term stable pillar systems appropriate to the low depth of cover involved. ▪ **Oil Shale Workings Multi-Seam Interaction Zone**: An area of panel and pillar mining in the Mount Airly plateau area and below the old New Hartley oil shale workings with maximum new subsidence up to 500 mm (worst case).

Key Feature	Approved Operation	The Project
Mine Ventilation	■ ventilation fans for air exhaust (located within the northern-most adit) ■ air intake via surface portals located at the pit top box cut ■ ventilation facilities approved at the approved Eastern Portal.	■ no change to air intake via existing portals ■ no change to existing ventilation fans for air exhaust (located within the northern-most adit) ■ construction of approved ventilation facilities at the Eastern Portal not proposed..
Underground Mine Access	■ underground access via a series of portals at the pit top box cut ■ the approved Eastern Portal southwest of Mount Genowlan was not constructed ■ access to extraction areas.	■ no change to the existing underground mine access from the pit top ■ approval for the previously approved Eastern Portal underground mine access is not sought ■ develop underground access roadways to access proposed mining areas
Airly Pit Top Mine Support Facilties	■ bath house, office and assembly building ■ wash-down facilities ■ workforce, materials and ventilation portals ■ store building ■ training center ■ bulk storage area ■ cable store ■ potable water provision ■ sewage treatment plant ■ hardstand areas, haul roads, car-parking and helicopter pad ■ diesel, fuel and oil storage area ■ refueling facilities ■ fire station and associated fire-fighting equipment ■ compressor room ■ water management structures (for surface catchment and separation of clean and dirty water) ■ electrical distribution network sub-station ■ workshop and service building.	■ minor upgrades will be required for majority of existing facilities. ■ Upgrade of the Train Refueling Station. ■ Installation of a Site Security Gate.

Key Feature	Approved Operation	The Project
Employment	120 personnel.	■ Up to 135 personnel and up to 20 contractors.
Coal destination	Domestic power stations and overseas export.	No change.
Coal Stockpiles	■ a 30,000 tonne ROM Emergency Stockpile ■ a 200,000 tonne Product Coal Stockpile.	■ an additional 40,000 tonne ROM Coal Stockpile in the vicinity of the proposed CPP location ■ no change to Product Coal Stockpile or ROM Emergency Stockpile.
Coal Handling and Preparation Plant	■ the system of conveyors for ROM coal handling constructed to operate at 500 tph and used for the transfer of coal for the underground to the stockpile areas. ■ CPP was approved but has not been constructed.	■ CPP (500 tph) proposed to be constructed with a dedicated ROM Stockpile Area (see above) ■ CPP to be equipped with water recycling facility ■ minor changes to conveyor systems required to allow material movement to incorporate the additional ROM coal stockpile and CPP.
Reject Material Management	■ Approved for 4.3 Mt coarse REA and a 740,000 tonne capacity tailings dam of, neither constructed.	■ A life-of-mine REA close to the CPP with a storage capacity of 5.2 Mm^3.
Electrical Services	■ 66 kV electricity line constructed (Substation 0) ■ Additional substations to supply the Airly Mine.	No change.
Coal Transport	■ Transport of coal to offsite locations via rail ■ Train loading facilities constructed comprise: ▪ a rail loop ▪ a train load out station ▪ a rail surge bin	■ No change.
Land Preparation	■ vegetation clearing and land preparation approved for the establishment of the pit top, REA, tailings dam, and Eastern Portal ■ vegetation clearing and land preparation undertaken only for the establishment of the pit top.	■ vegetation clearance for the proposed life of mine REA and associated water management dam ■ land preparation required at the REA, CPP, ROM Coal stockpile and Site Security Gate locations.
Water Management	■ a system of sediment dams, water storage dams and diversion drains for the separation of clean and dirty water at the pit top ■ clean water harvested and used as process water	■ modifications to the existing water management structures to accommodate new infrastructure requirements ■ construction of the water management structure for the life of mine REA

Key Feature	Approved Operation	The Project
	■ process water supplemented from the production bore supply on an as-required basis ■ effluent is treated on site in an Ecomax system.	■ construction of an oil and water separator to manage site's hydrocarbon contaminated water ■ an additional water tank installed at Ecomax effluent treatment system.
Rehabilitation and Final Landform	■ progressive rehabilitation of disturbed areas no longer required ■ creation of a final landform which will be stable, aesthetically consistent with surrounding landforms ■ final land form does not preclude possible alternative final land uses.	No change.
Exploration activities	■ exploration activities undertaken within A232 boundary. ■ activity approval sought under Part 5 of the EP&A Act.	■ exploration activities will continueto be undertaken within A232 boundary ■ approval for exploration program within A232 sought in this Project under Part 4 of the EP&A Act.



LEGEND

- Project Application Area
- ML1331 Current Lease Boundary (Offset for Clarity)
- A232 Authorisation Boundary (Offset for Clarity)
- Rail
- Main Road

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 4.1: Proposed Mining Zones

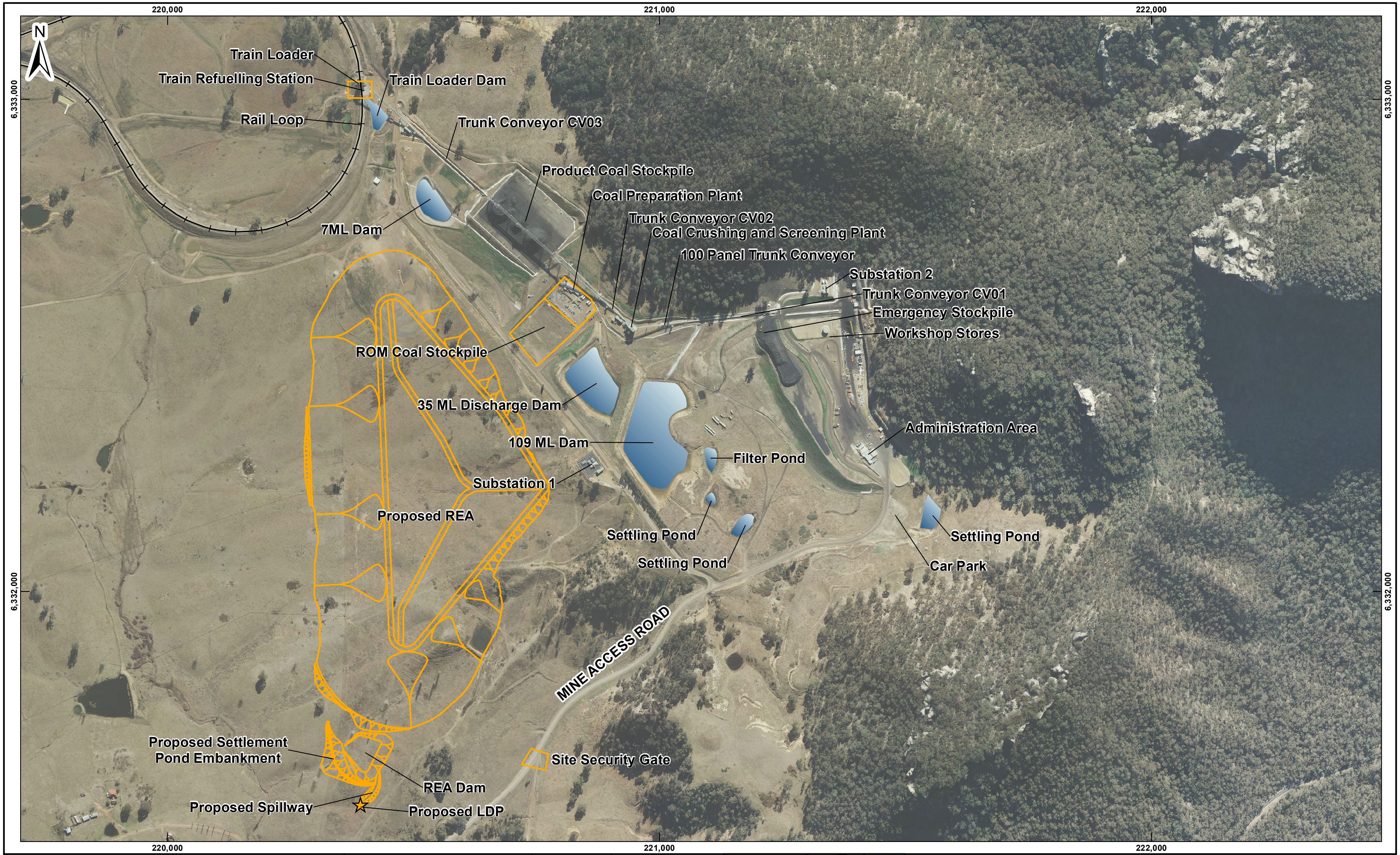
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 4-4.1

A4



LEGEND

★ Proposed Licensed Discharge Point

Rail

Waterbody

Proposed Infrastructure Area

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:10,000

Figure 4.2: Proposed Surface Infrastructure at the Pit Top

0 100 200 300 400 Metres

PLOTFILE No.

Centennial Coal

Airly

DRG No. 4-4.2

A4

4.3 Exploration Program

Exploration activities will continue to be undertaken within the Project Application Area with a view of refining the site's existing geological model used for detailed mine planning. The exploration program will be undertaken throughout the life of the Project and application for this program is being sought as part of the Project. Exploration activities being proposed include:

- Surface drilling of boreholes and installation equipment for the purpose of monitoring surface and alluvial water systems,
- Surface drilling of boreholes and installation of equipment for the purpose of monitoring ground water systems,
- Surface drilling of boreholes for the purpose of gathering geological and geotechnical data and
- Surface drilling of boreholes and installation of equipment for the purpose of strata and subsidence monitoring.

Exploration works will be undertaken in consultation with the National Parks and Wildlife Service and in accordance with the operational processes laid out in Section 3.3 and the State Conservation Area Plan of Management. This Plan of Management is yet to be gazetted.

Centennial Airly will continue to utilise area-based assessment procedures for the management of exploration activities to ensure that they are conducted in an environmentally responsible manner and with due consideration to the community. This will include a risk-based process for the selection, assessment and environmental management of proposed drill pad sites and access tracks based on environmental, geological, logistical and other operational constraints. Should potential impacts additional to those identified in Section 3.3 be encountered, consultation with both NPWS and DRE will be undertaken to determine the appropriate controles to be implemented.

Due-diligence field inspections and targeted surveys of the proposed drill sites and associated access tracks will be undertaken by appropriately qualified ecologist and heritage specialists prior to commencement of works to ensure the potential for localised impacts and risks are avoided in the first instance or minimised and appropriately managed as necessary. The combination of environmental sensitivity risk mapping and targeted due-diligence surveys of potential drill sites will provide greater flexibility in selecting the most suitable final drill site locations with minimal impact on the local environment and surrounding populace. All drill site selection and the preferred access routes will be undertaken in consultation with National Parks and Wildlife Service and subject to their agreement as the land owner.

The location of proposed exploration boreholes is currently unknown, and as a consequence, detailed environmental and social impact assessments cannot be undertaken at this time. As the required drill hole locations are determined, Centennial Airly will undertake impact assessments to consider the areas of concern identified in Section 3.3 and any other site specific impacts identified. The appropriate industry and legislative guidelines and policies in force at the time will be referenced and the assessments provided to the NSW DP&E. DRE will will be notified of the proposed exploration activities. The due diligence assessments will be provided to both National Parks and Wildlife Service and DRE if requested. All required approvals and agreements will be obtained prior to the commencement of any exploration activities.

The general approach of the due diligence assessments will be to conduct site investigation to ensure that significant impacts are avoided. For example, should the preferred drill hole location coincide with an endangered ecological community or Aboriginal artefact site, the drill hole location will be moved wherever possible. Following this micro-siting process, the due diligence reports will make a clear statement as to impact. In most cases, it is expected that only archaeology and ecology will be addressed; acoustic assessments will only be prepared by exception, should proposed drill holes be within an envelope likely to affect receivers.

In summary, drill sites and associated access tracks will be located where possible to:

- avoid threatened flora species
- avoid hollow bearing trees
- avoid endangered ecological communities
- minimise clearing
- minimise impacts on water courses
- avoid identified Aboriginal or European heritage sites.

Mitigation measures and management strategies will be implemented to address the potential for erosion and downstream sedimentation, noise emissions and bushfire risk as appropriate. The drilling activity will be undertaken as described in detail in Section 3.3. On completion of exploration activities, all boreholes and surface disturbance will be sealed and rehabilitated in accordance with the appropriate guidelines and legislation at the time.

4.4 Hours of Operation, Workforce and Project Life

Airly Mine will continue to operate 24 hours a day, seven days a week, 52 weeks per year. The workforce number will increase to up to 135 full time employees and 20 contractors. The Project will extend the life of Airly Mine by 25 years with rehabilitation occurring within this time.

4.5 Site Access

No change to the existing site access is proposed in the Project.

4.6 Land Preparation

Land preparation, including vegetation clearing, will be required for the:

- establishment of the life-of-mine REA
- construction of a CPP
- establishment of the ROM stockpile area in the vicinity of the CPP
- Construction of the Site Security Gate.

The proposed CPP, ROM Coal Stockpile, and the Site Security Gate, and the upgrade of the Train Refuelling Station will incur disturbance of approximately 39.09 ha, including land already disturbed. Clearing of approximately 37.94 ha of land will be required for the establishment of the REA, associated drain around the perimeter of the REA and the settlement dam located to the southeast of the REA. The targeted land for the REA is mostly cleared grasslands and individual paddock trees, and is discussed further in Section 10.2.4.1.

Prior to the construction of the toe drains around the REA and following clearing of the grasslands and individual paddock trees, erosion and sediment controls will be implemented. These controls, to mitigate any potential water quality impact on the receiving environment from proposed surface disturbance, will be described in a detailed Construction Environmental Management Plan. The localised erosion and sediment controls (for example, sediment fences, clean and dirty water diversion structures), to be implemented around the perimeter of the REA will be consistent with the objectives of Airly Mine's *Water Management System* and will be carried out in accordance with the industry best practice principles for the region and guidelines for erosion and sediment control (DECC, 2008; Landcom, 2004). Prior to excavation within the proposed REA,the associated REA Dam (to be located at the lowest point of the disturbance area) and the toe drains will be constructed first to capture and treat dirty water runoff from disturbed areas. The treated water will subsequently be used as operational process water. Details of excavation activities, the preparation of the REA base and soil stockpiling will be included in the updated Mining Operations Plan following development consent.

Given the REA will be progressively rehabilitated (Section 4.8.3) all disturbed areas and areas emplaced with reject materials will be progressively stabilised.

Installation of a sliding automatically controlled Site Security Gate will involve disturbance to 0.13 ha of mostly cleared grasslands as for the REA discussed above. Appropriate erosion and sediment control measures (DECC, 2008; Landcom, 2004) will be implemented during construction works.

The CPP and the ROM Coal Stockpile area (approximately 0.89 ha) will be constructed on land already disturbed previously during the establishment of the pit top. Grading of the area will be undertaken prior to the CPP construction. Erosion and sediment control measures (DECC, 2008; Landcom, 2004) will be implemented during the construction phase and retained as appropriate for the operational phase.

The existing Train Refuelling Station will be upgraded to an area of 0.25 ha (50 m x 50 m) to create a concreted pad (Section 4.10). The area will be graded prior to the concrete layer being laid down. Erosion and sediment control measures (DECC, 2008; Landcom, 2004) will be implemented during the construction phase and retained as appropriate for the operational phase.

4.7 Mining

4.7.1 Proposed Mining Method

Underground mining operations use a combination of first workings and partial extraction methods within ML1331 and extend into the eastern portion of A232.

Based on the differing levels of environmental sensitivity of surface features and depth of cover across the Project Application Area, the Project proposes to use mining methods that would vary across the entire area. The underlying premise of the mine design criteria to be utilised will be an optimal balance between resource recovery, responsible environmental management and a feasible mining operation.

A fixed mine design plan will not be proposed for the Project due to the flexible nature of first working, partial pillar extraction and panel and pillar mining methods proposed. The Project Application Area will instead be divided into mining zones, of varying mining systems, to engineer the desired subsidence levels. Significant surface features will be protected through the use of first workings only with long term stable pillars.

The proposed mining method design criteria incorporates extraction design elements currently used at Airly Mine for shallower parts of the proposed mining area and recognised methods used at other mines for deeper areas (example, Gretley Colliery, Clarence Colliery, Charbon Colliery and Myuna Colliery) using successful partial extraction systems.

Chapter 8.0 details the mine planning and design parameters, but in summary the following methods will be used in various zones, the indicative boundaries of which are shown in Figure 4.1.

- **Panel and Pillar Zone**: This is the plateau area with cover depths of >160 m. The maximum void width is 61 m and highly sub-critical. Long term stable pillars are to be left between the voids to allow spanning of the overburden between the pillars, thus greatly limiting the level of subsidence. This covers the majority of the proposed mining area.

- **Cliff Line Zone**: This is an area of first workings defined by setback of 30 m from both the crest and toe of the cliffs. In the vicinity of the cliffs affected by subsidence due to previous oil shale mining the setback from the crest is defined by half the depth of cover.

- **Partial Pillar Lifting Zone**: This zone extends from the Cliff Line Zone to typically the 100m depth contour and is the zone of partial pillar stripping, creating limited spans (15.5 m to 25.5 m) and leaving long- term stable pillars remaining to provide overburden support.

- **Shallow Zone**: This is a second zone of first workings between the 100 m and 20 m depth of cover contours. In areas of European heritage, this zone often extends into slightly deeper areas, with first workings protection areas around the heritage sites defined by half the depth.
- **New Hartley Shale Mine Potential Interaction Zone**: This is an area of panel and pillar mining in the Mount Airly plateau area below the old oil shale workings. Interaction between the underlying panel and pillar mining in the Lithgow seam and the overlying oil shale workings is expected.

Table 4.2 lists the proposed specific design criteria being applied for each mining zone.

Table 4.2: Proposed Design Criteria by Mining Zone

Design Criteria	Cliff Zone and Zone of First Workings	Panel and Pillar Zone	Partial Pillar Extraction Zone	Shallow Zone	New Hartley Shale Mine Interaction Zone
Mining height	<3.0 m	<3.0 m	<3.0 m	<3.0 m	<3.0 m
Maximum roadway width	5.5 m	5.5 m	5.5 m	5.5 m	5.5 m
Maximum void width	<10 m	61 m	15.5 m for single sided lifting and 25 m for double sided lifting	10 m	61 m
Remnant pillar system factor of safety (FOS)	>2.11	≥1.6	≥1.6	≥1.6	≥1.6
Minimum Pillar width to height ratio	≥5	≥9	na	≥4	>9
Supporting pillar width to height ratio	na	na	≥8	na	na
Remnant pillar width to height ratio	na	na	≥4	na	na
Other criteria	Zone extends 30 m horizontally from the crest and toe of a cliff. Zone increases to half depth of cover horizontally (26.5º angle of draw) from the crest and toe of a cliff in the New Hartley Shale Mine Interaction Zone.	na	na	Minimum plan pillar dimension ≥1/10 depth from surface or 10 m (whichever is greater). No formation of intersections during splitting and quartering operations at depths less than 30 m.	No panel and pillar mining within 26.5º angle of draw of cliffs.
Mining height	<3.0 m	<3.0 m	<3.0 m	<3.0 m	<3.0 m
Maximum roadway width	5.5 m	5.5 m	5.5 m	5.5 m	5.5 m
Maximum void width	<10 m	61 m	15.5 m for single sided lifting and 25 m for double sided lifting	10 m	61 m
Remnant pillar system factor of safety (FOS)	>2.11	≥1.6	≥1.6	≥1.6	≥1.6
Minimum Pillar width to height ratio	≥5	≥9	na	≥4	>9
Supporting pillar width to height ratio	na	na	≥8	na	na
Remnant pillar width to height ratio	na	na	≥4	na	na

Design Criteria	Cliff Zone and Zone of First Workings	Panel and Pillar Zone	Partial Pillar Extraction Zone	Shallow Zone	New Hartley Shale Mine Interaction Zone
Other criteria	Zone extends 30m horizontally from the crest and toe of a cliff. Zone increases to half depth of cover horizontally (26.5º angle of draw) from the crest and toe of a cliff in the New Hartley Shale Mine Interaction Zone.	na	na	Minimum plan pillar dimension ≥1/10 depth from surface or 10 m (whichever is greater). No formation of intersections during splitting and quartering operations at depths less than 30 m.	No panel and pillar mining within 26.5º angle of draw of cliffs.

Detailed discussions on the subsidence predictions for the proposed mining zones are provided in Chapter 8.0.

Over the majority of the mining area maximum subsidence will be managed to a maximum of 125 mm; maximum tensile strains will be 2 mm/m; maximum compressive strains will be 2 mm/m; and maximum tilt will be 3 mm/m. These values are substantially less than currently approved limits and are designed to prevent surface fracturing or other significant subsidence impacts.

The Project will not undertake full extraction under the centres of the Mount Airly and Genowlan Mountain mesas, as was approved in DA162/91. The Project instead is proposing a panel and pillar mining system for the centres of the Mount Airly and Genowlan Mountain mesas. Within these areas blocks of coal in panels will be systematically extracted, leaving a highly sub-critical 61 m void width with an extraction height of ≤3 m. Pillars of sufficient size to be long term stable will be left intact between the extracted panels to enable the overlying strata to span the void. This is a significant change from the previously approved mine design that allows full extraction within these areas without retention of any supporting pillars. An outcome of the Project's proposal to undertake only panel and pillar mining within the centres of the Mount Airly and Genowlan Mountain mesas will be that the predicted subsidence will be limited at a nominal 100 mm (but not exceeding 125 mm). This level of subsidence is predicted to have a negligible impact on the surface. Subsidence will be significantly lower than previously approved subsidence value of 1.8 m subsidence within the centres of the Mount Airly and Genowlan Mountain mesas in the DA 162/91 consent where full extraction was approved. Geotechnical designs will be used to determine appropriate criteria for the expected life cycle of the remaining pillar system after extraction given the relative sensitivity of the surface features to subsidence impacts. As such, the mine design criteria would take into consideration parameters such as the depth of cover, pillar width to height ratios, minimum dimensions of coal pillars, pillar design Factor of Safety maximum void width, and the geotechnical characteristics of the stratigraphy.

The Project is proposing to use performance criteria (Chapter 8.0) defined for the various mining zones identified above to provide the basis of the mining system and layout design over the life of the Project. These performance criteria would include maximum permissible subsidence, tilt and strain for each given mining zone.

The design level of maximum subsidence in previously unmined areas of 125 mm within the Project Application Area has been demonstrated at other similar mining operations in the Western Coalfields, for example Clarence Colliery, to have no perceptible impact on surface land features or surface water systems. Ongoing monitoring (including subsidence, underground pillars geotechnical conditions, flora and fauna and groundwater) over 13 years at Clarence Colliery has demonstrated success of the criteria selected in very similar topographical and hydrological conditions. Gretley Colliery previously used panel and pillar mining, similar to concepts proposed at Airly Mine, under residential areas in the Newcastle area. For those areas, subsidence was effectively controlled to generally less than 100 mm.

It should be noted that the current Clarence Colliery Development Consent (DA 504-00), granted in 2005, has subsidence criteria for first workings is as follows:

- vertical subsidence 20 mm
- maximum tilt of 1.0 mm/m
- maximum strain of 1.0 mm/m

While the subsidence criteria for the partial extraction areas are:

- Maximum vertical subsidence 100 mm,
- Maximum tilt of 3.0 mm/m
- Maximum strain of 2.0 mm/m.

The subsidence design criteria that has been adopted for Clarence Colliery over the long term (Shepherd 1999; Strata Engineering 2005) is for the magnitude of surface subsidence to be limited to a value well within that considered to be characteristic of ‘elastic’ overburden behaviour / displacement only (i.e. no-caving to surface). This has been defined as 100mm ± 25mm; i.e. vertical subsidence to be nominally limited to 100 mm but shall not exceed 125 mm. Airly Mine will adopt the maximum vertical subsidence criterion of 125 mm.

4.7.2 Mining Sequence

Mining will continue on from the existing workings in the west of the Project Application Area and progress generally eastwards under Mount Airly and Genowlan Mountain.

The main body of Mount Airly will be mined first. The next area to be mined will be the western portion of Genowlan Mountain followed by the area under Genowlan Point. The last area scheduled to be mined is the northern outlier of Mount Airly, locally referred to as Black Mountain. It should be noted that both partial extraction in the deeper areas and first workings in the shallower areas would be occurring concurrently.

4.8 Coal Handling, Processing, Stockpiles and Transport

4.8.1 Coal Handling and Processing

ROM coal will continue to be conveyed from the underground via the trunk conveyor (UC01) and fed directly onto a surface conveyor system (Figure 4.2) to the existing coal crushing and screening plant. Crushed coal will be transferred, either to the proposed ROM Coal Stockpile (Section 4.8.2) for beneficiation in the CPP or directly to the Product Coal Stockpile depending on market requirements.

The 30,000 tonne Emergency Stockpile, located adjacent to the transfer between UC01 and CV01 conveyors, will either receive coal from a diversion conveyor at the UC01 and CV01 transfer point or via truck from the Product Coal Stockpile should it reach capacity. Coal would be fed back onto CV01 through an existing loading point by front end loader or dump truck.

Whilst a CPP is currently approved, to date only the CHP portion has been constructed and land prepared for the CPP. The construction of the CPP is proposed in the Project with the capacity to beneficiate 1.8 Mtpa ROM coal.

The proposed locations of the CPP and the ROM Coal Stockpile are shown in Figure 4.2. The CPP will be constructed to the west of CV02 conveyor between the crushing and screening plant and the Product Coal Stockpile. The CPP will be constructed on previously disturbed land used during the mine construction phase.

The CPP will consist of the following items associated with it:

- connection to the surface water distribution system for CPP process water (Section 4.11.3)
- connection to the conveyors
- a 40,000 tonne ROM Stockpile and reclaim facility
- a coal beneficiation plant
- a facility where the thickener can be added to process ultra-fine material
- a reject conveyor and truck loading bin
- a primary arrestor to remove sediment from surface run off prior to drainage into the existing 7 ML Dam
- an above ground bunded refuelling facility for mobile plant operating on the stockpiles and REA
- an office, store and workshop facility
- an effluent storage and transfer system to allow effluent to be transferred to the existing Effluent Treatment System
- a car park for plant operators and contractors.

No bathing facilities for the CPP will be constructed. CPP personnel will use the existing bathhouse at the pit top.

4.8.2 Coal Stockpiles

No change to the capacity of the existing Product Coal Stockpile (200,000 tonne) or the Emergency ROM Stockpile (30,000 tonne) is proposed in the Project.

Establishment of a 40,000 tonne ROM Coal Stockpile in the vicinity of the CPP for the storage of ROM coal prior to transfer into the CHPP for beneficiation is proposed in the Project.

4.8.3 Reject Materials Management

Management of coarse and fine rejects from the CPP has been assessed through an options feasibility analyses (GHD (2014c) study and included a number of potential options for feasibility. The report is attached in Appendix R. The options considered were based on two main aspects. Firstly, the disposal methodology was assessed and in this regard three disposal options were investigated. The second aspect assessed was the disposal location and two sites were investigated in the Project. Discussions on the alternative disposal methodologies and the alternative REA location are included in Chapter 12.0, Section 12.4.3.

In this Project a co-disposal REA for the emplacement of both the fine and coarse reject materials and an associated settlement dam (REA Dam) is proposed to be constructed at the location shown in Figure 4.2. The concept design is discussed in GHD (2014d) provided in Appendix S. The REA has been designed to limit external batters and direct the maximum runoff to the internal areas, where runoff will be collected by internal drains running adjacent to construction access roads, then directed to silt traps. This runoff would then be transported along external toe drains, before reporting to a water management dam.

The proposed REA will be located adjacent to the pit top facilities and directly adjacent to the proposed CPP site (Figure 4.3). The site is on a hill side within the Airly Creek catchment and is predominantly cleared grazing land with only isolated native trees. The REA on the western side has been designed to conform to the natural topography of the area. This site was selected as the preferred option for the REA, over the alternative REA location discussed in Section 12.4.3, for the following reasons.

- No threatened species or EECs have been recorded in the impact footprint. Vegetation clearing for the construction of the REA will be limited to grazing pasture and isolated non-threatened native trees.
- No heritage issues exist on the site.
- The site is in the same catchment as the rest of the surface infrastructure, namely Airly Creek catchment.
- Water management can be achieved with all gravity flow and only one collection drain around the perimeter of the REA footprint.
- The REA location is close to the CPP and hence reject material transport distances are greatly reduced which also reduces noise and dust impacts from reject material transport.

A number of impact assessments (surface water, ecology, noise, air quality, visual) undertaken over the two REA locations investigated (Section 12.4.3) revealed the proposed REA location to have lower potential environmental impacts. In addition, this proposed location offers operational practicality and safety, potential for expansion and overall feasibility compared to the alternative REA location.

As discussed in GHD (2014c) Appendix R), the potential advantages of using co-disposal within the REA are as follows.

- Coarse waste rock emplaced in a REA would normally have a porosity in the order of ~30%, presenting ideal conditions for Acid Metalliferous Drainage (AMD) formation where Potentially Acid Forming (PAF) waste materials exist. It has been anecdotally noted that this may by the case at Airly Mine. Mixing the fine tailings with the coarse waste would reduce the porosity of the resultant soil matrix, reducing permeability and increasing the moisture holding properties of the mixed waste thus limiting oxygen access and reducing the risk of AMD.
- The overall volume of reject materials is reduced and the required footprint of a combined fine and coarse reject material storage would be smaller than for the separate coarse and fine reject material streams.
- No containing embankment is required for either the coarse and fine reject material streams.
- The combined coarse and fine reject material is expected to have superior engineering properties to the separate materials and will be suitable to construct an easily trafficable, low dust generating, stable landform with likely good properties for drainage and revegetation.

The proposed REA will have a total storage volume of 5.2 Mm^3. This volume has been based on remaining recoverable reserves, an approximate 15% reject material production and a density of 1.5 t/m^3. This is considered a conservative estimate, and densities in excess of 1.5 t/m^3 are considered likely to be achieved. The disturbance footprint required for the REA is approximately 37.94 ha.

Four other components associated with the REA are:

- Perimeter stormwater or toe drains (REA Run-off Diversion Drain)
- Stormwater management dam (REA Dam)
- Emergency spillway
- Pump and pipeline.

Perimeter Stormwater Drain

The northwest and south drains have been designed as trapezoidal open channels with capacity for the 1:100 AEP flood event. The drains will run by gravity with a minimum 1% slope, reporting to the REA Dam. Bunds will be constructed around the drains to allow the drains to remain on grade.

Concept design parameters of the drains are presented in Table 5, with cross-sections presented in Figure 2 and Figure 3 in GHD (2014d) (Appendix S).

REA Dam

The REA Dam has been modelled as a cut/fill balance, with embankment material taken from within the storage area. The additional cut material (~7,250 m^3) will be used in the construction of the drainage bunds described above. The design has a storage volume of approximately 52.4 ML, accommodating the required storage of 51.8 ML. Concept design parameters of the REA Dam are summarised in Table 6 of GHD (2014d) (Appendix S),

Emergency Spillway

The emergency spillway for the REA Dam has been designed to have the capacity to pass a 1:1,000 AEP flood event. The design flow for this event was calculated to be approximately 9.7 m^3 /s. Concept design parameters of the spillway design are provided in Table 7 of GHD (2014d) (Appendix S),

A new licensed discharge point is proposed for the spillway to be constructed for REA water management (Section 4.11.6). No volumetric limit is proposed, as discharges are expected to occur as a result of emergency discharges due to extreme rainfall conditions.

Pump and Pipeline

A pump and pipeline system is required at the REA Dam in order to keep the pond level low, so that there is sufficient storage for flood events. The pump and pipeline have been sized with a capacity that exceeds the maximum monthly required outflow during a wet year (February, 18 L/s). Concept design parameters for the system are provided in Table 8 of GHD (2014d) (Appendix S).

REA Construction and Progressive Rehabilitation

Construction of the proposed REA will require the stripping of topsoil material and the subsoil to allow a suitable base for the REA to be constructed on. This material will be stockpiled within the REA footprint area wherever possible. Where it is not possible to stockpile topsoil and subsoil material within the REA footprint, it will be stockpiled within a dedicated soil stockpile area. Subsoil will be stockpiled separately to topsoil. If the subsoil material is found to be suitable as final capping material, it will be used as such. Should the subsoil material not be suitable for capping or there is a requirement for additional capping material, material will be sourced externally and brought to site as required.

Operation of the REA would involve loading the blended reject material into an off highway dump truck at the CPP and transporting the material to the REA. This material will be emplaced and the spread out and compacted using a bulldozer. Initially a large bund wall to the full lift height will be constructed along the front wall or the downslope (west-facing) side of the first lift of the REA. This will allow rehabilitation to commence on this initial slope. Reject material will then be emplaced behind the bund wall to complete the lift. This process will be repeated for each lift of the REA. In this way rehabilitation can be carried out progressively over the life of the mine, and noise, dust and visual impacts can be minimized at the nearest sensitive receptors.

A stock fence will be built around the REA to prevent cattle and other animals from entering.

The construction of the REA will be staged and the four rehabilitation stages over the life of mine are proposed to be as follows.

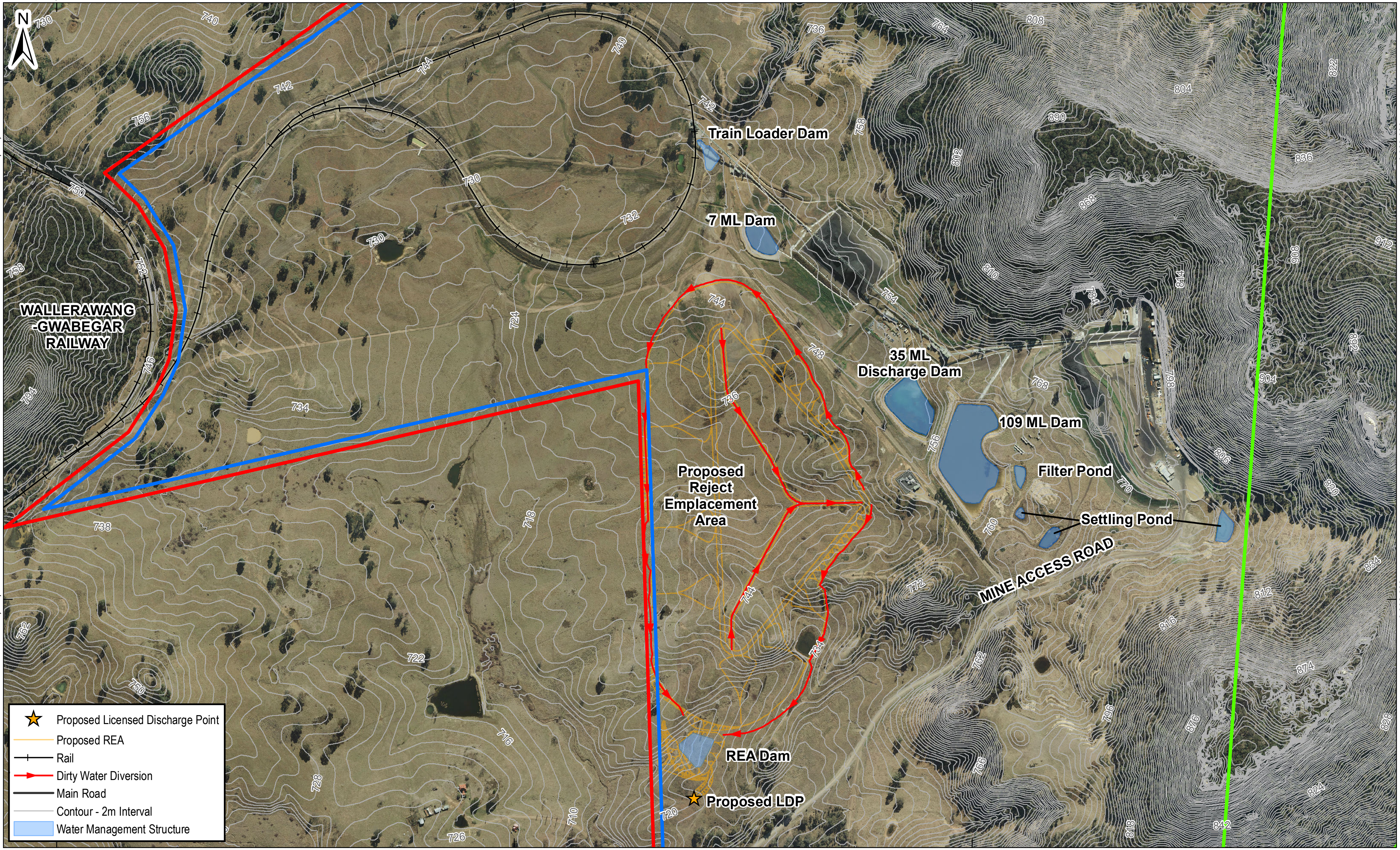
- **Stage 1**: This stage will comprise the construction of the front wall (western embankment) to the full lift height of 745 m AHD and establishment of water management structures including the following. The outer batter of the front wall will be rehabilitated by approximately Year 3 and, as noted above, will serve to mitigate visual and noise impacts of reject material emplacement activities, and minimize batter erosion.

  - An internal dirty water drain will be constructed in the centre of the REA and maintained in such a way to shed water to the external perimeter drains for transfer to the REA Run-Off Diversion Drain and subsequent flow to the REA Dam. The internal drains will minimise the amount of water running off the rehabilitated area and minimise erosion.
  - A dirty water diversion drain (or toe drain) will be constructed around the perimeter of the REA footprint for the diversion of water to the REA Run-Off Diversion Drain and subsequent flow to the REA Dam.

- **Stage 2**: The front wall will be lifted to the full Stage 2 lift height of 750 m AHD and rehabilitated prior to the completion of Stage 1 emplacement activities covering the rest of the REA specifically the eastern portion, by approximately Year 9. Again as for Stage 1 the sequence of emplacement activities is to maintain noise and visual shielding as much as possible during operations.
- **Stage 3**: In this stage the front wall will continue to be lifted to achieve the full Stage 3 height of 755 m AHD prior to completing the Stage 2 emplacement activities on the eastern portion of the REA.
- **Stage 4**: The front wall of the REA will be constructed to the final crest height of 765 m AHD prior to completing the Stage 3 emplacement activities. During Stage 4 rehabilitation of the outer batter of the embankment will be completed. Following completion of emplacement activities in Year 20, the top of the REA will be shaped and rehabilitated to create a final height (765 m AHD) which is compatible with the local topography and lower than the local peaks of up to 790 m AHD at the adjacent remnant vegetation to the west of the Project Application Area. Typical longitudinal (NS) and transverse (EW) sections for different stages of the REA as well as the final landform created at the end of reject materials emplacement activities are shown in Figure 4.4. Figure 4.5 and Figure 4.6 illustrate the REA final landform as a 3D image.

Water from the REA Dam will be pumped, via the pump and pipeline station, to the 109 ML Dirty Water Dam for use as process water. The pipeline and services conduit for the pump station will follow the drainage line of the REA and then directly to the 109 ML Dirty Water Dam. Recycling of the water from the REA Dam will occur on a regular basis to ensure that the REA Dam always has sufficient water storage capacity.

Table 4.3 provides a summary of the forecast staged REA construction and rehabilitation. The final rehabilitated footprint noted in the table is for the REA footprint only and does not include the drains on the perimeter or the REA Dam. The drains and the REA Dam will be retained in the final landform as the water management structures.



LEGEND
Project Application Area
ML1331 Current Lease Boundary (Offset for Clarity)
A232 Authorisation Boundary (Offset for Clarity)

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:11,000

Site
Newcastle
Lithgow
Sydney

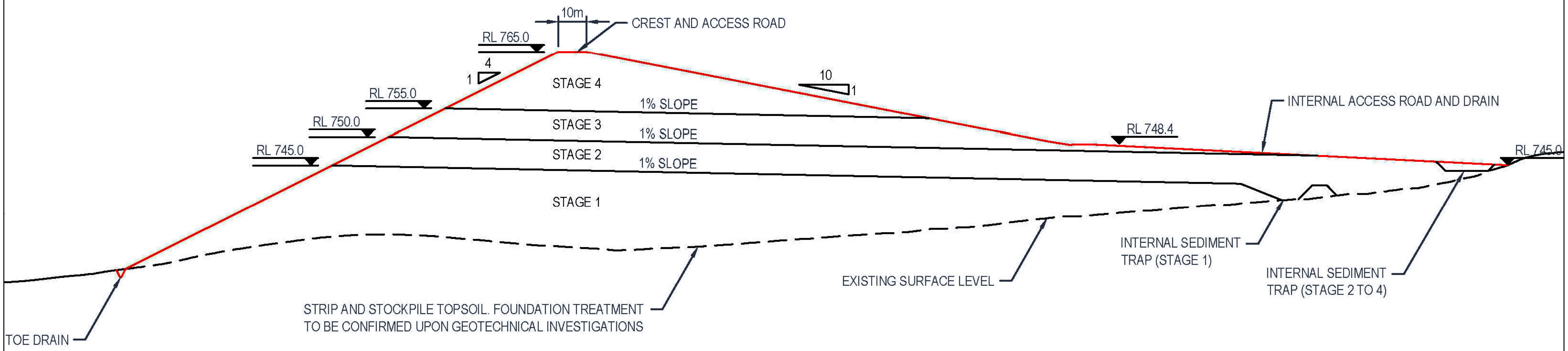
Figure 4.3: Concept Reject Emplacement Area

0 100 200 300 400 Metres

PLOTFILE No.

Centennial Coal
Airly

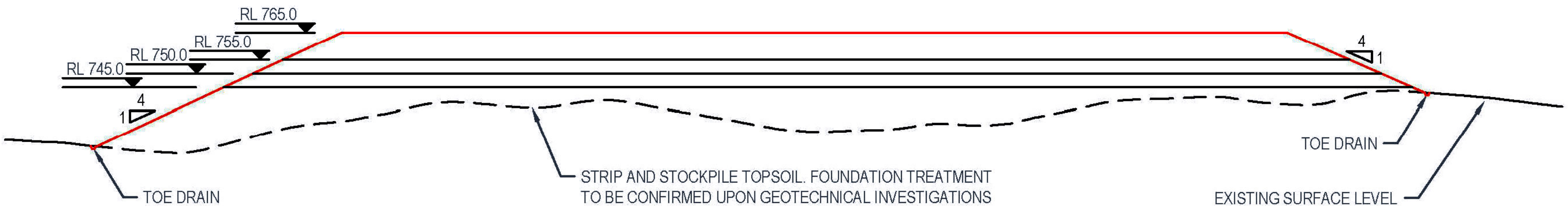
DRG No. 4-4.3
A4



Cross-Section (B-B')

SCALE 1: 2,000 (Horizontal)

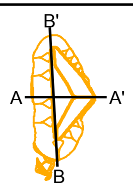
SCALE 1: 1,000 (Vertical)



Cross-Section (A-A')

SCALE 1: 5,000 (Horizontal)

SCALE 1: 2,500 (Vertical)



DATE	15/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	AS SHOWN

Figure 4.4: Cross-Sections Across Proposed Reject Emplacement Area

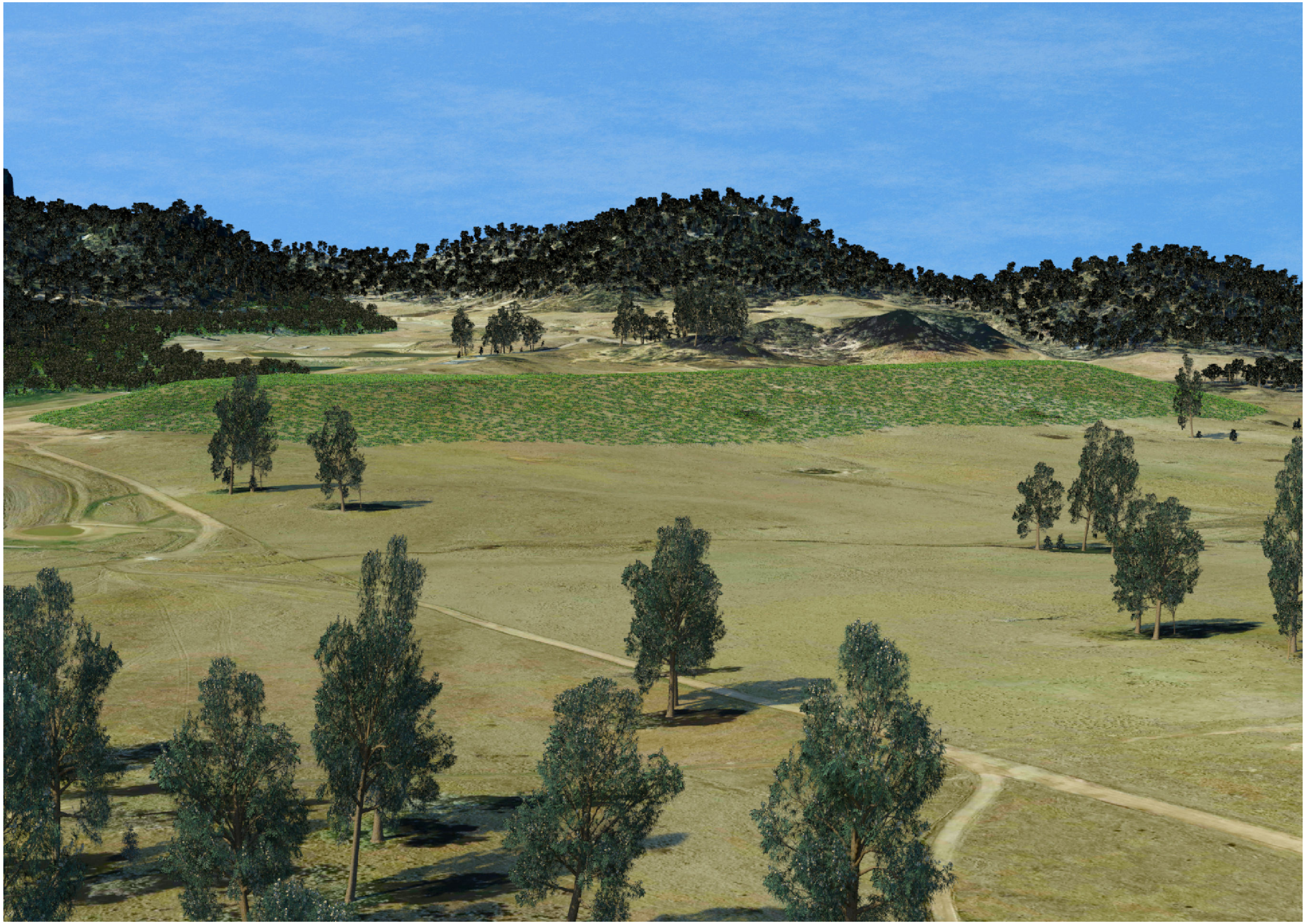
PLOTFILE No.

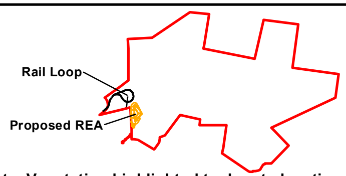
Centennial Coal

Airly

DRG No. 4-4.4

A4





Note: Vegetation highlighted to denote location of REA.

CENTENNIAL AIRLY PTY. LTD.

DATE	3/09/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

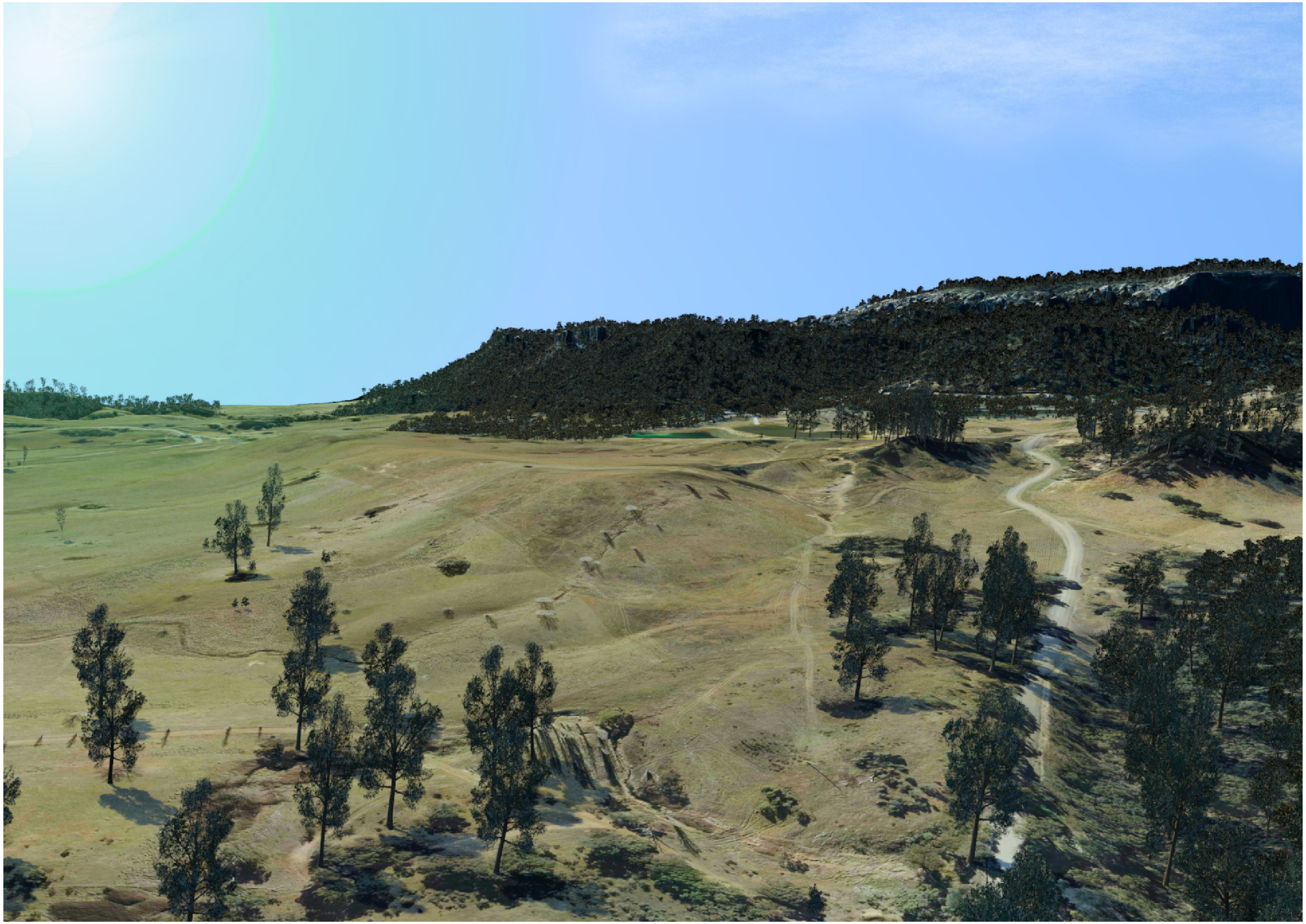
Figure 4.5: Reject Emplacement Area Final Land Form Viewed From Above the Rail Loop

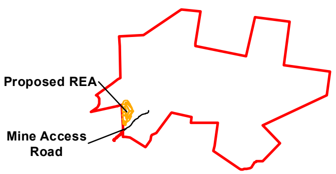
PLOTFILE No.

Centennial Coal
Airly

DRG No. 4-4.5

A4





CENTENNIAL AIRLY PTY. LTD.

DATE	3/09/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Figure 4.6: Reject Emplacement Area Final Land Form Viewed From Above the Mine Access Road

PLOTFILE No.

Centennial Coal
Airly

DRG No. 4-4.6

A4

Table 4.3: Progressive REA Batter Construction and Rehabilitation

Stage	Crest Height (m AHD)	Rejects Volume (m^3)		REA Surface Area Rehabilitated (ha)		
		Stage	Cumulative	Stage	Cumulative	Timing (year)
1	745	2,357,000	2,357,000	9.0	9.0	3
2	750	1,198,000	3,535,000	2.9	11.9	9
3	755	886,000	4,421,000	3.1	15.0	14
4	765	765,000	5,186,000	6.3	21.3	18
Final Rehabilitation	765			13.7	35.0	25

4.8.4 Coal Transport

No changes are proposed to the current transport infrastructure.

The existing rail load out facilities will continue to be used for the handling and transport of coal from the site to offsite locations. All coal will be transported off site by rail. No coal will be transported off site by road.

4.9 Plant and Equipment

The Project will continue to use plant and equipment for both underground and surface operations as described in Section 3.9, and this will involve use of continuous miners for coal extraction and a range of other ancillary equipment both in the underground workings and during operations at the pit top. New plant and equipment will be purchased (equating to approximately $77M) to support the different types of mining proposed for each mining zone as required.

The existing conveyor system will continue to be used and extended to access new extraction areas. Other underground services such as ventilation, electrical distribution, compressed air, water, waste water will be extended as mining proceeds.

Existing underground mobile plant will continue to be used. This includes personnel transport, load haul dump vehicles, and other load carrying plant. This plant will be maintained and refueled at the surface workshop facilities. Existing fixed plant on the surface will continue to be used and may be upgraded as required. Other approved fixed plant as described in Table 4.1 and the Project will be constructed during the life of the Project.

Existing mobile plant in use on the surface will be used in the Project. This would typically include: bulldozer, front end loader, off highway dump trucks, light vehicles, forklift, telehandler and other earthmoving plant as and when required.

External plant coming to site would include trains, delivery vehicles and employees' vehicles. This would also be a continuation of the existing conditions at the mine.

4.10 Mine Support Facilities and Underground Access

Existing underground mine access will not change as a result of the Project. All existing infrastructure and mine support facilities will continue to be used and upgraded as required, however, upgrades to the majority of facilities will be minimal. The existing refueling location will be upgraded as described below.

- Installation of a self bunded portable transfer tank of approximately 28,000 L capacity. The tank will be fitted with Banlaw fittings to prevent spillage during fuel transfer from refueling trucks to the tanks and subsequent transfer to trains.
- Concreting of the bunded fuel transfer area to provide an impermeable surface for the fuel truck and fuel tank to stand on.

- A valve fitted to the outlet of the existing sump that would be closed during refueling activities to prevent spills from reaching the Train Loader Dam. Spills captured within the sump will be removed from the site by a licensed contractor.

The existing concrete sump will be retained for the containment and management of diesel fuel spills. The power for the facility will be supplied by the adjacent train loading facility.

A number of new facilities will require to be constructed to support the proposed mining operations. These facilities will be constructed on already disturbed areas at the pit top. The following new facilities will be constructed and operated:

- a permanent workshop
- stores building and bulk storage yard
- service building including hydrocarbon storage area
- an above ground bunded refueling facility servicing the pit top and underground vehicle fleet
- cable store
- compressor building
- fire station
- additional water management structures
- additional tank at effluent treatment system
- a site security gate
- electricity distribution network and communications infrastructure required to serve new developments
- internal travel roads
- rejects bin, internal haul road and additional conveyors for rejects emplacement area (as required)
- CPP as described in Section 4.8.1.

4.11 Water Management

The existing water management, as outlined in Section 3.11 and comprising surface, potable, bathhouse, waste and underground elements, will continue to be managed in accordance with the Airly Mine Water Management Plan. A new REA Dam will be constructed (Section 4.8.3).

4.11.1 Surface Water Management

The separation and storage of clean and dirty water at the pit top will continue to be managed as described in Section 3.11.1. An additional dam (REA Dam) associated with the proposed REA will be installed. The REA Dam will hold dirty water runoffs from the REA prior to its recycling, via a dedicated pump and pipeline, to the 109ML Dirty Water Dam for further treatment (de-silting) and subsequent use as process water in operations.

The location of the REA dam is shown on Figure 4.2.

The REA dam will be sized to accommodate a 1 in 100 year, 72 hour rainfall event and will be maintained on a regular basis to ensure sufficient capacity.

4.11.2 Underground Water Management

As mining progresses it is predicted that groundwater flows into the mine will increase. This will require the installation of a mine dewatering system. Typical underground water management that will be installed in the Project will include:

- small mobile pumps in working areas of the underground mine that deliver water to local collection tanks in each working panel
- delivery of water from local collection tanks to large underground impoundment areas by a system of pipelines
- removal of water from the impoundment areas to the 109 ML Dirty Water Dam using large pumps and pipelines.

No underground treatment of mine water is proposed. Some groundwater may not be recoverable due to seepage into inaccessible parts of the mine where mining is complete.

Pipelines, underground impoundment dams and pump stations will be constructed to facilitate the removal of water from underground.

The mine inflows pumped and stored in the 109 ML Dirty Water Dam will be used as process water for dust suppression on the surface, as process water in the CPP and as underground process water for dust suppression, as described in Section 4.11.3.

4.11.3 Process Water

Process water will continue to be sourced from the 35 ML Discharge Dam which stores clean water from surface run-off and settled water from the 109 ML Dirty Water Dam. Water will continue to be pumped to the Process Water Tank prior to distribution using pipelines, for dust suppression and fire-fighting supply to both underground and surface facility areas, and toilets.

The operation of the proposed CPP will require supply and disposal of process water. Water for the CPP will be supplied from the 35 ML Discharge Dam at an estimated rate of 120 L/tonne of ROM coal. An in-built water recycling system will reduce the net demand of the CPP, with approximately 80% of water supplied to the CPP returned to the 109 ML Dirty Water Dam, for re-use.

4.11.4 Drinking Water and Bathhouse Water

No changes to the drinking water and bathhouse water supplies are proposed. Drinking water requirements for offices and underground personnel will continue to be met by bottled water.

Water for showers in the bathhouse will continue to be supplied by harvested rain water from the rooftops of the administration and facilities buildings, stored in rainwater tanks prior to use. Trucked potable water will continue to be used to fill up these Administration Buildings Tanks in order to meet bathing water requirements in the bathhouse.

Water for the toilets in the administration buildings will be supplied from the Process Water Tank.

4.11.5 Effluent Management

No change to the existing onsite effluent treatment is proposed. Sewage and grey water from the bathhouse offices, workshop, store and CPP at the pit top area will continue to be treated on site by the upgraded the life of mine Effluent Treatment System.

Underground sewage will continue to be managed by the portable toilets currently in use with effluent being disposed of into the Effluent Treatment System.

4.11.6 Licensed Discharge Points and Water Monitoring

The Project will retain the existing LDPs LDP001, LDP002 and LDP003 within EPL 12374. Water monitoring will continue to be undertaken at the site in accordance with the conditions of the amended EPL 12374 and as described in Section 3.11.6.

A new licensed discharge point is proposed at the outlet from the proposed REA Settlement Dam and will be an emergency discharge point. The location of this proposed LDP is shown in Figure 4.2.

An ANZECC Water Quality Assessment was undertaken as part of the Project to identify potential impacts on Airly Creek of water discharge from the pit top via LDP001. Additionally the monitoring data acquired to date within Airly Creek has been analysed to establish Site Specific Trigger Values for the Project. The proposed trigger values have been derived in accordance with ANZECC/ARMCANZ (2000) methodologies. Trigger values have been modified for water hardness where appropriate in accordance with ANZECC/ARMCANZ (2000).

4.11.7 Site Water Requirements- Proposed

The water balance model was simulated over the predicted life of mine including existing (scenario 1), approved (scenario 2) and proposed (scenario 3) conditions (Appendix F). The modelled results of the existing operations are presented in Section 3.11.7.

Table 4.4 provides the site water requirements for the proposed operations. The site water requirements for the approved scenario (scenario 3) are also included for comparison purposes.

Table 4.4: Site Water Requirements – Approved and Proposed

	ML/yr	ML/yr
Direct rainfall onto storages and catchment runoff	194.5	194.5
External bathing and potable water supply	0.3	0.6
Groundwater inflows into underground workings	598.4 (maximum in mining year 16)	180.2 (maximum in 2030)
Extraction from production bore	0.0	2.4
In situ coal moisture	46.1	46.1
TOTAL INPUTS (rounded)	**839**	**422**
OUTPUTS		
Evaporation	52.6	45.2
Dust suppression	99.8	99.8
Sewage to effluent treatment	1.7	2.1
Discharge through LDP001	485.9	76.0
Discharge through LDP002	0.0	0
Discharge through LDP003	0.0	0
Discharge through proposed LDP	0.5	0.5
Coal product moisture	142.3	142.3
Rejects moisture	56.5	56.5
TOTAL OUTPUTS (rounded)	**839**	**422**
Surface water storages	0.0	0.0
TOTAL CHANGE IN STORAGE	**0**	**0**

Table 4.4 shows the following for proposed operations (scenario 3):

- the largest source of water is from surface water harvesting at 195 ML/yr
- coal product moisture is the largest output from the site, accounting for approximately 142 ML/yr, followed by dust suppression and evaporation. 56.5 ML/yr will be lost to reject materials
- discharges through LDP002 and LDP003 are not expected to occur
- annual discharge through LDP001 is predicted to be approximately 76 ML/yr
- predicted groundwater inflows for the proposed operation are expected to peak in 2030 at approximately 5.8 L/s.

For the proposed operations, the predicted increase in groundwater flows recirculated through the Airly Mine water management system will significantly reduce the demand for supplementary water extracted from the production bore. Modelling indicates that additional direct rainfall to storages, runoff and evaporation will occur under proposed operations due to the new REA and associated REA water storages and additional runoff from the CPP and ROM Stockpile Area. The additional water collected by these storages will be transferred to the 109 ML Dirty Water Dam and reused on site. The difference in evaporation from surface water storages between proposed and approved operations is minor.

Increased LDP001 discharges modelled under proposed operations is a result of increased groundwater inflows being transferred to the surface water system. The average annual discharge through LDP001 under proposed operations in 2030 was predicted to be approximately 66 ML/yr, which is also skewed by high rainfall events and prolonged wet periods. Discharges are predicted to occur in 2030 on less than 9% of days, or approximately 31 days in 2030. The current EPL limit is not expected to be exceeded under proposed operations.

The average annual discharge from the REA water storages through the proposed LDP was predicted to be approximately 0.5 ML/year, with the 10th and 90th percentile values estimated to be 0 ML/day. One overflow from the REA water storages of approximately 31 ML was modelled to occur in response to a large rainfall event in the historic rainfall dataset, which recorded 270 mm over five consecutive days. As this is in excess of the design criteria for the REA water storages, discharges through the proposed LDP are expected to occur only as a result of rainfall which exceeds the 100 year, 72 hour rainfall event.

The most significant difference between the approved and proposed operations is that the Project mining method, with its lower consequential height of fracturing, significantly reduces groundwater inflows into the mine. The consequences of this are less mine water to manage, less impact to groundwater resources above the mining area and less discharge through LDP001.

4.12 Underground Ventilation

No major change to the existing ventilation system is proposed in the Project. Three out of the existing four adits to the underground will continue to act as air intakes and air from the underground will continue to be exhausted via the two electrically powered centrifugal fans attached to the northern-most access adit. There will be minor works associated with extending the ventilation network into the new mining areas.

All mine design options have been designed with sufficient numbers of roadways to achieve adequate ventilation quantities in all working areas in accordance with relevant legislation over the life of the Project. The existing ventilation facilities are adequate to meet requirements even when mining is being undertaken 8 km to the east at the furthest extent of mining.

4.13 Waste Management

4.13.1 Production Waste

Reject material generated underground and from the CPP (both coarse and fine materials will be co-disposed within the REA as described in detail in Section 4.8.3.

4.13.2 Non-Production Waste

Non-production waste generated at the pit top and underground will continue to be managed as described in Section 3.13.2.

4.14 Environmental Management

Airly Mine will continue to undertake environmental management and monitoring as described in Section 3.14.4 and in accordance with the following.

- Airly Mine's EMS comprising Airly Mine Environmental Management Plans, following a review and updating of the plans, as appropriate. The review will take into consideration the environmental assessments undertaken as part of this EIS, the commitments made in this EIS and all relevant consent conditions.
- Centennial Environmental Policy.

Airly Mine will undertake monitoring and reporting in accordance with an updated environmental monitoring network, monitoring noise, dust, groundwater, surface water and subsidence. An Extraction Plan will be prepared and approval will be sought prior to commencement of partial extraction mining methods.

Monitoring results will continue to be reported monthly on Centennial's website and on an annual basis in an Annual Review.

4.15 Rehabilitation and Final Landform

The approved MOP details the proposed rehabilitation objectives to ensure the final landform is commensurate with the surrounding topography and relevant zoning requirements of the time. These are further detailed, specific to the Project, in the Decommissioning and Rehabilitation Strategy (SLR 2014d, Appendix O and Section 10.9) and relevant legislative requirements.

Staged and final rehabilitation will ensure that there will be little change to the landform of the Project Application Area during and after mining compared to current conditions. Existing and proposed components of the Project will be decommissioned and rehabilitated once they have performed their functions, to ensure minimal disturbance areas within the Project Application Area. Rehabilitation of the pit top area will mitigate the largest area of surface disturbance.

Regular monitoring of the rehabilitated areas will occur during the initial vegetation establishment period and beyond, to ensure the objectives of the Rehabilitation Strategy are being achieved. Further detail on life-of-mine and rehabilitation is provided in Section 10.9.

On cessation of all mining activities the disturbance areas will be fully rehabilitated to create stable and self-sustaining landform for the nominated end land uses and further discussed in Section 10.9.

CHAPTER 5.0

Planning Considerations

5.0 PLANNING CONSIDERATIONS

The Airly Mine Extension Project has been assessed with full consideration of the applicable legislative requirements of the Commonwealth and State, along with the local planning and environmental frameworks of the Lithgow LGA, where applicable. This section describes the relevant regulatory framework and the application to the Project.

5.1 Approval Pathway and Permissibility

The development assessment and approval system in NSW is set out in Parts 4 and 5 of the EP&A Act. Division 4.1 in Part 4 provides for the assessment and determination of State significant development (SSD). Pursuant to Section 89C of the EP&A Act, projects are classified as SSD if they are declared to be such by the *SEPP (State and Regional Development) 2011* (SRD SEPP). Schedule 1 of the SRD SEPP identifies development for the purpose of coal mining as SSD, and as outlined in Section 5.4.1, the Project is permissible with development consent. As a result, pursuant to clause 8(1) of the SRD SEPP, the Project comprises SSD.

The Minister for Planning and Infrastructure (or his delegate) determines development applications for SSD under Part 4 of the EP&A Act. The Minister has delegated his consent authority function to the Planning Assessment Commission for development applications made by private proponents for SSD.

A Project Briefing Paper (Centennial 2012b) was submitted to the then NSW P&I, along with various other State and local government agencies, in September 2012 seeking the DGRs for the form and content of the EIS to accompany the development application. The DGRs were first issued by the NSW P&I on 06 November 2012 outlining the general requirements and key issues to be addressed within the EIS. Revised DGRs, following the declaration of the Project as a controlled action on 24 December 2013 in relation to EPBC 2013/7076 referral, were re-issued on 4 February 2014 and contained the Department of the Environment's requirements. The DGRs and input received from other consulted government agencies are contained within Appendix A and summarised in Chapters 1.0 and 7.0. The Project was subsequently declared a controlled action on 24 December 2013 and DGRs issued on 4 February 2014.

The Project will be assessed under the EPBC Act through the bilateral agreement with NSW, accrediting the EP&A Act (SSD process). The bilateral agreement between the Commonwealth of Australia and the State of New South Wales relating to environmental assessment (the bilateral agreement), allows the Commonwealth Minister for the Environment to rely on specified environmental impact assessment processes of the State of New South Wales in assessing actions under the EPBC Act.

5.2 Commonwealth Legislation

5.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment, the former Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as matters of 'national environmental significance' (NES). An action that "*has, will have or is likely to have a significant impact on a matter of National Environmental Significance*" may not be undertaken without prior approval from the Commonwealth Minister, as provided under Part 9 of the EPBC Act. Approval under the EPBC Act is also required where actions are proposed on, or will affect, Commonwealth land and its environment.

Airly Mine has the benefit of the "grandfather clause" contained in Section 43A of EPBC Act. It is also important to recognise that, by reason of the relevant transitional provision, namely item 10 in Part 2 of Schedule 2 to the *Environment and Heritage Legislation Amendment Act (No 1) 2006*, it is the original Section 43A which was inserted in the EPBC Act on 11 July 2001 which applies to the Airly Mine. The effect of Section 43A for the Airly Mine, is that no approval under Part 9 of the EPBC Act is required for the carrying out of the already approved activities.

An assessment of whether the Project may have a significant impact on any matters of NES or on the environment of Commonwealth land was undertaken during the EIS investigations and preparation. Specifically, RPS Australia East Pty Ltd (RPS) conducted an on-line search of the EPBC Act Protected Matters Search Database (accessed in September 2013) to generate a list of those matters of NES within a 10 km radius of the Project Application Area. RPS used this data, together with other local knowledge and records, to assess whether the Project will have, or is likely to have, a significant impact upon a matter of NES or on the environment of Commonwealth land.

RPS (2014a) concluded that the Project was considered to have or is likely to have, a significant impact on any of the matters of NES listed under the EPBC Act]. Consequently a referral to the Department of the Environment was made on 02 December 2013 (EPBC 2013/7076) and the Project was declared a controlled action on 24 December 2013.

The groundwater (GHD 2014a) and surface water (GHD 2014b) impact assessments were undertaken based on the recommended guidelines provided by IESC (2014). The outcomes of these assessments are discussed in detail in Section 10.1 of this EIS.

5.2.2 Native Title Act 1993

The *Native Title Act 1993* recognises that Aboriginal people have rights and interests to land and waters which derive from their traditional laws and customs. Native title may be recognised in places where Indigenous people continue to follow their traditional laws and customs and have maintained a link with their traditional country. It can be negotiated through a Native Title Claim, an Indigenous Land Use Agreement (ILUA) or future act agreements.

An ILUA is an agreement between a native title group and other parties who use or manage the land and waters. The ILUA process allows for negotiation between indigenous groups and other parties over the use and management of land and water resources, and the ability to establish a formal agreement. An ILUA is binding once it has been registered on the Native Title Tribunal's Register of Indigenous Land Use Agreements.

Any native title matters will be managed within the provisions of the *Native Title Act 1993* (and *Mining Act 1992*).

5.2.3 National Greenhouse and Energy Reporting Act 2007

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) provides a single national framework for the reporting and dissemination of information about the greenhouse gas emissions, greenhouse gas projects, and energy use and production of corporations. It makes registration and reporting mandatory for corporations whose energy production, energy use or greenhouse gas emissions meet specified thresholds. Centennial Coal reports emissions from the corporation on an annual basis, including those from the Airly Mine, in accordance with the NGER Act.

5.3 NSW State Legislation

5.3.1 Environmental Planning and Assessment Act 1979

Objects of the EP&A Act

The EP&A Act is the principal piece of legislation overseeing the assessment and determination of development proposals in NSW. It aims to encourage the proper management, development and conservation of resources, environmental protection and ecologically sustainable development.

The objects of the EP&A Act generally seek to promote management and conservation of natural and artificial resources, while also permitting appropriate development to occur. The principles of ecologically sustainable development and public participation are also objects of the EP&A Act. The consistency of the Project with these objects is summarised in Table 5.1

Table 5.1: Objects of the EP&A Act

Objects of the EP&A Act	Consistency of the Project
(a) to encourage:	
(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,	Specialist consultants have been engaged to assess and report on the potential for the Project to impact upon the natural and artificial resources within the vicinity of the Project Application Area. Notably: • The impacts on the natural environment have been addressed within Chapter 8.0 and Chapter 10.0. • The impacts on agricultural land have been addressed within Section 10.8. • The social and economic implications have been addressed within Chapter 6.0.
(ii) the promotion and co-ordination of the orderly and economic use and development of land,	The orderly and economic use of land is best served by development which is permissible under the relevant planning regime and predominantly in accordance with the prevailing planning controls. The Project comprises a permissible development which is consistent with the statutory and strategic planning controls. As detailed in this EIS, the proposal will result in positive economic impacts, with appropriate mitigation measures and management strategy being proposed to reduce adverse environmental impacts.
(iii) the protection, provision and co-ordination of communication and utility services,	The Project will not affect public communication networks or utilities.
(iv) the provision of land for public purposes,	Not applicable to the Project.
(v) the provision and co-ordination of community services and facilities, and	Not applicable to the Project.
(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and	Specialist consultants have been engaged to assess and report on the potential for the Project to impact upon the local environment. Notably, the impacts on flora and fauna have been addressed within Section 10.2.
(vii) ecologically sustainable development, and	The Project is consistent with the principles of ecological sustainable development as outlined in Chapter 12.0, addressing both this object of the EP&A Act and clause 7(1)(f) in Schedule 2 of the EP&A Regulation.
(viii) the provision and maintenance of affordable housing, and	Not applicable to the Project.
(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and	As outlined in Section 5.1, the SSD proposal is subject to the provisions of Part 4 of the EP&A Act, where the Minister for Planning and Infrastructure is the consent authority.
(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.	As outlined in Chapter 7.0, Centennial Airy has undertaken significant consultation in relation to the Project with government agencies, the local community and other stakeholders. This consultation process is continuing with respect to the progression towards obtaining development consent and a mining lease for the Project. Any relevant public representations will need to be considered by the NSW P&Eduring the assessment of the development application.

Section 79C Evaluation

Section 79C of the EP&A Act applies to the determination of development applications for SSD. In determining the Project, the consent authority is required to consider the matters listed in Section 79C (1) of the EP&A Act as are of relevance to the development. Each of the relevant matters has been addressed in the EIS and will need to be considered by the consent authority during the assessment of the Project.

Other Approvals

Pursuant to Section 89J of the EP&A Act, the following authorisations are not required for approved SSD proposals:

- the concurrence under Part 3 of the *Coastal Protection Act 1979* of the Minister administering that Part of the Act
- a permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*
- an approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*
- an Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974*
- an authorisation referred to in section 12 of the *Native Vegetation Act 2003* (or under any Act to be repealed by that Act) to clear native vegetation or State protected land
- a bushfire safety authority under section 100B of the *Rural Fires Act 1997*
- a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000*
- an order under Division 8 of Part 6 of the *Heritage Act 1977* restricting harm to buildings, works or relics that are not protected by a heritage listing.

Pursuant to Clause 89K of the EP&A Act, an authorisation of the following kind cannot be refused if it is necessary for carrying out an approved SSD proposal, and must be granted "substantially consistent" with the SSD consent:

- an aquaculture permit under section 144 of the *Fisheries Management Act 1994*
- an approval under section 15 of the *Mine Subsidence Compensation Act 1961*
- a mining lease under the *Mining Act 1992*
- a production lease under the *Petroleum (Onshore) Act 1991*
- an environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any of the purposes referred to in section 43 of that Act)
- a consent under section 138 of the *Roads Act 1993*
- a licence under the *Pipelines Act 1967*.

The need to obtain any of the above approvals for the Project is outlined in Section 5.3.2.

5.3.2 Other Key NSW State Legislation

The existing approvals relevant to the Project are described in Section 3.1.

In addition to the requirement for development consent under Part 4 of the EP&A Act, the Project will require approvals, licences and/or authorities under various other pieces of NSW State legislation. Table 5.2 lists the key relevant pieces of NSW State legislation and indicates the implications, if any, for the Project.

Table 5.2: Relevant NSW State Legislation

NSW State Legislative Act	Project Implications (approvals, licences and/or authorities)
Protection of the Environment Operations Act 1997 (POEO Act)	Airly Mine is a premises-based "scheduled activity" under Schedule 1 of the POEO Act and currently operates under the provisions of EPL 12374. The Project will operate under an EPL, which will include the existing LDP001, LDP002 and LDP003 as discussed in Section 4.11.6. Under the POEO Act, the regulatory authority is required to consider the matters listed in section 45 of the Act. The regulatory authority is required to take into consideration the following matters as are of relevance: ▪ any protection of the environment policies ▪ the objectives of the EPA as referred to in section 6 of the *Protection of the Environment Administration Act 1991* ▪ the pollution caused or likely to be caused by the carrying out of the activity or work concerned and the likely impact of that pollution on the environment ▪ the practical measures that could be taken to prevent, control, abate or mitigate the pollution and to protect the environment from harm as a result of the pollution ▪ the environmental values of water affected by the activity or work, and the practical measures that could be taken to restore or maintain those values ▪ any guidelines issued by the EPA to the authority. These matters have been addressed within this EIS.
Mining Act 1992	To permit the extraction of coal within the Project Application Area a new mining lease will be required over the Project Application Area under the *Mining Act 1992*. It is expected that the conditions of the new mining lease and SSD consent will require a new Mining Operations Plan and Extraction Plan to be prepared and approved for the Project. Schedule 1 of the *Mining Act 1992* provides for the consultation required with respect to the granting of mining leases. Division 2 provides that landowner consent is not required to accompany an application for development consent. However, section 47J of the *National Parks and Wildlife Act 1974* requires that a mining lease interest cannot be granted without the concurrence of the Minister for the Environment. Therefore, the Minister for the Environment's concurrence is required for the mining lease application for A232.
Water Act 1912	The *Water Act 1912* governs access, trading and allocation of licences associated with surface water and groundwater sources where a Water Sharing Plan is not in place. Airly Mine holds one groundwater production bore licence (10BL6035) and two monitoring bore licences (10BL6045, 10BL6053).

NSW State Legislative Act	Project Implications (approvals, licences and/or authorities)
Water Management Act 2000 (WM Act)	The WM Act is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. Water sharing plans prepared in accordance with the WM Act include rules for protecting the environment and administrating water licencing and trading. The Project Application Area is within an area covered by two water sharing plans: ▪ Water Sharing Plan for the Greater Metropolitan Region Unregulated River Source 2011. ▪ Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011. In accordance with clause 4(1) of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* the Project Application Area falls within the Hawkesbury and Lower Nepean Rivers Water Source. In accordance with clause 4(1) of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* the Project Application Area falls within Sydney Basin North Groundwater Source. Airly Mine holds two water access licences for the extraction of groundwater from the Sydney Basin North Groundwater Source: ▪ WAL36565 for 120 ML granted in October 2013 ▪ WAL24386for 158 ML, granted in Febrruary 2011. Appendix E and Appendix F, respectively, list the groundwater and surface water licencing required for the Project under the WM Act as a result of the Project. By the operation of Section 89J of the EP&A Act, the Project will not require water use approvals under Section 89 of the WM Act, water management approvals under Section 90 or a controlled activity approval under Section 91. However, it may require an aquifer interference approval under Section 91 of the WM Act.
Coal Mine Health and Safety Act 2002 (CMH&S Act)	Centennial Airly currently holds all necessary approvals under the CMH&S Act, which aims to assist in securing and promoting the health, safety and welfare of people at work at coal operations. Gas drainage and management at Airly Mine will continue to be regulated under the provisions of the Act.
Mine Subsidence Compensation Act 1961	The Project Application Area is not located within any Mine Subsidence District.
Dams Safety Act 1978	The Project does not propose any underground mining or surface disturbance on or in the vicinity of any dams prescribed under the *Dam Safety Act 1978.* The proposed REA will not trigger the Dam Safety Act.
Crown Lands Act 1989	There is Crown land within the Project Application Area. Surface infrastructure at the pit top has been partly constructed on Crown Land and all the access portals are located on Crown Land. No additional surface infrastructure is proposed for the Crown Land parcels. The Project will require a licence to use Crown Land under the provisions of the *Crown Lands Act 1989*.
Roads Act 1993	Section 138 of the *Roads Act 1993* requires consent be obtained prior to disturbing or undertaking work in, on or over a public road. The Project proposes no additional disturbance of public roads**.** By operation of Clause 89K of the EP&A Act, consent under Section 138 of the *Roads Act 1993* cannot be refused if it is necessary for carrying out an approved SSD proposal, and must be granted substantially consistent with the SSD consent.

NSW State Legislative Act	Project Implications (approvals, licences and/or authorities)
Threatened Species Conservation Act 1995 (TSC Act)	The TSC Act provides protection for threatened plants and animals native to NSW excluding fish and marine vegetation) and integrates the conservation of threatened species into development control processes under the EP&A Act (Appendix H and Section 10.2).
National Parks and Wildlife Act 1974 (NPW Act)	The NPW Act contains provisions for the protection and management of national parks, historic sites, nature reserves and Aboriginal heritage. By operation of Section 89J of the EP&A Act, the Project does not require an Aboriginal Heritage Impact Permit under the NPW Act. An application for a mining lease will be made over the land currently covered by A232. To the extent that this land falls within the boundaries of the Mugii Murum-ban State Conservation Area, it will be necessary to obtain the concurrence of the Minister for the Environment to the grant of the mining lease. An Aboriginal Heritage Assessment is provided in Section 10.3 and Appendix J.
Aboriginal Land Rights Act 1983	The *Aboriginal Land Rights Act 1983* provides for the constitution of local, regional and State Aboriginal Land Councils and a mechanism for Land Councils to claim Crown land. There are no known granted claims over Crown land in the Project Application Area. Updated land status reports will be obtained as part of the Extraction Plan process to confirm the status of any claims.
Heritage Act 1977	Historical archaeological relics, buildings, structures, archaeological deposits and features are protected under the *Heritage Act 1977*. There are no references to heritage items in the Project Application Area within the World Heritage List, NSW Heritage Register, Australian Heritage Database or the relevant Local Environmental Plans. In any event, Approval is not required under Part 4 of the *Heritage Act 1977* due to the operation of Section 89J of the EP&A Act.
Contaminated Land Management Act 1997	The relevance of this legislation to the Project is outlined in Section 5.4.6.

5.4 State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are Environmental Planning Instruments (EPIs) prepared by the Minister to address issues significant to NSW. The SEPPs outlined in the below sub-sections contain provisions that are relevant to the Project and therefore are matters to be taken into consideration by the consent authority.

5.4.1 SEPP (State and Regional Development) 2011

SEPP (State and Regional Development) 2011 (SRD SEPP) came into effect upon the repeal of Part 3A of the EP&A Act and identifies development to which the SSD assessment and determination process under Division 4.1 in Part 4 of the EP&A Act applies. The relevance of the SRD SEPP for the purposes of the Project is outlined in Section 6.1.

5.4.2 SEPP (Mining, Petroleum Production and Extractive Industries) 2007

SEPP (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW. Section 5.5 discusses the permissibility of the Project due to the application of clauses 7(1)(a) and 5(3) of the Mining SEPP.

Part 3 of the Mining SEPP stipulates matters for consideration by the consent authority before determining an application for consent in respect of development for the purposes of mining. Specifically, Clauses 12 to 17 (inclusive), requires consideration to be given to the significance of the resource, the compatibility of projects with other surrounding land uses, including the existing and potential extraction of minerals, natural resource management and environmental management, resource recovery, transportation and rehabilitation.

In July 2014 amendments were made to the Mining SEPP to, amongst other things, provide clarification on the transitional arrangements pertaining to development on strategic agricultural land, specifically the need to obtain a site verification certificate.

Clause 21 of the Mining SEPP states that Part 4AA of this Policy does not apply to an application for development consent under Part 4 of the EP &A Act that involves mining or petroleum development on strategic agricultural land if:

(a) the land to which the application relates was not included on the Strategic Agricultural Land Map before 28 January 2014, and

(b) the relevant environmental assessment requirements under Part 2 of Schedule 2 to *the Environmental Planning and Assessment Regulation 2000* for the development were issued on or before 3 October 2013.

For Airly Mine the land to which the application relates was not included on the Strategic Agricultural Land Map before 28 January 2014 and the environmental assessment requirements were issued on 6 November 2014. Regardless, Airly Mine has made an application to obtain the site verification certificate for the Project Application Area.

The information presented in this EIS addresses each of the matters for consideration prescribed in the abovementioned clauses, and the assessment undertaken has been multi-disciplinary and involved consultation with various government agencies and stakeholders. Emphasis has been placed on anticipation and prevention of potential environmental and social impacts, with various mitigation measures, management strategies, and monitoring activities proposed to minimise adverse impacts.

5.4.3 SEPP (Infrastructure) 2007

SEPP (Infrastructure) 2007 (Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across NSW by improving regulatory certainty and efficiency through a consistent planning regime and greater flexibility in the location of infrastructure and service facilities.

Clause 45 of the Infrastructure SEPP provides that for a development application in respect of development carried out:

- within or immediately adjacent to an easement for electricity purposes (whether or not the electricity infrastructure exists)
- immediately adjacent to an electricity substation
- within 5 m of an exposed overhead electricity power line.

The consent authority must give written notice to the electricity supply authority for the area and invite comments about potential safety risks, and take into consideration any response to that notice received within 21 days after the notice is given.

5.4.4 SEPP No. 55 – Remediation of Land

SEPP No. 55 – Remediation of Land (SEPP 55) provides for a state-wide planning approach to the remediation of contaminated land in order to reduce the risk to human health or any other aspect of the environment.

Clause 7(1) of SEPP 55 provides that a consent authority must not consent to the carrying out of any development on land unless:

- it has considered whether the land is contaminated
- if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out
- if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

Further, clause 7(2) of SEPP 55 provides that before determining an application for consent to carry out development that would involve a "change of use" in respect of certain land specified in clause 7(4) of SEPP 55, the consent authority must consider a report specifying the findings of a preliminary investigation of the land concerned carried out in accordance with the contaminated land planning guidelines (being the 1998 publication *Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land*).

Given that the Airly pit top infrastructure was very recently built, Centennial Coal did not assess the site when it undertook a contaminated site assessment across all its other sites in accordance with the *Contaminated Land Management Act 1997* to determine whether any site triggered the Duty to Report criteria.

The proposed mining area in the Project has not been used for industrial purposes (the Torbane processing plant site is west of the mining area), and so the potential for contamination in these areas is low. Construction and operation of the surface facilities at the pit top will involve the storage and handling of hydrocarbon fuels. To reduce the potential for contamination, all pipework and tanks will be constructed to Australian Standard AS 1692. Refuelling of mobile equipment during construction will be via mobile tankers, equipped with spill kits and will be undertaken in bunded areas.

Centennial Airly will implement best management practices for hydrocarbons, along with the approved EMS and occupation health and safety management systems to ensure the potential for contamination and associated issues remains low.

5.4.5 SEPP No. 44 – Koala Habitat Protection

SEPP No. 44 – Koala Habitat Protection provides for the protection of koala habitat by ensuring that areas subject to development proposals are considered for their value as habitat or potential habitat for koalas. The Greater Lithgow LGA is listed under Schedule 1 of SEPP No. 44 as an area to which the SEPP applies.

RPS (2014a), Appendix H considers the Project Application Area contains core koala habitat.

5.4.6 SEPP No. 33 – Hazardous and Offensive Development

SEPP No. 33 - Hazardous and Offensive Development (SEPP 33) regulates, amongst other things, the determination of development applications to carry out what is defined in SEPP 33 as development for the purposes of a "potentially hazardous industry" or "potentially offensive industry". With the continued implementation of best management practices for hydrocarbons and explosives used within the Project Application Area and the other measures outlined in this EIS to reduce or minimise the impact of the Project, as well as effective implementation of the approved EMS and occupation health and safety management systems, the Project would not pose any significant risk, in relation to its locality, to human health, life or property or to the biophysical environment.

Further, by employing the management and mitigation measures outlined in this EIS during the Project's operation, the Project would not result in the emission of a polluting discharge in a manner which would have a significant adverse impact in its locality or on the existing or likely future development on other land.

On the above bases, the Project is not considered to comprise a "potentially hazardous industry" or a "potentially offensive industry" within the meaning of these expressions in SEPP 33, and therefore a preliminary hazard analysis was not prepared as required by clause 12 of SEPP 33 and nor does clause 13 of SEPP 33 apply to the consent authority's determination of the Project's development application.

5.5 Local Environmental Plans

Local Environmental Plans (LEPs) are EPIs that guide planning decisions for LGAs and allow Councils to manage the ways in which land is used through zoning and development consents.

5.5.1 Lithgow City Local Environmental Plan 1994

The aims of the *Lithgow City Local Environmental Plan 1994* (Lithgow LEP 1994) include the encouragement of the proper management, development and conservation of natural resources and the built environment within the City of Lithgow, by protecting, enhancing or conserving, amongst other things, timber, minerals, soil, water quality, stream environment and other natural resources.

The land use zoning of the majority of the Project Application Area (Figure 2.4) pursuant to the Lithgow LEP 1994 is Zone No 1(a) Rural (General).

Development for the purposes of "mining" is permissible with development consent under the Lithgow LEP 1994 within Zone No 1(a) Rural (General).

Sub-clause 7(1)(a) of the Mining SEPP (Section 5.4.2) also states that development for the purpose of underground mining may be carried out on any land with development consent. In relation to any inconsistency between the Mining SEPP and an LEP, sub-clause 5(3) provides that the Mining SEPP prevails to the extent of the inconsistency. On this basis, any provision in the Lithgow LEP 1994 that would otherwise operate to prohibit the Project has no effect, and accordingly, the Project is permissible with development consent on the land in which the Project will be carried out that is within the Lithgow LGA.

The Lithgow LEP 1994 also contains the following provisions:

- the consent authority must not grant consent unless it is of the opinion that the development is consistent with the objectives for the zone in which it is proposed to be carried out (clause 9(2))

The objective of Zone No 1(a) Rural (General) is to promote the proper management and utilisation of natural resources by:

(a) protecting, enhancing and conserving:

(i) rural land, in particular prime crop and pasture land, in a manner which sustains its efficient and effective agricultural production potential

(ii) soil, by controlling and locating development in accordance with soil capability

(iii) forests of existing and potential commercial value for timber production

(iv) valuable deposits of minerals, coal and extractive materials, by controlling the location of development for other purposes in order to ensure the efficient extraction of those deposits

(v) trees and other vegetation in environmentally sensitive areas, where the conservation of the vegetation is significant for scenic amenity or natural wildlife habitat or is likely to control land degradation

(vi) water resources for use in the public interest, preventing the pollution of water supply catchment and major water storages

(vii) localities of significance for nature conservation, including places with rare plants, wetlands and significant wildlife habitat

(viii) items of heritage significance.

(b) preventing the unjustified development of prime crop and pasture land for purposes other than agriculture

(c) facilitating farm adjustments

(d) minimising the cost to the community of:

(i) fragmented and isolated development of rural land

(ii) providing, extending and maintaining public amenities and services.

(e) providing land for other non-agricultural purposes, in accordance with the need for that development

- clause 11 of the Lithgow LEP 1994 provides that before determining a development application within Zone No 1(a) Rural (General), the consent authority must take into consideration the effect the proposed development would have on:

(a) the present use of the land, and the potential for sustained agricultural production of so much (if any) of the land as is prime crop and pasture land

(b) vegetation, timber production, land capability and water resources (including the quality of the water, stability of watercourses, groundwater storage and riparian rights)

(c) the future recovery from known or prospective areas of valuable deposits of minerals, coal, petroleum, sand, gravel or other extractive materials

(d) the protection of areas of nature conservation significance or of high scenic or recreational value, and of items of heritage significance

(e) the cost of providing, extending and maintaining public amenities and services

(f) development on adjoining land and on other land in the locality, including any cumulative impact

(g) the future expansion of settlements in the locality.

- certain relevant provisions in Parts 3 and 4 of the Lithgow LEP 1994 that operate as controls in respect of the decision-making function of the consent authority, including certain development standards

The operation of the above provisions in respect of the Project is subject to the application of clause 8 of the Mining SEPP, which provides:

8 Determination of permissibility under local environmental plans

(1) If a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if provisions of the plan are satisfied:

(a) development for that purpose may be carried out on that land with development consent without those provisions having to be satisfied

(b) those provisions have no effect in determining whether or not development for that purpose may be carried out on that land or on the determination of a development application for consent to carry out development for that purpose on that land.

(2) Without limiting subclause (1), if a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if the consent authority is satisfied as to certain matters specified in the plan, development for that purpose may be carried out on that land with development consent without the consent authority having to be satisfied as to those specified matters.

Notwithstanding the application of clause 8 of the Mining SEPP, the assessment of the Project in this EIS:

- enables the consent authority to form the opinion that the development is consistent with the objectives for the zones in which the Project is to be carried out
- enables the consent authority to take into consideration the effect of the Project on the matters set out in clause 11 of the Lithgow LEP 1994
- demonstrates that the Project is consistent with any relevant controls set out in Parts 3 and 4 of the Lithgow LEP 1994.

5.5.2 Rylstone Local Environmental Plan 1996

The land use zoning of the northeast odportion of land within the Project Application Area not covered by Lithgow LEP 1994 is zoned Zone No 1(a) Rural (General) pursuant to *Rylstone Local Environmental Plan* (Rylstone LEP 1996).

Development for the purposes of "mining" is permissible with development consent under the Rylstone LEP 1996 within Zone No 1(a) Rural (General).

The objective of Zone No 1(a) Rural (General) is to promote the proper management and utilisation of natural resources by:

(a) protecting, enhancing and conserving:

(i) agricultural land in a manner which sustains its efficient and effective agricultural production potential,

(ii) soil stability by controlling and locating development in accordance with soil capability,

(iii) forests of existing and potential commercial value for timber production,

(iv) valuable deposits of minerals, coal, petroleum and extractive materials by controlling the location of development for other purposes in order to ensure efficient extraction of those deposits,

(v) trees and other vegetation in environmentally sensitive areas where the conservation of the vegetation is significant to scenic amenity, recreation or natural wildlife habitat or is likely to control land degradation,

(vi) water resources for use in the public interest,

(vii) places and buildings of archaeological or heritage significance, including Aboriginal relics and places,

(viii) the rural character and amenity of the zone,

(b) preventing the unjustified development of prime crop and pasture land for purposes other than agriculture, and

(c) facilitating farm adjustments, and

(d) minimising the cost to the community of:

(i) fragmented and isolated development of rural land, and

(ii) providing, extending and maintaining public amenities and services, and

(e) providing land for future urban development, for future rural residential development and for future development for other non-agricultural purposes, in accordance with the need for that development, and

(f) encouraging the establishment of rural and rural-related industries.

5.5.3 Draft Lithgow City Local Environmental Plan 2013

Lithgow City Council has prepared a planning proposal for the *Draft Lithgow City Local Environmental Plan 2013* (Draft Lithgow LEP 2013), which was lodged with the NSW Department of Planning and Infrastructure in April 2013. It is intended that the Draft Lithgow LEP 2013 would implement the Standard Instrument LEP across the Lithgow LGA, and repeal the Lithgow LEP 1994.

The Draft Lithgow LEP 2013 will seek to implement the key strategic directions of the *Lithgow Land Use Strategy 2010-2030* (Section 5.6.1).

The planning proposal for the Draft Lithgow LEP 2013 received its Gateway Determination from the NSW Department of Planning and Infrastructure in May 2013, after which the Draft Lithgow LEP 2013 was prepared in compliance with the conditions of the Gateway Determination, and then publicly exhibited. The exhibition period concluded on 6 August 2014.

5.6 Other Considerations

5.6.1 Lithgow Land Use Strategy 2010-2030

Lithgow City Council's *Lithgow Land Use Strategy 2010-2030* (LLUS) was adopted by Council on 31 October 2011 and endorsed by the NSW Department of Planning and Infrastructure on 24 May 2012.

The LLUS is a combined Land Use Issues Paper and Strategy. It explores the issues that currently face the Lithgow LGA and recommends a new planning approach to address these issues. The Strategy will be implemented through the planning system, primarily through the Draft Lithgow LEP 2013 and Development Control Plan, as well as Council’s other policy, regulatory and governance functions. This Strategy is significant to Council and the community because it will set directions and policy for the Lithgow LGA’s settlement and land use management for the next 20 years. The Strategy will be reviewed throughout this period every five years to ensure that its findings and recommendations remain relevant, are in keeping with sound planning principle and are continuing to meet the needs and expectations of the community.

5.6.2 Water Sharing Plans

Water sharing plans prepared in accordance with the *Water Management Act 2000* include rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading within defined areas and specified water sources. The Project Application Area is within an area covered by the three water sharing plans outlined below. The Project’s water licensing requirements under the *Water Management Act 2000*, are summarised in Appendices E and F.

The Project Application Area is within an area covered by two water sharing plans.

- Water Sharing Plan for the Greater Metropolitan Region Unregulated River Source 2011.
- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011.

In accordance with clause 4(1) of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* the Project Application Area falls within the Hawkesbury and Lower Nepean Rivers Water Source. In accordance with clause 4(1) of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* the Project Application Area falls within Sydney Basin North Groundwater Source

5.6.3 Strategic Regional Land Use Policy

The NSW Government's *Strategic Regional Land Use Policy* was introduced in September 2012 and sets out a range of initiatives to better balance growth in the mining industry with the need to protect agricultural land and water resources. The Policy includes a package of measures including the following key elements:

- the preparation of *Strategic Regional Land Use Plans* (SRLUPs) for both the Upper Hunter and the New England North West regions of NSW which identify and map Strategic Agricultural Land (SAL) and Critical Industry Clusters (equine and viticulture land uses) within these areas
- the introduction of the *NSW Aquifer Interference Policy* (Section 5.6.4)
- the requirement for Agricultural Impact Statements to accompany SSD applications for mining projects that have the potential to affect agricultural resources (Section 10.8).

The proposed key policy response for resolving land use conflict between mining and coal seam gas proposals and agricultural land is a 'gateway process'. Under this process, a panel of independent experts would assess proposals involving mining or coal seam gas development on mapped SAL at an early stage before the lodgement of a development application. The outcome of the 'gateway process' would be that the proposal either meets the gateway criteria relating to agricultural and water impacts, or the proposal does not meet the criteria and therefore stringent requirements will be imposed that must be addressed at the development application stage. The 'gateway process' will commence when the relevant amendments to the Mining SEPP and EP&A Regulation are made.

The existing SRLUPs do not apply to the Project Application Area. Notwithstanding, matters relating to soil landscapes, land use impacts, land capability and agricultural suitability have been addressed within this EIS. Section 10.8 discusses the soils, land suitability and agricultural suitability aspects of the Project Application Area. These assessments concluded that the Project Application Area does not contain biophysical SAL or BSAL.

5.6.4 NSW Aquifer Interference Policy

The *NSW Aquifer Interference Policy* (AIP) (NSW Office of Water 2012) is a key component of the NSW Government's *Strategic Regional Land Use Policy* (DP&I, 2012). The AIP clarifies the water licensing and approval requirements for aquifer interference activities, including the taking of water from an aquifer in the course of carrying out mining, and defines the considerations for assessing potential impacts to key water-dependent assets.

The AIP indicates that where mining results in the loss of water from an overlying source that is covered by a WSP, a water access licence is required under the WM Act to account for this take of water. According to the AIP, proponents of a mining project seeking development consent under Part 4 of the EP&A Act must provide estimates of all quantities of water likely to be taken from any water source during and following cessation of the activity and all predicted impacts associated with the activity. Hydrogeological modelling for the Project has been undertaken by GHD contained in Appendix E.

The AIP requires that potential impacts on groundwater sources, including their users and groundwater dependent ecosystems (GDEs), be assessed against minimal impact considerations. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable Appendix E considers groundwater impacts and aquifer interference requirements and clarifies that the Project is compliant with Level 1 Minimum Harm Criteria of the NSW Aquifer Interference Policy for Porous Rock Water Sources.

Any impacts on potential GDEs, basic landholder rights and existing registered bores are addressed in Appendix E.

CHAPTER 6.0

Socio-Economic Analysis

6.0 SOCIO-ECONOMIC ANALYSIS

This chapter specifically responds to the Director General's Requirements (DGRs), which provide the following in regard to social and economic aspects:

The Director-General's requirements

Social & Economic – including an assessment of the:

- potential direct and indirect economic benefits of the development for local and regional communities and the State
  - potential impacts on local and regional communities, including:
  - any increased demand for local and regional infrastructure and services (such as housing, childcare, health, education and emergency services)
  - impacts on social amenity, particularly impacts on local residents of and other nearby landowners and residents
- a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the development, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism
- a detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community.

The assessment of the social and economic costs and benefits of the Project are inter-related and as such are addressed together within this chapter. The socio-economic analysis has not been developed as a mutually exclusive component of the EIS but has been considered throughout the development of the Project including its feasibility, mine design, identification and management of environmental impacts, to ensure that ESD principles have been applied throughout the decision making process and incorporated into the EIS. The social impact assessment undertaken for the Project is discussed in Section 6.1, while the economic impact assessment is presented in Section 6.2. This section is informed by the technical assessments, Airly Mine Extension Social Impact Assessment (J.Marshall 2014, Appendix M) and Airly Mine Extension Economic Impact Assessment (Aigis 2014, Appendix N).

6.1 Social Impact Assessment

6.1.1 Methodology

The Social Impact Assessment (J. Marshall 2014, Appendix M) provides a systematic approach to the identification, consideration and assessment of the social impacts of the Project. The assessment identifies and develops mitigation measures to address these potential impacts. The methodology is summarised as follows:

- **Profiling**: Understanding the scale and scope of the Project, parameters of the assessment and identifying the stakeholders (determined by the areas of affectation).
- **Scoping**: Identifying the potential impacts as a result of the Project through consultation and feedback with identified stakeholders. As identified in Chapter 7.0 of the EIS, consultation has been undertaken in accordance with a stakeholder engagement strategy developed for the Project utilising a range of consultation methods such as informal and formal direct consultation, surveys and print media.
- **Social Impact Assessment**: Utilising the outcomes of the Project engagement strategy to determine the extent to which the Project is perceived to impact upon local, regional and State stakeholders.
- **Management**: Identification and development of mitigation measures where feasible. These management measures are for not only potential adverse or detrimental social impacts, but also where those identified as positive can be enhanced and developed. This allows for an assessment as to whether the Project meets a net community benefit criteria.

- **Monitoring**: Strategies to monitor identified impacts to ensure that management strategies are adhered to and that the potential cumulative impacts are identified and monitored where relevant.

6.1.2 Profiling

The Social Impact Assessment has considered the strategic objectives of the Lithgow LGA. The Lithgow region has a long history with mining and as identified in the most recent Australian Bureau of Statistics (ABS) Census 2011 data, mining is the largest industry of employment and is the economic base of the Lithgow Local Government Area (Lithgow LGA) employing 11.6% of the population aged 15 years and over. The importance of the coal mining industry to the regional economy is clearly defined within Lithgow City Council's *Economic Development Strategy 2010-2014* (EDS, 2010), identifying "…*only the mining sector had a greater percentage contribution to gross regional product (27%) than its share of employment (12%)".*

A review of the Lithgow Land Use Strategy 2010- 2030 (LLUS 2011) emphasizes this regional focus on the importance of the mining industry. The LLUS has informed the draft Lithgow Local Environment Plan (2013), represents a shift towards consolidating residential settlement and away from Lithgow's industrial traditions to creating a more diverse economy via transparent land use planning principles, policies and strategies. For example the existing and potential for tourism growth was identified in the LLUS and has been considered within the assessment. According to EDS (2010) "*tourism is becoming of increasing importance for economic growth and has caused governments and industry to engage in aggressive and intense promotional activities in order to develop and increase the effectiveness and quality of the sector. Lithgow LGA is a place endowed with significant natural and cultural resources that can capture the interests of visitors and therefore increased tourism investment*".

Table 6.1 summarises some of the key changes highlighted in the Land Use Strategy and the potential impacts for Centennial Coal.

Table 6.1: Lithgow Land Use Strategy and Potential Areas of Impact for Centennial Coal

Activities	Reason for Potential Impact
There is an increased number of people living in rural areas	▪ Usually in-migration characterised by people from areas outside the LGA. ▪ Landholders in rural areas not always resident of the LGA. ▪ Emergence of different values and connections to Lithgow ie. people do not always identify with the area's mining history. ▪ Small lifestyle farms meaning that land holders will actively protect water and other resources if they feel they are being threatened. ▪ Fear in loss of land value.
Addressing land use conflict, especially between industrial uses and residential land uses.	▪ There are a number of examples where communities and industry has co-existed for many years. However the shift in demographics, differing community expectations away from Lithgow's industrial past, and the desire to preserve social amenity has led to increasing land use conflict.
Protection of sensitive environmental areas.	▪ Centennial Airly has a number of activities within identified sensitive environmental areas such as Mugii Murum-ban State Conservation Area and Capertee Valley. ▪ There is an increasing move to protect these areas by a range of stakeholders which are not limited to NGOs eg The Colong Foundation; The Blue Mountains Conservation Services (BMCS) but also include land holders who have moved into the area.
Support and protection of other industries such as tourism.	▪ There is a move to recognise and pursue other industry sectors that are not related to mining and power generation to broaden and stabilise the economic profile of the Lithgow LGA. Tourism is one such sector. ▪ Moves to retain and protect key 'gateways' and scenic landscapes for visitors / travellers will become a priority.

The Social Impact Assessment (Appendix M) identifies the mechanisms employed by Centennial Airly to avoid and mitigate these impacts, where possible.

It is recognised that there is a benefit brought to local communities through ongoing employment within the region. Employment in the mining industry provides flow-on effects for local support services via direct and indirect employment opportunities across a range of sectors. The flow-on effect of mine related employment and importance to the wider regional community is achieved through direct spending, participation in social infrastructure programs such as local school attendance and participation in local sporting and volunteering activities.

In juxtaposition with the benefit of mine related employment is community concern. There are a range of reasons as to why people have come to live in and around the Capertee Valley, however, the majority have chosen to live there because of its high scenic and conservation value. It is evident that many of the landholders in this area do not identify with the Lithgow LGA and the traditions of mining and power generation. These landholders do not shop in Lithgow and question the services (or lack of) they receive from Lithgow City Council.

Population and demographic data for Capertee and Glen Davis also indicate some key differences when compared to the Lithgow LGA including the following.

- The population of the area has a high median age when compared with the Lithgow LGA. The median age for the LGA is projected to be 51 years by 2036. The median age would potentially be much higher for Capertee and Glen Davis / Glen Alice given that the current median age is 48 years and 51 years respectively.
- There are more people who work in agriculture and farming in Capertee and Glen Davis compared to Lithgow LGA on average.
- There are a significant number of unoccupied private dwellings. It is noted that an increasing number of landholdings are owned by people not resident in the locality. These landholdings may be used as weekend and holiday retreats. Consultation with local residents found that the ‘quoted’ population figure fluctuates however is much higher than what is recorded by the ABS Census 2011. Therefore the above population characteristics may not necessarily reflect the entire profile of community stakeholders who are landholders in the area and therefore may have an interest in the Project.
- There is a lower than average weekly family income than that of the Lithgow LGA.
- Mortgage and rental repayments are substantially lower than that of the LGA.
- A high proportion of people who either own outright or are purchasing their home.

There is a strong sense of ‘neighbouring’ found across the Capertee Valley, demonstrated for example, via membership in local bushfire brigades, involvement in social events and a willingness to assist if assistance is required.

Many residents undertake activities that aim to preserve and protect the environment and can be described as being custodians of the land. This is evident via a number of examples that include; planting of native vegetation to create green corridors and foster bird habitats in areas that have been cleared, gaining general knowledge simply by walking throughout the area, documenting the place via painting and photography, providing water and food in areas where there is a lack of wildlife, observing wildlife and publishing reports on their findings, hosting events and activities to generate social cohesion and providing opportunities to promote the area to others through tourism.

There is widespread concern about the Project. The area has high conservation value and the community with an interest in the Project are not limited to landholders. The areas of concern most often identified are the following.

- Surface and groundwater impacts have been raised as key areas of concern from surrounding landholders, especially in the Glen Davis, Glen Alice and Bogee areas. It has been often stated that water in these areas is scarce and there is fear that the limited access to groundwater will be threatened in terms of quality and quantity by the Project.
- Impact of subsidence on surface features on the area and in particular cliff lines.
- Loss of rural amenity due to noise, deposited dust, visual impacts, night time lighting and traffic.
- The potential for irreversible damage to the environment if the mine does not perform as it is intended resulting in polluted water discharge into Airly Creek, damage to surface features such as cliffs due to subsidence and loss of groundwater.
- The lack of benefit for the broader community as the Project will not employ local people and will therefore not generate local spending, participation in social / community activities, contribute to the school population etc.
- The risk to the environment due to the perceived lack of financial viability of the Project.

There is also support for the Project. Some landholders who live in the Capertee Valley do not see Airly Mine as having any adverse impact on people's lifestyle or on the environment. Some of these residents are long term landholders and some have come to the area more recently. Issues and concerns around loss of ground and surface water; adverse air quality and noise are dismissed. What is stated to be a priority by these landholders is the need to create employment and that mining can be undertaken without having an adverse impact on the environment or on people's way of life.

6.1.3 Scoping

The assessment was supported by a number of site visits, extensive consultation, participation in Airly Mine's Special Monitoring Committee (Section 7.3.1), and participation in four Community Technical Sessions where specialist consultants provided an overview of their work and findings. The following primary stakeholder 'groups' have been identified as the following.

1) Those who are supportive of the Project due to the potential for employment of local residents.
2) Those who approach the Project with caution as there are concerns regarding the potential environmental impacts. These stakeholders request information to satisfy their concerns and are open to this feedback.
3) Those who oppose the Project and mining generally due to general environmental impacts, impacts on required resources (in particular water) which will have an adverse impact on agricultural viability and land value.
4) Those who oppose the Project as their social values and connection to the area is lost or threatened due to the mine regardless of actual impacts.
5) Visitors and tourists.
6) Employees of Airly Mine and National Parks and Wildlife Service.

Understanding of the land ownership surrounding the Project (i.e. near neighbours) is also important to identify if there are potential amenity impacts arising from the Project. The following has been considered in this regard.

- Near neighbours can be affected by noise, dust, visual, light, traffic impacts and any other factor of the mines operation which adversely impacts on residential social amenity.
- Identified potential environmental impacts of the Project (ie ground and surface water) may extend beyond the Project Application Area and adversely affect the economic viability of agricultural land uses.
- Residents living on major transport routes may be impacted upon by employee traffic at various times (aligning with shifts).
- Any requirement to purchase property may cause existing residents to relocate. Therefore social networks and social fabric of the area may be adversely affected.
- The impacts of the mine may extend to other users of the area. For example this area may have high tourist value and elements of these values may be adversely impacted upon.

Centennial Airly owns approximately 2000 ha of land around the pit top and surface facilities which provides a significant buffer between it and other sensitive receptors (i.e. private residences). Furthermore, the majority of the Project Application Area is Crown Land and classified as State Conservation Area. This land is managed by National Parks and Wildlife Service. These factors significantly reduce the potential for adverse social amenity impact of Airly Mine's operations on near neighbours. There is no requirement to purchase property as a means of managing any environmental impact.

6.1.4 Social Impact Assessment

The mine design is the means in which changes to the environmental, economic and social conditions are determined. The likelihood and extent of these changes are key factors in determining the scale of social impact. The mine design chosen for the Project is the most viable and preferred option, taking into consideration that the Project is within a State Conservation Area with varying constraints of geology (lithology and ash content), geotechnics (structural zones, strata characteristics), and the environment (cliffs, pagodas and archaeological features).

The outcome of detailed mine planning and design reduces the occurrence of subsidence effects to negligible levels, without compromising the viability of the business. While the environmental impacts are reduced, the mine design results in increased development costs and the sterilisation of coal reserves. The potential environmental impacts of the Project have been minimised through obtaining a detailed understanding of the key environmental issues. The multi-disciplinary assessment and consultation have been undertaken to a level of detail commensurate with the scale of the Project, industry standards and the legislative framework under which the Project is considered.

The proposed use of various partial extraction mining methods in the Project will manage subsidence not to exceed 125 mm in previously unmined areas, and minimise further potential subsidence impacts in areas where the historical New Hartley Shale Mine has already impacted the environment. The Project has been designed to ensure there is negligible impact, meaning the changes to the environment are no greater than what would occur under natural conditions. Mining zones have been identified to ensure that the mining methods employed meet the mine criteria.

The extent of long term social change arising from the Project is minimal and will not adversely impact on people's lifestyle or how people access and utilise the Mugii Murum-ban State Conservation Area. There will be no change to the social amenity of the area; economic activities in neighbouring properties arising from this Project brought about by subsidence, ground and surface water impacts (quality or quantity), noise, dust or visual impacts. The conservative mine design, the low coal production rate (1.8 Mtpa) and a small pit-top footprint will ensure the Project will have a negligible impact on the environment.

Employment is a positive social impact of the Project. However, the Charbon Colliery employees that have been redeployed to Airly Mine will provide little additional benefit to the local financial and social economy.

The employment profile however does not indicate any adverse impact on existing services or facilities and the Project will not create any demand for additional services or facilities.

As stated above, the Project has resulted in some degree of angst across the community, evident through the consultation process and feedback received from the community technical sessions. Despite there being limited change proposed in the Project over that was already approved in the current consent and thus minimal impact to the environment and community, it is expected that these concerns will continue.

The key social impact arising from the Project is related to the high regard the surrounding community has for the environment. The presence of the Project, regardless of the actual physical change, represents a loss of the connection to the environment which the community hold in high regard. This impact is called solastalgia, a term used to explain the psychological change when people's connection to the land is at risk. It is sometimes described as "… *a form of homesickness one gets when one is still at 'home'*" (G. Albrecht 2005).

6.1.5 Management

In order to assess the level of social change arising from the Project, the various specialist consultants' reports have been reviewed against areas of concern raised by the community, to assess if any changes to the social conditions of the area are likely and if so, the extent of change.

It is demonstrated that the Project has adopted a conservative mine design that limits impacts to the surrounding community. In essence the potential impacts have been managed to largely remain within the Project Application Area. The potential impacts outside the Project Application Area are limited to the following.

- Very minor and localised reductions in total average flow in Gap and Genowlan Creeks (<3%) are expected resulting in negligible impact to surface water supplies on neighbouring properties.
- Limited visual impact will arise from the existing surface infrastructure at the pit top and the Proposed REA primarily from Cameron Road and when travelling along Glen Davis Road.
- Potential for water discharge to Airly Creek will be minimal.
- Potential for noise and dust to extend beyond the Project Application Area however is unlikely and the predicted noise levels are well within compliance limits.

In summary the Project results in:

- no requirement to purchase property as a means of managing impact on social amenity
- no impact on surrounding land use or viability of agricultural production
- no significant change to the economic profile of the community except for the potential for incidental economic benefit via localised spending
- no change to the social fabric of the area
- no change to how residents or visitors utilise the area
- employment of up to 135 comprising full time employees and 20 contractors for a period of 25 years.

The Project will result in overall benefit to the region and NSW economy. The findings of the assessment with regards to the specific requirements of the DGRs are outlined in Table 6.2.

Table 6.2: Social Impact Assessment Findings

Assessment	Findings
Any increased demand for local and regional infrastructure and services (such as housing, childcare, health, education and emergency services)	There will be no increased demand for local and regional infrastructure and services. The Project will employ existing residents who are likely to be largely from communities other than Capertee or Glen Davis/Glen Alice. Employees are established in their communities and will not require any further infrastructure.
Impacts on social amenity, particularly impacts on local residents of and other nearby landowners and residents	The Project will result in only minor changes to areas outside of the Project Application Area. This is due to the significant buffer that exists and the conservative mine design and method. Relevant changes to social amenity are as follows: ▪ Very minor and localised reductions in total average flow in Gap and Genowlan Creeks (<3%) are expected resulting in negligible impact to surface water supplies on neighbouring properties. ▪ Limited visual impact on surface infrastructure and the REA primarily from Cameron Road and when travelling along Glen Davis Road. ▪ Water discharge to Airly Creek will be minimal. ▪ Noise impact that exceeds the Project Application Area however is well within compliance. These impacts are minor and within compliance.
A detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the development, including any infrastructure improvements or contributions and/or voluntary planning agreement or similar mechanism.	The conservative mine design, the small disturbance footprint, the size of the buffer lands to the north, west and south of the pit top and relative low coal production rate are the measures that have been implemented to minimise the adverse social impacts. The Project will not result in changes to the existing community, change the way in which residents or visitors will utilise the area or change the characteristics of any surrounding landholdings (ie agricultural production). Adaptive mine methods will allow for correction to be undertaken before any adverse impacts result.

6.1.6 Monitoring

As discussed in Section 3.13 and Section 4.13, Airly Mine will continue to undertake monitoring in accordance with approved EMPs. A review of the existing EMPs will be undertaken, and plans undated as appropriate, to take into consideration the environmental assessments undertaken as part of this EIS, the Statement of Commitments, and all relevant consent conditions. Reviews of the monitoring data will be undertaken on a regular basis to ensure that management strategies are adhered to and that the potential cumulative impacts are identified and monitored where relevant.

6.1.7 Conclusion

The Project will result in an overall benefit to the region and the NSW economy. It is found that the principles of ESD have been considered and achieved in all aspects of the Project.

6.2 Economic Assessment

6.2.1 Methodology

The Economic Impact Assessment (August 2014)for the Project has been completed by AIGIS Group (Aigis 2014, Appendix N) and addresses the relevant economic assessment requirements of the DGRs and further relevant legislation. This has been undertaken principally through providing an assessment of the direct and regional economic benefits and costs of the Project and identifying the Project’s net cost or benefit to the NSW community. The approach taken to this assessment is to apply a ‘triple bottom line’ framework to considering the interdependent social, economic and environmental benefits and costs associated with the

Project. This approach is consistent with consideration of the requirements of ecologically sustainable development required under the legislation.

The approach used in Aigis (2014) could be considered as being unorthodox in the context of the use of cost-benefit analysis techniques. However, the aim of the assessment approach was to produce material which facilitates ‘lay’ stakeholders to better comprehend the analysis presented, as it relates to Project impacts likely to be of greater significance to such stakeholder groups.

In order to estimate the net cost or benefit of the Project, all technical reports that address the key issues associated with the Project have been the subject of qualitative and quantitative analysis to provide monetised estimates of key aspects of the Project.

6.2.2 Social and Economic Benefits and Costs

In the context of the Project, potential risks to social amenity are:

- impact on the intrinsic value of the area
- direct impact on the social amenity of the area (brought about by noise, dust, visual impacts etc.) that requires the use of conventional mitigation strategies, or where conventional prospective controls and/or mitigation strategies are effective
- direct impact on the social amenity of the area (brought about by noise, dust, visual impacts etc.) where conventional prospective controls and/or mitigation strategies are not effective.

The Social Impact Assessment (Section 6.1) concludes the social impacts of the Project are minimal. This is because the extent of the change to the physical environment will have a low adverse impact on the existing land use.

As identified in the LLUS, the role of the mining industry is critical to the functioning and economic wellbeing of the Lithgow LGA economy.

The NSW Department of Planning and Infrastructure has determined that the appropriate planning authority to determine if a Voluntary Planning Agreement (VPA) or S94 contribution is applicable is Lithgow City Council. Discussions between Centennial Airly and Lithgow City Council are ongoing on this matter.

6.2.3 Estimated Economic Benefits

The benefit – cost analysis (BCA) data presented in this section are present values (PV) and net present values (NPV), at an assumed discount rate of 7%, except as otherwise noted[1]. The assumed Project timeframe is 2014 to 2034.

The key economic benefits that accrue to the local and State communities, as distinct from the proponent corporation, are as follows.

- Salaries and wages paid to contract workers in the construction phase of the Project. These incomes then support additional activity in other sectors of the economy.
- Salaries and wages paid to full time employees on mining operations associated with the Project, with similar flow-on effects to those noted above.
- Royalties on product coal which are remitted to the State. These are then redistributed across the State community in the form of publicly-provided goods and services.
- A range of federally-levied taxes, a proportion of which is similarly redistributed across the State community.

[1] The economic appraisal principles employed herein are consistent with relevant parts of NSW Treasury/Planning NSW Cost Benefit Analysis for mining and coal seam gas proposals (2012) and NSW Treasury TPP07-6 Economic Appraisal Principles and Procedures Simplified.

- Various State (e.g. payroll tax) and Local Government (e.g. council rates) taxes, rates and charges. These contribute to provision of further public goods, services and facilities.

The construction of the surface infrastructure will support an average of 20 contract employees over the nine-month Project's construction program.

The Project will require the employment of 135 persons FTE potentially, and up to 20 contractor positions. These forms of employment are the source of significant direct and derived economic benefits, and also have positive social and welfare benefits, for the local communities in which these employees reside and spend a proportion of their incomes.

In addition to these household income-related benefits, the royalties and taxes generated are also a source of benefit to these communities. Table 6.3 shows the valuation of these benefits, and the basis of the valuation for each.

Table 6.3: Estimate of Economic Benefit of the Project

Economic Benefit	Estimation assumptions	Estimate
Construction phase employment	23 FTE positions over 9-month construction program commencing April 2014.	Assessed PV ≈ $0.5 million.
Mine operation-stage additional/sustained employment	Direct operations employment: 135 FTE positions.	Assessed PV ≈ $87.8 million.
	Mining related contractor employment: 20 FTE positions	Assessed PV ≈ $14.3 million
Coal royalties (State Government)	Based on assessed output over mine life extension period 2014-2034, and royalty rate of 7.2%[2]	PV ≈ $120.4 million
Other State taxes/Local Government rates & charges	e.g. Payroll tax[3]; council rates	PV ≈ $15.9 million
Federal taxes (e.g. Corporate income taxes)	Based on assessed corporate income & corporate tax rates	Return to NSW at 30.6%, assessed PV ≈$70.5 million[4][5][6]
Project impact controls and mitigation provisions[7]	Particulars included in Table 10 the Economic Impact Assessment (**Appendix N**), rehabilitation section (Section 10.9 of this EIS).	PV ≈ $35 million
Total economic benefit (PV)		**≈ $344.4 million**

[2] Deep underground coal (+400m) 6.2 per cent; other underground coal 7.2 per cent, open cut coal 8.2 per cent. Includes deductions for beneficiation and other levies.

[3] Assessed on NSW OSR January 2014 assumptions: $750,000 threshold, 5.45% tax rate.

[4] Commonwealth of Australia (2014): Budget 2014-15 Budget Paper No 3, Part 3, General Revenue Assistance. Table 3.2 General revenue assistance by State. < http://www.budget.gov.au/2014-15/content/bp3/html/bp3_04_part_3.htm >

[5] Includes provision for tax treaty impacts associated with foreign ownership.

[6] No provision is allowed for the Mineral Resources Rent Tax, due to its planned repeal under the current Federal Government.

[7] The benefit of the conservative mine plan proposed (NPV $19 million) assumed as an environmental benefit to the community, is offset by the cost to the community of $19 million in government revenues (royalties) foregone. Present value of environmental works and compliance activity is estimated at $18 million (2014-2034).

6.2.4 Estimation of Economic Costs

The DGRs identify key issues that the EIS prepared for the Project must address. These relate to:

- subsidence
- land resources
- water resources
- biodiversity
- heritage
- air quality
- greenhouse gases
- noise
- traffic and transport
- visual
- social and economic
- rehabilitation.

Each of these matters is addressed within the EIS, and are the subject of specialist assessment reports appended to the EIS. A qualitative and quantitative analysis of these aspects of the Project is included in Table 10 of the Economic Assessment (Appendix N). The table also details or cites controls and mitigation measures proposed by Centennial Airly for addressing these impacts.

In order to estimate the net cost or benefit of the Project, it is necessary to provide a monetised estimate of these impacts, based on specialist assessments of their magnitude, and relevant valuation methodologies, which are displayed in Table 3 of the Economic Assessment (Appendix N). In relation to these valuations, three key points must be observed as follows:

- Where possible, valuation methodologies are derived from studies accessed through relevant government bodies. This may be considered as placing some greater level of reliability on these studies.
- The identified valuation methodologies have been selected to provide approaches which were the most appropriate for application to this Project as was achievable.
- There remains an unquantified element of social impact. This may be described as the ‘intrinsic value’ of certain impacts or effects, as attributed by individual stakeholders. This aspect is highly individualised and subjective, and consequently may not be accurately quantified, as the estimation techniques applied, although based on valid methodologies, may not align with individual stakeholders’ values. It is noted that a number of specialist reports relating to the Project estimate no impacts, or very limited impacts. As a consequence, the valuations made in this report in respect of these specific matters may be considered as taking account of this less tangible aspect of impact.

Table 3 presented in the Economic Assessment (Appendix N) identifies the bases for quantifying the environmental impacts contained in the DGRs as described above. Table 4 in Appendix N applies these valuation methodologies, relevant population data (e.g. Australian Bureau of Statistics Census 2011) and specialist consultant estimates of impacts, to derive present values of the relevant estimates for the Project. Table 10 of the Economic Assessment (Appendix N) compares the benefit and cost impacts in the context of those quantified assessments and the key qualitative aspects of each impact, with particular emphasis on the matters identified through the stakeholder consultation process. In addition Table 10 (Appendix N) identifies the policies, prospective controls and mitigation measures, including those currently employed by Airly for existing operations and/or those specifically proposed for management or mitigation of the external impacts of the Project.

The estimated economic cost of the Project is $85 million. Table 6.4 itemises the estimated assumptions and costs associated with the impacts of the Project.

Table 6.4: Economic valuation of social and environmental costs of the Project[8]

Social/environmental cost	Estimation assumptions	Estimate of cost (Life of Mine)
Noise	Cost to community $106,080 (2014 value)	Assessed NPV ≈ $1.5 million
Subsidence	Cost to community $1,458,825 (2014 value)	Assessed NPV ≈ $20.1 million
Soil and land capability	Cost to community $1,458,825 (2014 value)	Assessed NPV ≈ $20.1 million
Surface water & groundwater	Cost to community $1,458,825 (2014 value)	Assessed NPV ≈ $20.1 million
Air	Cost to community $19,805 (2014 value)	Assessed NPV ≈ $300K
GHG emissions	Cost to community $132,250 (2014 value)	Assessed NPV ≈ $1.4 million
Heritage	1. Cultural Heritage: Cost to community $7,756 (2014 value) 2. Natural Heritage (Natural Landscape Features): Cost to community $1,458,825 (2014 value)	Assessed NPV ≈ $107K Assessed NPV ≈ $20.1 million
Biodiversity[9]	Cost to community $48,444 (2014 value)	Assessed NPV ≈ $667K
Visual amenity	Cost to community $46,367 (2014 value)	Assessed NPV ≈ $638K
Economic valuation of social and environmental cost		**≈ $85 million**

6.2.5 Estimation of Net Economic Benefit/Cost

Based on the benefit and cost assessments detailed in Table 6.3 and Table 6.4, the following provides a summary of the net economic benefit/cost of the Project (rounded to the nearest $1 million) for the State and regional communities:

- Economic benefit (PV) ≈ $344 million
- Economic cost (PV) ≈ $85 million
- Net present value (NPV) ≈ $259 million
- Benefit-Cost Ratio of 4.0

[8] All estimates presented are rounded to the nearest $100,000.

[9] The valuation for subsidence and natural heritage also entail recognition of the value of possible biodiversity effects on significant surface features such as cliffs, pagodas and the ecological communities associated with these. This assumption is stated in Table 10 in Aigis (2014) (Appendix N).

6.2.6 Net Contribution of the Mining Sector

The mining sector is of significant importance in the context of a relatively small regional economy. This is suggested by a number of matters raised in the Lithgow City Council's *Economic Development Strategy 2010-2014*. . The comparison of employment to output identified previously is indicative of a number of factors. Firstly, mining is relatively capital intensive, so the labour input may be comparatively lower.

The Lithgow City Council's *Economic Development Strategy 2010-2014* notes however that as much of the mining in the area is underground mining, this is relatively more labour intensive than open cut mining. Secondly, in terms of regional output, the sector stands out from the remainder of the local economy on the basis of its productivity and income effects relative to labour.

The *Economic Development Strategy 2010-2014* (EDS 2010) also notes that there is scope for expansion in the coal industry, however "*there is still pressure for coal industry downsizing from efficiency rationalisation and this may ameliorate [sic] the benefits of increased exports*" (p. 87). The Project represents a commitment to maintaining operations and the associated employment in the Lithgow LGA.

The sustained operational and additional construction-related positions in the Project are of regional significance. The *Economic Development Strategy 2010-2014*. emphasises the potential for severe impacts on the local economy that are likely to result from any premature curtailment of mining activity, as is exemplified in the following statements from the document.

- "*The major concern here is that many of these mining jobs are concentrated into a handful of businesses hence, as has been experienced in the past, any job losses tend to be on a large scale and hence may have an immediate impact upon the community".*
- *"This may have an impact upon the level of disposable income available to the Lithgow Resident Workforce in the future should the number of people in the mining industry decline further".*
- *"This industry sector [mining] has also been shown as having a propensity to fluctuate mainly due to its sensitivity to international market forces. A critical impact of this is local business being heavily reliant upon a relatively small proportion of the community which has disposable income but one which can also be severely affected by changes to employment status. These families can also be considered as transient due to the specialised nature of their skills base. In other words a workforce with niche skills such as those in the mining industry are [sic] more likely to move from one region to another for work taking their disposable income with them".*

With regard to the Mid Western Regional Council (MWRC LGA), its Land Use Strategy document includes several references to the important role of mining in the current and future economic development of the Lithgow LGA. Relevant commentary from the document is included below.

- (from Section 1.4 Objectives, Subsection 1.4.1, Economic prosperity): "*ensure that existing industrial development (including mining and extractive industries) is allowed to prosper and grow*.
- (from Part 2, Guiding principles for the Strategy, Section 2.1, Rural land): "*Recognise the important contribution of industry makes (sic) to Mid-Western Regional Council local government area and the region"; "Recognise mining, extractive industry, forestry as a key primary production use and potential in the Mid-Western Regional Council local government area".*
- (from Section 4.4 Mining and Extractive Industries): "*despite only accounting for less than 1% of the total land area, mining is a key driver in the growing population and economy in the Mid-Western Regional local government area with the coal (and oil) mining sectors making the largest contribution to wages and salaries in the local government area*".

As is the case with the Lithgow LGA, these statements substantiate the strategic importance of mining to growth and prosperity in the region.

In applying the above methodology, both the Economic Impact and Social Impact Assessments have considered the broader socio-economic impacts of the Project. The sustainability of the mining sector and its related employment is clearly vital to the broader economic wellbeing of the area. The Project will have a direct and positive impact on economic sustainability over the period in which coal resources can be economically extracted, both directly for employees and their households and indirectly for the broader regional economy.

Employment in the mining industry provides flow-on effects for local support services via direct and indirect employment opportunities across a range of sectors. The flow-on effect of mine related employment and importance to the wider regional community is demonstrated by the application of multipliers for both the ongoing employment and engagement of contractors during construction.

6.2.7 Employment Multipliers

The NSW Department of Trade, Investment, Regional Infrastructure and Services (Division of Resources and Energy) identified output and employment multipliers for mining and related services. While acknowledging the limitations on multiplier analysis, observed by, for example the ABS[10] the application of the relevant NSW Government Department's declared multipliers adds validity to the analysis. The relevant multipliers are displayed in Table 6.5 and Table 6.6.

Table 6.5: Type 2A Multipliers – mining and services

Description	Multiplier value
Output Multiplier – mining & services	2.136
Gross Value Added Multiplier – mining & services	4.099
Income Multiplier – mining & services	2.839
Employment Multiplier – mining & services	3.977

In addition to these mining multipliers, similar multipliers for construction activity were also identified. These are relevant for assessment of the impacts of the initial stimulus associated with the various construction works required for the Project.

Table 6.6: Type 2A Multipliers – construction

Description	Multiplier value
Output Multiplier – construction	2.694
Gross Value Added Multiplier - construction	4.369
Income Multiplier - construction	2.899
Employment Multiplier – construction	2.727

As the stimulus to the economy is equivalent to the additional activity and output associated with both construction and operational phases of the Project, the net benefit of the Project may result in extended economic effects of approximately 2.1 to 4.4 times the initial stimulus, dependent on the economic measure being considered. Employment of the magnitude of approximately 2.7 to 4 times the economic stimulus will result. These indirect positions represent employment supported in the broader economy as a result of the demand for additional goods and services generated by the Project.

6.2.8 Alternatives Considered

The proposed mine plan and design of the Project has been developed to maximise resource recovery and economic benefits to the State (royalties and taxes), while reducing the potential impacts to the site and

[10] A detailed discussion on interpretation and limitations of multiplier analysis is included in ABS Cat No 5246.0; *Information Paper Australian National Accounts Introduction to Input-Output Multipliers*;

[10] For example ABS Cat No 1301.0, *Year Book Australia, 2002*

regional area, particularly in regard to potential subsidence impacts. Centennial Airly has foregone more profitable mine planning options with the aim of ensuring that potential impacts are reduced and managed to an acceptable level. Comparative analyses of the alternatives are included in the Economic Impact Assessment (Appendix N) and Chapter 12.0 of the EIS.

6.2.9 Conclusion

Benefits associated with the Project include the broad social benefit gained as a consequence of the Project in terms of the royalties and taxes that are provided to the State. These are subsequently redistributed across LGAs, including Lithgow LGA and MWRC LGA.

The mine planning stage of the Project involved consideration of the principles of ecologically sustainable development and adopting the ‘triple bottom line’ paradigm. As a consequence, the design of the Project is expected to result in a beneficial outcome for the region and the NSW State, in addition to maximising the positive social benefits of the Project and minimising environmental and social effects to the greatest achievable extents. Due to the detailed mine design planning process and adoption of relevant mitigation strategies and commitments by the Applicant (Chapter 11.0 of the EIS), the potential negative impacts associated with the Project will be of significantly lesser magnitude than the benefits that will be generated by the Project. This is demonstrated through the qualitative and quantitative analysis completed within the Economic Impact Assessment (Appendix N).

With proposed employment numbers being only marginally higher compared with the Airly Mine as currently approved, the Project will not result in any increased demand for local or regional infrastructure services. The Project will have a low impact upon social amenity and will therefore make no significant change to the existing lifestyle, land use or surface characteristics and will not change the manner in which the public utilise and access land within the Project Application Area. Similarly, the Project will have a low impact upon social amenity and will therefore make no significant change to the existing lifestyle, land use or surface characteristics and will not change the manner in which the public utilise and access land outside the Project Application Area.

This is critical to the socio-economic wellbeing of Lithgow and MWRC LGAs and the broader region with the Project providing a net benefit to the community with regard to social, economic and environmental impacts and benefits.

CHAPTER 7.0

Stakeholder Engagement

7.0 STAKEHOLDER ENGAGEMENT

7.1 Introduction

This chapter identifies the engagement strategies of both the existing operation and the Project, including an overview of the Airly Mine's Stakeholder Engagement Strategy. It details the strategies and results of Government and community consultation during the preparation of the EIS. Key issues raised during this consultation and where these issues are addressed in the EIS are identified.

This chapter specifically responds to the DGRs, which provide the following in regard to stakeholder engagement:

The Director-General's requirements

During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, community groups and affected landowners.

In particular you must consult with the:

- Commonwealth Department of Sustainability, Environment, Water, Population and Communities
- Office of Environment and Heritage (including the Heritage Branch)
- Environment Protection Authority
- Division of Resources and Energy within the Department of Trade and Investment, Regional Infrastructure and Services
- Department of Primary Industries (including the NSW Office of Water, Forestry NSW, NSW Agriculture, Fisheries NSW and Catchments and Lands (Crown Lands Division))
- Transport for NSW (including the Centre for Transport Planning, Roads and Maritime Services)
- NSW Health
- Hawkesbury- Nepean Catchment Authority
- Lithgow City Council
- Delta Electricity
- relevant Aboriginal stakeholders.

The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, justification should be provided.

7.2 Engagement Strategy and Stakeholder Identification

7.2.1 Engagement Strategy

Centennial Airly places upmost importance on stakeholder consultation and engagement. Centennial Airly recognises that effective consultation and engagement is a critical element of its operations and projects and underpins its 'licence to operate' in both social and regulatory spheres.

Effective consultation and engagement is inclusive of all stakeholders and include landholders, residents, local communities, indigenous groups, non-government organisations, local, state and federal government, staff and workforce.

The Airly Mine Extension Project Stakeholder Engagement Plan has been prepared to specifically cover the consultation and engagement activities that are required for the life of the Project. The purpose of the Stakeholder Engagement Plan is to provide a consistent management framework to identify and consult with stakeholders with an interest in the Project and to ensure appropriate monitoring and reporting of community initiated enquiries is developed. The strategy within the Stakeholder Engagement Plan includes the need for ongoing consultation with local and state government authorities, neighbouring landholders and surrounding community, Aboriginal groups and other relevant stakeholders.

Desired outcomes of the stakeholder engagement strategy are to:

- maintain and continue to develop trust in Centennial Airly's operations with neighbouring residents, local communities, regional community, Indigenous groups, non-government organisations, government and other stakeholders through comprehensive and well-timed engagement and communication
- contribute to good working relationships with neighbouring residents, local communities, regional community, Indigenous groups, non-government organisations, government by proactively anticipating and addressing concerns about the Project
- respond to community concerns by incorporating community feedback into periodic internal and external reviews of environmental compliance, community engagement and Stakeholder Engagement Plan
- contribute to the development of social capital and capacity by sponsoring and giving to local community organisations.

The consultation strategy process involved the following:

- preparation and submission of a Briefing Paper describing the Project to request DGRs
- issue of the DGRs (Section 1.6) on 6 November 2012 and the revised DGRs on 6 February 2014, which is publically available at the NSW Department of Planning and Environment (NSW P&E) website
- placement of advertisements in local and regional newspapers (Lithgow Mercury and the Mudgee Guardian) to make the community aware of the Project. Dates of advertisements include: 22 October 2012- 16 November 2012; 30 September 2013- 11 October 2013; 28 October 2013- 8 November 2013; 25 November 2013- 6 December 2013; 3 February 2014- 14 February 2014)
- holding face-to-face consultations, site inspections and further discussions with key stakeholders/authorities, providing additional information as required to address any key issues
- holding public information and 'question and answer' sessions
- preparing letter/ newsletter/ information flyer drop-offs in the local community
- providing Project updates at Airly Mine's website
- conducting specific consultation with the Aboriginal Community in accordance with appropriate legislation and guidelines
- addressing any feedback received following consultation within the EIS
- submitting final EIS to NSW P&E and make it publically available for submissions from the community, government agencies, and other stakeholders
- responding to any submissions once the EIS is available for public comment.

7.2.2 Stakeholder Identification

Stakeholder engagement and consultation are determined by a range of factors which include but are not limited to:

- scope of the proposed Project
- the nature of the Project
- statutory notification/consultation requirements associated with the Project
- other notification/consultation requirements that have been set out
- those who are likely to be directly affected by the project (areas of affectation may be by geographic or issue basis)
- those who are interested and whose involvement is likely to be important to this matter
- level of complexity of the overall process or the issues concerned.

The key stakeholders identified and consulted with as part of the consultation and engagement strategy were the following groups.

- Local, State or Commonwealth government authorities, including the:
  - Commonwealth Department of Sustainability, Environment, Water, Population and Communities
  - Department of Planning and Infrastructure
  - Office of Environment and Heritage
  - Environment Protection Authority
  - Division of Resources and Energy within the Department of Trade and Investment, Regional Infrastructure and Services
  - NSW Health
  - Hawkesbury- Nepean Catchment Management Authority
  - Lithgow City Council.
- The Special Monitoring Committee
- The Local Aboriginal Land Councils and Aboriginal stakeholder groups
- The public, including community groups and adjoining landowners
- Other established forums in the area such as the Capertee and District Progress Association, Capertee Valley Alliance, Glen Davis Environmental Group, Glen Alice Community Group.

7.3 Stakeholder Consultation and Engagement

The Project's stakeholder consultation and engagement were undertaken in accordance with a dedicated Airly Mine Extension Project Stakeholder Engagement Plan. A number of avenues were used for the purpose, as follows:

- Airly Mine's Special Monitoring Committee Meetings (Section 7.3.1)
- Community General Information Sessions (Section 7.3.2)
- Community Technical Information Sessions (Section 7.3.3)
- Social Impact Assessment Consultation (Section 7.3.4)
- Aboriginal Stakeholder Consultation (Section 7.3.5)
- Government Agency Consultation (Section 7.3.6).

7.3.1 Special Monitoring Committee Meetings

The Project was discussed with Airly Mine's Special Monitoring Committee at the announcement of the Project on 10 October 2012; and during EIS preparation specialist assessments on 13 March 2013.

The Special Monitoring Committee is a condition of current consent and has provided an opportunity to discuss the Project, results of ongoing environmental monitoring and an opportunity to discuss specific issues relating to Airly Mine. The contents and the timing of the Community Technical Information Sessions (Section 7.3.3) were discussed and agreed at the Special Monitoring Committee meetings.

The minutes of the Special Monitoring Committee meetings are available to the public via the Airly Mine's website (www.centennialcoal.com.au/project/airlyextension).

The Airly Mine Special Monitoring Committee comprises of the following external stakeholders.

Voting Members

- Lithgow City Council (Chair)
- Department of Trade & Investment, Regional Infrastructure & Services
- Office of Environment and Heritage (National Parks and Wildlife Service)
- Capertee & District Progress Association
- Colong Foundation for Wilderness
- Colo Committee

Non-Voting Participants

- Capertee Valley Alliance Inc.
- Capertee Valley Environmental Group Inc.
- Blue Mountains Conservation Society.

7.3.2 Community General Information Sessions

Consultation with the local community has been undertaken via community general information sessions as follows:

- Community Information Session at Capertee on 3 November 2012
- Community Information Session at Glen Alice on 10 November 2012
- Community Information Session at Wallerawang on 17 November 2012.

The Project was discussed at other events as follows:

- *Celebrate Lithgow* on 25 November 2012
- *Rylstone Show* on 23 February 2013 for Rylstone Community
- *Capertee Valley Catchment Group Meeting* on 12 March 2013 Capertee Valley Community.

The community was informed of the meetings and information sessions via newsletter and flyer drop-offs to individual dwellings, material sent to community organisations, and placement on Centennial Airly's website.

These information sessions and meetings were undertaken at the commencement of the EIS preparation stage and were restricted to the dissemination of general information on the Project design, timing of the EIS completion and submission of the EIS to the Department of Planning and Infrastructure for assessment.

7.3.3 Community Technical Information Sessions

Four technical information sessions were facilitated in the Project for the purpose of providing the community an opportunity to understand the environmental impact assessment process, key technical assessments undertaken, methodologies used in the technical assessments and outcomes of the assessments. These technical information sessions were organised following completion of technical assessments undertaken for the Project, informed by the DGRs and the results of a Risk Assessment which directed the scope of technical studies to enable adequate assessment and management of key issues (Chapter 9.0, Section 9.1).

The dates of the technical sessions, the topics covered are listed below. The technical sessions provided an opportunity for the community raise specific concerns relating to the topics discussed, ask questions and discuss aspects of the technical studies. As with other consultation sessions, the technical sessions were advertised to the community.

The presentations and subsequent questions and answers discussed in each technical session were made available to the community via Airly Mine's website (www.centennialcoal.com.au). The questions and answer documents for all technical sessions can be found in Appendix M.

Information gathered during these technical sessions have assisted in the further refinement of the Project design and the development of appropriate management and mitigation strategies to address issues of concern and relevance to the local community.

Session 1 – 13 October 2013 (Venue: Airly Mine)

The following areas were discussed:

- mine design and the minimisation of impact through mining method selection and performance management
- the stability of the mine workings post mining and the long term impact of subsidence
- the impact of subsidence on groundwater and surface water within the Project Application Area and surrounding properties

- water in-flow into mine workings post mining and the impact on the surrounding catchment
- the use of water on site and the impact on the surrounding catchment.

Session 2 – 10 November 2013 (Venue: Glen Alice Hall)

The following areas were discussed:

- a review of aquatic ecology studies carried out to date and likely impacts mining on aquatic ecology. Impacts from subsidence, and mine water discharge
- findings from studies conducted and impacts on terrestrial flora and fauna systems from proposed mining activities
- presentation of the findings of the cultural heritage studies and likely impacts from proposed mining on European and Aboriginal heritage
- sharing of local knowledge regarding terrestrial flora and fauna and Aboriginal and European cultural heritage sites
- ongoing monitoring of aquatic and terrestrial ecology, and cultural heritage sites during the life of the mine

Session 3 – 8 December 2013 (Venue: Capertee Hall)

The following areas were discussed:

- the statutory frameworks for setting assessment criteria for noise, air quality and visual impact assessments
- methodologies used to assess the impacts and accuracy of predictions. Potential noise, air quality and visual impacts from the operation of the mine
- the decommissioning and rehabilitation strategy to be employed during and at the conclusion of the project life, including discussions of the proposed final landform.

Session 4 – 16 February 2014 (Venue: Airly Mine)

The fourth information session included:

- an overview of the Project, specialist consultants' topics presented to date through the community information sessions and, how community feedback provided in the first three technical sessions has been considered by Centennial Airly, and incorporated into the EIS, as appropriate
- Presentation of Social and Economic Impact Assessments undertaken for the Project.

7.3.3.1 Summary of Key Outcomes from Technical Assessments

The following dot points summarise the key outcomes of the technical assessments prepared in support of the EIS, and Table 7.1 provides details of all issues raised. Table 7.1 also provides information on how the issues raised were addressed in the EIS:

- subsidence can be limited to a maximum of 125 mm in previously unmined areas (except in the New Hartley Shale Mine Interaction Zone)
- negligible impacts are predicted to surface and groundwater systems
- terrestrial and aquatic ecology will not be impacted due to the proposed mine design and avoidance of potential impacts

- no impact to European or Aboriginal heritage sites identified within the Project Application Area
- limited visual impact from the Project
- the predicted noise levels at the non-project related sensitive receptors are less than the Project's project specific noise criterion
- the air quality parameters (deposited dust, PM_{10} and $PM_{2.5}$) predicted for the Project at the non-project related sensitive receptors fall within the respective statutory limits
- the noise, air quality, terrestrial ecology, cultural heritage and visual impact assessments undertaken for the two REA locations investigated in the Project, comprising the proposed and the alternative location, confirm that the proposed REA location (Section 4.8.3) will result in less environmental impacts than the alternative REA location (Section 12.4.3) investigated.

Table 7.1: Summary of Key Outcomes from Technical Assessments

Technical Assessment	Issues	How these are addressed in the EIS
Subsidence	▪ Damage to cliffs, pagodas, gorges (e.g. Grotto). ▪ Impact on ecology.	▪ Mine design to cause negligible impact. ▪ Mining zone concept. ▪ Performance monitoring and adaptive management. ▪ New Hartley Shale Mine Interaction Zone already impacted – minimal additional impact. ▪ Increased cliff protection zone. ▪ Terrestrial ecology assessment confirms predicted levels of impact minimal to negligible.
Surface and Groundwater	▪ Loss of surface water to creeks. ▪ Loss of groundwater in licensed bores. ▪ Water discharge from the site. ▪ Discharge water quality in Airly Creek. ▪ Airly Mine future water requirements.	▪ Determination of extent of underground impact – limited to Permian strata. ▪ Mine design to eliminate or minimise surface cracking. ▪ Site water and salt balances for the Project = shows low risk of poor discharge. ▪ No new groundwater licences required. ▪ Surface water catchments are adequate for Project needs. ▪ REA design to prevent acid mine drainage.
Ecology and Heritage	▪ Impact of mining on European and Aboriginal heritage sites. ▪ Questioning of which sites were addressed and what resources were used. ▪ Various flora and fauna species raised for consideration.	▪ All European and Aboriginal heritage sites in areas with negligible subsidence levels. ▪ Shallow sites excised from mining. ▪ All queries on European and Aboriginal heritage raised were checked and verified. ▪ Local Aboriginal community was extensively involved in the Aboriginal heritage survey work. All issues raised on terrestrial flora and fauna assessment, including the presence of certain species were checked and verified; any uncertain species (e.g. the Capertee snail) were assessed as if present.

Technical Assessment	Issues	How these are addressed in the EIS
Visual, Noise and Air Quality	▪ Visual amenity ▪ Noise amenity ▪ Dust emissions ▪ Vibration ▪ Community is left with impact if modelling is wrong.	▪ Low visual impact site. Little change to existing infrastructure. ▪ Progressive construction and rehabilitation of the REA. ▪ Low background noise levels. Noise levels meet lowest statutory levels at nearest residential receptors. Ongoing proactive management of specific noise-related issues. ▪ Underground mine – low levels of emissions. ▪ Expand existing dust monitoring gauge program to additional nearest receptors. ▪ Vibration due to underground machinery has been assessed to be of limited range (<200 m) of influence. No fracturing of massive overburden units. ▪ All processes managed by a Trigger Action Response Plan (TARP) developed for the Project.
Rehabilitation and Mine Closure	▪ Water quality from site after mine closure. ▪ What happens to the rehabilitation if Centennial Airly goes bankrupt. ▪ Visual impact of REA	▪ Site rehabilitation plan is to restore pre-mining grazing and native vegetation landform. ▪ Water quality will have to meet levels appropriate for Airly Creek before lease can be relinquished. ▪ REA design incorporates co-disposal, inert capping and progressive rehabilitation. ▪ Centennial Airly will continue to pay rehabilitation bonds to ensure this work is carried out.

7.3.4 Social Impact Assessment Consultation

The social impact assessment process has followed a long-term approach to stakeholder engagement and consultation in relation to the Project. Specific activities included:

- direct engagement with residents / landholders to identify individual and collective values of the area
- consultation with specialist consultants preparing technical assessments in support of the EIS
- numerous site visits.

The process also involved participation and observation of Centennial Airly's own stakeholder engagement strategies to understand who is engaged in the process, the rationale for their engagement and key areas of enquiry. This included attendance at the Special Monitoring Committee meetings at Airly Mine (Section 7.3.1) and attendance at the four technical sessions facilitated in the Project (Section 7.3.3).

Information gathered from the community profile, the social impact assessment undertaken for the Project including consultation and site visits (Section 6.1) and feedback from consultation and community engagement has identified a number of key themes which are relevant to the social impacts relating to mining in general at Airly Mine. These are summarised below.

- Surface and groundwater impacts have been raised as a key area of concern from surrounding landholders, especially in the Glen Davis, Glen Alice and Bogee areas. It has been often stated that water in these areas is scarce and there is fear that the limited access to groundwater will be threatened (quality and quantity) by the Project, which will in-turn have an adverse impact on agriculture in the area.
- Impact of subsidence on surface features over the mining area and in particular cliff lines and items of cultural heritage value.
- Loss of rural amenity due to noise, deposited dust, visual impacts, lights and traffic.
- Adverse impact on the areas tourism.

- The potential for irreversible damage to the environment if the mine does not perform in accordance with the mine design criteria and overall project design resulting in for example polluted water discharge into Airly Creek, damage to surface features such as cliffs due to subsidence, and loss of groundwater.
- The lack of benefit for the broader community as the Project will not employ local people and will therefore not generate local spending; participation in social / community activities, contribute to the school population etc.
- The risk to the environment due to the perceived lack of financial viability of the Project.
- The area has high conservation value, and the community with an interest in the Project are not limited to landholders.

The issues raised have been considered against the findings of the EIS. Given the Project has adopted a conservative mine design that limits impacts to the surrounding community, and that the potential impacts have been managed so they will largely remain within the Project Application Area then the potential impacts outside of the Project Application Area are limited to the following:

- very minor and localised reductions in total average flow in the Gap and Genowlan Creeks (<3%) are expected resulting in negligible impact to surface water supplies on neighbouring properties
- limited visual impact on surface infrastructure and the REA primarily from Camerons Road and when travelling along Glen Davis Road
- minimal to negligible water quality impacts to Airly Creek predicted
- predicted noise levels on nearest residential receptors (located outside the Project Application Area are within compliance limits.

In summary the Project results in:

- no requirement to purchase property as a means of managing impact on social amenity
- no impact on surrounding land use or viability of agricultural production
- no significant change to the economic profile of the community except for the potential for incidental economic benefit via localised spending
- no change to the social fabric of the area
- no change to how residents or visitors utilise the area.

7.3.5 Aboriginal Stakeholder Consultation

Consultation with Aboriginal stakeholders was undertaken by Centennial Airly and RPS in accordance with the *NSW Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010b), which includes a four stage consultation process and identifies specific timeframes for each stage. The objective of the Aboriginal consultation process is to ensure that an opportunity is given to a broad range of Aboriginal stakeholders to express their cultural heritage values of the Project, including spiritual connections, archaeological sites, and the natural environment and landscape values.

The consultation methodology involved the identification of Aboriginal Land Councils, Elders and other interested parties in accordance with the consultation requirements (DECCW 2010b), followed by consultation with Aboriginal communities and other stakeholders in the area. There were 15 Aboriginal community groups who were identified as potentially having an interest in the project. Of these, 10 Aboriginal stakeholder groups, listed below, registered their interest in the Project, six groups returned their comments on the methodology and four groups participated in the site surveys.

- Bathurst Local Aboriginal Land Council
- Gundungurra Aboriginal Heritage Association Inc
- Gundungurra Tribal Council Aboriginal Corporation
- Mooka Traditional Owners
- North-East Wiradjuri Company Ltd
- Warrabinga Native Title Claimants Aboriginal Corporation
- Wiradjuri Council of Elders
- Wiray-dyuraa Ngambaay-dyil and Wiray-dyuraa Maying-gu
- Warrabinga/Wiradjuri people
- Mingaan Aboriginal Corporation.

A register of interested parties was maintained and specific comments regarding the cultural significance of the Project is outlined in the *Cultural Heritage Impact Assessment prepared by RPS Australia East Pty Ltd* and is supplied in Appendix J.

7.3.6 Government Agency Consultation

The then NSW P&I advised that a Planning Focus Meeting for the Project will not be required to formally seek the views of relevant statutory authorities in respect of potential impacts of the Project, or to identify those issues, which would need to be addressed in this EIS. However, a Government Briefing Meeting to discuss collectively four of Centennial Coal's projects from the Western Operations was organised for 17 October 2012 to provide an opportunity for statutory authorities to establish the requirements for the form and content of the EISs for the projects. Site visits were organised for 18 October 2012 and included a visit to the Airly Mine pit top. .

Table 7.2 outlines the Government (Local Government, State and Commonwealth) consultation undertaken to date.

Table 7.2: Summary of Consultation with Government agencies

Agency	Comment
Local Government- Lithgow City Council (LCC)	On 11 July 2012 Centennial Coal's senior management presented an overview of all projects from the Western Operations, including the Airly Mine Extension Project, to Councillors of Lithgow City Council, the General Manager, the Mayor and the Deputy Mayor. A Government Briefing Meeting was organised on 17 and 18 October 2012 to discuss a number of Projects from Centennial Coal's Western Operations, including the Airly Mine Extension Project. Lithgow City Council staff present at the meeting and took part in a site visit on 18 October 2012, which included a visit to the Airly Mine pit top and the locations for the reject emplacement areas. On 7 November 2013, a combined consultation meeting was held with representatives of LCC's Development and Planning Department to present the key features of a number of projects being proposed by Centennial Coal including Airly Mine Extension Project. An overview of the project was presented including the proposed mine design, surface infrastructure and findings of the specialist consultants to date.

Agency	Comment
NSW State Government Agencies- ▪ (Former) Department of Planning and Infrastructure (NSW P&I) ▪ Office of Environment and Heritage (OEH) ▪ Environment Protection Agency (EPA) ▪ Division of Resources and Energy (DRE), Department of Trade & Investment, Regional Infrastructure and Services DTIRIS ▪ Sydney Catchment Authority (SCA) ▪ Transport for NSW ▪ NSW Health ▪ Department of Primary Industries- Forestry Corporation of NSW (the former NSW Forests)	Representatives of these Government agencies attended the Government Briefing Meeting held in Lithgow on 17 October 2012. The representatives were given the opportunity to provide feedback and/or raise issues of concern on the Project. Representatives from the NSW P&I, OEH, DRE, SCA, NSW Health and LCC attended a site visit on 18 October 2012, which included a site visit to Airly Mine pit top, the Carinya homestead and locations of the REAs.
Department of Planning and Infrastructure	A meeting was held with officers of the Department of Planning and Infrastructure on 28 November 2013 to discuss key elements of the Project and findings of the specialist consultants reports completed to date. Outcomes of this meeting are summarised below: ▪ Verical subsidence to be referred to as a maximum 125 mm. ▪ The lease renewal will reflect the National Park boundary which was declared after Airly Mine's current consent was granted. ▪ Confirmation of the area covered by critically endangered heathland on Genowlan Mountain. ▪ Confirmation that no new discharge points would be required. ▪ Further consideration of mitigation measures in the New Hartley Shale Mining Area. The Subsidence Impact Assessment is to include sensitivity analysis 500/200/100/50 mm. ▪ There will be a requirement to map existing historical workings in the New Hartley Shale Mining Area ▪ The size and location of the Reject Emplacement Area. Centennial Coal's senior management met with the Department of Planning and Infrastructure on 12 December 2013 to discuss biodiversity and water aspects for the various Centennial Coal projects, including the Project.
Environment Protection Agency Hawkesbury Nepean Catchment Management Authority and Sydney Catchment Authority	A meeting was held with officers of the NSW Environment Protection Agency, the Hawkesbury Nepean Catchment Management Authority and Sydney Catchment Authority on 29 October 2013 to discuss key elements of the Project and findings of the relevant technical assessment reports. Outcomes of this meeting are summarised below: ▪ REA catchment dam will be designed and installed for LOM requirements from the beginning ▪ air quality assessment has taken into consideration the requirements of the latest Dust PRPs on Airly Mine's EPL 12374. A further meeting with the EPA was held on 13 March 2014 at Airly Mine to discuss the outcomes of the air quality, noise, surface and groundwater impact assessments undertaken for the Project.

Agency	Comment
Division of Resources and Energy, Department of Trade & Investment, Regional Infrastructure and Services	A meeting was held with officers of Division of Resources and Energy, Department of Trade & Investment, Regional Infrastructure and Services on 15 October 2013 to discuss key elements of the Project and findings of the specialist consultant's reports. Outcomes of this meeting are summarised below: ▪ confirmation of subsidence predictions and mining methods ▪ consider the data from Gretley Mine regarding the eventuality of flooding and the stability of pillars ▪ factor of safety under cliffs to refer to industry practice and refer to the nominal angle of draw to determine the factor of safety. Factors such as weak roof and floor to be considered in all pillar size determinations ▪ mining under the New Hartley Shale Mining Area to be first workings ▪ sustainability and viability of the mine given that it is currently in care and maintenance. A meeting was held with officers of the Division of Resources and Energy, on 8 April 2014 to discuss rehabilitation and final landform for the Project. Particular emphasis was placed on the establishment and rehabilitation of the proposed REA. The following issues were raised at the meeting: ▪ nearest sensitive receptors for the potential visual impact of the proposed REA ▪ the size of the proposed REA compared to the footprint of the REA previously approved; ▪ the crest height of the REA at the highest point ▪ availability of plans cross-sections through the REA at all stages of establishment and rehabilitation and through the final landform ▪ the land capability of the rehabilitated REA and whether the Project will commit to pre-mining Land Capability Classes of 4 and 5 as per community expectations ▪ justification for the restricted grazing domain proposed for the REA final landform ▪ whether co-disposal option for reject material management underground had been investigated as part of the Project, and the underground storage available for this option ▪ whether Airly Creek extremely high salinity is diluted as it flows downstream. A meeting was held with DRE at Airly Mine on 13 August 2013 to discuss outcomes of the subsidence impact assessment undertaken for the Project. Public safety issues were also discussed. These discussions were followed by a site visit over the proposed mining area within ML1331 and A232 boundaries.
NSW Health	A meeting was held with officers of NSW Health and the Nepean Blue Mountains Public Health Unit on 5 November 2013 to discuss key elements of the Project and findings of the specialist consultants' reports relating to air quality and noise assessments. Outcomes of this meeting are summarised below: ▪ clarification of some terminology used, for example co-disposal. ▪ confirmation of mine production ▪ outline of the planned community consultation relating to air quality and noise impact assessments.
Office of Environment and Heritage (OEH)	A meeting was held with officers of the Office of Environment and Heritage (OEH) at OEH's Mudgee Office on 14 February 2013 to discuss Centennial's Western Operations proposal to develop a Regional Biodiversity Offset Strategy to offset the direct and indirect potential impacts, including cumulative impacts, of the Projects on regional biodiversity. A meeting was held with officers of the Office of Environment and Heritage on 30 October 2013: Outcomes of the meeting are summarised below:

Agency	Comment
	▪ discussion on the outcomes of the baseline historic heritage assessment for the Project ▪ discussion on flora and fauna monitoring activity over the Mugii Murum-ban State Conservation Area. Centennial Coal's senior management met with OEH on 30 October 2013 to discuss biodiversity aspects for the various Centennial Coal projects, including the Project. A meeting was held with officers of the Office of Environment and Heritage on 25 November 2013 to further discuss flora and fauna monitoring activity over the Mugii Murum-ban State Conservation Area. A further meeting with OEH was held on 13 March 2014 at Airly Mine to provide information on: ▪ potential impacts of the Project on terrestrial ecology and cultural heritage ▪ Centennial Coal's proposal for the development of a Regional Cultural Heritage Management Plan to cover all its Western Operations ▪ the proposed Regional Biodiversity Offset Strategy for the Angus Place and Springvale Mine Extension Projects and Neubecks Coal Project ▪ the metric and methodologies used for direct and indirect offsets proposed in the Regional Biodiversity Offset Strategy. While extensive discussions on the Regional Biodiversity Offset Strategy were held the majority of the discussions were not relevant to the Airly Mine Extension Project. The following issues were raised in relation to the Project: ▪ clarification on the Aboriginal heritage sites and their locations within the Project Application Area; ▪ whether National Parks and Wildlife Service has undertaken any cultural heritage surveys within the Project Application Area ▪ format of the Regional Cultural Heritage Management Plan and the role that OEH will play in the development of the Plan ▪ whether the Plan will include the management of heritage items within the proposed offset area in the Regional Biodiversity Offset Strategy ▪ whether any bats have been tracked to the caves within the Project Application Area ▪ whether there are any plans to commence monitoring the microclimate (e.g. wind, moisture, temperature) of the caves prior, during and post mining ▪ whether the ecology survey results in the EIS are actual distribution-based or based on accessibility to areas for surveys ▪ why are the ecology survey results from University of Queensland team distinguished from the RPS survey team, and survey methodologies employed by both teams ▪ clarification on water discharges off site, and the downstream catchment of the Airly Creek. Centennial Coal's senior management and the Airly Project Team will be involved in consultation with National Parks and Wildlife Service on the Draft SCA Plan of Management for the Mugii Murum-ban SCA and landowner access agreements. The consultation is ongoing. A meeting with OEH and NPWS was held on 01 August 2014 at Airly Mine to: ▪ Review monitoring activities undertaken in 2013 ▪ Discuss proposed monitoring for the remainder of 2014 ▪ Discuss monitoring requirements for 2015 and beyond ▪ Discuss OEH's role in determining priorities for terrestrial flora, fauna, aquatic ecology monitoring ▪ Consider monitoring in relation to recovery programs ▪ Consider monitoring items related to SCA management issues , e.g. impacts of access for monitoring and exploration activities

Agency	Comment
	▪ Discuss involvement of other regulatory authorities to discuss limiting monitoring to prevent unnecessary impacts on the SCA from surface/groundwater and subsidence monitoring ▪ Present findings of recent re-survey of the proposed REA including occurrence of derived native grassland within the area ▪ Inspect the proposed REA to gauge the consition of the condition of derived native grasslands.
Department of Primary Industries	A joint meeting with the Office of Water and the Department of Planning and Infrastructure was held on 22 October 2014 to discuss projects from Centennial Coal's Western Operations including the Airly Mine Extension Project. The general discussions included: ▪ the hydrogeological modelling methodologies undertaken for the projects (MODFLOW for the Airly Mine Extension Project) ▪ the water licensing requirements for the projects.
Roads and Maritime Services (RMS)	An email was sent to the Development Assessment Officer at the Parkes Office of RMS on 7 July 2014 requesting a consultation meeting. A copy of the Traffic Impact Assessment undertaken for the Project was provided with the email. RMS emailed on 7 August 2014 to note that a face-to-face consultation on the Project was not warranted.
Commonwealth Government Agency Department of the Environment (former SEWPAC)	Centennial Coal's senior management met with the former SEWPAC on 15 June 2013 to discuss the various upcoming Centennial Coal's projects, including the Project. At this meeting, SEWPAC were informed that the Airly Mine Extension Project would be referred under the *Environment Protection and Biodiversity Act 1999*. A second meeting was held between Centennial Coal's senior management and the former SEWPAC on 3 December 2012 for Centennial Coal to provide additional information on all Centennial Coal projects that will be referred for declaration as controlled actions. The Airly Mine Extension Project was discussed at this meeting. A meeting was held with the Department of the Environment on 12 March 2014 to discuss Centennial Coal's Regional Biodiversity Offset Strategy proposed for projects from the Western Operations. The Airly Mine Extension Project was discussed at this meeting to provide justification of why an offset strategy was not being proposed for this Project. .

Issues raised at the Government Briefing Meeting on 17 October and site visit on 18 October 2012 and particularly areas that need to be discussed within the EIS are included in Table 7.3. The table also provides EIS reference where each issue has been addressed.

Table 7.3: Summary of Issues Raised at the Government Briefing Meeting on 17 October 2012 and Site Visit on 18 October 2012

Stakeholder	Key Issues Raised	EIS Reference
(Former) Department of Planning and Investment (NSW P&I)	1) The cumulative impacts of the Project require consideration. 2) Expectations for regulation of environmental issues such as water discharge have increased since the consent was approved and must be considered. 3) The Project needs to include the long term strategy with regards to the final rehabilitation plan. 4) The Project needs to consider the requirements of the Rural Fire Service, particularly safety of workers in a bushfire. 5) The Project will be assessed by the Planning Assessment Commission (PAC) due to political donations. 6) It was noted that "no impact" is not a government policy. The trade-off between the economic objectives of the Project and conservation, using cost benefit arguments, needs to be presented. 7) Potential noise and dust issues need to be discussed within the EIS. 8) The impacts of additional rail traffic (noise and dust) are required to be discussed within the EIS. 9) The EIS must articulate how the important values over the mine will be managed. 10) Outcomes to protect 'values' of the area are required. The new consent will not be as per existing consent where it stipulates that Division of Resources and Energy be consulted on subsidence damage. 11) Subsidence impacts of the previous Torbanite (oil) shale) mining should be understood and clarified within the EIS. The subsidence impact assessment for the project should take into consideration subsidence from these previous mining activities. 12) Heritage values of the old mine workings that were fully extracted could be lost if we mine beneath them and this should be noted within the EIS. 13) Risks to sensitive areas should be addressed within the EIS. 14) Surface cracking will be an issue and should be discussed within the EIS. 15) A map is required that defines risk/significance due to the proposed mine design criteria across the Project Application Area. 16) Alternatives for subsidence monitoring to minimise the impacts of the monitoring program (remote sensing, high resolution photography versus survey line) should be discussed within the EIS. 17) Notes that land holder consent is required given the Project Application Area lies within a state conservation area. 18) Discussions on mine closure plan and rehabilitation options should be included within the EIS.	1) Chapter 10.0 2) Chapter 10.0 Section 10.1 Water 3) Chapter 10.0 Section 10.9 Life of Mine and Rehabilitation 4) Chapter 10.0 Section 10.12 Hazards 5) Noted 6) Chapter 6.0 Socio-Economic Analysis and Chapter 12.0 Justification and Conclusion 7) Section 10.5 Noise Management 8) Section 10.5 Noise Management and Section 10.6 Air Quality Management 9) Chapter 8.0 and Subsidence Predictions and Impact Assessment (Appendix D) 10) Chapter 8.0 and Subsidence Predictions and Impact Assessment (Appendix D) 11) Chapter 8.0 and 10.0 12) Section 10.3 Heritage and Cultural Heritage Impact Assessment (Appendix J) 13) Section 8.2.3 14) Chapter 8.0 and Subsidence Predictions and Impact Assessment (Appendix D) 15) Figure 8.2 shows the proposed mining zones that are based on surface feature sensitivity 16) Chapter 8.0 and 10.0 17) Noted 18) Section 10.9 Decommissioning and Rehabilitation

Stakeholder	Key Issues Raised	EIS Reference
Sydney Catchment Authority (SCA)	The following principles need to be taken into consideration: 1) There will be no impacts on the quality or the quantity of water flowing into Sydney's drinking water catchment. 2) Any change must have a neutral or beneficial impact on water quality. 3) Discharges need to achieve drinking water quality goals. 4) The Project needs to address the cumulative impacts, not just impacts from mining developments (eg. impacts from Delta's operations need to be included in the western projects). 5) Clarification on hydrological model scope should be included.	1) – 5) Chapter 10.0 Section 10.1 Water and Surface Water and Groundwater Impact Assessments (Appendix E and F)
Office of Environment and Heritage (OEH)	1) Any alterations to surface water flows that impact on Endangered Ecological Communities must be considered. 2) There is a need to study surface water flow changes due to the Project, and cumulative impacts from all projects. 3) OEH were interested in the 100+-25 mm subsidence and clarification on whether this will cause no surface impacts is required within the EIS. 4) Consideration needs to be taken that some plant species are very sensitive to 'drying'. 5) Queries as to whether the project will be economically viable if partial extraction over the entire Project Application Area is not undertaken and whether management plans will be approved over the entire Project Application Area was raised by OEH at the site visit on 18.11.12.	1) Chapter 10.0 Section 10.1 Water and Section 10.2 Ecology 2) Chapter 10.0 Section 10.1 Water and Section 10.2 Ecology 3) Chapter 8.0 and Subsidence Predictions and Impact Assessment (Appendix D) 4) Section 10.2.4.4 5) The Project and economic analysis is based on an economically viable proposal.
Environment Protection Authority	1) The EPA was satisfied with the existing operations and water management structures in place. 2) Clarification is required on the impact of the REA on surface water. 3) Impacts of noise on the nearby residents when the washery is built are required to be assessed.	1) Noted 2) Appendix F Surface Water Impact Assessment 3) Section 10.5 Noise Management
Division of Resources and Energy	1) Emplacing rejects underground should be considered. 2) Detailed exploration proposals into the EIS should be included to avoid further REF assessments. The more information included regarding the exploration program the better and this will simplify the process going forward. 3) Include discussions on mine closure and final landform.	1) Section 4.8.3 and 12.4.3 2) Section 3.3 3) Section 10.9 Decommissioning and Rehabilitation
Lithgow City Council	1) Queries where the water supply for the CPP will be sourced from.	1) Section 10.1
Department of Sustainability, Environment, Water, Populations and Communities (former SEWPAC)	1) Cumulative impacts of the Project must be understood and included in the EIS.	1) throughout the EIS
NSW Health	1) The impacts on health from cumulative impacts need to be considered. The then NSW P&I however advised that there is no government policy on this topic at this stage and this may be included in the Strategic Regional Land Use Policy, but noted the issue for the Western Coalfields is relatively low priority compared to the Hunter valley coal mines.	1) Chapter 10.0

Consultation with stakeholders listed below was undertaken by then NSW P&I during the development of the DGRs. During the application process and submission of the Briefing Paper, government agencies were afforded the opportunity to provide feedback and requirements were considered by the NSW P&I within the DGRs. A summary of the aspects raised by government agencies and how each of these has been addressed within this EIS is provided in Table 7.4**.**

Table 7.4: Summary of Government Agency Submissions to the DGRs

Stakeholder	Key Issues Raised	EIS Reference
(Former) Department of Planning and Infrastructure	1) DGRs for the Project were issued on 06.11.12. 2) The Office of Agricultural Sustainability & Food Security believes that impacts to agriculture will be unlikely from this proposal. Hence an Agricultural Impact Statement is not required. The project area is not on or near land used for agricultural production. However, the Project may extract groundwater resources and therefore the EIS should address the impact on groundwater for agriculture as part of the water management investigations.	1) Chapter 1.0 Introduction 2) Chapter 10.0 Section 10.9 Agriculture and Land Use Impact Assessment (Appendix Q)
Department of Trade & Investment, Regional Infrastructure & Services	1) Requested that the EIS clearly identifies existing coal titles within and adjacent to the Project areas and any new mining titles which will be required in order to undertake the Project. 2) Requested that the proponent complies with the Commonwealth *Native Title Act 1993*. 3) Requested specific information relating to rehabilitation post mining land use and landforms, objectives and mine closure completion criteria. 4) Exploration activities should be clearly defined in the EIS. 5) The EIS must consider alternative rejects disposal options, including disposal in underground mine workings. 6) The EIS should provide a subsidence assessment. Baseline assessment of the surface features above the mining areas must be sufficient to identify environmental features at risk.	1) Chapter 3.0Existing Operations and Chapter 4.0 Project Description 2) Chapter 5.0 Planning Considerations 3) Chapter 10.0 Section 10.9 Life of Mine and Rehabilitation 4) Section 4.3 5) Chapter 8.0 Mine Design 6) Chapter 8.0 Mine Design and Subsidence Impact Assessment (Appendix D
Lithgow City Council	The EIS should address the likely increase in train traffic.	There will be no increase in train traffic
NSW Office of Water	Key issues to be addressed: 1) That adequate and secure water supply is available for all activities for the life of the mine. 2) Compliance with the rules in any relevant Water Sharing Plan and legislation. 3) Baseline monitoring (minimum of fortnightly data sampling for at least 2 years prior to mine operations) of all surface water and groundwater sources and dependent ecosystems within and adjacent to the mining area for calibration of models and development of trigger criteria. 4) Predictive assessments of potential impacts to surface water and groundwater sources, basic landholder's rights to water, adjacent licensed water users and dependent ecosystems and monitoring to enable comparison with ongoing monitoring. 5) Mitigation strategies to address impacts on surface water and groundwater sources and dependent ecosystems for the operational and post mining phases of the proposal and final landform.	Chapter 10.0 Section 10.1 Water and Surface and Groundwater Impact Assessment (Appendix E and F)

Stakeholder	Key Issues Raised	EIS Reference
NSW Health	Key issues to be addressed: 1) use of local air quality monitoring as far as possible to establish background PM_{10} 2) assess the incremental impacts on PM_{10} from the Project 3) include an assessment of potential cumulative impacts on PM_{10} by considering other known new air pollution emissions sources in the area 4) where schools, nursing homes or health facilities are subject to noise from the Project include the modelled noise impacts.	1) Chapter 10.0 Section 10.6 Air Quality and Appendix L 2) Chapter 10.0 Section 10.6 Air Quality and Appendix L 3) Chapter 10.0 Section 10.6 Air Quality and Appendix L 4) Chapter 10.0 Section 10.5 Noise and Appendix K
Office of Environment and Heritage	1) include full flora and fauna studies and offset proposals 2) clearly detail the expected quality, temperature and quantity of water being released and any impacts on aquatic biodiversity 3) consider changes to groundwater levels, as changes in groundwater can lead to impacts such as drying of vegetation communities 4) include the regional water strategy 5) ensure that a due diligence assessment to avoid harming Aboriginal objects is conducted prior to ground disturbance 6) consultation must be in accordance with the Aboriginal Cultural Heritage Consultation Requirements For Proponents 2010 (DECCW 2010) 7) address direct and indirect impacts on public land. The EIS at a minimum should include viewshed analyses from visitors to public land 8) address the issue of linear infrastructure such as new tracks and power lines linking previously isolated natural features 9) historic heritage will need to be assessed and heritage management plans prepared 10) include details of expected greenhouse gas emissions and how these will be minimised. A greenhouse gas management plan should be included within the EIS 11) clearly identify all natural features and detail how impacts to these will be avoided, mitigated and offset 12) details of environmental protection zones should be included and how they have been avoided, monitored and or managed 13) the EIS should identify sensitive features and how sensitivity was defined and delineated 14) the EIS will need to provide specific details of intended monitoring programs and methods 15) address impacts on the Mugii Murum-ban State Conservation Area.	1) Chapter 10.0 Section 10.2 Ecology 2) Chapter 10.0 Section 10.1 Water and 10.2 Ecology 3) Chapter 10.0 Section 10.1 Water and 10.2 Ecology 4) Appendix F Regional Water Balance 5) Chapter 10.0 Section 10.3 Heritage 6) Chapter 10.0 Section 10.3 Heritage 7) Chapter 10.0 Section 10.10 Visual Amenity 8) Chapter 10.0, various sections 9) Chapter 10.0 Section 10.3 Heritage 10) Chapter 10.0 Section 10.7 Greenhouse Gas Management 11) Chapter 8.0 Mine Design, Chapter 10.0 Section 10.1 (Water), 10.2 (Ecology) and 10.3 (Heritage). 12) Chapter 8.0 Mine Design (there are no environmental protection zones as such) 13) Chapter 8.0 Mine Design 14) Chapter 3.0 Existing Operations, Chapter 4.0 Project Description and Chapter 10.0 15) Throughout EIS

Stakeholder	Key Issues Raised	EIS Reference
Roads and Maritime Services, NSW	A traffic impact study should be prepared in accordance with Section 2 of the RTA's Guide to Traffic Generating Developments, including: 1) hours and days of construction and operation and how proposed operations will interact with existing operations 2) the road and rail traffic and transport volumes and types. Volumes should also include mine input related traffic generation and impact of mine related traffic generation on public roads. The traffic study should address internal traffic movements and parking facilities 3) any oversize and over-mass vehicles and loads 4) the selection of routes having regard to the risk and impact to other motorists 5) the impact of traffic and measures employed to ensure efficiency and safety on the adjacent road network, in particular the Castlereagh Highway 6) any mitigation measures required to address expected traffic generation 7) local climate conditions that may affect road safety for vehicles; 8) an assessment of potential impacts on the capacity, efficiency and safety of the rail network, and what measures would be implemented to maintain capacity, efficiency and safety over the life of the project 9) access arrangements for coal being transported by rail, including train configurations and confirmation of path availability 10) details of required infrastructure works to support any increased demand on the rail or road network as a result of the Project.	Chapter 10.0 Section 10.4 Traffic and Transport

7.4 Feedback on Stakeholder Engagement

The EIS will be placed on public exhibition for a minimum of 30 days to allow for government agencies, organisations, interest groups, stakeholders and community members to provide written submissions. Table 7.5 provides information regarding the tools and activities adopted by Centennial Airly to encourage the community and stakeholders to provide feedback on the Project or EIS.

Table 7.5: Tools and Activities to Encourage Community Feedback

Engagement tool	Details
Contact Mechanisms	A dedicated Project telephone (number 6354 8700) at Airly Mine was established to enable all stakeholders to provide feedback on the Project and ask questions of the Project team. The feedback has been considered during the preparation of the EIS.
Project Website	Information on the Project (Briefing Paper and DGRs) has been posted on the Department of Planning and Infrastructure's website and Centennial Airly's website.
Advertisements	Mudgee Guardian and Lithgow Mercury
Aboriginal Consultation	Aboriginal consultation was undertaken in line with *Aboriginal Cultural Heritage Consultation Requirements For Proponents* (DECCW 2010).
Stakeholder Briefings	Face-to-face and written briefings to stakeholders informing them of the public exhibition phase and requests for comment.

Once the EIS exhibition period is complete, Centennial Airly will prepare a Response to Submissions Report, if required, summarising the issues and concerns raised through the written submissions by the community and stakeholders prior to determination by the Department of Planning and Infrastructure.

7.5 Conclusion

As demonstrated in Table 7.3 and Table 7.4 all perceived issues raised by stakeholders have been considered within this EIS and through the completion of technical assessments.

Centennial Airly is committed to the timely, orderly, consistent and credible dissemination of appropriate information within the constraints of legal and regulatory requirements to all interested stakeholders. To date, no major complaints have been received from the community on Airly Mine operations.

Consultation with stakeholders will continue throughout the life of the Project to:

- maintain strong and effective relationships with the community throughout the life of the Project
- ensure the community remains informed of Airly Mine's progress
- disseminate the outcomes of the EIS assessment process and the development application for the Project.

CHAPTER 8.0

Mine Design and Subsidence

8.0 MINE DESIGN AND SUBSIDENCE

This chapter specifically responds to the Director General's Requirements (DGRs), which provide the following in regard to subsidence:

The Director-General's requirements

Subsidence – including a detailed quantitative and qualitative assessment of the potential conventional and non-conventional subsidence impacts of the development that includes:

- the identification of the natural and built features (both surface and subsurface) within the area that could be affected by subsidence, and an assessment of the respective values of these features
- accurate predictions of the potential subsidence effects and impacts of the development, including a robust sensitivity analysis of these predictions
- a detailed assessment of the potential environmental consequences of these effects and impacts on both the natural and built environment, paying particular attention to those features that are considered to have significant economic, social, cultural or environmental values
- a detailed description of the measures that would be implemented to avoid, minimise, remediate and/or offset subsidence impacts and environmental consequences (including adaptive management and proposed performance measures).

8.1 Introduction

This chapter describes the proposed mine design and plan, the resulting subsidence predictions and the potential impact of subsidence on the natural and built environment as a result of the Project. It is informed by the technical study of Golder Associates Pty Ltd *Subsidence Predictions and Impact Assessment for Airly Mine,* July 2014 (Golder Associates 2014, Appendix D).

The proposed mine design (Figure 4.1) philosophy is described, including mining constraints and any sensitive surface features that were avoided as part of current and future mining operations. It also describes how the potential impacts that are not able to be avoided have been mitigated through optimisation of the mine design.

The potential environmental and social consequences of subsidence are detailed in Chapter 10.0.

8.2 Mine Design Constraints

8.2.1 Geological and Geotechnical Features

Airly Mine extracts the Lithgow seam, which is the only economic coal seam within the Project Application Area. The Lithgow seam is the lower portion of the coalesced Lithgow and Lidsdale seams, which have a combined thickness of 4.8 to 5.9 m (Figure 2.1). The target extraction horizon is the lower 2.7 to 2.8 m of the Lithgow and Lidsdale seam combination. This seam section has been selected as it is the largest recoverable section with an appropriate ash content and calorific value for current target markets.

Roof, floor and coal seam strata conditions play an important role in the selection of appropriate mining systems at any underground mine. Strata competency is determined by the strength properties of the rock mass itself, the amount of geological structure (such as faults, jointing and seam undulations) and the stress environment.

Rock mass strength is an inherent property driven largely by the material in the rock. For instance, coal has relatively low strength characteristics when compared to a fine grained sandstone. Another factor that determines rock mass strength is the amount of naturally occurring bedding from the original deposition of the sediments that formed the rock and fracturing in the rock. The greater the amount of bedding and/or fracturing, the greater the impact on rock mass strength. These natural characteristics are combined to give a relative rating of the strata, particularly roof strata. This rating system is known as the Coal Mine Roof Rating (CMRR). The CMRR is a relative number from 1 to 100 designed as a comparative strength measure.

Table 8.1 illustrates the relative values of CMRR in an Australian context (Strata Engineering 2012a and 2012b). The CMRR of the Airly Mine roof strata is 40 and is defined as weak.

Table 8.1:Values of Coal Mine Roof Rating

Coal Mine Roof Rating Number	Roof Ranking
<25	Extremely Weak Roof
≥ 25, but<35	Very Weak Roof
≥ 35, but <45	Weak Roof
≥ 45, but <55	Moderate Roof
≥ 55, but <65	Strong Roof
≥ 65	Very Strong Roof

The immediate one to two metres of floor is silty sandstone with a CMRR of 45-60 and is therefore regarded as moderate to strong. This value plays an important part in the ability of the floor to bear the loads placed upon it by the remaining coal pillars after extraction is complete. Where the floor is weak there is a likelihood that the remaining pillars may punch into the floor and thereby generate higher levels of subsidence. As the floor at Airly Mine has been assessed as moderate to strong, no significant issues are expected with regard to the floor bearing capacity.

Geological structure is any feature in the rock mass that has been imposed during the period after the rock has formed. Typical geological structures would include jointing (fractures in the rock), faulting (extensional movements), thrusting (compressional movements), shearing (horizontal movements), folding and external features such as volcanic intrusions into the rock. The amount and magnitude of geological structure can play a significant role in mining method selection. High levels of structure can lead to a restriction on mining method selection. Conversely, lower levels of structure can allow greater flexibility in mining method selection. A number of studies into the geological structural environment at Airly Mine have been conducted to date. For example, in 2012, SRK Consulting (Australasia) Pty Ltd (SRK 2012) analysed the results of a high resolution aeromagnetic scans of the Mount Airly and Genowlan Mountain mesas. The study considered the various structural features encountered in the workings at that time as the jointing and lineal features visible on the aerial photograph of the Airly Mine holdings. This work was done to better understand the structural environment within the Project Application Area. SRK (2012) found that:

- there are a number of basement and surface faults trending northwest, northeast and north to south
- the north to south trending faults pose the highest geotechnical risk
- the intersections of the various trending faults are likely to concentrate horizontal stress
- igneous intrusions are not pervasive across the mining area and therefore have low geotechnical risk to the operation.

Figure 8.1 shows the major fault zones identified in SRK (2012).

Further to the analysis of aeromagnetic survey in SRK (2012), Golder Associates (2014) analysed data from the following sources to better define the geotechnical environment:

- LiDAR survey
- bore core logs from the exploration drilling done previously
- aerial and satellite photographs of the Airly Mine holdings
- the results of underground mapping of geological structure
- the results of underground roof monitoring programs

- aerial cliff line assessments done to determine the extent and condition of cliffs
- fieldwork and surface mapping over the Airly Mine holdings.

The Golder Associates (2014) work confirmed the overall structural environment at Airly Mine. It was also found that while no faults of greater than two metres displacement had been encountered or inferred in the workings to date, such faults could be expected based on surface topography and experience elsewhere in the Western Coalfield. Significant magnetic signatures and persistent surface lineal features such as valleys, large cliffs or jointing have been shown at Angus Place Colliery and Springvale Mine to correlate with significant underground strata disturbances. Given the presence of similar features at Airly Mine, it is expected that there will be some seam level geological structure that will have an impact on mining conditions, particularly in deeper parts of the mine.

Rock stress is the other major geotechnical determinant for the selection of mining method in a given deposit. Rock stress is generated from vertical load due to the overburden above the seam and horizontal stress acting on the rock mas. The vertical component of the stress field is directly related to the depth of the seam below ground surface as well as the density of the rock above the seam. The greater the depth and/or the higher the density of the overburden, the higher the vertical stress on the seam being mined.

Horizontal stress is generated in two ways. Firstly, it is generated as a horizontal reaction to the vertical load being placed on the rock. Put simply, when the rock is loaded vertically from the overburden above, it tends to be squashed and push out sideways, thus generating horizontal stresses. The greater the overburden depth, the higher the vertical load and therefore the greater the horizontal load generated as a result.

The second mechanism by which horizontal stress is generated is from larger scale tectonic forces. As the Earth's crust moves horizontally due to tectonic movement there can be significant horizontal compressional stresses generated in different parts of the rock mass. These stresses are known as "tectonic horizontal stress". For tectonic horizontal stress to be able to transmit through a rock mass, it is necessary for there to be a continuum of rock. Where there is a gap in a rock mass such as a valley, the tectonic horizontal stresses must redistribute into the floor of the valley to be able to be transmitted. Where an isolated mountain sits within a valley, it is disconnected from the surrounding tectonic horizontal stress field. As a result any mining is therefore far less likely to be effected by such stresses than a comparable operation in a continuous rock mass such as a wide plateau environment.

Airly Mine is just such a case. The mine sits within a mountain complex that is an isolated mesa in the Capertee Valley. It would be expected that such a situation would be unlikely to see any significant impact from tectonic horizontal stresses. This has been borne out in the workings to date where no evidence of deterioration from horizontal stress has been evident. Depth of cover ranges from 20 m at the sub-crop to a maximum of 280 m under Mount Airly and 310 m under Genowlan Mountain. At a depth of approximately 300 m, Golder Associates (2014) predicts a maximum horizontal stress of <15 MPa, which is a moderate level in the Australian mining context.

Other mines in the Western District such as Springvale Mine and Angus Place Colliery that extract the Lithgow seam under the broad Newnes Plateau have high horizontal stresses. These require a much higher level of support than that expected for the conditions at Airly Mine. In these environments the partial extraction type mining methods being proposed for Airly Mine are not practical or feasible.

Airly Mine, has a relatively weak roof, with a Coal Mine Roof Rating of 40. However, this moderate horizontal stress allows safe partial extraction methods that rely on long term roof and pillar stability. The ability to use partial extraction methods provides a degree of mine planning flexibility that allows the avoidance of sensitive surface features.

8.2.2 New Hartley Shale Mine Interaction Zone

A particular geotechnical constraint at Airly Mine is the presence of old shale oil (or torbanite) workings of the New Hartley Shale Mine. The old workings associated with this mine are shown in Figure 8.1 and are approximately 25 m above the roof of the Lithgow Seam. The mine operated between 1893 and 1913 and fully extracted oil shale from the deposit using a type of hand worked advancing longwall method.

Records of the New Hartley Shale Mine workings are scant, but analysis of historical records, the mine plans and interviews with local residents who are familiar with the operational history of the shale mines shows that:

- the depth of cover varied from 20 to 260 m
- main access and gate roads (or their equivalent) were probably 1.8 m high
- production workings were 0.8 m high on average and were partially backfilled with hand-stacked waste rock
- the extraction ratio is unlikely to have exceeded 0.75 (75% extraction of deposit), given the need to retain some pillars to protect workers.

The Project proposes to carry out mining under these workings. Due to the fully extracted nature of the old workings, the surface above them has been significantly impacted by surface subsidence. As the cliffs in particular have been previously impacted by the oil shale mining, there is a need to constrain the type and extent of mining in the Lithgow seam so as to eliminate any further impact on these features. Detail of the proposed mining in the oil shale mine interaction zone is provided in Section 8.3.7.5.

8.2.3 Sensitive Surface Features

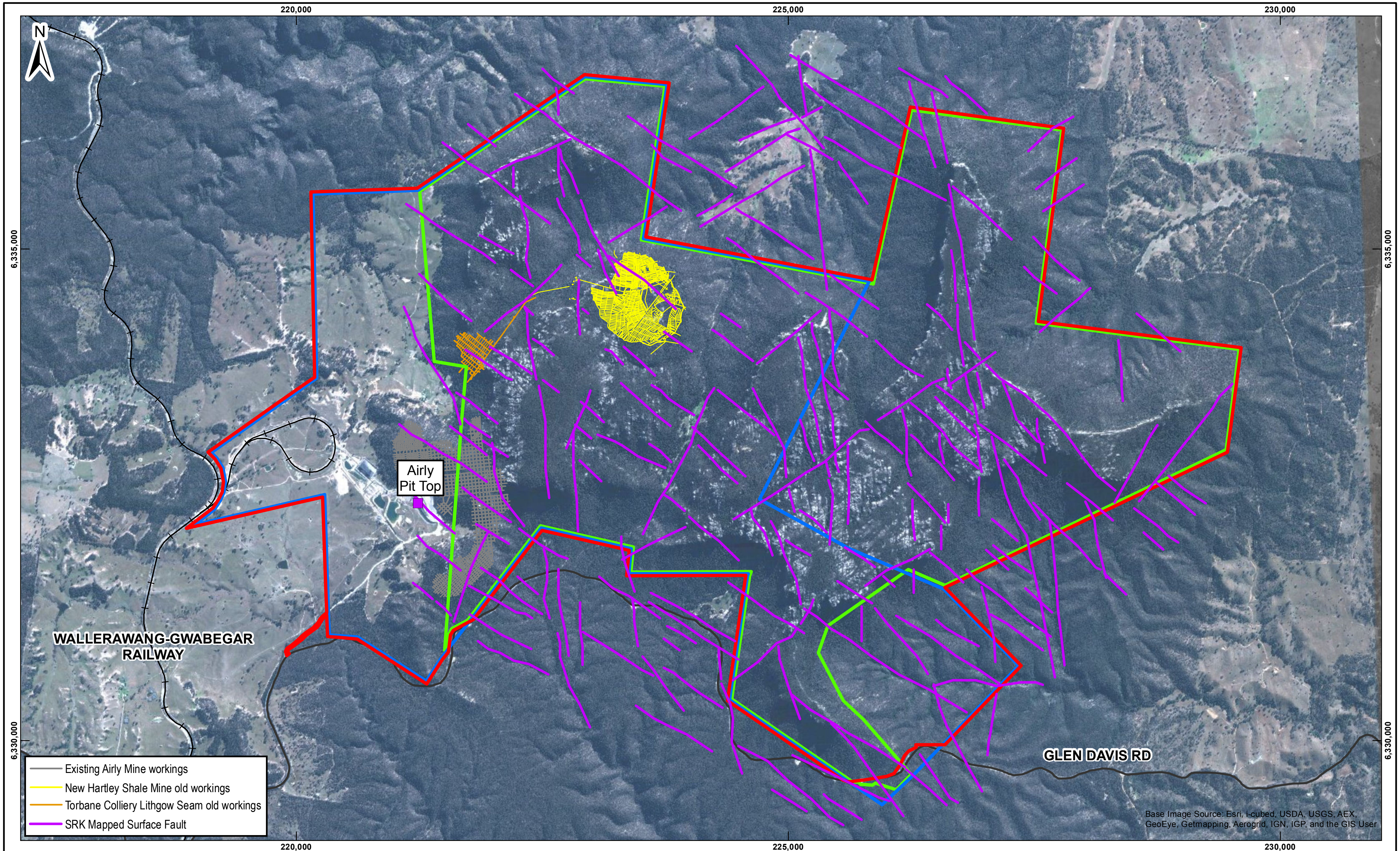
Airly Mine is notable in that it is under a State Conservation Area that has significant natural and human landscape features.

Figure 8.2 shows the locations of a range of key surface features. Key natural and built features with a degree of sensitivity to subsidence within the Project Application Area (Section 2.3) are:

- cliffs
- steep slopes
- pagodas
- deeply incised canyons (e.g. The Grotto and The Oasis)
- third order and above watercourses
- aquifers in alluvium and colluvium material
- aquifers in the Triassic sandstone
- aquifers in the Permian strata of the Illawarra Coal Measures above and below the Lithgow seam
- aquifers in the Shoalhaven formation underlying the Illawarra Coal Measures
- aquifers in the Devonian strata underlying the Shoalhaven formation
- a single state survey mark at Genowlan Trig Station
- the emergency services communications tower on Genowlan Mountain
- a single buried telephone cable in Airly Gap
- public unsealed road in Airly Gap and numerous four wheel drive tracks

- private residence (Stone Cottage at Airly Gap and Nissen Hut at the old diamond mine on Genowlan Mountain)
- Aboriginal heritage sites such as shelters under rock overhangs some with artwork and grinding grooves
- historical heritage items, concentrated around the old Airly Village site
- Genowlan Point *Allocasuarina nana* Heathland (TSC Act) Endangered Ecological Community
- potential habitat sites for threatened fauna such as caves and overhang dwellings for bats such as the Large-eared Pied Bat (Chalinolobus dwyeri); and the Eastern Bentwing-bat (Miniopterus schreibersii oceanensis).

A comprehensive list of features with potential to be affected by subsidence is included as part of the subsidence constraints risk assessment (**Section 9.3.3**). That assessment identifies what sensitive features exist in the various proposed mining zones.



LEGEND

Project Application Area

ML1331 Current Lease Boundary (Offset for Clarity)

A232 Authorisation Boundary (Offset for Clarity)

Rail

Main Road

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Site
Newcastle
Lithgow
Sydney

Figure 8.1: Fault Zones

0 500 1,000 1,500 2,000 Metres

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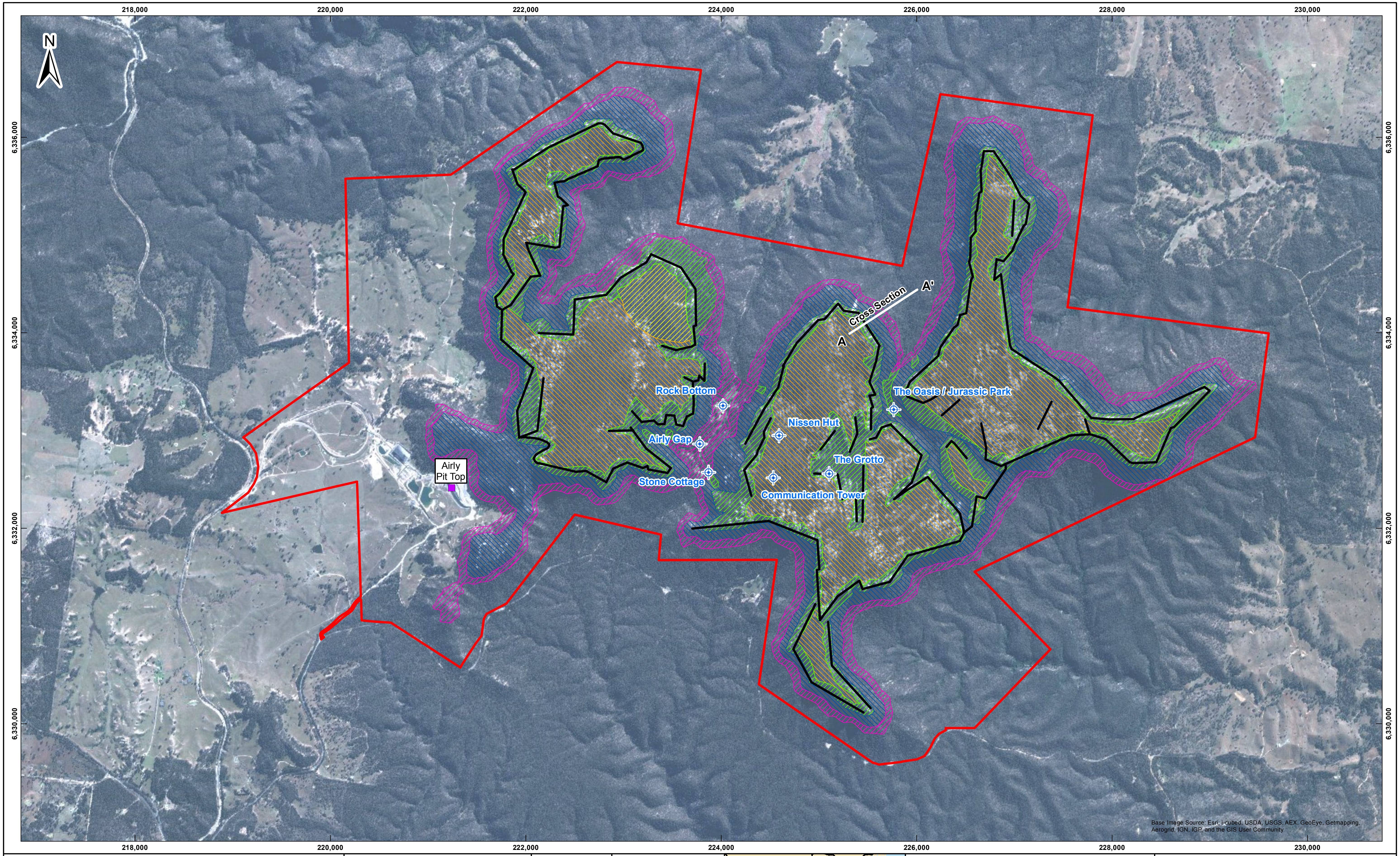
Centennial Coal

Airly

DRG No. 8-8.1

A4



LEGEND
- Project Application Area
- Sensitive Feature
- Cliff Line
- Cliff line zone and zone of first workings
- New Hartley Shale mine potential interaction zone
- Panel and pillar mining zone
- Partial pillar extraction zone
- Shallow zone

See Figure 8.5 for Mining Zone Cross Section Profile A-A'
Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:35,000

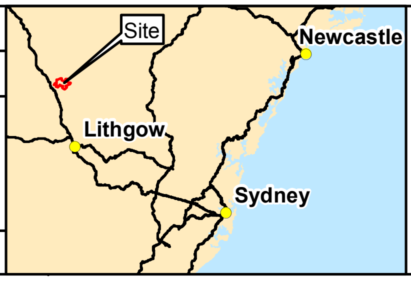


Figure 8.2: Sensitive Features and Mining Zones

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 8-8.2

A3

8.3 Previous Subsidence and Development of Current Mine Plan and Design

8.3.1 Definitions

Subsidence is the vertical displacement of the land surface as strata above the extracted seam collapses into the mined-out void. Associated with vertical subsidence are horizontal movements (strain) generated by the bending of the overlying strata into the mining void. These horizontal movements may be tensile or compressive depending on the location in relation to the mining void. The combination of both vertical and horizontal movements will produce tilting of the surface at certain points. A typical subsidence profile is shown in Figure 8.3.

Mining-induced subsidence can affect land surfaces, sub-surface rock masses and associated natural and built features in a variety of ways and to varying extents. The impact is largely driven by four main factors: the height of extraction, the width of the fully extracted mining void, the depth of the void from the surface and the nature of the rock mass the void is situated in. Certain other factors also have an impact and these are discussed in Section 8.4.

Subsidence occurs over time as the mining face moves along causing the strata to settle and new surface profiles to form. Sometime after mining is completed, the subsidence movements will cease, and the final new land surface profile is achieved. Typically around 80% of subsidence movements will occur within the first two months after mining ceases with the majority of the remaining 20% occurring up to two years after completion of mining assuming no further mining takes place in the vicinity of the extracted area. Subsidence is cumulative up to a certain limit in the case of mining multiple seams or several adjacent extraction areas (known as “panels”). Mining of one panel I will cause a certain level of vertical subsidence and associated strains, but extraction of adjacent panels will increase the subsidence above the first panel and so on up to the maximum possible subsidence for a given extraction height and depth of cover.

Subsidence is measured and predicted in a number of ways. The first is the vertical change in elevation, which is the resultant of downwards subsidence. In certain unusual circumstances such as the base of gorges an upwards movement of the rock strata may occur due to compression of the valley floor. This situation is called upsidence. Either subsidence or upsidence can occur, depending on several factors including surface topography, depth of cover and the lithology of the overburden. Other components of subsidence effects are tilt, curvature and resultant strain.

Various terms describing subsidence, its predictions and impacts are defined in the Glossary of Terms in this EIS. For clarity of terminology, subsidence movements or effects can potentially lead to impacts (such as cracking and slope failure), and that these impacts may in turn result in environmental or social consequences. Some pertinent terms are defined as follows.

- *Chain pillar*: A block of coal left unmined between two mining panels. The chain pillar holds up the roof between panels while regular cut throughs allows the passage of air, materials and personnel between mined roadways.
- *Depth of cover*: The vertical thickness of rock and soil above the mining area.
- *Goaf*: The area of fractured rock above the mined out void. The process of the collapse of strata into the mined out void is referred to as goafing.
- *Angle of draw*: The angle measured from the vertical, connecting the edge of the mining void to the surface expression of the lateral limit of subsidence (usually defined as less than 20 mm of subsidence). At most of the NSW coalfields, this angle of draw is 26.5 degrees.
- *Critical width*: This is the width of extraction void that, for a given depth of cover and height of mining extraction, produces the maximum possible vertical subsidence. If mining height is held constant, it follows that the shallower the mine workings are, the smaller the mining void will be to produce maximum possible subsidence. Also, if mining height is held constant, it follows that the deeper the

mine workings are, the larger the mining void will be to produce maximum possible subsidence. This is an important factor in mine design at Airly Mine.

Any void that is smaller than the critical width will produce less subsidence than the maximum possible as a given depth and mining height. This situation is known as sub-critical width. Conversely any void that is larger than the critical width will produce no more subsidence than the maximum possible as a given depth and mining height. This situation is known as super-critical width.

A single mining panel may have a sub-critical width by itself, but if it is not separated by sufficiently large chain pillars from adjacent voids, the effects of the voids become cumulative and eventually become super-critical (i.e. maximum subsidence is reached). If sub-critical voids are separated by large chain pillars, the individual voids remain isolated and thus subsidence is maintained at levels below maximum values. This concept is at the core of mine design for the Airly Mine.

- *Tilt*: The change in ground slope measured by the difference in height of two points divided by their distance apart, usually measured in mm/m. Positive tilt is towards the direction of measurement.
- *Strain*: The change in the horizontal distance between two points divided by the original horizontal distance between the points. If this distance increases, it shows tensile strain. If the distance decreases, it shows compressive strain.
- *Conventional movements*: Those smooth subsidence movements that can be explained and predicted by expected caving mechanisms in areas of consistent geology and topography.

The process of caving and resulting surface deformations is illustrated in Figure 8.3 and shows the following zones.

- *Caved Zone* comprises loose blocks of rock detached from the roof and occupying the cavity formed by mining. This zone can contain large voids and can extend vertically up to ten times the extraction height.
- *Fractured Zone* comprises in-situ material lying immediately above the caved zone which have sagged downwards and consequently suffered significant bending, fracturing, joint opening and bed separation. From the Hunter Valley data where Forster and Enerver analysed data, this zone can extend up to 33 times the extraction height for large fully extracted voids such as longwalls and full extraction bord and pillar workings. For small void widths such as those proposed at Airly, the height of the fractured zone is much lower.
- *Constrained Zone* comprises confined rock strata above the disturbed zone which have sagged slightly but, because they are constrained by the more fractured material below, have absorbed most of the strain energy without suffering significant fracturing or alteration to the original physical properties. Some bed separation or slippage can be present as well as some discontinuous vertical cracks, usually on the underside of thick strong beds, but not of a degree or nature which would result in connective cracking or significant increases in vertical permeability. Some increases in horizontal permeability can be found. Weak or soft beds in this zone may show plastic deformation.
- *Surface Zone* comprises unconfined strata at the ground surface in which mining induced tensile and compressive strains may result in the formation of surface cracking or ground heaving.

The mine plan is the lateral extent of mining, while design consists of the specific engineering controls imposed to maintain safety, minimise disruption to surface infrastructure, and minimise environmental and social consequences.

Unconventional (or "non-systematic") subsidence effects, such as upsidence, valley closure and far-field horizontal displacements are generally associated with large scale redistributions of horizontal stress due to longwall mining. These effects are generally most pronounced in high horizontal stress environments or where faulting intersects large voids. Airly Mine differs in two key respects. Firstly, it has low horizontal stress and secondly the mine plan constraints of limited spans and long-term stable wide pillars will ensure that there is limited redistribution of horizontal stresses. The combination of moderate levels of horizontal stress and the limited extraction voids proposed in the Project means that the triggers for such far field displacement are absent. Therefore unconventional subsidence effects or far field horizontal movements are highly unlikely to occur. It is useful to note that Clarence Colliery, which employs a subsidence limit in mine design identical to that proposed in this Project and operates in a similar topographic, stratigraphic and structural environment, has not experienced impacts that can be attributed to unconventional subsidence or far field horizontal movements.

8.3.2 Historical Precedent and Observations

8.3.2.1 Airly Mine

Mining to date has consisted of the formation of pillars by first workings only.

Airly Mine began full scale production in December 2009. Mining since that time has focussed on the shallower parts of the deposit adjacent to the mine entrances. This was to allow experience to be gained in the conditions of the deposit and to determine the most appropriate method for the long term operation of the mine.

Initial mining operations have been limited to the formation of first workings pillars only in the production panels. This method was selected to provide a long term stable pillar system that would support the overburden and minimise subsidence to negligible levels whilst providing a safe and productive mining system. In areas where depth of cover is less than 120 m, a system known as splitting and quartering has been employed. In this system, large pillars are driven and then subsequently have unsupported roadways driven into them at predetermined intervals, thus producing a layout of smaller pillars that are designed as long term stable and also meet the minimum required pillar dimensions stated in Clause 88(2)(a) of the *Coal Mines Health and Safety Regulation 2006*.

Pillar sizes were designed to be long term stable and also to comply with the minimum requirements of the *Coal Mines Health and Safety Regulation 2006*. This legislation requires a minimum plan dimension of a pillar to be no less than one tenth the depth from surface or 10 m, whichever is greater. The pillar width to height ratio is to be at least 4:1. In areas where the depth of cover was less than 120 m, a final pillar minimum dimension of 12 m was used. All roadways have been maintained at a maximum of 5.5 m.

Strata Engineering (201b) carried out an assessment of the splitting and quartering methods to be used and found that the fundamental stability measures of both pillar width to height and Factor of Safety (FOS) where adequate for long term stability of the pillar system. FOS is a basic engineering measure of the ability of a designed structure to sustain the loads placed upon it. It is calculated by dividing the strength of the structure by the load it must bear. A result greater than 1 means the structure has a higher strength than the load it must bear. In civil engineering a FOS closer to 1 is acceptable to the high level of homogeneity and material property confidence in manufactured structural members. In mining, the rock material is not homogenous and of consistent strength, so a higher FOS must be used to account for this. Extensive industry experience in Australia and other countries has shown that a FOS of 1.6 gives a probability of failure of 1 in 1000 or less than 0.1%. This has been regarded as a long term stable design outcome. The pillars used at Airly Mine to date have a FOS of 1.8 or more and are considered long term stable. Experience underground with this method showed no evidence of catastrophic or progressive pillar failure. Recent inspections of the old workings have found minimal deterioration of the roadways. Roadways were generally standing as formed with only localised skin failure in noted in a small percentage of those roadways driven with no support as part of splitting and quartering operations. No large scale falls of ground were noted. All the splitting and quartering panels driven have shown a high level of stability more than 18 months after mining was completed. The inspections found all pillars formed to be intact with minimal spalling of the sides.

Subsidence monitoring to date at Airly Mine has consisted of surface inspections only due to the high factors of safety (FOS >1.6) surrounding the first workings used in the current mining areas. No secondary extraction to reduce pillars below the statutory minimum dimension has been undertaken, therefore there has been no requirement for a Subsidence Management Plan to be developed. Given that no mining other than first workings has taken place under the currently designated Environmental Protection Zones the surface inspections undertaken to date over the mined areas have been sufficient. These surface inspections have shown no visible impact on the ground surface such as cracking, sink holes or pressure ridges. There has been no indication of impacts on the existing vegetation over the current mining areas.

Modelling of the first workings used at Airly Mine indicates that subsidence levels for the maximum depth of cover encountered would be <30 mm. Whilst no formal subsidence monitoring has been conducted, as stated above, surface inspections have not revealed any evidence of subsidence impacts.

The success of the splitting and quartering method at Airly Mine has led to its selection for continued use in the shallow (<100 m depth of cover) areas in the remainder of the deposit.

8.3.2.2 Experience from Similar Operations

In looking for mining methods that would suit Airly Mine in the longer term an assessment of successful industry examples in similar conditions was carried out to determine the appropriate criteria for the avoidance of subsidence impact on sensitive surface features and minimisation of impact to sub-surface features,. The operation that most closely resembles Airly Mine in terms of topography, hydrology and other key features is the Clarence Colliery operation near Lithgow also part owned by Centennial Coal. This mine operates under very similar surface and sub-surface features to Airly Mine. These include:

- cliffs >20 m in height with overhangs and significant natural fracturing
- steep slopes
- pagodas
- deeply incised gorges
- third order and above watercourses
- overlying aquifers that provide water to surface water systems.

Clarence Colliery was purchased by Centennial Coal in 1998 and the decision was made at that time to move to partial extraction. The reason for this was threefold. Firstly to minimise groundwater inflows into the mine traditionally associated with fracturing of the overburden from previous full extraction workings, Secondly, to minimise underground operational and safety issues with the very strong immediate roof of the Katoomba seam that Clarence Colliery extracts, and thirdly to minimise impacts on the Bungleboori Creek gorge where mining was to take place.

It was determined by mine management, in consultation with industry geotechnical expertise and the regulatory authority, that an appropriate limitation on subsidence in the Project would be nominally limited to a maximum of 125 mm in order to prevent damage to the surface. A maximum value for tilt of 2.5 mm/m and a maximum value of strain of 2.0 mm/m where also determined to be appropriate. These values were deemed to be sufficiently conservative that should an exceedance occur, there was sufficient leeway to allow changes to the mine design to be made in subsequent extraction panels to bring the system back into compliance without incurring significant surface impacts. It should be noted that the term ±25 mm reflected the fact that the accuracy of subsidence monitoring at such low levels could be affected by issues such as instrument error and the natural swelling and contraction of the ground surface with seasonal and rainfall changes.

Partial pillar extraction was commenced at Clarence Colliery in 1999 and since that time has been highly successful in terms of maintaining their specified subsidence limit of 100 mm. Only in areas that are at the greatest depth of cover and have experienced flooding post mining has the value of 100 mm been approached. No evidence of mining induced surface cracking has been found on any sensitive surface feature. Cliffs as high as 100 m have remained intact with no additional spalling of rock noted. Overlying aquifers that feed surface water systems remain undisturbed. Surface water systems have not seen changes outside seasonal and natural variations. No evidence of mining induced change in terrestrial ecology has been detected to date.

With this consistent positive performance in similar conditions over many years as a guide, it was decided Airly Mine should select a similar set of limiting performance criteria for any mining system to be implemented. Lithgow seam lithology at Airly Mine dictates that different mining methods to Clarence Colliery would be required. Provided that any system designed for Airly Mine met or improved on the Clarence Colliery performance criteria, it was reasonable to expect similar outcomes.

Therefore the subsidence performance criteria proposed for all mining systems used in previously unmined areas at Airly mine is not to exceed 125 mm. Mining system design will seek to minimise subsidence nominally to 100 mm thus allowing around 25 mm for survey error and swelling and other natural movements of the land surface. Tilt is not to exceed 2.5 mm/m and strain is not to exceed 2.0 mm/m.

8.3.3 Methodology

The primary objectives of mine planning and design is the creation of a mine that is safe for workers and visitors, considers sensitive natural and human surface features and provides an economic return for company shareholders.

Centennial Airly's approach to the Project has been to apply a best practice system of environmental management, that is, a hierarchy of avoidance, minimisation, mitigation and finally, offsetting residual impacts. In a general chronology, the following steps have been taken to design the Project.

- *Detailed geological investigations to delineate the target coal seams and understand associated strata*. Numerous exploration boreholes have been drilled on both Mount Airly and Genowlan Mountain since the 1980s. This exploration has provided information on seam thickness and coal quality that has, in turn, allowed the delineation of the economically recoverable portion of the Lithgow seam over the Project area.

- *Detailed geotechnical investigations to understand important parameters that can affect the suitability of mining methods in certain areas of the deposit, and the way in which subsidence might occur.* Strata Engineering (2012b) carried out an extensive review of the available geotechnical data on the deposit within the Project Application Area. This geotechnical characterisation provided recommendations on the level of support required for the different parts of the deposit as well as the suitability of various proposed mining methods in existing geotechnical and natural environment.

- *Detailed investigation of natural underground features, particularly geological structure and groundwater systems.* The SRK (2012) aeromagnetic survey and Strata Engineering (2012b) geotechnical characterisation study provided information on geological structure that further defined what mining methods where potentially suitable at Airly Mine.

- *Detailed survey of natural surface features such as cliffs, pagodas, canyons, vegetation communities and watercourses and an assessment of their relative sensitivity to the effects of subsidence.* Golder Associates (2014) carried out a comprehensive airborne survey of the Mount Airly and Genowlan Mountain complex studying internal and external cliffs, pagodas and deeply incised gorges. This was combined with surface examinations of key features to verify the airborne observations. From this work a detailed Cliff Line Assessment using a recognised Australian Coal Association Research Project (ACARP) cliff sensitivity assessment tool was undertaken. This study enabled an understanding of the relative sensitivity of the surface of the mountains to the effects of subsidence.

- *Assessment of terrestrial and aquatic ecology and groundwater systems.* RPS (2014a) has conducted a baseline survey of the terrestrial flora and fauna of the Project Application Area to define the populations and vegetation communities present. Cardno (2014) carried out studies relating to the aquatic ecology present in the Project Application Area. GHD (2014a and 2014b) assessed groundwater and surface water systems.

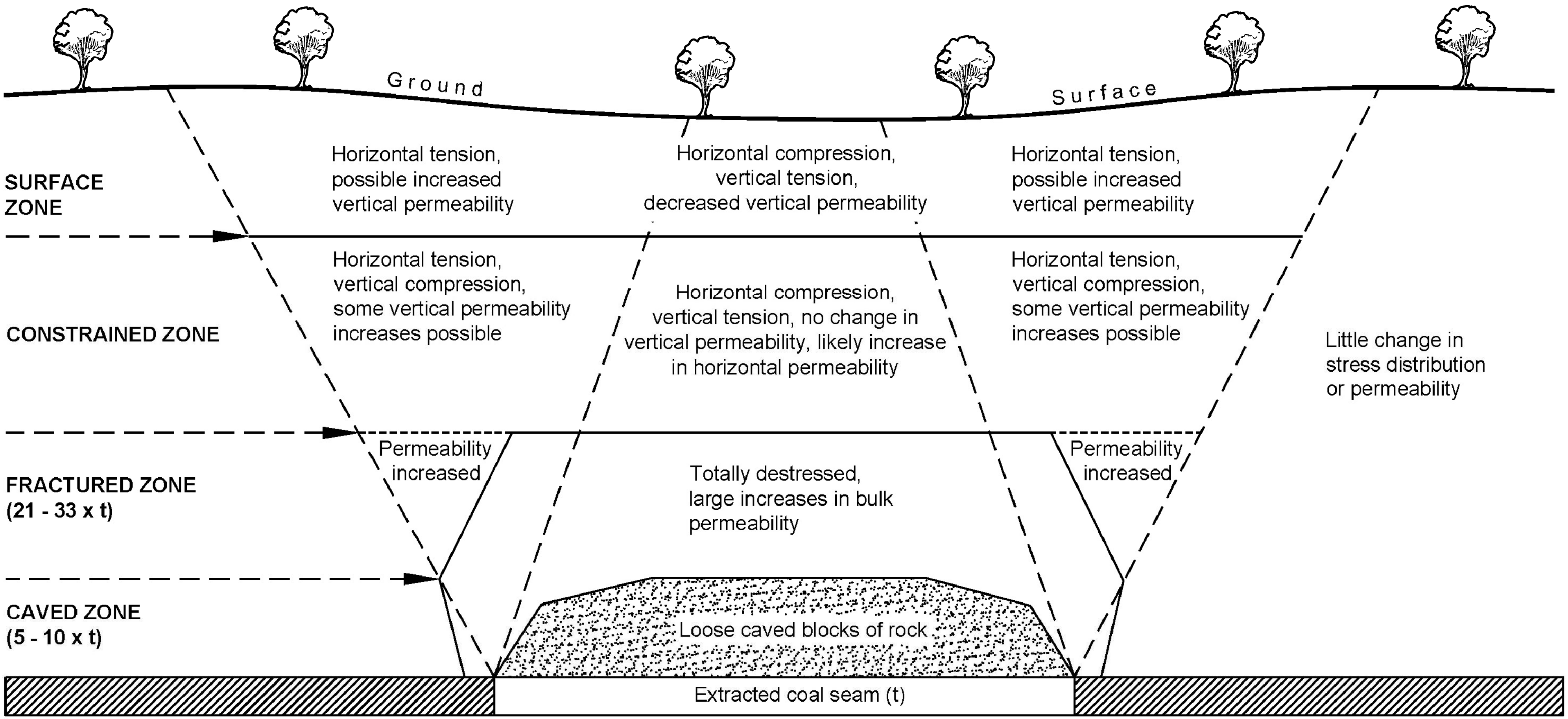


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Figure 8.3: Typical Subsidence Profile

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Centennial Coal
Airly

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- *The formulation of appropriate subsidence criteria such as maximum values of subsidence, tilt and strain, to avoid subsidence impacts wherever possible*. Strata Engineering (2012a), as part of the geotechnical characterisation study, assessed the success of partial extraction systems used in similar topography at Clarence Colliery. That mine has demonstrated over nearly 14 years that limiting subsidence to a nominal 100 mm (but not exceeding 125 mm) has resulted in negligible impacts to the surface including cliffs, pagodas, steep slopes and creeks. It was determined that this criteria will be directly transferable to the Airly Mine situation so as to manage potential subsidence impacts.

- *The formulation of various mine design options based on the previously determined criteria and suited to the geotechnical environment in which they were to be employed (e.g. depth of cover, mining height, surface feature sensitivity and rock mass strength).* Strata Engineering (2011a, 2011b, 2012a and 2012b) undertook a number of preliminary geotechnical assessments of potential mining techniques designed to limit subsidence to 100 mm or less in different parts of the coal deposit. This work culminated in their 2012 geotechnical characterisation report (Strata Engineering 2012a and 2012b).

- *Detailed financial and operational (i.e. safety and process) assessment of the optional mine designs to select preferred mining method options for the various parts of the deposit.* A prefeasibility study has modelled the various mining methods proposed for financial and operational viability. This reduced the number of potential mining methods to those ultimately assessed in the Subsidence Impact Assessment.

- *Detailed assessment of the deposit to determine the extent of application of the selected mining methods to provide the desired level of protection to the surface and sub-surface features identified (i.e. development of mining zones for the deposit).* Golder Associates (2014) has assessed subsidence impacts to examine the impacts of the proposed mining methods. It was clear that a single mining method was not applicable over the entire deposit if the pre-determined subsidence management level of 100 mm was to be achieved. The deposit was divided into a number of mining zones where the various mining methods assessed in the earlier work would be applicable in order to give the desired outcomes. Subsurface fracturing was also considered as this had a direct bearing on impact to groundwater systems. A subsidence impact risk assessment was conducted to bring all the specialist study groups together and determine what the likely impacts from subsidence would be in each specialised subject area. Issues such as post mining flooding of the workings, heritage site locations and potential drawdown of groundwater baseflow in some areas further refined the mining zone definition.

This approach of primary consideration of the impact of mining on surface and sub-surface features as the driver for mine design differs considerably from that taken in the EIS prepared by Novacoal Australia Pty Limited in 1991 (Novacoal 1991) in support of Airly Mine’s current development consent (Section 3.1). Indeed, it varies considerably from many contemporary mining proposals in which subsidence impacts are managed through mitigation or offset.

The 1991 EIS proposed full extraction in all but the most sensitive locations such as large external cliffs. Management of surface and sub-surface impacts was of secondary importance to the issues of resource recovery and process efficiency. Centennial Airly has recognised the changing nature of community expectations around subsidence impact at Airly Mine. Mining to date has deliberately focussed on methods that generate negligible levels of subsidence.

The Project seeks to continue that philosophy of avoidance of impact wherever possible. Mine design plays the major role in achieving this goal.

8.3.4 Previous Subsidence at Airly Mine

Detailed records are lacking for the New Hartley Shale Mine workings (Figure 8.1) but the style of workings and expected extraction ratio could have easily produced super-critical voids, although undoubtedly, sub-critical voids would also have been formed as a result of pillars being left around key roadways to maintain access. Golder Associates (2014) carried out an assessment of the potential amount of subsidence that may have occurred over the oil shale workings. Predicted subsidence in the oil shale zone above super-critical voids, based on the available plans and mining records and conservative assumptions of how much material was extracted and the height of mining, is likely to have been in the order of 390 mm vertical subsidence, with typical associated tensile and compressive strains of 3 and 4 mm/m respectively and tilts typically of 10 mm/m. These levels of subsidence effects are sufficient to have caused surface cracking and that the extensive damage to cliffs above the workings suggests that strains here may have been higher than 10 mm/m. This assessment provided a means to calibrate any further assessment work on the potential interactions between the existing oil shale workings and any potential mining in the Lithgow seam. The calculated amount of expected damage was compared to the actual level of damage found during inspections. The correlation was found to be good and allowed design work to continue albeit with a higher level of uncertainty than for unmined areas.

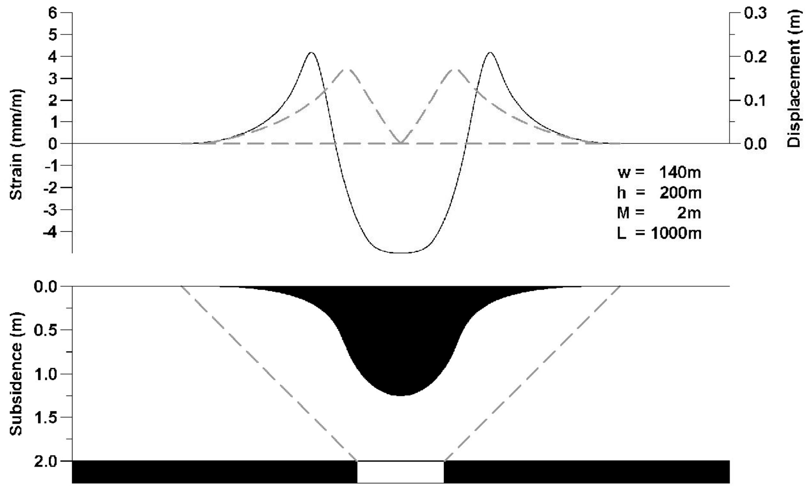
Golder Associates (2014) identified the following three distinct zones of mining induced damage above the New Hartley workings:

- a persistent tension crack (up to 80 mm wide) located 50 to 80 m horizontally from the southern edge of the old workings Photograph 8.1)
- mining induced cracking and joint dilation within approximately 40 to 70 m of the cliff line crests (Photograph 8.2)
- very limited fracturing (i.e. fractures typically limited to hairline widths) and no noticeable subsidence depression above the central areas of the shale mine noting in this area the minimal rock outcrop and dense vegetation was a limiting factor (Photograph 8.3).

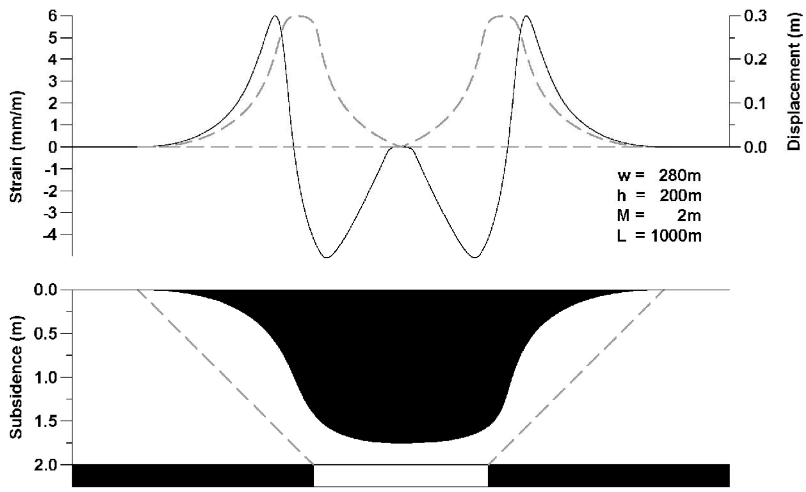
While the surface cracking above the New Hartley Shale Mine workings matches subsidence predictions, there were no pre-mining surveys prior to mining commencing in 1893 and so the vertical extent of subsidence cannot be measured. It is possible that two general zones of subsidence developed above the New Hartley Shale Mine. The first is above super-critical voids widths, where the maximum possible subsidence will have already occurred, many years ago. Golder Associates (2014) predicts that this would have been approximately 390 mm vertical subsidence. The second zone, should it occur, is above remnant stable pillars, whereby the void widths have remained sub-critical, and in these areas the total subsidence will have been much less, perhaps less than 100 mm.

The possibility of the existence of large pillars in the old workings is a critical factor in determining the amount additional of subsidence likely to be generated by mining in the Lithgow seam under the oil shale workings. If no large pillar exist and the oil shale has been essentially fully extracted, the voids would be already super critical and a significant amount of subsidence would have already occurred. Any additional subsidence from mining in the Lithgow seam would be likely to be around 200 mm (Golder Associates 2014). If some large pillars still exist in the oil shale workings, then it is possible that some sub-critical voids may still exist. Undermining in the Lithgow seam would cause the pillars in the shale mine area to collapse and thus initiate a higher level of additional subsidence than for the super critical case. Golder Associates (2014) predicts this case to generate up to 500 mm of subsidence. This is effectively the worst case scenario and is the one on which the impact assessment is based. Figure 8.4 shows a series of conceptual cross section across sub-critical, critical and super critical extraction voids, showing the subsidence generated above each.

(i) Sub-critical extraction



(ii) Critical extraction



(iii) Super-critical extraction

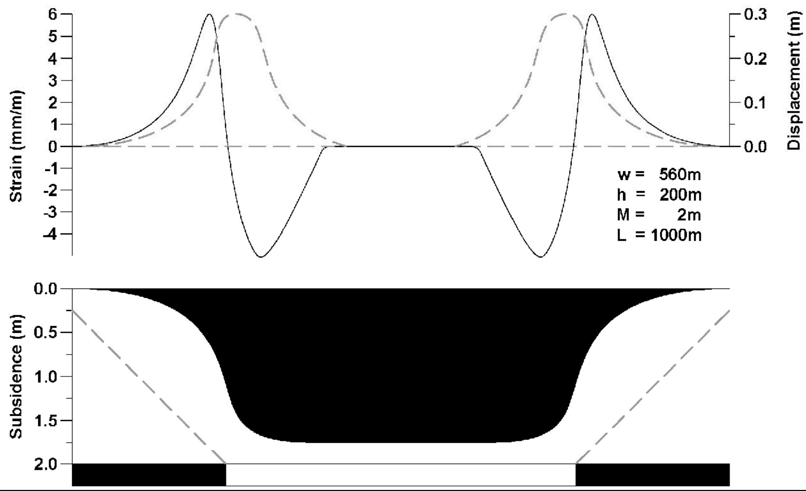


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Figure 8.4: Sub Critical and Super Critical Void Widths and Subsidence

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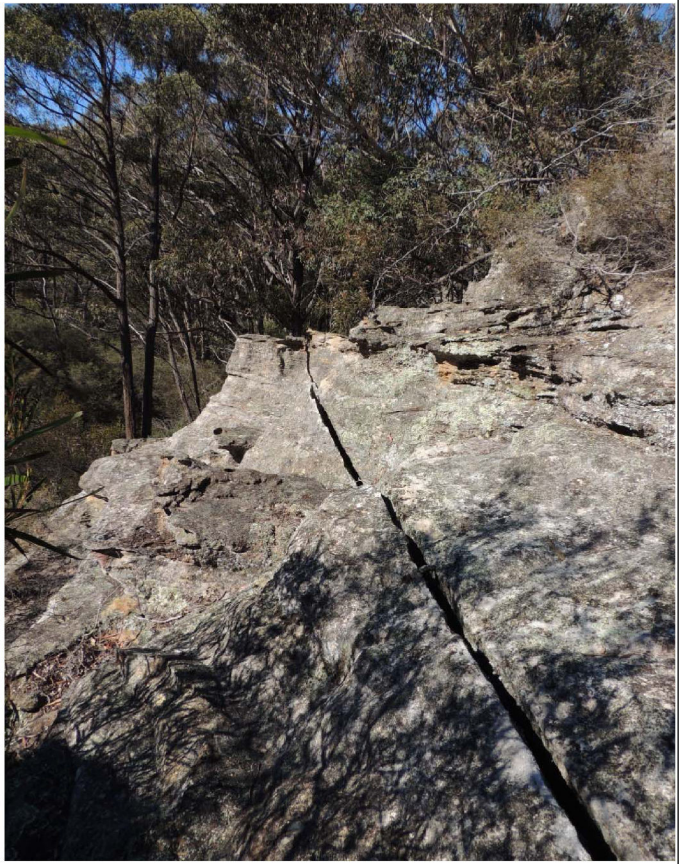

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	SEAM	LITHGOW			Centennial Coal Airly
	REFERENCE				DRG No. 8-P8.1
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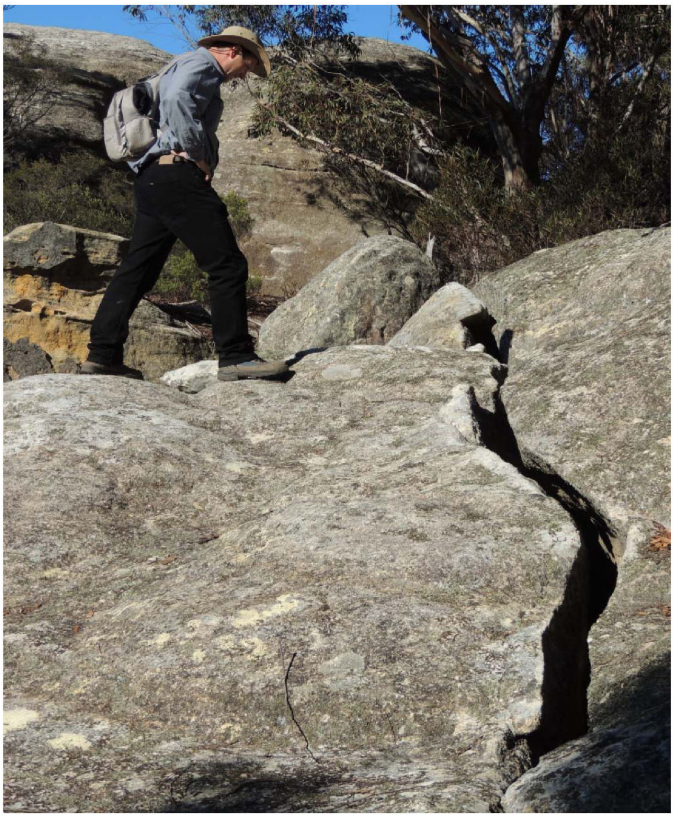

CENTENNIAL AIRLY PTY. LTD.	DATE	17/04/2014	**Photograph 8.2: Significant Cracking Near the Cliff Lines**	PLOTFILE No.
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Photograph 8.3: Hairline Cracking Near the Cliff Lines

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8.3.5 Development of Current Mine Plan and Design

The current approved mine plan is based on the initial plan and design put forward in the 1991 EIS, that was subsequently the subject of a Commission of Inquiry but was approved in 1993 with several modifications. In summary the approved mine plan and design allowed partial and full extraction in different zones within ML 1331. The area to the east, part of the A232 boundary was excluded from the consent as it was outside the then 21 year mine life. The approved mine plan is provided in Figure 3.1.

The current approval permits:

- first workings only within 50 m of coal outcrop barrier and where the depth of cover is less than 50 m
- first workings and partial secondary extraction within designated Environmental Protection Areas
- first workings and total extraction in remnant areas, generally within the centres of Mount Airly and Genowlan Mountain (the unshaded area in Figure 3.1)
- subsidence predictions were that no measurable subsidence would occur in the first working and partial extraction zones, and that subsidence of up to 1.8 m would occur in the total extraction zones.

To date, mining has consisted of first workings in all areas mined with splitting and quartering practiced in areas of less than 120 m depth of cover. No secondary extraction has occurred within the Environmental Protection Areas defined in the current development consent. The Environmental Protection Areas were established as a result of the 1993 Commission of Inquiry into the Airly Coal Project (Section 3.1). This area was defined by a 25º angle of draw from both the crest and toe of the external cliffs greater than 20 m high.

8.3.6 Evolution of Proposed Mine Design

Community regulatory and industry expectations have changed since development consent was granted to Airly Mine in 1993. Centennial Airly has been developing detailed mine design outcomes to take into consideration the sensitive surface and sub-surface features within the Project Application Area as highlighted in Section 8.2.3. All proposed mining systems are designed with both safety of mine personnel and productivity as key design features.

While the current development consent allows for 1.8 m of subsidence and correspondingly large tilts and strains in full extraction areas, Centennial Airly chose to continue the development of low-impact underground mining methods. The proposed concept in the Project is to design the mining methods to limit void widths and leave sufficiently large remaining pillars to restrict mine-induced subsidence to 100 mm (but not exceed 125 mm) over the previously unmined parts of the mining area. Doing this minimises the consequences to the natural and social environment. Restricting void width also reduces fracture height in the sub-surface environment and minimises impact to groundwater systems as far as practicable. The Clarence Colliery experience was valuable as the same controlled subsidence limits at that mine have been proven over 14 years to have negligible subsidence-induced impacts.

Centennial Airly applied an iterative methodology to mine design and plan characteristics and the resulting predicted impacts and consequences on the environment, safety and productivity. The following extraction methodologies were examined in 2012 and subsidence effects and impacts considered for each methodology (Chapter 12.0 and Appendix D for details of the alternatives considered):

- partial pillar extraction layout with void widths between 50.5 m and 70.5 m
- a form of Wongawilli style partial extraction with void widths between 45.5 m and 65.5 m
- a miniwall with void widths between 51 m and 71 m
- a shortwall (similar to a miniwall but extraction using continuous miner and flexible continuous coal haulage) with void widths between 51 m and 71 m.

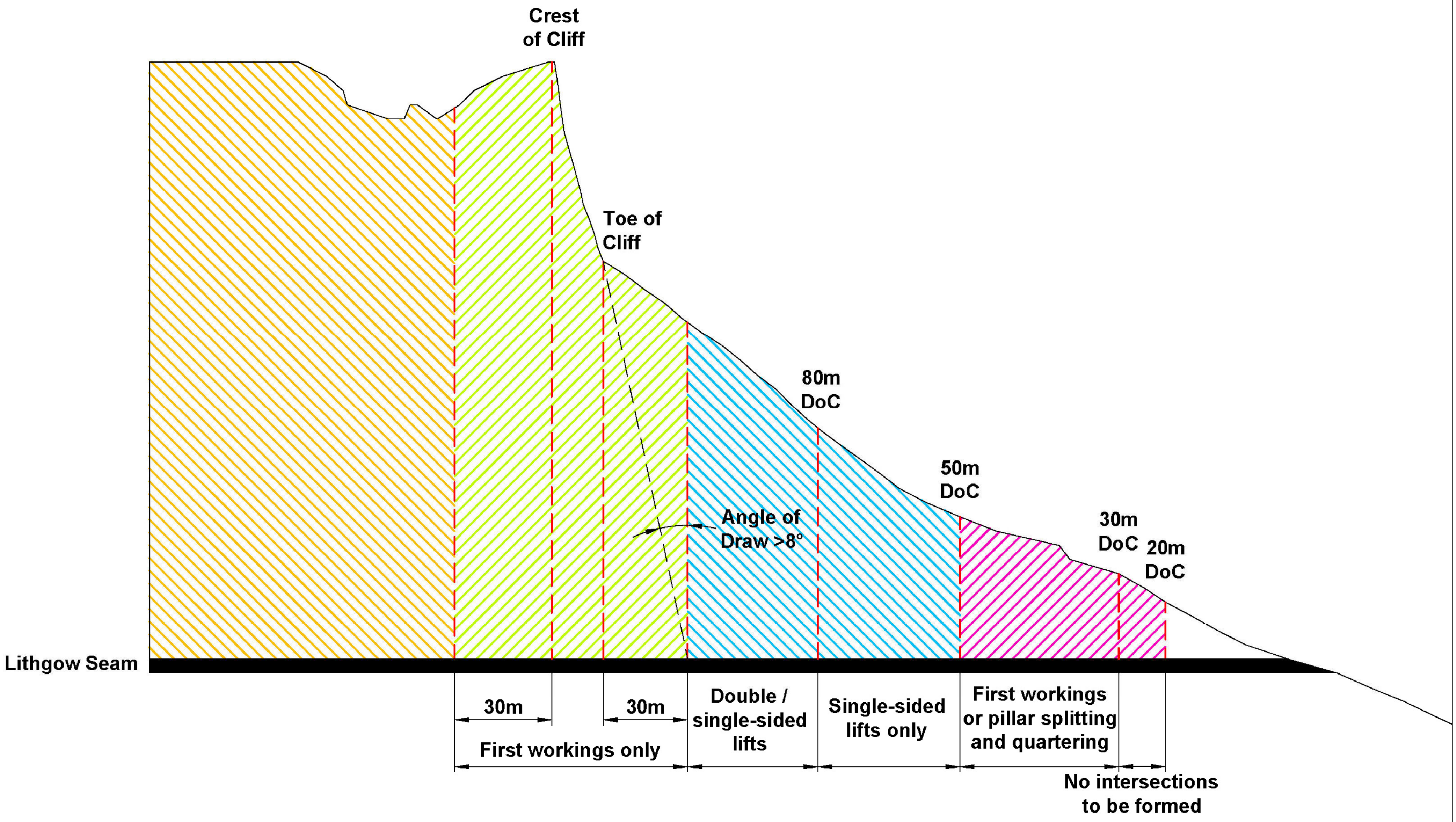
Golder Associates (2014) in the Subsidence Impact Assessment reports on the outcomes of the work undertaken on the alternative extraction methodologies in 2012 and notes that the outcome was refinement of considered mining methods to: panel and pillar mining, double-sided lifting and single sided lifting bord and pillar partial extraction mining, and pillar splitting and quartering. Further refinement lead to the adoption of the following zones of mining, the areas of which are shown on Figure 8.2, while Figure 8.5 shows a cross section through these zones:

1) Cliff Line Zone and Zone of First Workings
2) Panel and Pillar Mining Zone
3) Partial Pillar Extraction Zone
4) Shallow Zone
5) New Hartley Shale Mine Potential Interaction Zone.

The zones have particular environmental sensitivities and are discussed in detail in Section 8.3.7.5.

The size and shape of each of the zones is determined by a number of factors such as:

- mining height
- depth of cover
- void width (including roadway width)
- subsidence prediction
- sensitivity of the surface features to subsidence impact
- appropriate angles of draw for the type of mining proposed
- potential interaction with the New Hartley Shale Mine workings (where applicable)
- post mining flooding of the mine workings.



Note: Section A - A' showing proposed mining zones, refer to figure 8.2 for location.

LEGEND
- Panel and pillar mining zone
- Cliff line zone and zone of first workings
- Partial pillar extraction zone
- Shallow zone

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Figure 8.5: Mining Zone Cross Section

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8.3.7 Proposed Mining Methods

8.3.7.1 *Cliff Line Zone and Zone of First Workings*

Constraints

Extensive large sheer sandstone cliffs define the visual landscape of Mount Airly and Genowlan Mountain. Associated with the tops of these cliffs are the rock stack features known as “pagodas”. Because of the close proximity of these pagodas to the cliffs, they have been assessed together in terms of sensitivity to impact. The key features to be managed in the Cliff Line Zone and Zone of First Workings are listed below.

- cliffs
- cliffs overlying the New Hartley oil shale mine
- historical heritage items, concentrated around the old Airly Village site
- steep slopes
- pagodas
- deeply incised canyons (e.g. The Grotto and The Oasis)
- aquifers in alluvium and colluvium material
- aquifers in the Triassic sandstone
- four wheel drive tracks
- Aboriginal heritage site rock shelter (45-1-0167)
- Genowlan Point *Allocasuarina nana* Heathland (TSC Act) Endangered Ecological Community
- potential habitat sites for threatened fauna such as caves and overhang dwellings for bats such as the Large-eared Pied Bat (*Chalinolobus dwyeri*); and the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*).

Golder Associates (2014) surveyed the cliffs and their relevant features are as follows:

- at Mount Airly the cliffs heights range from 10 to 130 m and average 45-50 m. On Genowlan Mountain the cliffs range from 10 to 140 m high with two thirds of the cliffs fall in the 60-90 m range. On Genowlan Point cliff height ranges from 20 to 160 m with two thirds in the 65-135 m range
- based on the ACARP (2002) ranking system, many of the cliffs have very high rankings from an aesthetic stand point and a significant proportion exhibit natural instability and could thus be susceptible to mining induced failure if subsidence is not managed to acceptable levels
- the cliffs are generally abutted at their bases by thickly vegetated talus slopes at approximately 20 to 30 degrees from the horizontal
- at least three cliffs falls have occurred on Genowlan Mountain since 2006, well away from the current or historical mining areas

The design objective with regards to cliffs was to develop a mining system that would not increase cliff failures above the current natural rates. Golder Associates (2014) estimated the natural rate of significant cliff failure on the Mount Airly and Genowlan Mountain complex to be in the order of once in four years. While it is accepted that cliffs fail naturally, and it is this process that keep them fresh and vertical, the landscape significance of the Mount Airly and Genowlan Mountain cliffs is such that acceleration of these failures would be unacceptable. Golder Associates (2014) reports on past ACARP studies on cliff failures above coal mines and reported that there was close correlation between mine design parameters and failure, and that, highly sub-critical void widths such as those being proposed for Airly Mine with resulting low levels of subsidence caused negligible cliff line damage.

Despite the historical data supporting the negligible impact on cliffs of highly sub-critical voids, a conservative approach was taken to the protection of both external and internal cliff features on the mountain complex. This approach extended to the large, deeply incised gorge systems typical of Genowlan Mountain. So as to prevent damage to cliff lines, first workings only will be developed in the cliff line zone, which is defined as the area 30 m either side of the crest and toe of each cliff. Golder Associates (2014) found that panel and pillar mining method could be implemented right to the edge of the cliffs without impact because of the zero or even a negative angle of draw associated with this type of mining. The same is true for the partial pillar extraction or splitting and quartering first workings proposed below the cliffs. An offset figure of 30 m from the crest and the toe was selected as a conservative approach to further ensure negligible impact outcomes for these features.

The ACARP cliff sensitivity assessment method (ACARP 2002) was employed in Golder Associates (2014) to predict potential damage due to the Project. In order to calibrate the ACARP method to Airly Mine conditions, an assessment to predict (after the fact) cliff damage due to oils shale mining in the New Hartley Shale Mine Potential Interaction Zone was undertaken. The method predicts historical cliff damage to the New Hartley Shale Mine Potential Interaction Zone due to oil shale mining, albeit after the fact, to 100% of the cliff face area based on subsidence of 700 mm and strains greater than 10 mm/m. Such damage would be predicted to consist of major cliff falls, which would be categorised as extremely high impact by the ACARP method. An inspection of the cliffs around the New Hartley Shale Mine Potential Interaction Zone reveals significant cracking and the occurrence of relatively recently fallen large boulders, over approximately 80% of the cliff face area, which confirms in qualitative terms, these post-dated predictions. The amount of damage predicted by the ACARP method showed a good correlation with the actual amount of damage done to the cliff faces around the part of Mount Airly impacted by oil shale mining. The method apportions fixed scores and weightings to a range of factors based on cliff morphology, visibility, ease of access etc. The method then provides an impact scoring classification based on the individual scores apportioned to each cliff, considering the subsidence effects of specific mining method to be employed. The methodology converts this numeric impact score to an impact ranging from insignificant to extremely high. The Golder Associates (2014) Cliff Line Assessment report in Appendix D provides the impact scores for the various cliff lines.

Mining Method

Mining in Cliff Line Zone and Zone of First Workings zone would consist of first workings only with pillars designed to be long term stable. The pillars used in this area would be typically large with an appropriately high FOS equivalent to that used for protection of key surface features (typically FOS >2.11). Apart from the major cliff lines, this zone also covers other key areas where subsidence impact would be significant, such as the talus slope below the cliffs adjacent to the New Hartley Oil Shale Mine; or where depth of cover is too shallow for panel and pillar mining but also too great for partial pillar extraction, such as around The Grotto as shown on Figure 8.2. A typical pillar layout for the cliff zone is shown in Figure 8.6.

Key features of this type of mining include:

- Mining height: <3.0 m
- Maximum roadway width: 5.5 m
- Maximum void width: <10 m
- Pillar system FOS: >2.11 (protection of key surface features)
- Pillar width to height ratio: >8.0.

Subsidence Prediction and Impact

Predicted subsidence effects in the cliff line zone and zone of first workings are:

- subsidence: 10 to 65 mm
- tilt: 0.6 to 1.1 mm/m
- tensile strain: 0.2 to 0.3 mm/m
- compressive strain: 0.2 to 0.5 mm/m
- fractured zone height: <10 m above the seam
- surface cracking: not expected.

An analysis of past cliff failures in the NSW coalfields has shown that cliff damage increases in proportion to the extent of mining and associated subsidence. This analysis also shows that where mining voids are highly sub-critical, as they are proposed to be in this zone, that cliff damage was negligible. Figure 8.7 plots the distribution of past cliff damage against mining void ratios. The upper bound curve shows that for the void to width ratio of <0.38 that is proposed in this zone, no cliff damage is predicted.

The restriction of mining to first workings only under the cliffs reduces the expected risk of damage to less than 5% of the cliff face area. This level of damage is expected to manifest itself, at worst, as isolated, individual rockfalls, which in accordance with the ACARP methodology discussed above is defined as insignificant.

In the area of the New Hartley Shale Mine the cliffs have already been significantly impacted by the previous mining activity. The Subsidence Impact Assessment (Golder Associates 2014) found that adequate protection from further damage can be given to these cliffs by extending the cliff zone of first workings over the entire down slope section of the oil shale workings. To provide adequate protection from impact due to the adjacent proposed panel and pillar mining zone, the cliff zone has been increased from the normal 30m to a distance equal to half the depth of cover. This is equivalent to an angle of draw of 26.5 degrees and is regarded as acceptable for full extraction workings.

Due to the proposal to use first workings in the Cliff Line Zone and Zone of First Workings zone, the subsidence levels are minimal and for this reason no further management action, other than strict implementation of the mine design, is required to manage the sensitive features identified.

(i) First Working Pillars Only

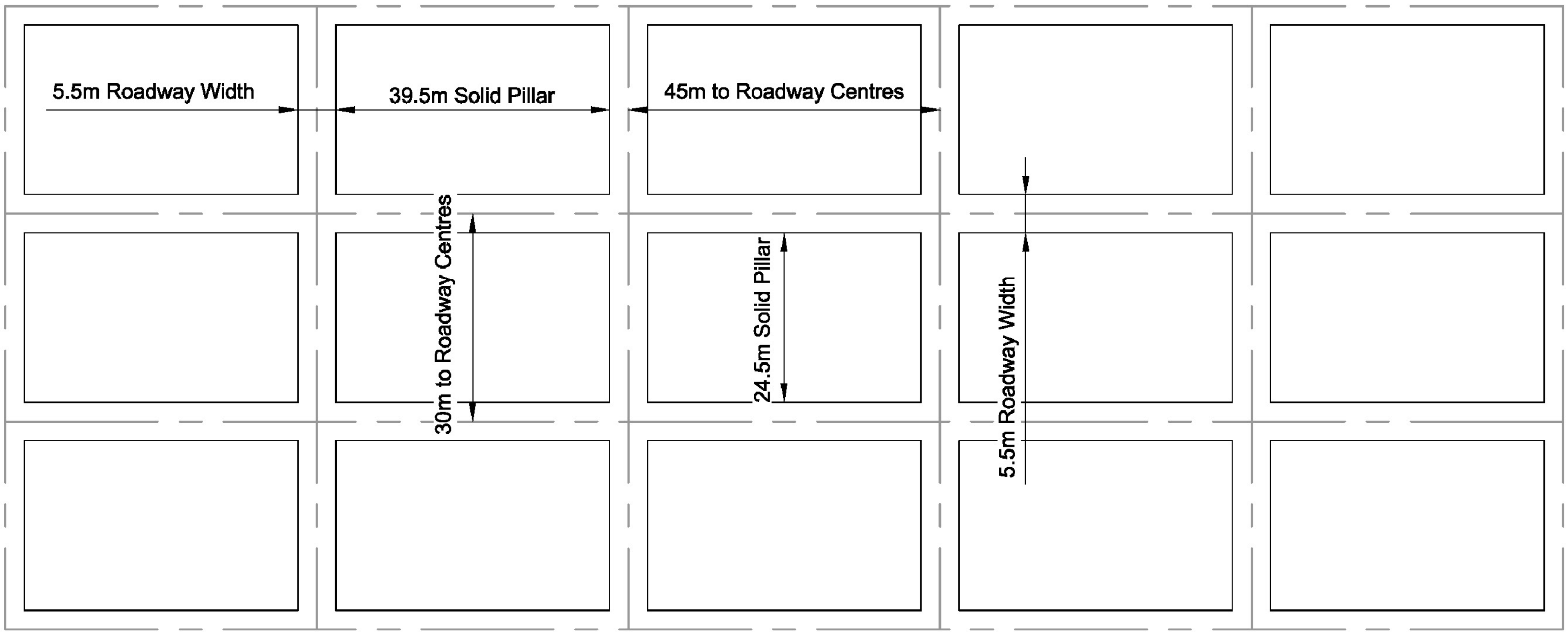

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Figure 8.6: Typical Pillar Layout for the Cliff Zone

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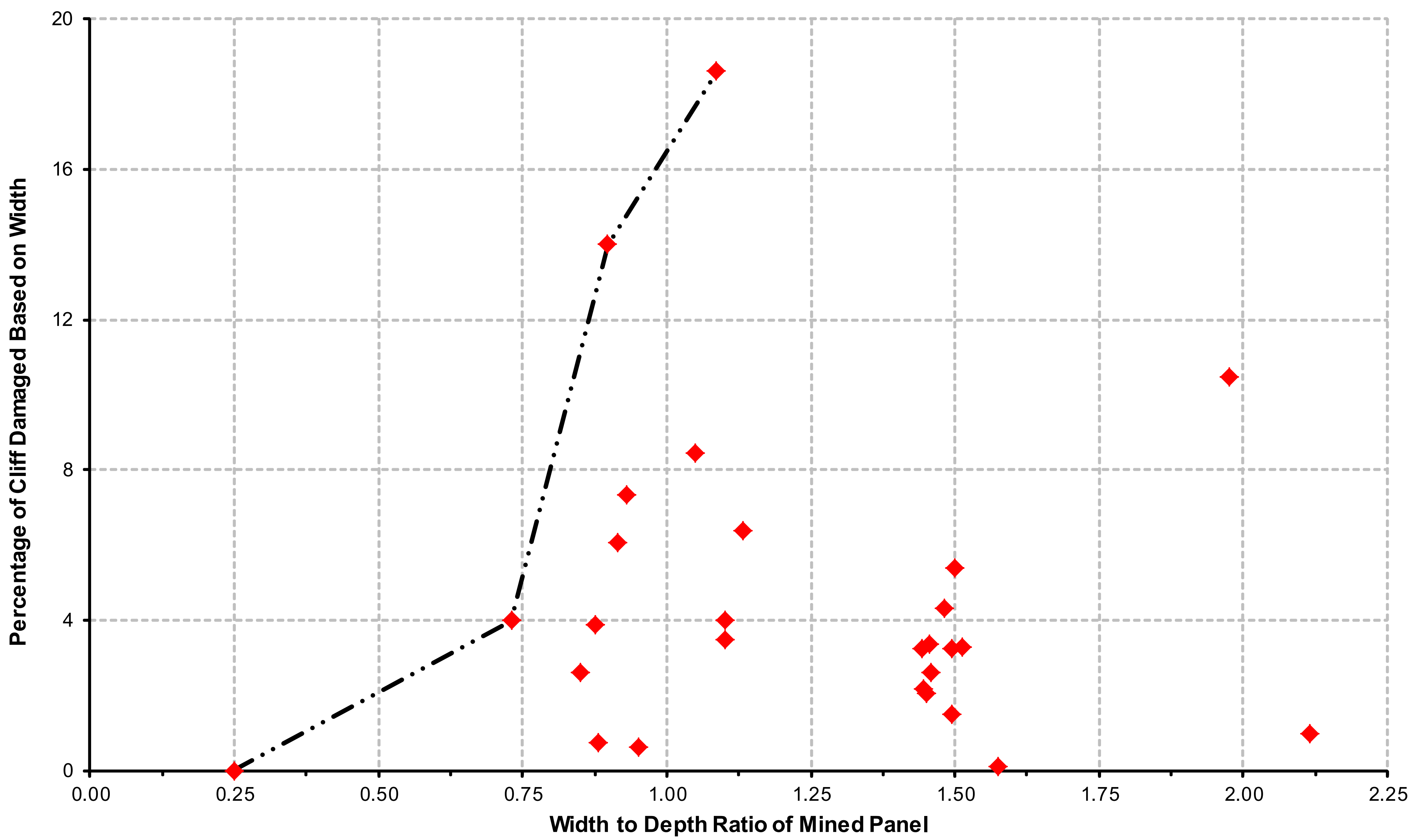

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Figure 8.7: Cliff Damage Versus Void Ratio

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8.3.7.2 Panel and Pillar Mining Zone

Constraints

The Panel and the Mining Zone covers the plateau areas of the mountain complex. There are a number of natural features that are potentially impacted by subsidence in this zone. These are listed below:

- cliffs
- pagodas
- aquifers in alluvium and colluvium material
- aquifers in the Triassic sandstone
- aquifers in the Permian strata above and below the Lithgow seam
- aquifers in the Shoalhaven formation underlying the Permian strata
- aquifers in the Devonian strata underlying the Shoalhaven formation
- a single state survey mark at Genowlan trig station
- emergency services communications tower Genowlan mountain
- four wheel drive tracks
- Nissen hut at the old diamond mine on Genowlan mountain)
- Aboriginal heritage sites (45-1-2766; 45-1-2768) including a rock shelter with art and a rock shelter with artefacts
- potential habitat sites for threatened fauna such as caves and overhang dwellings for bats such as the Large-eared Pied Bat (*Chalinolobus dwyeri*); and the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*).

Successful management of these features from a subsidence impact standpoint involves the selection of a mining method that prevents fracturing of the surface and minimises sub-surface fracturing. The panel and pillar method described below is intended to provide a mining method that achieves that aim.

Where the depth of cover exceeds 160 m, the thickness of the overburden permits the larger voids to be formed whilst maintaining subsidence nominally at the 100 mm level by separating these voids with large, long term stable pillars. The highly sub-critical void width combined with large interpanel chain pillars minimises the extent of caving above the void and allows spanning of the overburden between chain pillars. There are several possible mining layouts that could achieve this goal, but a typical panel and pillar layout is shown in Figure 8.8. It shows 61 m void separated by a 29.5 m wide solid chain pillar. This sized pillar has been assessed as long term stable after extraction at even the greatest depth of cover in the deposit.

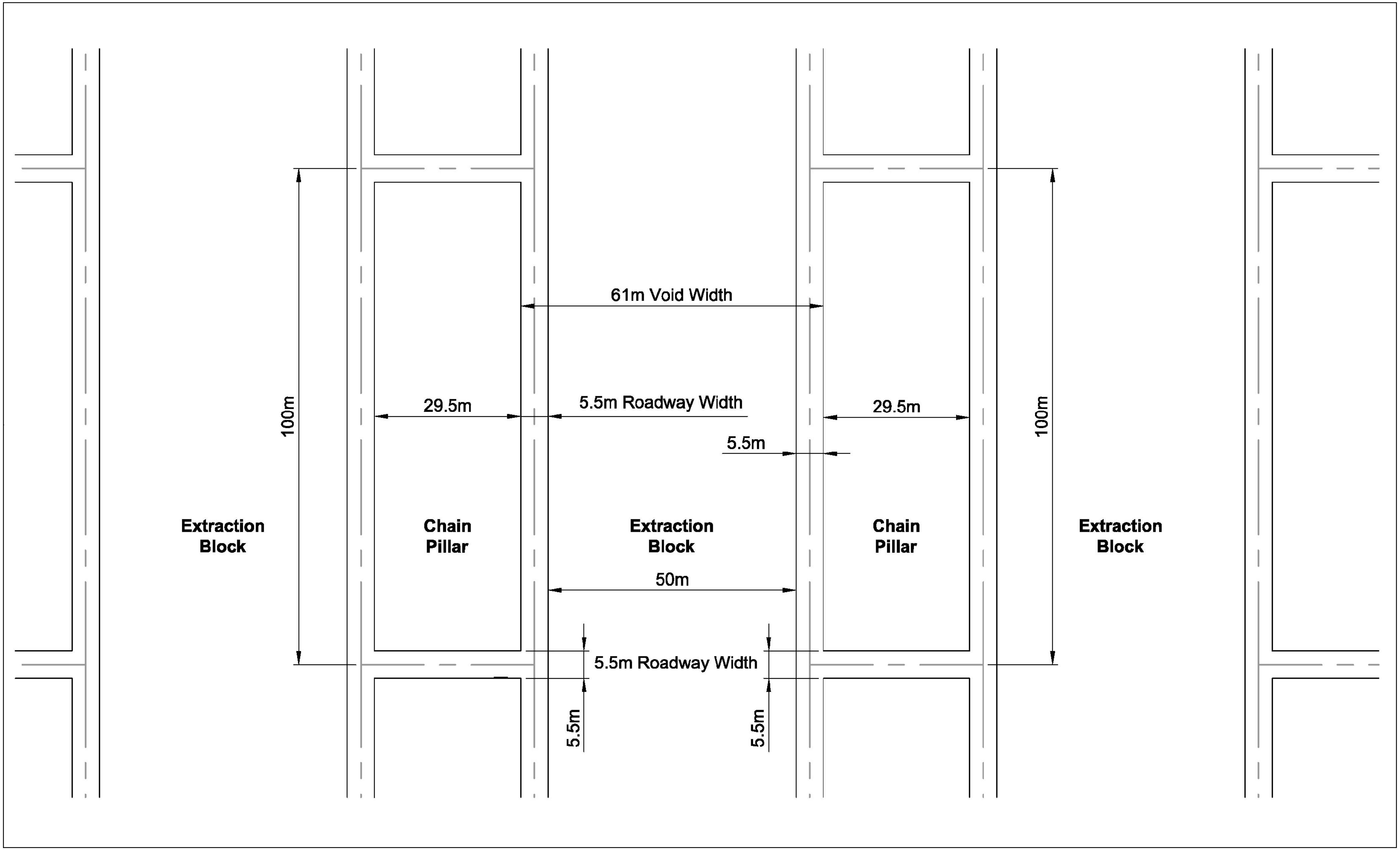

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Figure 8.8: Typical Panel and Pillar Layout

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Mining Method

When determining the appropriate void width for the panel and pillar design, a sensitivity analysis was carried out. This assessment used accepted empirical calculation methods to assess the effect on subsidence, tilt and strain of increasing void width. Several void widths where assessed, namely 50.5, 55.5, 60.5, 65.5 and 70.5 m. Each void width was assessed for subsidence, tilt and strain using expected input parameters and an upper bound based on highly conservative, and unlikely in practice, input parameters. The analysis looked at both single and multiple extraction panels at various depths. As this was an early assessment to give a void width to carry out more detailed work on, it was decided that provided the upper bound of subsidence at 160 m (the typical depth at the top of the cliffs) remained <125 mm (the value not to be exceeded), the design was worth pursuing. The results of the analysis are summarised in Table 8.2.

Table 8.2: Void Width Sensitivity Analysis

Width (W) of Void (m)		50.5	55.5	60.5	65.5	70.5
Depth (H) of cover (m)		160	160	160	160	160
W/H Ratio		0.32	0.35	0.38	0.41	0.44
Extraction Height (m)		2.8	2.8	2.8	2.8	2.8
Single panel maximum subsidence (mm)	Expected	35	38	41	45	48
	Upper Bound	89	96	103	109	115
Multi-Panel Increment (mm)		10	10	10	36	36
Final maximum subsidence (mm)	Expected	45	48	51	81	84
	Upper Bound	99	106	113	145	151
Tilt (mm/m)	Expected	1.5	1.7	1.8	2.8	2.9
	Upper Bound	3.4	3.6	3.9	5	5.2
Compressive strain (mm/m)	Expected	0.4	0.5	0.5	0.8	0.8
	Upper Bound	0.9	1	1.1	1.4	1.4
Tensile strain (mm/m)	Expected	0.7	0.8	0.8	1.3	1.3
	Upper Bound	1.5	1.7	1.8	2.3	2.4

It can be seen from the sensitivity analysis in Table 8.2 that the optimum void width at 160 m depth of cover is 60.5 m. Even though these panels are highly sub-critical, only a small increase in width from 60.5 m to 65.5 m places the upper bound subsidence value for multiple panels well outside the 125 mm maximum subsidence value. Tilts are similarly sensitive to void width and strain less so. As a result of this analysis, detailed design work concentrated on the 61 m void width.

A full evaluation of the panel and pillar mining method was then carried out. It is noted that the sensitivity analysis described above was a preliminary analysis. Input parameters were further refined during the full analysis and there are some slight differences in the predicted values of subsidence between the preliminary sensitivity analysis and the final design.

An important feature of the panel and pillar style of mining is the limitation of the height of fracturing above the Lithgow seam. Golder Associates (2014) indicates that the likely height of fracturing above the Lithgow seam in the panel and pillar zone to be 60-70 m. Given the average thickness of the Permian strata above the Lithgow seam is 105 m, the fractured zone (Figure 8.5) would remain well within that stratum. This coupled with the lack of surface fracturing predicted due to the low levels of subsidence means that the overlying Triassic sandstone unit is left intact. It is this Triassic unit and associated alluvium and colluvium that provide much of the groundwater baseflows to the creek systems such as Genowlan Creek. The only exception to this scenario is in the limited area of the oil shale interaction zone, which is discussed later in Section 8.3.7.5.

Due to the limited void width, fracturing of the floor strata is not likely to occur.

The issue of post mining flooding is significant in the workings in this Panel and Pillar Mining Zone due to the potential impact of water ingress on the remaining pillars, floor and roof strata. Previous experience at Clarence Colliery shows that flooding of partially extracted workings has caused a reactivation of subsidence in areas that had become stable over a number of years before they were flooded. The post mining flooding has not caused any exceedance of the imposed subsidence limits at Clarence Colliery and there is no evidence of pillar system failure. There is no clear explanation for the mechanism causing this behaviour. For this reason a detailed assessment was undertaken for the Project as there is a potential for some of the mine workings to become flooded with groundwater post mining.

Flooding was considered as part of the Subsidence Impact Assessment (Golder Associates 2014). In the case of the panel and pillar workings the underground environment is not elastic due to the caving of the roof during extraction. Subsidence was initially predicted from analytical, empirical and numerical methods. The empirical method relies on formulae derived from an Australian narrow panel industry database of subsidence behaviour. This empirical method returns both an expected and an upper bound result for subsidence.

For most mining layouts where large voids are created, post mining flooding is not important as the amount of subsidence is large and any contribution from post mining flooding would be of relatively low significance. In the case of the proposed mining at Airly Mine, allowing for flooding is important because of the small levels of subsidence involved. For the Panel and Pillar Mining Zone, the empirically derived upper bound value of subsidence has captured flooded panels and was therefore considered suitable to represent the effect of post mining flooding on the workings. No other modifications to the panel and pillar zone design were found to be necessary.The Panel and Pillar Mining Zone is the area of highest extraction ratio at approximately 67% in panel recovery (i.e. not including main headings and other ancillary roadways). It covers the majority of the plateau areas of both Mount Airly and Genowlan Mountain. Depth of cover in this zone ranges from 160 m to 310 m.

Mining in this zone would consist of a series of voids with a maximum width of 61 m separated by long term stable (FOS >1.6) pillars. Mining is restricted to a minimum depth of 160 m and a maximum depth of 310 m.

Panel and pillar type mining can be achieved using various techniques. Typical equipment used in this type of mining would depend on the methodology selected. Regardless of the final method selected, the main feature is the narrow extraction width combined with significant width pillars to allow overburden spanning to occur.

Key features of this type of mining include:

- mining height: <3.0 m
- maximum roadway width: 5.5 m
- maximum void width: 61 m
- pillar system FOS: ≥1.6 (after extraction is complete)
- pillar width to height ratio: >9.0.

Subsidence Predictions and Impact

The predicted subsidence effects for the Panel and Pillar Mining Zone are:

- subsidence: typically less than 100 mm but ranging from 40 to 106 mm
- tilt: typically 1 to 2 mm/m (lower bound 0 mm/m and upper bound 3 mm/m)
- tensile strain: 0 to 1 mm/m

- compressive strain: 0 to 2 mm/m
- fractured zone height: 60 to 70 m above the seam
- surface cracking: not expected.

No impact is predicted on the following features within the Panel and Pillar Mining Zone:

- pagodas
- aquifers in alluvium and colluvium material
- aquifers in the Triassic sandstone
- aquifers in the Devonian strata underlying the Shoalhaven formation
- four wheel drive tracks
- Aboriginal heritage sites such as shelters under rock overhangs some with artwork and grinding grooves (site 45-1-0167)
- Genowlan Point *Allocasuarina nana* Heathland (TSC Act) Endangered Ecological Community.

The Groundwater Impact Assessment (Appendix E) has predicted that aquifers in the overlying Permian strata will be impacted by the panel and pillar mining in this zone. Loss of baseflow due to drawdown in the Permian is predicted to be less than 3% on the Genowlan Creek and Gap Creek system. This creek system is currently monitored for flow and this is expected to continue during the Project life.

While this area does not contain any of the large external cliffs, it does encompass four internal and two smaller external cliffs and specific predictions for these follow.

Cliff line Mta 43 is located along the western margin of Mount Airly (Figure 8.2). The section of this cliff in the panel and pillar mining zone is 175 m long, 20-30 m high and is dissected and rounded with multiple pagodas. Subsidence of 60 mm is expected, with tilts and strains of less than 2 mm/m. The predicted impact is low to moderate and the predicted upper bound for the proportion of cliff line damage is 18% of its length. However, the proportion of cliff line likely to be damaged is expected to be significantly lower at less than 10%.

Damage to 10% of the cliff area does not imply that 10% of the cliff face will fail in one single event. In practice, damage is distributed over the entire cliff face totalling 10% of the area. This level of damage predicted to these listed cliffs is expected to manifest itself, at worst, as isolated, individual rockfalls, which in accordance with the ACARP (2002) methodology, is defined as minor.

Cliff lines B9 and B12 (Figure 8.9) are in an extensive area of pagodas near the south-east end of Genowlan Mountain (Figure 8.2). The cliffs are relatively low at around 20 m and subsidence of 50 mm is predicted, with tilts and strains of less than 2 mm/m and 1 mm/m, respectively. The predicted upper bound for the proportion of cliff line damage is 2 to 3% and in practice it is considered probable that no damage would occur due to undermining of these cliffs as they are naturally stable.

Cliff line B15 (Figure 8.9) is an internal cliff approximately 20 m high, located in the southern end of Genowlan Mountain. Subsidence of 50 mm is expected, with tilts and strains of less than 2 mm/m and 1 mm/m respectively. The predicted upper bound for the proportion of cliff line damage is 5% and in practice it is considered probable that no damage would occur due to the natural stability of this cliff.

Cliff line B17 (Figure 8.9) is an internal cliff up to 60 m high, located in the southern end of Genowlan Mountain (Figure 8.2). Subsidence of 50 mm is expected, with tilts and strains of less than 2 mm/m and 1 mm/m, respectively. The predicted upper bound for the proportion of cliff line damage is 3% and in practice it is probable that no damage would occur.

Cliff line B19 (Figure 8.9) is an external cliff approximately 50 m high, located in the southern end of Genowlan Point (Figure 8.2). Subsidence of 50 mm to 60 mm is expected, with tilts and strains of less than 2 mm/m and 1 mm/m, respectively. The predicted upper bound for the proportion of cliff line damage is 13%. It is probable that minimal damage would occur i.e. less than 5% of the area of the cliff.

Damage to 5% of the cliff area does not imply that 5% of the cliff face will fail in one single event. In practice, damage is distributed over the entire cliff face totalling 5% of the area. This level of damage predicted to these listed cliffs is expected to manifest itself, at worst, as isolated, individual rockfalls, which in accordance with the ACARP methodology, is defined as insignificant.

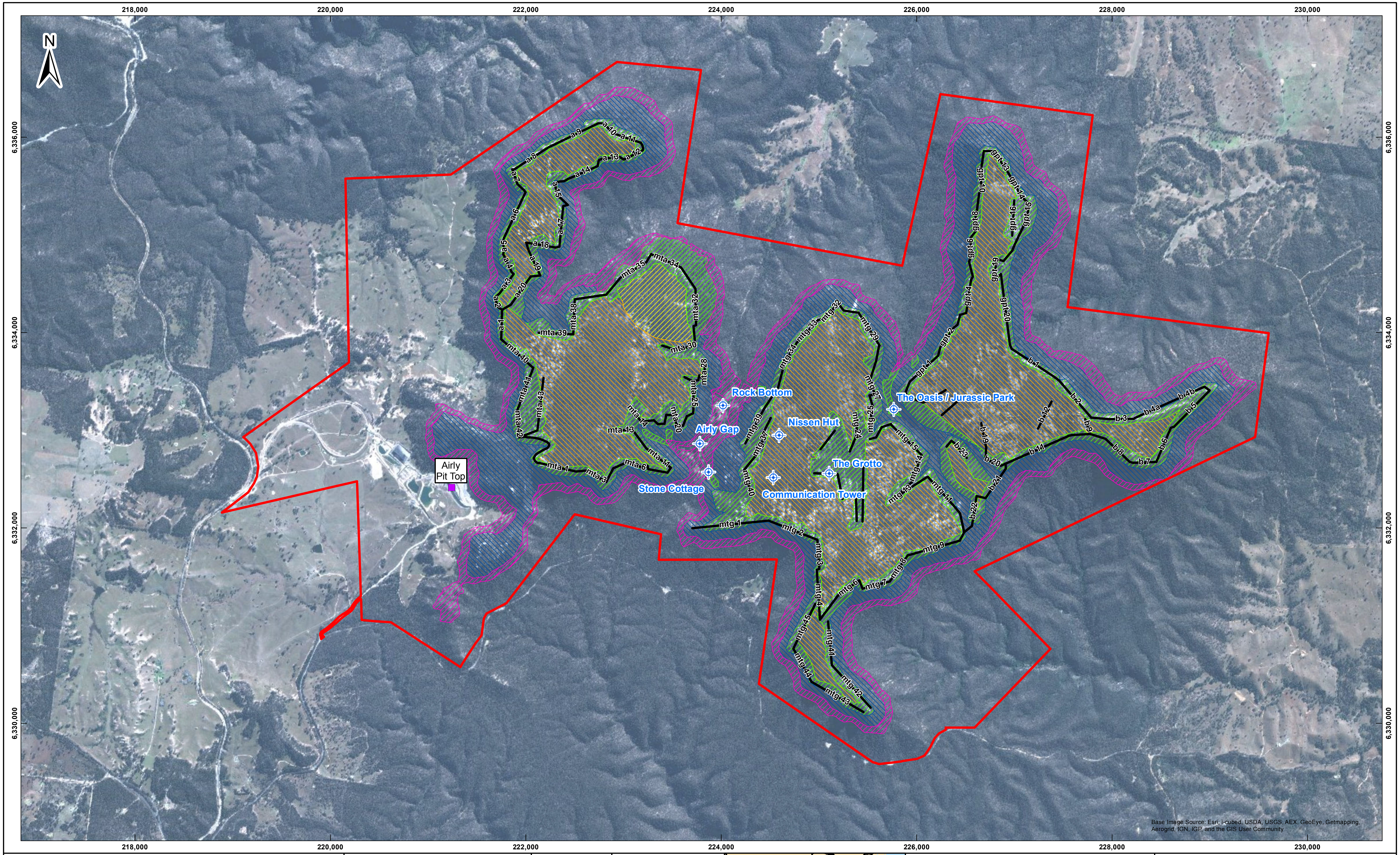
There is an emergency services communications tower and associated structures located on Genowlan Mountain (Figure 8.2). The tower, made of bolted steel construction, is bolted to three piers and is approximately 20 m high. Solar panels are mounted on the concrete shed and cabling connects the shed to the tower. There are also two small sheds associated with the tower. One shed is a 3 m x 4 m prefabricated steel structure bolted to four concrete pier foundations. The second shed is a 2 m x 2 m concrete block structure on a concrete slab.

Panel and pillar mining will be conducted under the communications tower infrastructure area. Subsidence in this area would not cause surface cracking. Tilts and strains would be in the order of 2 mm/m and 2 mm/m respectively. Given the small size and bolted steel construction of this structure, the predicted movements would be sustainable without damage or failure of the structure. It is proposed to develop a management plan for the undermining of the tower complex in consultation with the owner of the infrastructure.

A military style Nissen Hut and small out building are indicated on Figure 8.2 and members of the Ribbaux family have permissive occupancy rights within the SCA during their lifetime. The Nissen Hut is 11 m x 5 m and of bolted steel construction with timbered ends. The entire structure is resting on timber posts. These posts vary in length from 0.2 to 1.2 m in height and are generally in poor condition. There is a 2.5 x 5 m out building adjacent to the Nissen Hut that is also of bolted steel construction with a rough timber frame resting on a poor quality concrete slab. Subsidence is not likely to cause collapse of these structures. As these structures are in poor state of repair it is proposed to conduct a dilapidation survey prior to undermining them. Consultation with the owner (NPWS) and the occupier will be undertaken to develop an appropriate management plan for these structures.

A state survey mark exists at the Genowlan Trig Station site (Figure 8.2). This site is overgrown and no longer maintained by the State. Permission would be sought to undermine this from the Department of Lands (Land and Property Information division) prior mining taking place.

Subsidence and mining system performance management is discussed in Section 8.5.



LEGEND

- Project Application Area
- Sensitive Feature
- Cliff Line
- Cliff line zone and zone of first workings
- New Hartley Shale mine potential interaction zone
- Panel and pillar mining zone
- Partial pillar extraction zone
- Shallow zone

Abbreviations:
mta - Mount Airly
mtg - Mount Genowlan
gpt - Genowlan Point
a - Area A
b - Area B

Coordinate System: GDA 1994 MGA Zone 56

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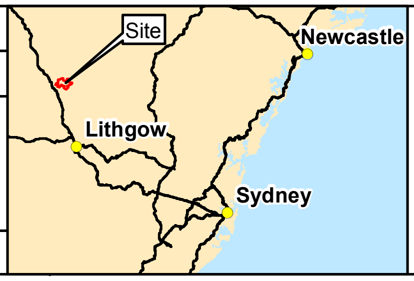

Figure 8.9: Cliff Line Zone and Zone of First Workings

0 500 1,000 1,500 2,000 Metres

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Airly

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A3

8.3.7.3 Partial Pillar Extraction Zone

Constraints

The Partial Pillar Extraction Zone adjoins the downslope side of cliff line zone, in the outer vegetated talus slopes of Mount Airly and Genowlan Mountain. This zone extends generally from the downslope edge of the cliff zone to 80 m depth of cover where no post mining flooding is expected and to 100 m depth of cover where post mining flooding is expected. The lower depth constraint is set by the point at which subsidence would exceed the nominal 100 mm limit. Areas shallower than this require splitting and quartering first workings to meet the required subsidence outcomes. Research summarised in Golder Associates (2014) shows that full extraction and consequent significant subsidence, tilts and strains would trigger landslides in these talus slopes. Accordingly, the proposed mining method in this zone is partial pillar extraction described below.

Sensitive features identified in this zone include:

- steep slopes
- aquifers in the Permian strata above and below the Lithgow seam
- aquifers in the Shoalhaven formation underlying the Permian strata
- aquifers in the Devonian strata underlying the Shoalhaven formation
- Aboriginal heritage sites (45-1-2761; 45-1-2746; 45-1-2762; 45-1-2763) including one rock shelter with deposit and three artefact scatters.

Mining Method

Mining in the Partial Pillar Extraction Zone will consist of the initial formation of a layout of large pillars followed by the systematic removal or “lifting” of the edges of some of the pillars in the system during retreat. This lifting process would either be on one side of a roadway (single sided lifting) for areas where depth ranges between 80 and 120 m, or on both sides of the roadway (double sided lifting) for areas where depth ranges from 120 to a maximum of 160 m. Typical single and double sided lifting layouts are shown in Figure 8.10.

Single sided lifting will generate voids up to 15.5 m wide, whilst double sided lift would generate voids up to 25.5 m wide with long term stable pillars between. To be long term stable, the FOS will be ≥1.6 after extraction is complete. Voids are designed to be highly sub-critical and therefore allow the overburden to span between the remaining pillars. The remaining pillars would have a FOS ≥1.6 after partial extraction is complete which is considered as long term stable. Height of fracturing is expected to range from 20 m in shallower areas to 40 m in deeper areas. No surface cracking or slope destabilisation is expected from these workings. The in-panel extraction ratio is approximately 51%.

As with the Panel and Pillar Mining Zone (Section 8.3.7.2), post mining flooding was considered by utilising the upper bound value of subsidence from the empirical analysis to represent this scenario. Due to the much shallower nature of these workings, tilt and strain become more sensitive to a reduction in depth of cover. By accepting the upper bound values in flooded areas the result was a more conservative minimum depth restriction on the system. Therefore single sided lifting is restricted to a minimum depth of 80 m in areas that are not flooded and 100 min areas that are likely to be flooded. Double sided lifting is restricted to a minimum depth of 100 m in areas that are not flooded and 120 m in areas that are likely to be flooded. Maximum depth for this zone is 160 m in all cases.

Key features of this type of mining include:

- mining height: <3.0 m
- maximum roadway width:5.5 m
- maximum void width: 15.5 m for single sided lifting and 25.5 m for double sided lifting
- pillar system FOS: ≥1.6 (after extraction is complete)
- supporting pillar width to height ratio: >8
- remnant pillar width to height ratio: >4.

Subsidence Predictions and Impact

Predicted subsidence effects in the Partial Pillar Extraction Zone are:

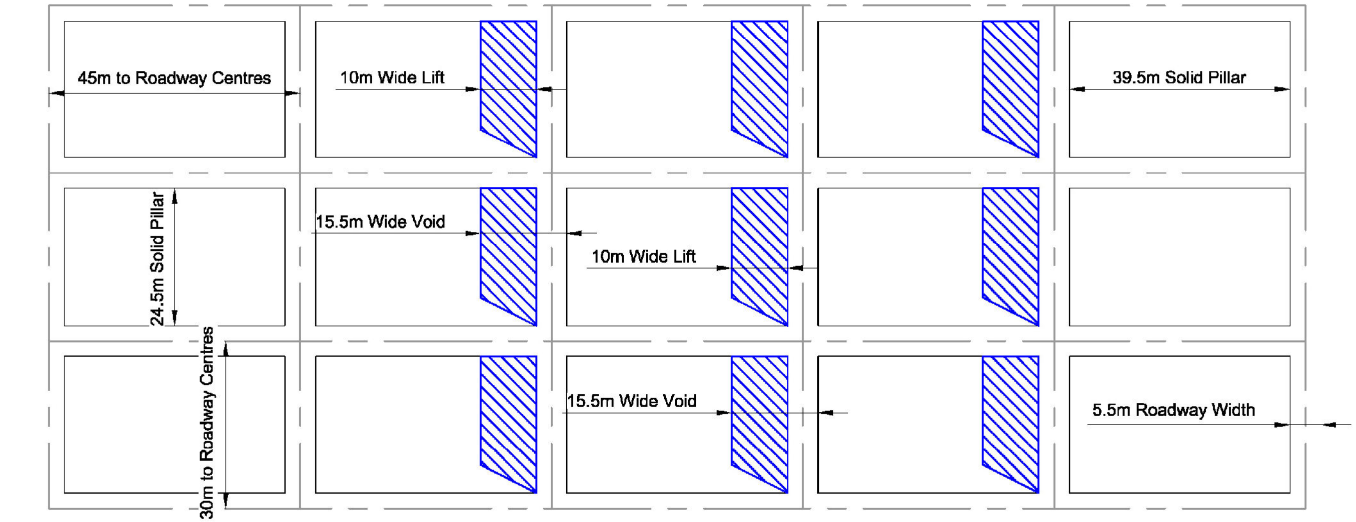
- subsidence: 25 to 65 mm
- tilt: 0.5 to 2.6 mm/m
- tensile strain: 0.2 to 1.1 mm/m
- compressive strain: 0.2 to 1.9 mm/m
- fractured zone height: 20 to 35 m above the seam
- surface cracking: not expected.

Tilts and strains associated with the partial pillar extraction type mining are higher than those quoted for the cliff zone first workings despite similar subsidence values. The reason for this is that the fist workings system proposed for the Cliff Zone comprises a pillar system where the main mechanism for deflection of the overburden is elastic compression of the pillars, whereas the Partial Pillar Extraction Zone has small fully extracted voids that is non elastic at seam level. Thus the response in the overburden to deflection into the voids generated in the partial pillar extraction will generate higher tilts and strains than those found in the Cliff Zone. Predicted tilts and strains in this zone are very low.

The very small predicted strains and tilts will generate a negligible risk of causing landslides in the talus slopes above this zone.

Due to the limited amount of fracturing above the seam as well as no floor fracturing, no impact is predicted on the Permian or any other aquifer systems in this zone.

(ii) Single-sided Lifts



(iii) Double-sided Lifts

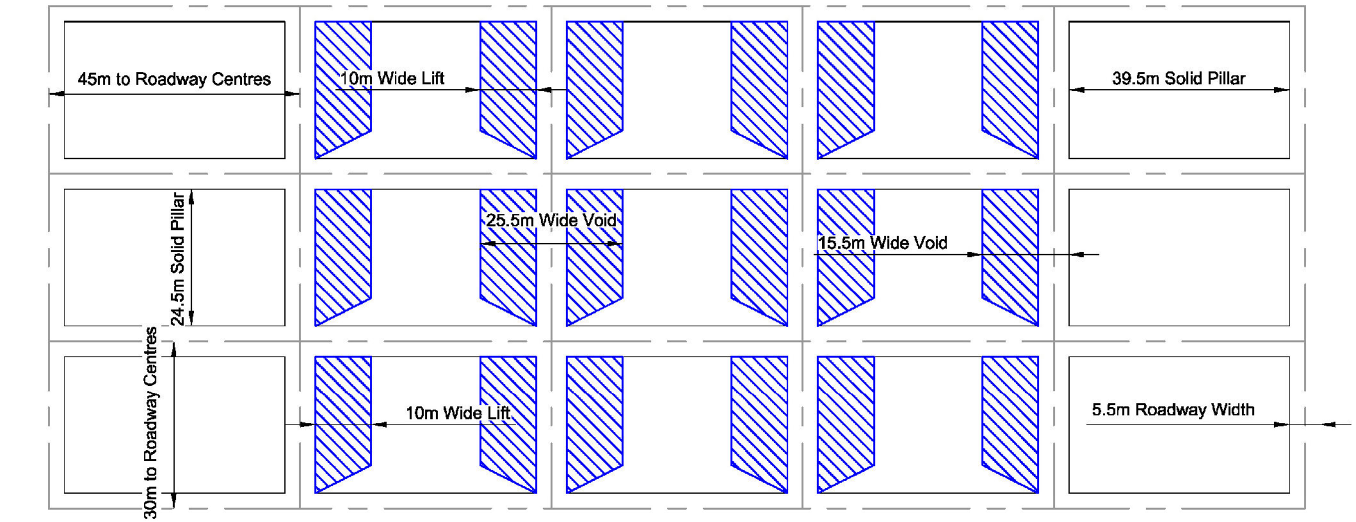


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Figure 8.10: Typical Single and Double Sided Lifting Layouts

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Airly

DRG No. 8-8.10

A4

8.3.7.4 Shallow Zone

Constraints

The Shallow Zone extends from 100 m depth of cover to 20 m depth of cover, generally around the periphery of the Partial Pillar Extraction Zone and includes significant areas to the west of Mount Airly and in Airly Gap. Much of the mining done to date at Airly Mine has been by first workings in this zone.

Sensitive features identified in this zone include:

- steep slopes
- third order and above watercourses
- aquifers in alluvium and colluvium material
- aquifers in the Permian strata above and below the Lithgow seam
- aquifers in the Shoalhaven formation underlying the Permian strata
- aquifers in the Devonian strata underlying the Shoalhaven formation
- a single buried telephone cable in Airly Gap
- public unsealed road in Airly Gap and four wheel drive tracks
- private residence (Stone Cottage at Airly Gap and Nissen Hut at the old diamond mine on Genowlan Mountain)
- Aboriginal heritage sites (45-1-2747; 45-1-2748) including an artefact scatter and an isolated find
- historical heritage items, concentrated around the old Airly Village site
- potential habitat sites for threatened fauna such as caves and overhang dwellings for bats such as the Large-eared Pied Bat (*Chalinolobus dwyeri*); and the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*).

Mining Method

Due to the shallow nature of the Shallow Zone, the formation of extracted voids where caving would occur, would result in subsidence that exceeded the 100 mm limit. Issues such as the formation of sink holes also become of concern in these shallow areas. To avoid any surface cracking or sinkhole formation due to caving of the overburden to the surface, it is proposed that only first workings be practiced in the shallow zone.

First working pillars in the shallow zone would be formed with certain minimum parameters in any mining layout implemented. These parameters are:

- a minimum pillar width to height ratio of 4:1
- a minimum dimension of any pillar of no less than one tenth the depth from surface or ten metres, whichever is greater (as per clause 88 of the *Coal Mines Health and Safety Regulation 2006*)
- pillar system factor of safety ≥1.6
- roadway width no greater than 5.5 m
- no formation of intersections during splitting and quartering operations at depths less than 30 m so as to avoid any risk of an intersection collapse causing caving through to the surface.

These parameters have been previously recommended by Strata Engineering (2011a and 2011b) and implemented in the Airly Mine workings to date at depths up to 120 m. No evidence of instability has been observed in the underground workings since the mine commenced pillar splitting and quartering operations in 2011. Both supported and unsupported roadways have been observed to stand well with minimal spalling of the sides and only occasional minor skin failure of the roof in the unsupported splits. No evidence of any surface impact has been found during surface inspections.

Mining in the Shallow Zone will consist of the initial formation of sufficiently large pillars to allow a later reduction in size to the minimum design dimensions. This reduction process would involve driving roadways at predetermined locations into the larger original pillars to effectively split the pillars in two or when done from two directions the pillars would be quartered. A typical layout for pillar splitting and quartering is shown in Figure 8.11.

The formation of smaller pillars during pillar splitting and quartering is done without roof providing support to the “splits”. Analysis was done by Strata Engineering (2011b) and summarised in the Subsidence Impact assessment as to the impact of the possible failure of a roadway or intersection underground. The height of fracturing associated of an intersection with a span of 12 m would be typically 10 m. This is sufficiently small to prevent the formation of a sinkhole on the surface.

Due to the elastic nature of the pillar system design, subsidence is due largely to pillar compression. The floor strata as described in Section 8.2.1 is competent and consistent in composition across the deposit and so pillar punching due to soft floor is not likely to be a factor in pillar behaviour. As mentioned earlier, experience thus far has shown that spalling of coal from the sides of the roadways after splitting and quartering is minimal due to the low depths of cover involved and so pillar strength would not be greatly affected by this issue. Even so, the pillars were assessed assuming a 0.5 m increase in roadway width due to spalling of coal. Also the analysis included the fact that intersection formation during splitting and quartering will also further reduce pillar size. With all these factors in place it was found that factor of safety was ≥1.6 and subsidence was minimal.

Flooding has again been considered. Unlike the panel and pillar zone and the partial pillar extraction zone, the shallow zone is designed as a non-caving system and therefore is analysed using elastic behaviour theory. Mechanically this represents a mining system much closer to that used at Clarence Colliery. The effect of flooding has been successfully predicted at Clarence Colliery by reducing the modulus of deformation of the roof and floor strata to half of that before flooding. The same approach has been used to predict the impact of flooding at Airly Mine on the proposed bord and pillar workings of the Shallow Zone.

Subsidence Predictions and Impact

Subsidence effects in the Shallow Zone are:

- subsidence: 3.5 to 25.5 mm
- tilt: 0.6 to 1.1 mm/m
- tensile strain: 0.1 to 0.4 mm/m
- compressive strain: 0.2 to 0.6 mm/m
- fractured zone height: <10 m above the seam
- surface cracking: not expected.

Natural and man-made features in the Shallow Zone can be summarised as follows. There are two Aboriginal heritage sites in the shallow zone, both located within Airly Gap. Referring to Figure 10.9 these are 45-1-2747, an artefact scatter, and 45-12748, an isolated find. These sites are ranked low on the local scale for overall archaeological significance, and being surface artefacts are not particularly prone to subsidence damage. Depth of cover exceeds 30 m at both sites and no subsidence impact is expected.

The northern and north-eastern sides of Mount Airly are the location of the historical heritage sites associated with Airly Village and the oil shale workings. Depth of cover at these sites varies between approximately 21 m and 60 m. For the sites with a depth of cover >30 m, no subsidence effects are anticipated with the subsidence, tilt and stains predicted. Sites 14, 17 and 18 (Figure 10.10) which are located in the zone of first workings beneath the cliff lines associated with the old oil shale workings and no subsidence impacts are expected at these locations. There are two sites that involve cover depths of less than 30 m; Site 3, a long abandoned dwelling (depth of cover around 21 m), and Site 24, a cave house (depth of cover around 25 m). These sites will not be undermined, with protection zone widths defined by half the depth of cover and as such, these have been excluded from the shallow zone and will not therefore be impacted by subsidence

“Rock Bottom” is a Centennial Airly owned cottage within the Airly village site, situated adjacent to Gap Creek. Depth of cover is only around 20 m at this location and no mining will be undertaken in the vicinity of this site and it has been excluded from the Shallow Zone workings. There is also a Stone Cottage at Airly Gap (owned by the Wilkinsons) where the seam is located at a depth of cover of about 45 m. This is included in the Shallow Zone workings but no subsidence impacts are expected at this depth of mining. It is proposed not to carry out splitting and quartering for a distance of half the depth of cover on all sides of the Stone Cottage.

The Shallow Zone is characterised by numerous creeks, including third order sections of Gap Creek and Genowlan Creek. Fractured zone heights above first workings are likely to be less than 10 m, based on experiences with roof monitoring and failures in bord and pillar workings. However, consideration also needs to be given to the maintenance of adequate constrained zone thicknesses, recognising that the larger creeks in particular, are liable to be associated with zones of geological structure and an associated increase in rock mass instability and permeability. It is proposed that a minimum mining depth of 40 m beneath creeks be adopted based on a criterion of ten times the mining height (28 m), plus an allowance of 12 m for the thickness of the weathered zone. Appropriate setback distances from the Gap and Genowlan Creeks will be defined by an angle of draw equivalent to half the depth of cover.

No other impacts are predicted in the Shallow Zone.

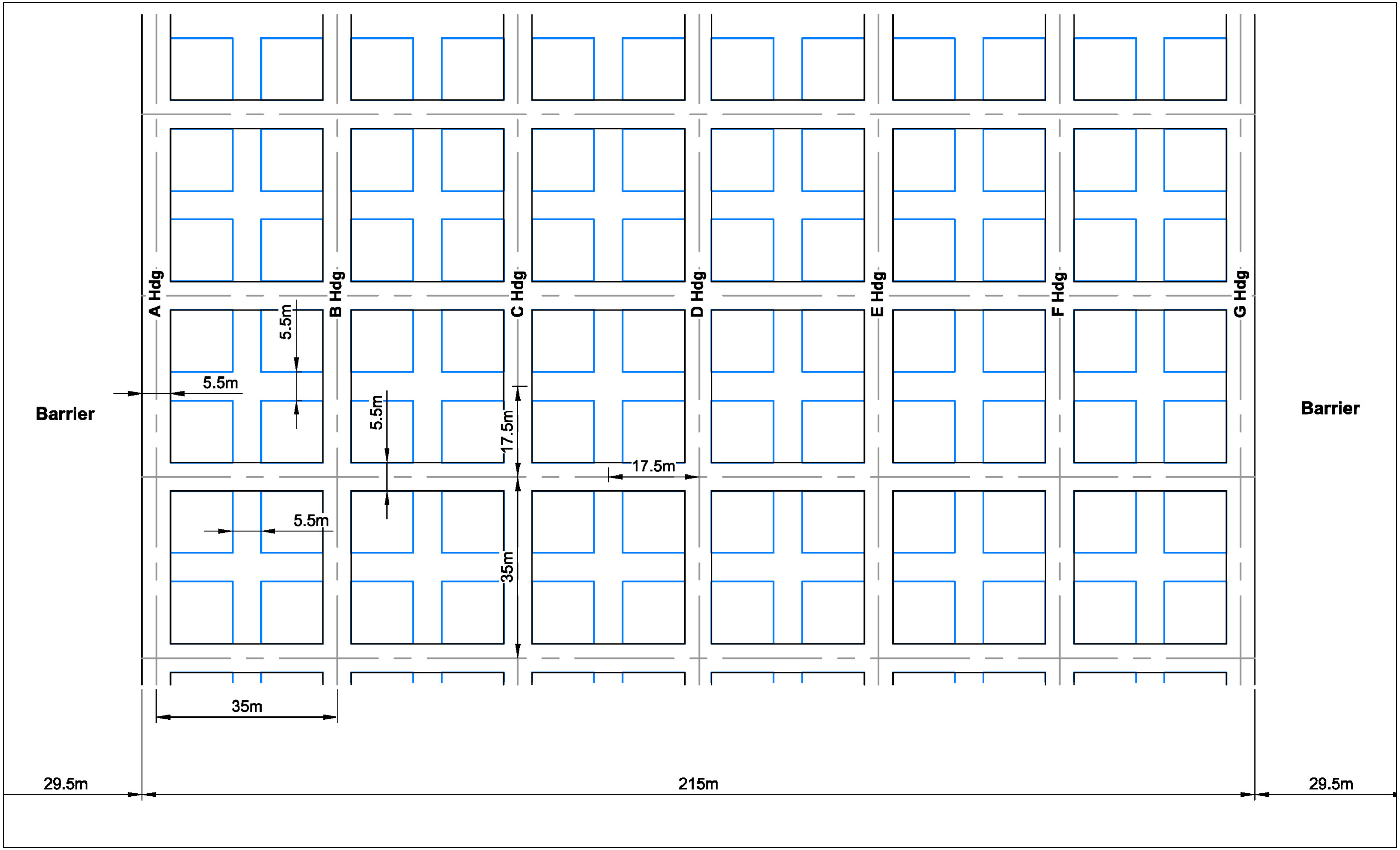

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Figure 8.11: Typical Layout for Splitting and Quartering

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A4

8.3.7.5 New Hartley Shale Mine Potential Interaction Zone

Constraints

The New Hartley Shale Mine Potential Interaction Zone represents the part of the deposit overlain by the abandoned New Hartley Shale Mine shown in Figure 8.1. The shale mine interaction zone represents a total recoverable coal resource of approximately 1 million tonnes which is around 3% of the total recoverable resource in the most productive part of the deposit, namely the Panel and Pillar Zone.

Sensitive features identified in the New Hartley Shale Mine Potential Interaction Zone include:

- cliffs
- pagodas
- aquifers in alluvium and colluvium material
- aquifers in the Triassic sandstone
- aquifers in the Permian strata above and below the Lithgow seam
- aquifers in the Shoalhaven formation underlying the Permian strata
- aquifers in the Devonian strata underlying the Shoalhaven formation
- potential habitat sites for threatened fauna such as cracks in sandstone for the broad headed snake.

In this area there is considerable previous subsidence impact from the full extraction workings done in the oil shale mine. It is proposed that panel and pillar mining takes place in the Lithgow seam below the shale mine workings. Two main considerations need to be addressed, namely mine safety and subsidence impact.

Mining Method

As panel and pillar type mining is proposed in this zone, there will be an interaction between the workings in the New Hartley Shale Mine and the proposed Lithgow seam workings. Safety of persons working in this zone is potentially affected by accumulations of water and/or harmful gases in the old workings above the Lithgow seam. If such accumulations were to be released into the Airly Mine workings, a significant risk of inrush of gases and/or water exists with very serious possible consequences for persons working underground. The risk of inrush is specifically dealt with in the *Coal Mines Health and Safety Act 2002* and *Coal Mines Health and Safety Regulation 2006*, which require the conduct of a risk assessment and development of a management plan to manage the risk of inrush at a mine.

Specific management practices for the control of the inrush risk due to the New Hartley Shale Mine will be determined at the point in the mining sequence where the Lithgow seam workings were approaching within a predetermined distance of the shale mine workings. Legislation dictates a distance of at least 50 m in any direction, but risk assessment may determine that a larger distance may be necessary. At that point in the sequence, actions will need to be taken to ensure as far as practicable that the New Hartley Shale Mine workings do not present a hazard of inrush.

There are many means by which this can be achieved but typical measures to be considered would include:

- records searches to ascertain any information on the mine workings
- interviews with any persons with knowledge of the workings
- exploratory drilling to determine the extent of the workings and whether or not they contain water or dangerous accumulations of gas
- geophysical techniques to determine the extent of the workings

- drilling of boreholes and installation of pumps where required to remove the accumulations of water and/or gas
- ventilation of the old workings to remove accumulations of gas.

To date the actions noted in the first two points above have been carried out. The actions noted in the remaining dot points would be considered as part of the development of a risk based management plan to manage the inrush hazard associated with the oil shale workings.

Subsidence impact carries with it a number of uncertainties due to the limited information on the workings in the New Hartley Shale Mine. Given the limited interburden between the two sets of workings, there will certainly be geomechanical interaction between the Lithgow seam workings and the oil shale seam workings. What is uncertain is the extent of pillars remaining in the old workings of the shale mine. The mine plan indicates a high level extraction from the shale seam, but it is likely that some pillars were left against critical access roadways to maintain these in a usable condition. These pillars would possibly have the effect of creating some sub-critical width voids in the workings should they be large enough.

The Subsidence Impact Assessment (Appendix D) assumes a worst case scenario in which there are pillars left intact in the oil shale workings that form sub-critical voids between the remnant pillars in places. If this is the case, fracturing from the caving associated with the extraction phase of panel and pillar mining in the Lithgow seam will cause these pillars in the oil shale workings to fail and thereby generate super-critical voids. If this worst case scenario is realised, approximately 500 mm of new subsidence in this area is predicted. Tilt would range from 6.2 to 16.7 mm/m and strain would range from 1.8 to 8.3 mm/m. Under such circumstances it is likely that there will be reactivation of existing fracture systems and possible formation of new minor fractures generated. The impact assessment assumes this worst case scenario.

To manage the impact of subsidence in the New Hartley Shale Mine Potential Interaction Zone it is proposed to increase the setback distance from the cliffs to half the depth of cover at the crest. This equates to an angle of draw of 26.5º which is typically used in full extraction layouts. This is sufficient to prevent any further damage to the cliffs adjacent to the area.

The remainder of the interaction zone is typified by tree covered plateau with occasional pagodas and rock shelves. Around the extremities of the zone, most of these features already show signs of significant previous subsidence impact in the form of fractures both large and small. The proposed Lithgow seam workings are not likely to cause significantly greater damage to that already existing in this area.

In summary, the following mining constraints will apply to the New Hartley Shale Mine Potential Interaction Zone:

- panel and pillar mining in the majority of the area
- cliff zone first workings only under the cliffs and extending to limit of the oil shale mine workings down slope of the cliffs
- increased set back from the cliffs to half the mining depth.

Subsidence Predictions and Impact

The total subsidence due to extraction from both the oil shale and the Lithgow coal seam is cumulative, and so predictions are provided for two cases. The first case is where the old workings have retained stable pillars and void widths are sub-critical. The second case is one in which stable pillars do not exist in the old workings and therefore the voids are super-critical.

While the subsidence due to pillar and panel mining in areas not previously mined is not predicted to cause surface cracking, applying this same mining method in the interaction zone will lead to greater subsidence because the new mining is expected to further destabilise the oil shale mine pillars and so allow a greater level subsidence to occur than is predicted elsewhere in the deposit.

In the case of sub-critical old voids, the subsidence predictions are:

- new subsidence: 500 mm
- tilt: 6.2 to 16.7 mm/m
- tensile strain: 2.4 to 5 mm/m
- compressive strain: 1.8 to 8.3 mm/m
- new surface cracking: expected.

Where the old workings had super-critical voids, the new subsidence predictions are less, essentially because much of the cumulative subsidence has already occurred.

- new subsidence: 200 mm
- tilt: 2.5 to 6.7 mm/m
- tensile strain: 1.0 to 2 mm/m
- compressive strain: 0.7 to 3.3 mm/m
- new surface cracking: expected.

For either the super-critical or sub-critical areas within the interaction zone, both the subsidence due to the Project mining and the cumulative subsidence from historical mining of the shale and the proposed mining of the Lithgow coal seam, will be greater than the values set and predicted for the rest of the mining area. Due to the pre-existing levels of damage, the proposed mining in the shale mine interaction zone would not cause a significant amount of additional damage.

Some loss of surface water flows in the drainage lines associated with the oil shale mine interaction zone has been predicted. GHD (2014a) have predicted a catchment run off loss to the Genowlan Creek system of 2%. No third order streams exist in this area.

Groundwater systems in this area have already been impacted due to the fracturing of the overburden caused by the previous shale mining activities. This has manifested itself in the form of the water spring that is located at the down-dip end of the old shale workings in the area of the historic Airly Village. Water percolates through the fractured strata and surfaces at the Village Spring. GHD (2014a) have predicted that this spring is likely to cease as the groundwater currently reporting to the shale mine workings will find its way into the Lithgow seam workings. There are no licensed water users or groundwater dependent ecosystems associated with the Village Spring.

8.3.7.6 Unconventional Subsidence and Far Field Effects

- Unconventional (or “non-systematic”) subsidence effects, such as upsidence, valley closure and far-field horizontal displacements are generally ascribed to strains associated with large scale redistributions of horizontal stress due to longwall mining. These effects are generally most pronounced in high horizontal stress environments, with many of the known examples accordingly pertaining to the Southern Coalfield (ACARP, 2002). The situation with the Project differs from the above in two key respects as follows. The Depth of Cover is a maximum of 280 m under Mount Airly, increasing to 310 m under Genowlan Point. As discussed, given the topography and the associated low potential for horizontal stress relief, it is considered likely that horizontal stress values would be low compared to the Southern Coalfield.
- The partial extraction concept in the Project with limited spans and long-term stable pillars is expected to have a relatively minor impact on the distribution of horizontal stress within the overburden in

comparison to an extensive longwall operation. Accordingly, concentrations of horizontal stress in the upper overburden (i.e. near surface) are expected to be very limited.

Further to the above, there is no known incident related to unconventional subsidence effects associated with a partial extraction operation. The partial extraction operation at Clarence Colliery has not experienced any appreciable impact that can be attributed to unconventional subsidence.

Furthermore, as the incised valleys and gorges within the Project Application Area are largely associated with cliff lines, a conservative strategy of first workings only is proposed in the vicinity of the great majority of these cliff lines, which by implication means that there will be negligible conventional or unconventional subsidence.

An additional unconventional subsidence effect is far-field horizontal displacement, which again has been attributed largely to the re-distribution of horizontal stress due to extensive longwall mining.

Given therefore:

- the absence of significant infrastructure within the Project Application Area
- that these displacements tend to occur en masse, as opposed to generating appreciable relative movements within the rock mass
- that the steep topography represents a free face for any movement
- the adoption of a partial extraction layout, and
- the moderate horizontal stress environment at Airly Mine

Any such movements are considered to be negligibly small and insignificant in terms of impact.

It is possible that additional (i.e. to that already experienced) vertical subsidence in the area of the old shale workings may be higher than that experienced elsewhere. A setback distance of half the depth between panel and pillar or partial pillar extraction workings in the Lithgow Seam and the cliff lines will limit the magnitude of contemporaneous valley closure or to negligibly small values in the area of the old shale workings.

There have been instances where faulting has resulted in a transfer of subsidence further than predicted. Angles of draw for the narrow spans being proposed at Airly Mine will be negative to low. For example, commonly at Clarence Colliery there is no external angle of draw (Golder Associates 2013). At the spans being planned for Airly Mine the risk of a far field transfer of subsidence through faulting or any other geological feature is regarded as negligible.

8.4 Subsidence Impact Assessment

Predicted subsidence impacts as compared to approved levels are listed by mining zone in Table 8.3.

Key landscape features in the Project Application Area are the external and internal cliffs, pagodas and canyons such as The Oasis (Photograph 2.5) and The Grotto (Photograph 2.4). The mine design recognises the inherent value of these features and a process of elimination and management has been applied (Section 8.6), with the result that negligible impacts are predicted for these features.

Table 8.4 provides a list of these key features and predicted impacts from the Project, based on the highest predicted impact for those features.

Based on preliminary subsidence predictions and the outcomes of risk assessments, detailed in Chapter 9.0 of the EIS, a number of specialist investigations were commissioned to assess the consequences of subsidence impacts on key aspects of the natural and built environment within the Project Application Area.

Sections 10.1 to 10.3 of the EIS summarises each of the technical assessments reports on environmental issues (water resources, ecology, and cultural heritage) with the potential to be impacted by subsidence. These sections and outline the environmental consequences of the predicted subsidence effects and impacts, mitigation measures and proposed offsets (where applicable) to ensure the potential impacts of subsidence as a result of the Project are not significant.

Table 8.3: Maximum Predicted Subsidence Impacts

<table>
<tr><th rowspan="3">Subsidence parameter</th><th>Approved (DA 162/91)</th><th colspan="7">Proposed</th></tr>
<tr><th rowspan="2">Total extraction area</th><th rowspan="2">Cliff Line and First Workings Zone</th><th rowspan="2">Panel and Pillar zone</th><th rowspan="2">Partial Pillar Extraction Zone</th><th rowspan="2">Shallow Zone</th><th colspan="3">New Hartley Shale Mine Potential Interaction Zone</th></tr>
<tr><th>Coal first workings below shale mine first workings</th><th>Panel and Pillar workings below super critical shale mine voids</th><th>Panel and Pillar workings below sub critical shale voids</th></tr>
<tr><td>Vertical subsidence (mm)</td><td>1800</td><td>65</td><td>106</td><td>65</td><td>25.5</td><td>65</td><td>200</td><td>500</td></tr>
<tr><td>Tensile strain (mm/m)</td><td>25.5</td><td>0.3</td><td>1</td><td>1.1</td><td>0.4</td><td>0.3</td><td>2</td><td>5</td></tr>
<tr><td>Compressive strain (mm/m)</td><td>42.5</td><td>0.5</td><td>2</td><td>1.9</td><td>0.6</td><td>0.5</td><td>3.3</td><td>8.3</td></tr>
<tr><td>Tilt (mm/m)</td><td>85</td><td>1.1</td><td>3</td><td>2.6</td><td>1.1</td><td>1.1</td><td>6.7</td><td>16.7</td></tr>
<tr><td>Fractured zone height (metres above seam)</td><td>-</td><td><10</td><td>70</td><td>35</td><td><10</td><td><10</td><td>to surface (pre-existing)</td><td>to surface (pre-existing)</td></tr>
<tr><td>Surface cracking</td><td>expected</td><td>not expected</td><td>not expected</td><td>not expected</td><td>not expected</td><td>not expected</td><td>expected (pre-existing)</td><td>expected (pre-existing)</td></tr>
</table>

Table 8.4: Expected Impacts to Key Sensitive Landscape Features

Parameters	Cliffs	Pagodas	Canyons such as The Oasis, The Grotto,
Mining zone	Primarily cliff line and first workings zone, limited extent in panel and pillar zone	Primarily in the Cliff Line First Workings Zone. Some located in Panel and Pillar Mining Zone	Cliff Line Zone and Zone of First Workings
Surface cracking	not expected	not expected	not expected
Expected damage	Nil to 5% of area of cliffs in Cliff Line and First Workings Zone – falls of isolated rocks only. For the six cliffs within the Panel and Pillar Mining Zone, nil to 10% of cliff area -falls of isolated rocks only.	not predicted	not predicted

8.5 Subsidence Management and Mitigation Measures

The primary objectives of mine design at Airly Mine are safety both underground and on the surface, management of impacts on the surface and sub-surface features and productivity. By implementing the proposed mine design, the mine seeks to avoid subsidence related impacts as far as is possible and in turn manages environmental and social consequences. At Airly Mine, the application of risk based planning, has driven mine planning, mine design and subsidence management, based on the geological and geotechnical constraints, and the overlying sensitive features.

A summary of the hierarchy of subsidence risk management controls implemented at Airly Mine is provided in Table 8.5.

Table 8.5: Hierarchy of Subsidence Management Controls

Mining Zone	Cliff Zone and Zone of First Workings	Panel and Pillar Zone	Partial Pillar Extraction Zone	Shallow Zone	New Hartley Potential Interaction Zone
Sensitive features requiring management	Nil	Cliffs Mta 43, B9, B12, B15, B17 and B19, communications tower, Nissen hut, Genowlan trig station, 2 Aboriginal heritage sites(45-1-2766; 45-1-2768), Groundwater and surface water	Nil	Steep slopes, European heritage sites, Aboriginal heritage sites (45-1-2747; 45-1-2748), 3rd order streams, infrastructure (Airly Gap road, private residence, telephone cable). Groundwater and surface water	Isolated pagodas, groundwater and surface water
Risk Management Hierarchy					
Elimination	First workings only. ▪ Mining height: <3.0 metres ▪ Maximum roadway width: 5.5m ▪ Maximum void width: <10 metres ▪ Pillar system FOS: >2.11 (protection of key surface features) ▪ Pillar width to height ratio: >8.0 ▪ Zone extends 30m horizontally from the crest and toe of a cliff ▪ Zone increases to half depth of cover horizontally (26.5º angle of draw) from the crest and toe of a cliff in the New Hartley Shale Mine Interaction Zone Negligible subsidence, tilt and strain. No fracturing or cliff failure predicted.		Partial pillar extraction only. ▪ Mining height: <3.0 m ▪ Maximum roadway width:5.5 m ▪ Maximum void width: 15.5 m for single sided lifting and 25.5 m for double sided lifting ▪ Pillar system FOS: ≥1.6 (after extraction is complete) ▪ Supporting pillar width to height ratio: >8 ▪ Remnant pillar width to height ratio: >4	First workings only. ▪ Mining height <3.0m ▪ Pillar width to height ratio ≥4:1 ▪ Minimum plan pillar dimension ≥1/10 depth from surface or 10m (whichever is greater) ▪ Pillar system factor of safety ≥1.6 ▪ Maximum roadway width 5.5 m ▪ Maximum void width 10 m ▪ no formation of intersections during splitting and quartering operations at depths less than 30 m	N/A
Substitution	Nil	Nil	Nil	Nil	Nil

Mining Zone	Cliff Zone and Zone of First Workings	Panel and Pillar Zone	Partial Pillar Extraction Zone	Shallow Zone	New Hartley Potential Interaction Zone
Engineering	Nil	Panel and Pillar mining only. ▪ Mining height: <3.0 metres ▪ Maximum roadway width:5.5m ▪ Maximum void width: 61 metres ▪ Pillar system FOS: ≥1.6 (after extraction is complete) ▪ Pillar width to height ratio: >9.0			Panel and Pillar mining only. ▪ Mining height: <3.0 metres ▪ Maximum roadway width:5.5m ▪ Maximum void width: 61 metres ▪ Pillar system FOS: ≥1.6 (after extraction is complete) ▪ Pillar width to height ratio: >9.0 ▪ No panel and pillar mining within 26.5º angle of draw of cliffs.

Mining Zone	Cliff Zone and Zone of First Workings	Panel and Pillar Zone	Partial Pillar Extraction Zone	Shallow Zone	New Hartley Potential Interaction Zone
Administration	Nil	▪ TARP to manage system implementation. ▪ Surface visual inspections prior, during and post mining. ▪ Subsidence monitoring lines during initial mining on Mount Airly only. Combine data with underground monitoring to confirm design. Underground monitoring only after that. Consider remote sensing or remote station monitoring if successful. ▪ Systematic underground pillar monitoring. ▪ Surface and groundwater monitoring. ▪ Dilapidation survey of any structures to be undermined. ▪ Subsidence management plan for undermining communications tower facility.	▪ TARP to manage system implementation. ▪ Surface visual inspections prior, during and post mining. ▪ Periodic underground pillar monitoring.	▪ TARP to manage system implementation. ▪ Surface visual inspections prior, during and post mining. ▪ Dilapidation survey of any structures to be undermined.	▪ TARP to manage system implementation ▪ Surface visual inspections prior, during and post mining. ▪ Consider subsidence monitoring lines. Combine data with underground monitoring to confirm design. ▪ Systematic underground pillar monitoring. ▪ Surface water monitoring

Using the methodology of “avoid and reduce impact” upon potentially sensitive receptors such as cliffs, rock features and heritage items, the mine plan and design has been formulated to optimise safe resource recovery while reducing potential impacts.

The following elimination, substitution and engineering controls have been applied:

- there will only be first workings with long term stable pillars under cliffs, and in the area containing The Grotto and The Oasis with a resulting predicted subsidence of up to 65 mm
- partial pillar extraction will be undertaken in the zone between shallow depth of cover and major cliffs with a resulting predicted subsidence of up to 65 mm
- first workings will be undertaken in the shallow area with subsidence up to 25.5 mm predicted
- panel and pillar extraction will form void widths of 61 m in areas without significant natural feature constraints with a resulting predicted subsidence typically less than 100 mm but with an upper bound prediction of up to 106 mm.

The strategy of avoidance means that mitigation measures are not required beyond the mining methods themselves. This places the emphasis on performance management. To successfully generate the outcomes proposed, it will be necessary to strictly implement the design criteria proposed and to subsequently monitor the performance of the mining systems. Should deviations be detected, there will be processes in place to modify the mine design to bring the system back into compliance with the design criteria.

Balancing the need for performance monitoring is the reality that conventional surface subsidence monitoring itself creates impacts. Conventional monitoring techniques require clearing of vegetation and access roads for personnel. There is a desire from the NPWS to minimise the amount of surface subsidence monitoring impact. Added to this is the rugged nature of the surface that will make access difficult and safety of personnel is of concern.

A number of other mining operations are in a similar position where surface monitoring is either undesirable or simply impossible. A case in point is the Centennial Coal’s Myuna Mine that operates underneath Lake Macquarie. It is not possible measure subsidence in such a case. System performance monitoring is achieved through the use of underground instrumentation to determine if key elements of the system, such as pillar stress, are within predicted limits. Clarence Colliery has also seen a marked reduction in the amount of surface monitoring conducted through the use of underground monitoring techniques.

A performance monitoring strategy that minimises surface impact is proposed as follows.

- Mining will progress from Mount Airly in the west to Genowlan Mountain in the east. There is an opportunity to establish conventional surface subsidence monitoring in this area to confirm system performance in the initial stages of mining.
- In this early stage of mining, underground pillar stress and deformation monitoring arrays will be installed in the areas of surface subsidence monitoring to develop a correlation between underground observations and successful subsidence results. This will be cross- referenced to the stress and subsidence values predicted in the design and the models calibrated from actual experience.
- Surface subsidence monitoring involving conventional surveyed line will then be discontinued and system performance monitored using systematic underground monitoring techniques combined with regular surface inspections.
- Consideration will also be made for the use of remote station type monitoring and remote sensing techniques such as InSAR or LiDAR. These would need to be evaluated for applicability given the very small levels of subsidence involved and the densely wooded nature of the surface. Techniques such as these may be more suited to the rocky outcrops in the Project Application Area. If remote sensing

techniques can be proven to provide sufficiently accurate data, this would be considered for adoption as a means of detecting surface movements where applicable.

- Trigger Action and Response Plans (TARP) would be developed to provide a consistent tool for performance management. These plans incorporate mining system design parameters to be implemented, items to be monitored, appropriate trigger values to define normal and abnormal behaviour and actions to be taken to maintain normal behaviour or rectify abnormal behaviour.

8.6 Conclusion

The Project mine design has taken into consideration the many sensitive features within the Project Application Area, including many cliffs including some very large cliffs, numerous pagoda complexes, and groundwater resources, and human built resources such as Aboriginal and European heritage sites and infrastructure.

The Project mine design has entirely moved away from the currently approved mine design, which permitted full extraction with associated predicted subsidence up to 1800 mm in identified zones, which in the Airly environment would most likely have had significant impact on surface sensitive features overlying the full extraction zones. Early in the mine design process, Centennial Airly decided that this level of predicted impact was unacceptable in any area within the Project Application Area including the Mugii Murum-ban State Conservation Area. The basic mine design parameter was to limit subsidence to a nominal 100 mm (but not exceeding 125 mm) over majority of the Project Application Area. This design criteria has been used at Centennial Clarence Colliery for over 14 years and proven to cause negligible subsidence impacts.

After a long and involved process of considering and evaluating a range of mine designs, with due regard to sensitive surface features, the Project mine design has selected a range of mining zones with an associated range of extraction void widths to match extraction with natural and social sensitivity to minimise impacts. Instead of the approved mine plan with its resulting 1800 mm subsidence, strains up to 42.5 mm/m, tilts of 85 mm/m and expected fracturing throughout the entire mining area, the Project mine design over most of the mining area would result in a nominal 100 mm subsidence, strains up to 2 mm/m, tilts up to 3.0 mm/m and no surface fracturing. In the New Hartley Shale Mine Potential Interaction Zone, which is already significantly impacted by previous oil shale mining, additional subsidence is predicted to be up to 500 mm vertical subsidence, up to 8.3 mm/m strains, up to 16.7 mm/m tilts and additional surface fracturing. Mining in the New Hartley Shale Mine Potential Interaction Zone will not generate significant additional impacts beyond those already existing.

The Project mine design allows an economic return at Airly Mine, while minimising environmental and social impacts.

CHAPTER 9.0

Identification of Key Environmental Issues

9.0 IDENTIFICATION OF KEY ENVIRONMENTAL ISSUES

This chapter outlines the environmental risk assessment process that has been undertaken to prioritise environmental issues relevant to the Project, potential impacts and consequences of the Project, and confirm the need for the level of assessment within this EIS.

This chapter specifically responds to the DGRs, which provide the following in regard to risk:

The Director-General's requirements

General Requirements:

- A risk assessment of the potential environmental impacts of the development, identifying the key issues for further assessment.

9.1 Introduction and Objectives

Centennial Airly employs a risk-based approach to manage safety, environment and business at Airly Mine. This process involves its employees (and contractors where appropriate) identifying issues, or recognising areas where further information is required to identify these issues, and recommending any necessary additional controls to address identified risks. This practice is guided by the overarching Centennial Environmental Policy, which identifies:

- the vision to conduct business in an efficient and environmentally sustainable manner that is compatible with the expectations of shareholders, government, employees and the community
- the belief that everyone has a responsibility for minimising impact to the environment and that environmental performance can always be improved
- the guiding principles of environmental impacts being recognised and minimised, continual improvement of environmental performance and risk management strategies implemented based on clear science and valid data.

The compilation of the EIS has been undertaken through a risk based and consultative approach.

A Broad Brush Risk Assessment (BBRA) was completed in May 2012 by Centennial Airly, providing an initial risk assessment and directing the scope of technical studies to enable adequate assessment and management of key issues. The risk register is presented as part of the Briefing Paper for the Project issued in September 2012 and is available at:

http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=5581

The objective of the environmental risk assessment process was to identify the environment and community risks associated with the Project and to identify knowledge gaps or recommend improvements to existing mitigation and management measures already in place to ensure the residual consequences are acceptable. Where there is a knowledge gap in the information available, or where risks are considered unacceptable, a technical assessment has been undertaken to support the EIS.

A subsidence constraints risk assessment was completed in September 2013 to identify and quantify potential risks to the Project due to mining related subsidence. Specialist consultants who participated in the risk assessment were those consultants who prepared the technical assessments for subsidence, terrestrial ecology, aquatic and stygofauna, Aboriginal and historical heritage, surface and groundwater, and the EIS lead consultant. The subsidence constraints analysis identifies known mine characteristics and known sensitive features that are potentially at risk of subsidence from the proposed mine plan.

A Bushfire Risk Assessment was held in December 2013 and was undertaken by the Airly Mine site personnel and personnel from National Parks and Wildlife Service. The primary objective of this risk assessment was to identify those issues relating to the Project which pose the greatest environmental bushfire risk, and to determine the likelihood and consequence of this issue occurring during the life of the Project.

Following completion of the technical assessments and the identification of management and mitigation measures (as appropriate), the residual risks of the Project have been identified to ensure all residual consequences are at an acceptable level. The residual risks and consequences of key environmental issues of the Project are discussed in Chapter 10.0.

9.2 Proposed Activities with the Potential to Cause Environmental Impacts

The activities of the Project with the potential to cause environmental impacts are identified in Table 9.1 and are ranked as 'high', 'significant', 'moderate' and 'low' based upon Centennial Coal's Issues Prioritisation Matrix. Table 9.1 identifies where these issues are discussed in the EIS.

The potential impacts of the Project and their associated environmental, social and economic consequences have been identified through the broad brush risk assessment undertaken for the Briefing Paper prepared to request Project DGRs, and consultation with Government agencies and the community. This environmental risk assessment was based on existing knowledge (prior to the preparation of any technical assessment), and identified a number of issues for which additional information and assessment was required to better determine their level of risk.

The activities identified for the Project with the potential to cause an environmental impact are as follows:

- **Subsidence**: Potential subsidence-related impacts for the mining area. Chapter 8.0 provides a detailed description of the predicted subsidence induced impacts and consequences for the Project and relate to:
  - social aspects
  - ecology
  - visual amenity
  - cliff and pagoda failure
  - cultural heritage (European and Aboriginal)
  - water.
- **Air Emissions**: Involving dust and GHG, from continued operation of the Mine and maximum annual coal production of up to 1.8 Mtpa ROM coal, including potential impacts at the pit top associated with coal handling . Potential consequences of air emissions from the Project relate to:
  - health and nuisance aspects.
- **Land Disturbance**: Associated with the construction of the REA, CPP and ROM coal stockpile areas. Potential consequences relate to:
  - water (quality and quantity)
  - visual amenity
  - ecology
  - heritage (European and Aboriginal).

9.3 Risk Assessment

9.3.1 Identification and Prioritisation of Environmental Risk

The key Project-related environmental issues warranting detailed assessment in the EIS have been identified through:

- the existing environmental context of Airly Mine and the surrounding locality (sensitive receivers, physical environment and existing management practices)
- consultation with stakeholders (government agencies and the community)
- Broad Brush Risk Assessment outcomes
- subsidence constraints risk assessment
- technical assessments
- on-going review of long term environmental monitoring data
- the legislative framework that underpins the Project
- the DGRs issued for the Project initially issued on 6 November 2012 ad re-issued on 4 February 2014
- government briefing meeting and site visit 17/ 18 October 2012
- SEWPAC (now DoE) requirements as provided in the revised DGRs re-issued on 4 February 2014.

These environmental issues are then ranked utilising an Issues Prioritisation Matrix developed by Centennial Coal.

The ranking of environmental, consequences is based upon the principles of the *Australian and New Zealand standard AS/NZS 4360:2004* (SASNZ 2004) – *Risk Management* and Centennial Coal's Risk Management Standard Risk Matrix (Centennial 2012d). Risk allocation considerations are illustrated in Table 9.1. The issue prioritisation matrix is provided in Table 9.2 that apportions priority on the basis of the likelihood of occurrence and the potential consequence if it occurs.

Table 9.1: Risk Allocation Considerations

Likelihood of Risk	Consequences of Unmanaged Effects
A Certain	1 Catastrophic
B Probable	2 Major
C Possible	3 Moderate
D Remote	4 Minor
E Improbable	5 Insignificant

Table 9.2: Issues Prioritisation Matrix

Risk Rating	Risk Category		Generic Management Actions
1 to 4	E	Extreme	Immediate intervention required from senior management to eliminate or reduce this risk.
5 to 9	H	High	Imperative to eliminate or reduce risk to lower level by the introduction of control measures. Management planning required at senior level.
10 to 15	S	Significant	Corrective action requires senior management attention needed to eliminate or reduce risk.
16 to 19	M	Moderate	Corrective action to be determined, management responsibility must be specified.
20 to 25	L	Low	Monitor and manage by corrective action were practicable.

9.3.2 Broad Brush Risk Assessment

The primary objective of this risk assessment was to identify those issues relating to the Project which pose the greatest environmental risk, and to determine the likelihood and consequence of this issue occurring. The issues and potential impacts assessed in the Broad Brush Risk Assessment for the Project were:

- subsidence
- impacts to flora and fauna communities (including threatened and endangered species/communities and groundwater dependent ecosystems)
- impacts to surface features including cliffs and rock formations
- loss of groundwater or depressurisation of groundwater aquifers
- discharge requirements exceeding current EPL limits for volume
- cumulative impact
- rehabilitation
- traffic impacts
- noise impact
- impacts to air quality
- potential increases greenhouse gas emissions
- community and social impacts
- impacts to Aboriginal/cultural heritage sites
- economic impacts
- visual
- soils, land use and agriculture

Potential environmental risks were ranked in the Broad Brush Risk Assessment. Each risk was assessed by determining the probability and consequence of each and in light of the mitigation measures and management strategies already in place.

The identified ‘high’ and ‘significant’ environmental issues relate to potential subsidence related impacts to groundwater, flora and fauna as well as potential surface water quality impacts resulting from mine water discharges.

The risk assessment also identified several extreme, medium and low risk as summarised inTable 9.3.

Table 9.3: Summary of Environmental Risk Categories

Risk Category	Environmental/Socio-economic Factor
Extreme	■ Ecology ■ Groundwater ■ Surface water
High	■ Aboriginal heritage ■ European heritage ■ Waste management
Significant	■ Community identification and engagement ■ Air Quality
Moderate	■ Visual amenity ■ Bushfire ■ Greenhouse Gas ■ Noise ■ Traffic and Transport
Low	■ Land Use and Land Capability ■ Rehabilitation and closure

Outcomes gained in terms of risk ratings and recommended controls have guided the development of the technical assessments. Where the risks were considered unacceptable, or a knowledge gap identified, technical assessments have been undertaken to determine any potential impacts of the Project on these identified risks. Proposed additional controls discussed in Table 9.4 are those recommended at the time of the development of the Broad Brush Risk Assessment. Further mitigation measures are discussed in Chapter 10.0.

Table 9.4: Priority Risk Categories for Management and Proposed Additional Controls- from BBRA

Issues and Potential Impacts	**Highest Risk Rating with Existing Controls**	**Proposed Recommended Controls Required to Minimise Risk**	**Demonstrated implementation of these controls in the EIS**
Potential Extreme Risks NPWS was consulted with regards a collaborative monitoring programme in the SCA			
Flora and Fauna	2 (extreme)	1) Ecological impact assessment to be completed as part of the EIS. 2) Consider indirect offset opportunities i.e. NPWS weed and feral management. 3) Commence consultation with SEWPAC (now DoE) and state government agencies. 4) Mine design to consider minimising potential impacts. 5) Develop and implement an effective Stakeholder Engagement Plan. 6) Review Draft Plan of Management for Mugii Murum-ban SCA and comment at exhibition. 7) Consider engagement and involvement of stakeholders in fieldwork efforts and consult with stakeholders about their knowledge.	1) Chapter 10.0 (Section 10.2 Ecology) and Appendix H (Flora and Fauna Impact Assessment). 2) No offsets proposed. 3) Chapter 7.0 Stakeholder Engagement 4) Chapter 8.0 Mine Design and Subsidence 5) Chapter 7.0 Stakeholder Engagement 6) Draft plan has not been released for public comment. 7) NPWS was consulted with regards a collaborative monitoring programme in the SCA.

Issues and Potential Impacts	Highest Risk Rating with Existing Controls	Proposed Recommended Controls Required to Minimise Risk	Demonstrated implementation of these controls in the EIS
Surface water	4 (extreme)	1) Include site water balance as part of the project impact assessment. 2) Design CPP with suitable water controls. 3) Review proposed increase of tonnage in light of CPP design and site water balance. 4) Investigate in-seam tailings disposal options, and include in EIS process. 5) Investigate systems required to achieve nil-discharge site. 6) Undertake geotechnical assessment of likely subsidence amounts and impacts, specifically targeting creek areas. 7) Undertake stream bed geomorphology assessment. 8) Follow up with NPWS for surface water monitoring location approval. 9) include in REA design water management.	1) Appendix F Surface Water Impact Assessment. 2) Part of later detailed design process. 3) Tonnage maintained at current approved levels. 4) Section 4.8.3 and 12.4.3. 5) Site Water Balance, Appendix F. 6) Chapter 8.0. 7) Section 10.1.4 8) Access permits issued as part of the REF process. 9) Section 10.1.
Groundwater	2 (extreme)	1) Complete REF to enable stage 2 drilling to commence. 2) Continue to pursue groundwater monitoring in the authorization area. 3) Investigate options for groundwater monitoring in A232. 4) Complete isotope analysis of springs on Genowlan Mountain. 5) Follow up with NPWS for surface water monitoring location approval. 6) Engage consultant to review current data capture for site water balance review. 7) Investigate inseam drilling from surface in Airly gap.	1) Section 3.3 Exploration Program. 2) Section 3.14.4. 3) Consultation with NPWS ongoing, Section 7.3.6. 4) Not practical. 5) Access permits issued as part of the REF process. 6) Completed, Appendix F. 7) Not required.

Issues and Potential Impacts	Highest Risk Rating with Existing Controls	Proposed Recommended Controls Required to Minimise Risk	Demonstrated implementation of these controls in the EIS
Potentially High Risks (Require additional investigations/controls)			
Aboriginal Heritage	9 (high)	1) Aboriginal heritage impact assessment to be completed. 2) Consultation with the Aboriginal community in accordance with 2010 DECCW *Aboriginal Cultural Heritage Consultation Requirements for Proponents*. 3) Detailed subsidence assessment to be completed on final mine layout/design. 4) Mine design to consider potential impacts. 5) Continue stakeholder engagement. 6) Consider specific consultation with Mugii Murum-ban descendants. 7) Hold a post-fieldwork workshop to assess results of fieldwork and mitigation measures.	1) Section 10.3 (Heritage) and Appendix J (Cultural Heritage Impact Assessment). 2) Section 10.3 Heritage. 3) Chapter 8.0 and Subsidence Predictions and Impact Assessment (Appendix D). 4) Chapter 8.0 and Subsidence Predictions and Impact Assessment (Appendix D). 5) Chapter 7.0 Stakeholder Engagement and Section 10.3 Heritage. 6) Consultation undertaken in accordance with guidelines. Appendix J. 7) Section 10.3 Heritage.
European Heritage	9 (high)	1) Review mine plan once major relics are surveyed.	1) Chapter 8.0.
Waste Management	9 (high)	1) Assess waste production and management options during the preparation of the EIS. 2) Investigate in-seam tailings disposal options and include in EIS.	1) Section 10.11 Waste Management. 2) Section 4.8.3 and 12.4.3.
Potentially Significant Risks			
Community Identification and engagement	13 (significant)	1) Review and update Stakeholder Engagement Strategy during the EIS. 2) Investigate and implement stakeholder consultation as part of the EIS, e.g. newspaper advertisement, newsletters, etc. 3) Complete a Social-Economic Impact Assessment as part of the EIS. 4) Establish a consultation log for all identified stakeholders and maintain throughout the EIS. 5) Design surface facilities to minimise impacts. 6) Continue existing stakeholder and community engagement programs.	1) Chapter 7.0 Stakeholder Engagement. 2) Chapter 7.0 Stakeholder Engagement. 3) Appendix M Social Impact Assessment and Appendix N Economic Impact Assessment. 4) Chapter 7.0 Stakeholder Engagement. 5) Chapter 4.0 Project Description. 6) Chapter 7.0 Stakeholder Engagement.

Issues and Potential Impacts	Highest Risk Rating with Existing Controls	Proposed Recommended Controls Required to Minimise Risk	Demonstrated implementation of these controls in the EIS
Air Quality	14 (significant)	1) Undertake an air quality impact assessment as part of the EIS. 2) Investigate potential for use of dust management and mitigation measures. 3) Review location and the number of dust monitors following EIS Air Quality Impact Assessment. 4) Review and update if required, the Airly Dust Management Plan following the EIS Air Quality Impact Assessment. 5) Include Air Quality predictions in EIS consultation with stakeholders. 6) Investigate in-seam tailings disposal options, and include in EIS process.	1) Appendix L Air Quality and Greenhouse Gas Impact Assessment. 2) Section 10.6 Air Quality management. 3) Chapter 11.0. 4) Chapter 11.0. 5) Section 7.3.2. 6) Section 4.8.3 and 12.4.3.
Potentially Moderate Risks			
Traffic and Transport	19 (moderate)	1) Traffic impact assessment to be reviewed for the Project as part of the EIS. 2) Inform community of increased traffic predictions during EIS consultation. 3) Include repairs to roads and tracks in subsidence management program. 4) Restrict access to a number of tracks (locked gates). 5) Provide information on mining and potential subsidence to users, e.g. NPWS, 4WD Clubs, etc. 6) Subsidence monitoring undertaken pre, during and post-secondary extraction.	1) Chapter 10.0 (Section 10.4 Road Traffic and Transport). 2) Chapter 7.0 Stakeholder Engagement 3) To be addressed as part of Extraction Plan. 4) SCA under NPWS control. 5) NPWS has been consulted throughout the EIS process, Section 7.3.6. 6) Section 8.5.

Issues and Potential Impacts	Highest Risk Rating with Existing Controls	Proposed Recommended Controls Required to Minimise Risk	Demonstrated implementation of these controls in the EIS
Noise	18 (moderate)	1) investigate possible noise-attenuation i.e., silencing, covers, noise bunds etc. 2) Complete a Noise Impact Assessment as part of the EIS. 3) Inform community of noise predictions and acquisition criteria during EIS consultation and continue existing consultation programs. 4) Investigate possibility of expanding current noise monitoring program. 5) The location of surface infrastructure is to be taken into consideration with the community and nearby sensitive receptors. 6) Inform community of noise predictions during construction.	1) Section 10.5 Noise Management and Appendix K Noise Impact Assessment. 2) Appendix K Noise Impact Assessment. 3) Section 7.3.3. 4) Noise Monitoring Plan will be revised post-approval, Chapter 11.0. 5) Section 10.5 Noise Management and Appendix K Noise Impact Assessment. 6) Section 10.5 Noise Management.
Visual	17 (moderate)	1) Investigate highwall remediation techniques. 2) Investigate positioning and design of CHPP and REA to minimise visual impacts where possible. 3) Consider installation of cliff line monitoring points ahead of mining. 4) Finalise full cliff line assessment for EIS. 5) Develop a mining method that reduces subsidence and other mining impacts to surface features to a level that will not cause significant impact. 6) Determine location of the historical mining areas.	1) Section 10.9.5. 2) The position of the CHPP and REA minimise visual impacts. 3) Regular aerial surveys proposed pre-and post-mining, Chapter 11.0. 4) Appendix D. 5) Chapter 8.0. 6) Section 10.3.3 Historical Heritage.
Bushfire	17 (moderate)	1) Review current Fire Management Plan and update if required to reflect expanded operations. 2) Review water requirements to ensure they are adequate to support expanded operations as well as fire fighting capacity.	1) Section 9.3.4. 2) Current facilities provide adequate supply. Site Water Balance Appendix F.

Issues and Potential Impacts	Highest Risk Rating with Existing Controls	Proposed Recommended Controls Required to Minimise Risk	Demonstrated implementation of these controls in the EIS
Greenhouse Gas	18 (moderate)	1) Greenhouse gas assessment to be completed as part of the EIS. 2) Undertake additional in-seam drilling and gas testing. 3) Investigate options for reducing energy usage on site.	1) Chapter 10.0 (Section 10.8 Strategic Agricultural Land). 2) Gas tests commenced in 2013. 3) Section 10.7.5.
Potentially Low Risks			
Rehabilitation and Closure	21 (low)	1) Review and update closure/rehabilitation management plan as part of the EIS process, and implement changes as identified. 2) Update Rehabilitation Security Deposit following EIS approval.	1) Section 10.9. 2) To be implemented post approval.
Land Use/Land Capability	21 (low)	1) Undertake a Land Capability/Agricultural/Land Use Assessment as part of the EIS. 2) Awareness of potential need to address NSW Agricultural Impact Statement Guidelines.	1) Appendix Q Land Use Impact Assessment. 2) Section 10.8.3.

9.3.3 Subsidence Constraints Risk Assessment

Centennial Management Standard MS 004 Risk Management has the intent of integrating a consistent approach to risk management into all aspects of Centennial Coal's business. In accordance with this standard, a subsidence constraints risk assessment was undertaken for the Project to identify and quantify risks to the natural environment due to subsidence. This risk assessment followed on from the BBRA and was undertaken on 10 September 2013. Participants included senior mine personnel, the lead environmental consultant for the Project and the specialist consultants providing technical assessments.

In the context of the Project, potential subsidence induced impacts are noted as the following.

- *Depressurisation of aquifers* –increased groundwater inflow into the underground workings during extraction.
- *Strata deformation* – including localised uplift and buckling of strata and the fracturing and displacement of strata at depth.
- *Impacts to surface watercourses* – subsidence induced surface cracking can result in surface flows being redirected underground until an aquitard or aquiclude results in a lateral subsurface flow. The reduced availability of surface water can impact on regional catchments support ecological systems and surface water users. Tilts can result in grade changes which can change the geomorphology of a watercourse.
- *Ecological impacts* - reduced groundwater availability in upper near surface aquifers and perched aquifers can affect groundwater dependent ecosystems and critical fauna habitat. Tilts and strains can increase erosion / sedimentation / ponding potential which may affect an ecosystem. Surface cracking can affect the viability of surface water flows which sustain ecological communities.

- *Impacts to cliffs and rock features* - surface subsidence can cause rock cracking and fracturing as the surface readjusts to a post-mining surface level following underground mining. If not properly managed this can result in rock damage and cliff collapse.
- *Aboriginal heritage* - subsidence can impact upon Aboriginal heritage items often associated with natural features such as cliffs and rocks.
- *Infrastructure* -surface infrastructure such as roads, powerlines, mining infrastructure are susceptible to subsidence impacts. Adequate consideration needs to be given to both the mine design in addition to the design of infrastructure susceptible to subsidence impacts. Public safety hazards are related to this category.

On this basis, the specific objectives of the subsidence constraints risk assessment were to:

- identify mine characteristics (such as depth of cover, geology, mining method and mine layout), known geotechnical constraints and the mine design criteria to be applied
- identify sensitive natural and built features that might be at risk, and any characteristics that may be relevant in assessing potential subsidence related impacts and consequences
- review previous subsidence predictions from nearby operations against actual subsidence results
- identify knowledge gaps and requirements to be investigated in the technical assessments.

As with the BBRA, results of the subsidence constraints risk assessment have been rated on risk. Those identified as moderate or above are provided in Table 9.5.

Table 9.5: Priority Risk Categories – Subsidence Constraints Risk Assessment

Issues and potential impacts	Risk rating with existing controls	Proposed additional controls required to minimise risk
Potentially Significant Risks		
Shallow zone- third order watercourse (Genowlan and Gap creek)	14 (significant)	1) Broaden exclusion zone around Gap Creek. 2) Develop an adaptive management process for second and third order water courses based on experiences of Mount Airly. 3) Determine the magnitude of the potential loss of baseflow of Gap and Genowlan Creeks. 4) Determine potential aquifer recovery time.
Potentially Moderate Risks		
Panel and Pillar - fauna to be considered (stygofauna) - Triassic aquifers	18 (moderate)	1) Expand the aquatic ecology monitoring program to include: sampling locations that are representative of all the likely habitats for aquatic ecology.

Issues and potential impacts	Risk rating with existing controls	Proposed additional controls required to minimise risk
Panel and Pillar - endangered ecological communities - Genowlan Point heath land	16 (moderate)	1) Develop a subsidence monitoring plan that includes: measurements of vertical subsidence, tilts and strains, correlation of surface measurements with underground monitoring results, (with a view to limiting surface subsidence measurement requirements), consideration of remote monitoring techniques, monitoring of surface infrastructure, TARP. 2) Develop and implement a trigger action response plan for panel and pillar mining that includes: adaptive management for sensitive surface features.
Panel and Pillar - Archaeological / heritage significance - Aboriginal rock shelters 007 and 009	17 (moderate)	1) Develop a cultural heritage management plan that includes: monitoring protocols, TARP. 2) Develop a subsidence monitoring plan that includes: measurements of vertical subsidence, tilts and strains, correlation of surface measurements with underground monitoring results, (with a view to limiting surface subsidence measurement requirements), consideration of remote monitoring techniques, monitoring of surface infrastructure, TARP.
Panel and Pillar - Permanent survey mark - Genowlan trig station	19 (moderate)	1) Gain approval to undermine Genowlan Trig.
New Hartley Shale Mine interaction Zone - Pagoda	18 (moderate)	1) Develop and implement a trigger action response plan that includes adaptive management.
New Hartley Shale Mine - Rock shelf	18 (moderate)	1) Develop and implement a trigger action response plan that includes adaptive management
Cliff Zone - cliffs	16 (moderate)	1) Consult with land owner and develop public safety management plan.
Cliff Zone - water courses - second order (The Grotto)	16 (moderate)	1) Develop a subsidence monitoring plan that includes: measurements of vertical subsidence, tilts and strains, correlation of surface measurements with underground monitoring results, (with a view to limiting surface subsidence measurement requirements), consideration of remote monitoring techniques, monitoring of surface infrastructure, TARP. 2) Expand the surface and groundwater monitoring program to include: a more definitive understanding of alluvial water systems that feed the Grotto. Additional monitoring of the downstream portions of Gap and Genowlan Creeks.
Cliff Zone - water courses - third order (Genowlan Creek)	18 (moderate)	1) Expand the surface and groundwater monitoring program to include: a more definitive understanding of alluvial water systems that feed the Grotto. Additional monitoring of the downstream portions of Gap and Genowlan Creeks. 2) Develop an adaptive management process for second and third order water courses based on experiences of Mount Airly.

Issues and potential impacts	Risk rating with existing controls	Proposed additional controls required to minimise risk
Partial pillar extraction zone - threatened fauna - birds Partial pillar extraction in New Hartley Shale Mine Interaction Zone - threatened fauna Partial pillar extraction- threatened fauna - rock wallaby - bats Partial pillar extraction in New Hartley Shale Mine Interaction Zone - threatened fauna - bats	18 (moderate)	1) Additional targeted surveys for potential roosting habitat.
Partial Pillar Extraction Zone- fauna to be considered (stygofauna) - alluvial aquifers	18 (moderate)	1) Expand the aquatic ecology monitoring program to include: sampling locations that are representative of all the likely habitats for aquatic ecology.
Increased porosity in upper/near surface aquifers resulting in reduced water levels	17 (moderate)	1) Confirm the integrity of the Mount York Claystone with regard to porosity and behaviour of aquitard. 2) Groundwater monitoring to continue. 3) Review of current and proposed monitoring with regard to long term drawdown affects. Based on predicted extent of drawdown.
Shallow zone - threatened fauna – reptiles Shallow Zone- threatened fauna - rock wallaby	18 (moderate)	1) Additional targeted surveys for potential roosting habitat.
Shallow Zone - threatened fauna - presence of potential habitat - dragon fly	17 (moderate)	1) Expand the aquatic ecology monitoring program to include: sampling locations that are representative of all the likely habitats for aquatic ecology. 2) Determine the magnitude of the potential loss of baseflow of Gap and Genowlan Creeks.
Shallow Zone- fauna to be considered (stygofauna) - alluvial aquifers	18 (moderate)	1) Expand the aquatic ecology monitoring program to include: sampling locations that are representative of all the likely habitats for aquatic ecology.
Shallow Zone - spring - Airly Village Spring	19 (moderate)	1) nil

9.3.4 Bushfire Risk Assessment

A Bushfire Risk Assessment was undertaken with National Parks and Wildlife Service (NPWS) on 19 December 2014. The primary objective of this risk assessment was to identify those issues relating to the Project which pose the greatest environmental bushfire risk, and to determine the likelihood and consequence of this issue occurring. Table 9.6 summarises these risks.

Table 9.6: Priority Risk Categories – Bushfire Risk Assessment

Issues and potential impacts	Risk rating with existing controls	Proposed additional controls required to minimise risk	Demonstrated implementation of these controls
Potentially High Risks			
Fire that starts within the SCA and effects Airly activities within the SCA, resulting in damage to property, environmental damage or impact to business plan, injury to persons, and or Statutory non-compliance	5 (high)	1) Monitoring of fire warnings- Rural Fire Service (RFS) website. 2) Develop a fire management plan that includes: definition of asset protection zones, define operational integration with RFS and NPWS, training for site personnel in dealing with bushfire, management of natural fuel loads (grass, timber), withdrawal conditions for personnel working in SCA - no hot work at or above very high fire danger and withdrawal of personnel at extreme fire danger, no solid fuel fires at drill sites, definition of emergency response and muster points. 3) No hot work at or above very high fire danger days. 4) Withdrawal of personnel on extreme or above fire days.	1) A Fire Management Plan will be prepared.

Issues and potential impacts	Risk rating with existing controls	Proposed additional controls required to minimise risk	Demonstrated implementation of these controls
Potentially Significant Risks			
Fire that starts from an Airly Mine activity within the SCA and spreads to the SCA, resulting in damage to property, environmental damage or impact to business plan, injury to persons, and or Statutory non-compliance	13 (significant)	1) Develop a fire management plan that includes: definition of asset protection zones, define operational integration with RFS and NPWS, training for site personnel in dealing with bushfire, management of natural fuel loads (grass, timber), withdrawal conditions for personnel working in SCA - no hot work at or above very high fire danger and withdrawal of personnel at extreme fire danger, no solid fuel fires at drill sites, definition of emergency response and muster points. 2) Withdrawal of personnel on extreme or above fire days. 3) No hot work at or above very high fire danger days. 4) No solid fuel fires to be used by contractors.	1) A Fire Management Plan will be prepared
Fire that starts within the SCA or adjacent National Parks and spreads to Airly Mine site, resulting in damage to property, environmental damage, impact to business plan, injury to persons, loss of production and or statutory non-compliance.	13 (significant)	1) Monitoring of fire warnings - RFS website. 2) Consider mobile firefighting plant. 3) Consider training and orientation for RFS and NPWS personnel on a periodic basis. 4) Develop a fire management plan that includes: definition of asset protection zones, define operational integration with RFS and NPWS, training for site personnel in dealing with bushfire, management of natural fuel loads (grass, timber), withdrawal conditions for personnel working in SCA - no hot work at or above very high fire danger and withdrawal of personnel at extreme fire danger, no solid fuel fires at drill sites, definition of emergency response and muster points. 5) Develop a maintenance plan for asset protection zones. 6) Implement asset protection zones around all key fixed plant.	1) A Fire Management Plan will be prepared
There is a risk to Airly Mine from fire that starts on	13 (significant)	1) Consider mobile firefighting plant. 2) Consider training and orientation for RFS	1) A Fire Management Plan will be prepared

Issues and potential impacts	**Risk rating with existing controls**	**Proposed additional controls required to minimise risk**	**Demonstrated implementation of these controls**
adjacent rural land and spreads to Airly Mine site, resulting in damage to property, environmental damage, impact to business plan and or injury to persons or loss of production.		and NPWS personnel on a periodic basis. 3) Develop a fire management plan that includes: definition of asset protection zones, define operational integration with RFS and NPWS, training for site personnel in dealing with bushfire, management of natural fuel loads (grass, timber), withdrawal conditions for personnel working in SCA - no hot work at or above very high fire danger and withdrawal of personnel at extreme fire danger, no solid fuel fires at drill sites, definition of emergency response and muster points. 4) Develop a maintenance plan for asset protection zones. 5) Implement asset protection zones around all key fixed plant.	
Potentially Moderate Risks			
Fire that starts at the mine site and spreads to adjacent property or the SCA or adjacent National Parks, resulting in damage to property, environmental damage, impact to business plan, injury to persons , legal action, loss of reputation or Statutory non-compliance.	17 (moderate)	1) Develop a fire management plan that includes: definition of asset protection zones, define operational integration with RFS and NPWS, training for site personnel in dealing with bushfire, management of natural fuel loads (grass, timber), withdrawal conditions for personnel working in SCA - no hot work at or above very high fire danger and withdrawal of personnel at extreme fire danger, no solid fuel fires at drill sites, definition of emergency response and muster points. 2) Implement asset protection zones around all key fixed plant. 3) Develop a maintenance plan for asset protection zones. 4) Consider mobile firefighting plant. 5) Consider training and orientation for RFS and NPWS personnel on a periodic basis.	1) A Fire Management Plan will be prepared

9.4 Risk Register

9.4.1 Ranking and Prioritisation

Based upon the risk assessment methodology identified within Section 9.3, the potential consequence of key project-related environmental issues has been ranked. While this risk register and prioritisation of key environmental issues does consider existing mitigation and management measures, it does not consider the application of new mitigation and management measures arising from technical assessments of key environmental issues. Table 9.7 provides the Project risk register.

Table 9.7: Project Aspect Risk Register from BBRA

Project Aspect	Further information within the EIS
Extreme Risk	
Inadequate baseline groundwater data not allowing accurate modeling and assessment of impacts on groundwater dependent ecosystems.	Section 10.1 Water Management Section 10.2 Ecology
High Risk	
Less than adequate stakeholder relationship or survey effort in relation to ecology.	Chapter 7.0 Stakeholder Engagement
Subsidence related impacts upon cliffs, surface rock formations and Aboriginal heritage sites.	Chapter 8.0 Mine Design Section 10.3 Heritage
Subsidence impacts upon European heritage sites, surface infrastructure and stream morphology.	Chapter 8.0 Mine Design Section 10.3 Heritage
Subsidence related impacts on groundwater.	Chapter 8.0 Mine Design Section 10.1 Water Management
Management of coarse and fine rejects materials.	Section 10.11 Waste Management
Significant	
Aboriginal heritage and ecological assessment limitations as a result of inability to survey entire site due to terrain constraints.	Section 10.2 Ecology Section 10.3 Heritage
Project related impacts resulting from a potential lack of community support.	Chapter 7.0 Stakeholder Engagement
Exceedance of air quality criteria due to an increase in ROM production, increased CPP operating hours or increased traffic movements.	Section 10.6 Air Quality Management
Moderate Risk	
Traffic related impacts as a result of an increase in traffic accessing the pit top and or monitoring areas.	Section 10.4 Traffic and Transport
Failure to obtain Aboriginal community support caused by cultural significance improperly considered or due to inadequate consultation.	Section 10.3 Heritage
Surface water impacts as a result of subsidence.	Section 10.1 Water Management Chapter 8.0 Mine Design
Impacts on cliffs or pagodas caused by inadequate mine design or inadequate monitoring of subsidence impacts.	Chapter 8.0 Mine Design
Impacts of bushfires caused by construction, installation and operation of surface infrastructure.	Section 10.12 Hazards Management
Low Risk	
Amenity related noise, current land use and visual impacts at the Airly pit top and/or as a result of construction and operation of surface infrastructure.	Section 10.5 Noise Management Section 10.10 Visual Amenity Section 10.8 Strategic Agricultural Land
Inadequate allocation of rehabilitation funds.	Section 10.9 Life of Mine and Rehabilitation
Surface water quality and quantity related impacts resulting from pit-top discharges.	Section 10.1 Water Management
Project related impacts resulting from an increase in greenhouse gas emissions	Section 10.7 Greenhouse Gas

9.4.2 Assessment of Environmental, Social and Economic Consequences

The technical assessments for environmental issues that have the potential to impact on the environment (including Matters of National Environmental Significance in accordance with the EPBC Act), have been denoted with high risk ratings and are discussed in detail in Chapter 10.0. Socio-economic impacts to the region as a result of the continuation of mining are discussed in Chapter 6.0.

Through comprehensive monitoring programs for factors including subsidence, hydrology and hydrogeology, water quality, and flora and fauna, Airly Mine has accumulated a wealth of knowledge on sensitive environmental features within its mining lease areas. On-ground monitoring and statistical methods have been used to predict, assess and manage impacts to threatened flora and fauna as well as the site's ecology in general.

The assessment of subsidence (detailed in Chapter 8.0 and Appendix D) provides ground modelling and predicted subsidence effects arising from mining, with conventional and non-conventional mine subsidence movements identified and assessed.

Subsidence predictions and impact assessments for the natural features within the Project Application Area to inform the various technical assessments as listed below.

Water Management (Section 10.1)

The groundwater and surface water impact assessments have been completed to comply with the Aquifer Interference Policy minimal impact considerations, requirements of the Independent Expert Scientific Committee (IESC), the ANZECC guidelines and the DGRs.

Ecology - Terrestrial Ecology, Aquatic Ecology and Stygofauna (Section 10.2)

The terrestrial ecological impact assessment provides a review of previous ecological investigations undertaken within and in proximity to the Project Application Area, together with vegetation community and survey mapping within the Project Application Area. An impact assessment of the Project on the terrestrial ecology including threatened species, EECs and habitats due to subsidence impacts and changes in groundwater levels and surface water and groundwater interactions is carried out.

The aquatic ecological impact assessment includes a review of databases and the identification of threatened aquatic species, populations, ecological communities, GDEs and key threatening processes which may impact on these communities. Such processes include water discharges both surface water runoff and mine water make.

Cultural Heritage (Section 10.3)

This assessment includes background research, field surveys and an impact assessment of Aboriginal and European heritage items identified within the Project Application Area with due regard to subsidence assessment results. There has been extensive consultation and involvement with Aboriginal groups for the assessment of the potential impacts of the Project on the identified Aboriginal heritage items identifies within the Project Application Area.

Traffic and Transport (Section 10.4)

This assessment includes a review of the access and road traffic implications of the Project. This is also considered with cumulative traffic increases from the generation of other proposed local projects and annual average increases in traffic flows. Operations at the pit top are examined.

Noise Management (Section 10.5)

This assessment identifies the potential impacts of noise and vibration associated with the Project on the nearest surrounding residential sensitive receivers including consideration of cumulative impacts.

Air Quality Management (Section 10.6)

This assessment quantifies the air quality impacts associated with the Project on the surrounding sensitive residential receivers. Project elements with the potential for air quality impacts are assessed during construction and operation phases of the Project.

Greenhouse Gases (Section 10.7)

The assessment considers emissions of greenhouse gases from the Project (both direct and indirect).

Soils and Landscape Capability (Section 10.8)

The Soils and Land Capability assessment classifies and determines the soil types in the Project Application Area; identifies pre and post-mining rural land capability and agricultural suitability; identifies potentially unfavourable soil material which may pose high environmental risks if disturbed; and provides relevant management and mitigation measures to minimise potential impacts identified.

Strategic Agricultural Land (Section 10.8)

The Agricultural Impact Assessment assesses the impacts of the Project on the agricultural resources and associated water resources. The potential agricultural production value of the Project Application Area is assessed in this context. Impacts upon soils and land capability are also assessed.

Life of Mine and Rehabilitation (Section 10.9)

This assessment establishes objectives for the decommissioning and rehabilitation of land that will be impacted by the Project. Short, medium and long term objectives are set out which integrate closely with the existing Airly MOP.

Visual Amenity (Section 10.10)

This assessment identifies the visual character and existing aesthetic environment of the Project Application Area. Potential visual impacts arising from Project activities, including the construction and progressive rehabilitation of the Proposed REA, are assessed, particularly in relation to construction activities. Proposed mitigation and management measures are outlined.

Waste Management (Section 10.11)

This section provides an overview of existing waste management practices at Airly Mine and predicts proposed waste volumes arising from the Project.

Hazards Management (Section 10.12)

This section details the current hazards management plans in place at Airly Mine including the Fire Management Plan, and the transport and storage of hazardous materials proposed to be used in the Project.

CHAPTER 10.0

Assessment and Management of Key Environmental Issues

10.0 ASSESSMENT AND MANAGEMENT OF KEY ENVIRONMENTAL ISSUES

10.1 Water Resources

The Groundwater Impact Assessment (Appendix E) and the Surface water Impact Assessment (Appendix F) specifically respond to the DGRs, which provide the following in regard to water aspects:

The Director-General's requirements

Water Resources – including:

- detailed assessment of potential impacts on the quality and quantity of existing surface water and groundwater resources in accordance with the NSW Aquifer Interference Policy, including:
  - impacts on affected licensed water users and basic landholder rights
  - impacts on riparian, ecological, geo-morphological and hydrological values of watercourses, including groundwater dependent ecosystems and environmental flows.
- a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply and transfer infrastructure and water storage structures
- identification of any licensing requirements, including existing or future Environment Protection Licences (EPLs) or Pollution Reduction Programs (PRPs), and approvals under the Water Act 1912 and/or Water Management Act 2000
- demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP)
- a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo
- a detailed description of the proposed water management system (including sewerage), water monitoring regime, beneficial water re-use program and all other proposed measures to mitigate surface water and groundwater impacts.

10.1.1 Introduction and Background

This section identifies the potential impacts of the Project on the existing water environment and how these impacts can be appropriately managed and mitigated to ensure acceptable environmental outcomes. It is informed by the technical assessments, *Airly Mine Extension Project Groundwater Impact Assessment*, July 2014, GHD (GHD 2014a, Appendix E) and *Airly Mine Extension Project Surface Water Impact Assessment,* July 2014, GHD (GHD 2014b, Appendix F).

The surface water and groundwater assessments have been prepared in accordance with the DGRs and additionally in accordance with the following requirements and guidelines.

- Independent Expert Scientific Committee's *Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources*, Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development, April 2014 (A checklist against where specific items have been addressed are provided in Table A1 of Appendix E and Appendix F and Table 1.5 of this EIS).

- NSW Office of Water Environmental Assessment Requirements Airly Mine Extension Project (SSD 5581).

Recent and ongoing groundwater and surface water studies at Airly Mine has defined the groundwater system within the Project Application Area. Geological investigations have been undertaken through data from exploration logs and groundwater monitoring data.

GHD (2014a) has developed a numerical hydrogeological model (MODFLOW-NWT) to assess potential impacts to groundwater sources as a result of the Project.

Surface water flows and water quality in the creeks with the potential to be impacted by the Project have been monitored over the last two years. Investigations undertaken to date within the Project Application Area have provided sufficient baseline data to allow an understanding of the existing surface water and hydrogeological environments. An assessment of the potential impacts due to the Project on the environment can therefore be undertaken with a high level of certainty.

10.1.2 Existing Environment

Chapter 2.0 describes the topography, hydrology, geology and hydrogeology relevant to the Project Application Area.

The Project Application Area is characterised by a steep and rugged topography as well as lower lying, undulating areas. The topography is dominated by Mount Airly to the west and Genowlan Mountain (Photograph 2.1) to the east.

Airly Mine lies within and at the northern edge of the Western Coalfields where the high sandstone terrain characteristic of the Blue Mountains, breaks up into separate mesas and sandstone ridges.

10.1.2.1 Surface Water

Spatial details of catchments and associated watercourses are illustrated in Figure 10.1. The Project Application Area is located within the Capertee River catchment, which is part of the Greater Hawkesbury/Nepean catchment. Watercourses within the Project Application Area include four sub-catchments all of which drain into the Capertee River, which flows in a south-east direction to its confluence with the Wolgan River to form the Colo River, which ultimately contributes to the Hawkesbury River and Broken Bay.

The Project Application Area includes the following four major creek systems with the indicated Strahler stream order as follows.

- Airly-Coco Creek (1st and 2nd order stream)
- Emu Swamp Creek (1st order stream)
- Gap-Genowlan Creek (3rd order stream)
- Torbane-Oaky Creek (3rd and 4th order stream).

The stream ordering is in accordance with the Strahler system, which is a standard recognised method (referred to in the *Water Management (General) Regulation 2011*) of determining the relative ordering of streams, whereby the uppermost defined stream channels in a catchment are given an order of 1. As two order 1 streams join, the stream downstream of this confluence is given an order of 2. This ordering system continues downstream, with no theoretical uppermost order. In NSW, the *Water Management (General) Regulation 2011* makes specific reference to the map sheets that are to be used when applying the Strahler method, most commonly the 25,000 series topographic maps.

The Airly-Coco Creek system drains the southern part of the Project Application Area and joins the Capertee River approximately 17 km north-east of the Airly pit top area. Centennial Airly is currently licensed under EPL 12374 to discharge water to Airly Creek. Airly Creek is generally brackish, extremely hard and slightly alkaline in the vicinity of the Airly Mine surface facilities area. The water quality of Airly Creek is closely related to the natural geology of the catchment.

Surface runoff from a small area of the north-east of the Project Application Area drains to Emu Swamp Creek, which flows north east to join the Capertee River (Figure 10.1). Genowlan Creek and Gap Creek drain the northern part of the Project Application Area. Gap Creek joins Genowlan Creek approximately 2 km beyond the Project Application Area boundary, and then flows to the Capertee River. The Torbane-Oaky Creek sub-catchment drains the north-west part of the Project Application Area. A small north-west portion of the Project Application Area drains directly to an unnamed tributary of the Capertee River.

Flows at Gap and Genowlan Creeks are primarily rainfall dependant as flows at these locations occur after moderate rainfall events (successive days of rainfall greater than 50 mm). It is possible that baseflow contributes to subsurface flows which appear in the waterways further downstream. Gap Creek and Genowlan Creek are in general fresh and slightly acidic within the Project Application Area.

Waterways within undulating agricultural areas such as Airly and Torbane Creeks are largely ephemeral or intermittently flowing with some groundwater recharge expected for larger creeks such as Airly Creek. Medium-intensity, medium-duration flood events are expected for these waterways with overtopping of banks occurring for major storm events.

All of the creeks within the Project Application Area are ephemeral. Generally, these watercourses flow for relatively brief periods following significant rainfall events. Flows within Airly, Oaky, Coco and Genowlan Creeks become perennial outside the Project Application Area.

10.1.2.2 Groundwater

Overview

The relevant geological description is provided in Section 2.3.1, but in summary, the Triassic Narrabeen Group rocks overlie the Permian Illawarra Coal Measures. Further, below the coal measures lie the Shoalhaven Group sedimentary rocks, which are in turn underlain by a range of metamorphic strata comprising quartzite, shales, sandstones, limestone and tuff. There are small patches of quaternary alluviums adjacent to Gap and Genowlan Creeks. There is minimal hydraulic connection between the local and regional groundwater sources.

- *Alluvium and Quaternary strata*: these provide baseflow to Gap and Genowlan Creeks (including The Grotto and The Oasis), potential habitat to vegetation and stygofauna GDEs and supply a small number of users along Genowlan Creek downstream of the Project Application Area.
- *Narrabeen Sandstone of the Triassic:* local groundwater source within the Project Application Area that provides a potential habitat to stygofauna and feeds seepage areas/springs.
- *Illawarra Coal Measures of the late Permian*: local groundwater sources within the Project Application Area that provide baseflow to Gap and Genowlan Creeks and feed seepage areas/springs such as the Village Spring.
- *Shoalhaven Group of the early Permian*: a regional groundwater source to a small number of registered users, including Airly pit top.
- *Lower Devonian Metamorphic Strata*: a fresh regional groundwater source that provides the majority of registered groundwater users to the east of the Project Application Area.

Local Groundwater Sources

Local groundwater sources within the Project Application Area are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams that occur within Mount Airly and Genowlan Mountain. They are classified as ‘less productive’ in accordance with the criteria specified in the NSW Aquifer Interference Policy (i.e. the yield is typically less than 5 L/s and/or the salinity is typically greater than 1500 mg/L).

Small areas of alluvium in the Project Application Area form an unconfined shallow aquifer with groundwater depth ranging from less than 1 m to over 5 m below ground level (bgl) and aquifer thickness generally less than 12 m. The alluvium associated with Gap Creek and Genowlan Creek is generally a silty sand and is recharged from rainfall as well as inter-aquifer flow from adjacent Permian (Illawarra Coal Measures) strata. Alluvial groundwater discharges to connected streams.

A falling head test indicated a hydraulic conductivity of 0.11 m/day for alluvium at Gap Creek. Based on water sampling undertaken by Centennial Airly, the groundwater associated with the alluvium is fresh and slightly acidic.

Sections of Genowlan Creek and Gap Creek are fed relatively consistently by rainfall based subsurface flows that emerge from Quaternary colluvium and alluvium. Although the sources for this recharge is rainfall based, anecdotal evidence infers that these rainfall based flows are held in the Quaternary strata and released slowly into the reaches of Genowlan Creek above The Grotto and The Oasis (Figure 10.1) areas, as well as in certain reaches of Gap Creek. Flows throughout The Oasis area are relatively constant, and they have therefore been considered a component of baseflow for the assessment.

The local porous and fractured rock groundwater sources include the Narrabeen Sandstone as well as Permian sources including coal seams of the Illawarra Coal Measures and the Marrangaroo Formation. These sources are recharged by rainfall via fractures within overlaying strata and seep out of the side of the mountains or directly into watercourses. At some locations, including the Village Spring, the seepage flow is small but persistent. The majority of discharge from these groundwater sources is to seepage areas and there is minimal inter-aquifer flow to underlying regional groundwater sources. No evidence of near surface aquifers has been identified in the area where the Genowlan Point Pea (*Pultenaea sp. Genowlan Point)* occurs.

The local groundwater sources are confined to the Project Application Area as their outcrop boundaries occur entirely within this area.

Regional Groundwater Sources

The regional groundwater sources occur within the siltstones and sandstones of the Shoalhaven Group below the target coal seam, as well as within the underlying metamorphic rocks. These groundwater sources are part of the Sydney Basin North groundwater source.

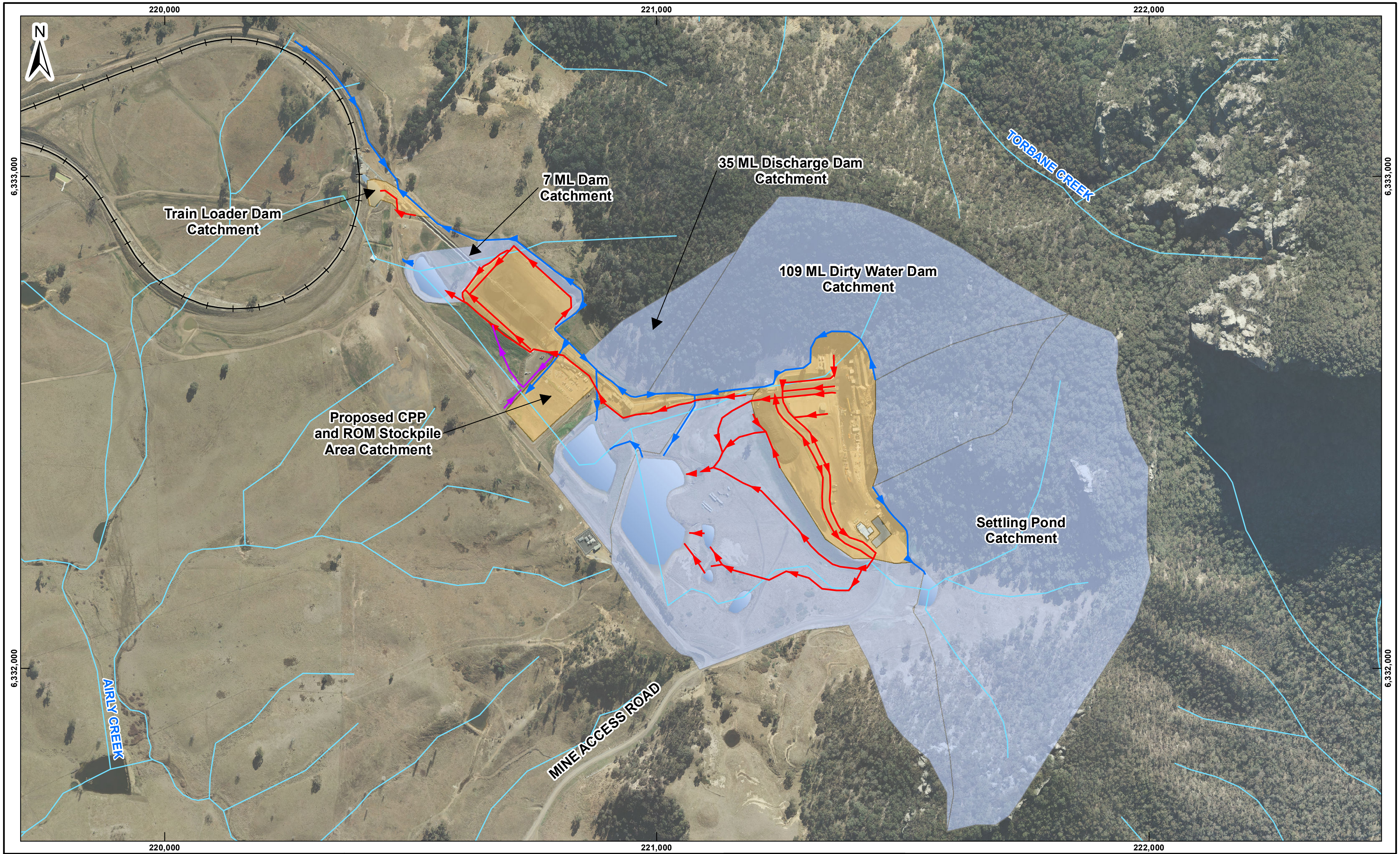
Regional groundwater sources occur within strata well below the target coal measures and extend laterally beyond the Project Application Area. According to the Western Coalfield (Southern Part) Regional Geology 1:100,000 map, the deeper Shoalhaven Group was deposited in a marine environment and therefore the groundwater is brackish to saline. The production bore at the pit top is screened within this groundwater source. Groundwater flow is generally to the east. It is a ‘less productive’ groundwater source since the salinity exceeds 1,500 mg/L based on available data.

The lower regional groundwater source occurs within metamorphic strata containing shale sandstone and limestone. The groundwater here has a lower salt content than the Shoalhaven Group and supplies numerous registered users to the east of the Project Application Area. Recharge areas occur to the north, south and east of the Project Application Area and groundwater flow is generally to the east. This groundwater source is ‘highly productive’ in parts where the yield exceeds 5 L/s and the salinity is less than 1.500 mg/L.

GHD (2014a) concluded there would be minimal inter-aquifer hydraulic connection between the upper and lower regional groundwater sources, based on differences in groundwater chemistry.

Groundwater Dependent Ecosystems

RPS (2014a) reports that GDEs are likely to occur within the shallow alluvial aquifer zones, where groundwater levels are shallow and exist as moist sheltered gully forests. They are unlikely to be entirely groundwater dependent and are termed facultative ecosystems. The GDEs that may exist within the Project Application Area are not listed as high priority GDEs in the WSP.



LEGEND

- Clean Water Diversion
- Dirty Water Diversion
- Dirty Water Diversion - Proposed
- Rail
- Watercourse
- Clean Water Catchment
- Dirty Water Catchment

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:10,000

Figure 10.1: Surface Water Management Catchments

0 100 200 300 400 Metres

PLOTFILE No.

Centennial Coal

Airly

DRG No. 10-10.1

A4

Mine Inflows

Since the commencement of operations at Airly Mine in December 2009, the seepage of groundwater into the existing mine workings has been negligible (i.e. not measurable or sufficient to require dewatering). Only minor ingress of water has been noted in seam low points and in a few discrete locations. No mine water has been discharged from the pit top during operations to date.

10.1.2.3 Water Sharing Plans and Licensing

The Project Application Area is regulated by two WSPs made under Section 50 of the *Water Management Act 2000* (WM Act). The Greater Metropolitan Region Groundwater Sources WSP (GMR WSP) regulates groundwater resources while the Greater Metropolitan Region Unregulated River Water Sources WSP (GMRU WSP) regulates surface water resources.

Airly Mine is located within the Capertee River Management Zone which is part of the Hawkesbury and Lower Nepean Rivers Water Source covered by the GMRU WSP.

The regional allocated entitlement for the water source is 120,532 ML/year.

Groundwater extraction and interception is from the Sydney Basin North Groundwater Source which is covered by the GMR WSP. The regional allocated entitlement for the water source is 15,923 ML/year.

Airly Mine is the only coal mine in the region that is located within either of the Hawkesbury and Lower Nepean Water Source and the Sydney Basin North Groundwater Source.

Airly Mine holds a groundwater extraction water supply works approval (10WA112537) and Water Access Licence (WAL24386) under the WM Act for this production bore on Lot 47 of DP755758. The volumetric limit specified in the Water Access Licence is 158 ML/year. Centennial Airly obtained an additional Water Access Licence (WAL36565) in 2013 under WM Act following a Controlled Allocation Order. The volumetric limit specified in WAL36565 is 120 ML/year, bringing Airly Mine's total groundwater entitlement to 278 ML/year.

There are 36 registered groundwater bores within a 5 km radius of the Project Application Area, shown in Figure 2.9. The majority are registered for basic rights use (domestic, irrigation and/or stock use) and primarily extract groundwater from the lower regional groundwater source (limestone, sandstone and conglomerate formations) to the east of the Project Application Area. Some registered bores are also located within Genowlan Creek alluvium to the north-east of Airly Mine. The closest registered bores are at least 1 km from the Project Application Area.

The three licensed surface water users identified to interact with water resources potentially affected by the Project are:

- irrigation use (WAL 25822)
- irrigation use (WAL 25839)
- irrigation use (WAL 26541).

10.1.2.4 Existing Monitoring Network and Overview

Surface water

Centennial Airly monitored surface water in accordance with EPL12374 for LDP001, LDP002 and LDP003 (Section 3.14.4). Surface water quality monitoring has been undertaken within Airly Creek, at the Airly Mine surface facilities area, within Gap Creek and at Genowlan Creek.

Figure 3.5 shows the locations of water monitoring points. An overview of surface water monitoring within watercourses is provided in Table 3.11.

Continuous flow monitoring is currently undertaken at the Village Spring, Gap Creek and Genowlan Creek. Recorded flows at the Village Spring are relatively constant over the monitoring period, with an average flow of 4.8 kL/day. The observed seepage at the Village Spring is fed by drainage from the New Hartley Shale

Mine workings (Figure 8.2). Monitoring of Gap Creek and Genowlan Creek indicate that flows are primarily rainfall-dependent with minimal contribution from groundwater seepage.

Water quality monitoring data from Airly Creek has been analysed to establish site-specific trigger values (SSTVs) to assess potential impacts of water discharge from the Airly Mine surface facilities area. Although the Airly Creek sampling location is downstream of Airly Mine, it is considered that at this point in time, this location represents background water quality for the Airly Creek catchment since discharge from the Airly Mine surface facilities area is minimal. It has not been possible to obtain a continuous water quality dataset further upstream within the Airly Creek catchment due to the ephemeral nature of the streams.

Due to limited discharges from LDP001 over the monitoring period there is limited monitoring data at this location. Therefore, monitoring data from the 35 ML Discharge Dam and the production bore have also been assessed to determine potential impacts from current and future discharges to Airly Creek. Water quality at LDP001, the 35 ML Discharge Dam and the production bore have been assessed against SSTVs.

Monitoring has been undertaken within Gap and Genowlan Creeks to establish baseline water quality for these creeks prior to the future underground coal mining and resulting subsidence effects. The water quality in Gap and Genowlan Creeks has been assessed against ANZECC/ARMCANZ (2000) default trigger values since these creeks will not receive mine water discharge.

Proposed SSTV are shown in Table 10.1. SSTVs have been derived for the Airly Creek catchment in accordance with ANZECC/ARMCANZ (2000) methodologies (GHD 2014b). SSTVs have been taken as the largest of the default trigger values (hardness corrected) or 80th percentile background concentration in accordance with ANZECC/ARMCANZ (2000).

A statistical summary for the results of monitoring physio-chemical parameters, nutrients and metals at the surface water locations is provided in Table 10.1. The 50th percentile is representative of the ambient water conditions. The 95th percentile concentrations at downstream monitoring locations have been compared to default triggers as recommended by ANZECC and ARMCANZ (2000). Exceedances of trigger values have been shown in bold.

Table 10.1: Water Monitoring Points Statistical Summary

Analyte	Unit	Assessment of Potential Mine Water Discharge to Airly Creek using SSTVs			Future Underground Subsidence Assessment using default trigger values				ANZECC Default Trigger Values (2000)	Airly Creek SSTVs
		LDP001	Production Bore	35 ML Discharge Dam	The Grotto		Gap Creek			
		50th%	50th%	50th%	50th%	95th%	50th%	95th%		
pH	pH Unit	8.2	6.3	8.5	**5.6**	**6.1**	7.2	7.6	6.5-8.0	6.5-9.0
Electrical Conductivity	µS/cm	715	**4,735**	970	60	70	150	174	350	2,998
TSS	mg/L	5	-	2	-	-	-	-	25	68
Turbidity	NTU	-	-	1	-	-	-	-	25	68
Nutrients										
Ammonia as N	mg/L	-	-	0.02	-	-	-	-	0.25	1.88
Total Nitrogen	mg/L	-	-	0.4	-	-	-	-	0.02	0.24
Total Phosphorous	mg/L	-	-	0.01	-	-	-	-	-	-
Dissolved metals										
Aluminium	mg/L	-	-	0.01	-	-	-	-	-	0.001
Antimony	mg/L	-	-	0.001	-	-	-	-	0.024	0.024
Arsenic	mg/L	-	0.004	0.001	0.001	0.001	0.001	0.001	-	0.0252
Barium	mg/L	-	-	**0.041**	-	-	-	-	-	0.001
Beryllium	mg/L	-	-	0.001	-	-	-	-	0.37	0.37
Boron	mg/L	-	-	0.05	-	-	-	-	0.0002	0.002
Cadmium	mg/L	-	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.001	0.0084
Chromium	mg/L	-	0.001	0.001	0.001	0.001	0.001	0.001	-	-
Cobalt	mg/L	-	-	0.001	-	-	-	-	0.0014	0.013
Copper	mg/L	-	0.001	0.001	0.001	0.001	0.001	0.002	0.3	0.3
Iron	mg/L	-	**29.35**	0.05	**0.53**	**1.18**	0.21	**1.0**	0.0034	0.091
Lead	mg/L	-	0.001	0.001	0.001	0.001	0.001	0.001	1.9	1.9
Manganese	mg/L	-	**5.92**	0.02	0.008	0.014	0.036	0.17	0.0006	0.0006
Mercury	mg/L	-	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	-	0.001
Molybdenum	mg/L	-	-	0.001	-	-	-	-	0.011	0.099

Analyte	Unit	Assessment of Potential Mine Water Discharge to Airly Creek using SSTVs			Future Underground Subsidence Assessment using default trigger values				ANZECC Default Trigger Values (2000)	Airly Creek SSTVs
		LDP001	Production Bore	35 ML Discharge Dam	The Grotto		Gap Creek			
		50th%	50th%	50th%	50th%	95th%	50th%	95th%		
Nickel	mg/L	-	**0.29**	0.003	0.001	0.0013	0.001	0.002	0.011	0.011
Selenium	mg/L	-	-	0.01	-	-	-	-	0.00005	0.001
Silver	mg/L	-	-	0.001	-	-	-	-	-	0.001
Tin	mg/L	-	-	0.001	-	-	-	-	-	0.01
Titanium	mg/L	-	-	0.01	-	-	-	-	-	0.01
Vanadium	mg/L	-	-	0.01	-	-	-	-	0.008	0.072
Zinc	mg/L	-	**0.251**	0.005	0.005	**0.015**	0.006	**0.021**		
Total metals										
Aluminium	mg/L	-	-	0.04	-	-	-	-	-	
Antimony	mg/L	-	-	-	-	-	-	-	0.024	
Arsenic	mg/L	-	-	0.001	-	-	-	-	-	
Barium	mg/L	-	-	**0.044**	-	-	-	-	0.37	
Beryllium	mg/L	-	-	-	-	-	-	-	0.002	
Boron	mg/L	-	-	0.05	-	-	-	-	-	
Cadmium	mg/L	-	-	0.0001	-	-	-	-	0.3	
Chromium	mg/L	-	-	-	-	-	-	-	0.091	
Cobalt	mg/L	-	-	0.001	-	-	-	-	1.9	
Copper	mg/L	-	-	0.001	-	-	-	-	0.0006	
Iron	mg/L	-	-	0.12	-	-	-	-	-	
Lead	mg/L	-	-	0.001	-	-	-	-	0.099	
Manganese	mg/L	-	-	0.044	-	-	-	-	0.011	
Mercury	mg/L	-	-	0.0001	-	-	-	-	0.00005	
Molybdenum	mg/L	-	-	-	-	-	-	-	0.072	
Nickel	mg/L	-	-	0.003	-	-	-	-		
Selenium	mg/L	-	-	0.01	-	-	-	-		

Analyte	Unit	Assessment of Potential Mine Water Discharge to Airly Creek using SSTVs			Future Underground Subsidence Assessment using default trigger values				ANZECC Default Trigger Values (2000)	Airly Creek SSTVs
		LDP001	Production Bore	35 ML Discharge Dam	The Grotto		Gap Creek			
		50th%	50th%	50th%	50th%	95th%	50th%	95th%		
Silver	mg/L	-	-	0.001	-	-	-	-		
Tin	mg/L	-	-	-	-	-	-	-		
Titanium	mg/L	-	-	-	-	-	-	-		
Vanadium	mg/L	-	-	-	-	-	-	-		
Zinc	mg/L	-	-	0.005	-	-	-	-		

Table 10.1 shows that water discharged through LDP001 is slightly alkaline and fresh. The pH level at this monitoring site was consistently within both the ANZECC/ARMCANZ (2000) default trigger range and EPL limits. EC levels consistently exceeded the ANZECC/ARMCANZ (2000) default trigger level of 350 µS/cm (with a median of 715 µS/cm) however, the SSTV for EC based on background data from Airly Creek, is 2298 µS/cm, well above the LDP001 value. Water from the 35 ML Discharge Dam is generally within SSTV limits with the exception of barium. Groundwater from the production bore exceeds SSTVs for EC, iron, manganese, nickel and zinc, although it is not proposed that this groundwater would be discharged directly to Airly Creek.

Table 10.1 shows that water in The Grotto and Gap Creek is fresh with metal concentrations, apart from nickel and zinc, are below ANZECC/ARMCANZ (2000) default trigger levels.

Groundwater

Monitoring locations are illustrated in Figure 3.5 and are listed in Table 10.2**.**

Table 10.2: Environmental Monitoring Points

Type	Location	Period of Data	Lithology
Vibrating wire piezometers	ARP01	June 2012 - present	Narrabeen Sandstone (74 m bgl)
			Irondale Seam (238.5 m bgl)
			Lithgow Seam (260 m bgl)
			Marrangaroo Formation (263 m bgl)
	ARP02A	May 2012 - present	Narrabeen Sandstone (65 m bgl)
			Irondale Seam (243 m bgl)
			Lithgow Seam (266 m bgl)
			Marrangaroo Formation (270 m bgl)
	ARP03A	July 2012 - present	Narrabeen Sandstone (136 m bgl)
			Middle River Seam (165 m bgl)
			Lithgow Seam (252 m bgl)
			Marrangaroo Formation (257 m bgl)
	ARP04	April 2012 - present	Lithgow Seam (25 m bgl)
			Marrangaroo Formation (28.5 m bgl)
			Shoalhaven Siltstone (210.3 m bgl)
	ARP06	June 2013 - present	Narrabeen Sandstone (230 m bgl)
			Irondale Seam (252 m bgl)
			Lithgow Seam (288 m bgl)
			Marrangaroo Formation (295 m bgl)
	ARP07	July 2013 - present	Middle River Seam (168 m bgl)
			Lithgow Seam (252 m bgl)
	ARP08	Sept 2013 - present	Narrabeen Sandstone (183 m bgl)
			Irondale Seam (282.5 m bgl)
Bore	AM2B	2009 – present (quality only)	Shoalhaven Group
	ARP05	August 2012 - present	Gap Creek Alluvium
	ARP07	July 2013 – present (dry)	Narrabeen Sandstone
	ARP08	Sept 2013 – present (dry)	Narrabeen Sandstone
	ARP09	June 2013 – present (mostly dry)	Genowlan Creek Alluvium
Seepage	Village Spring	February 2011 - present	Permian Siltstone
	Mine Workings	December 2009 - present	Lithgow Seam

*bgl= below ground level

Groundwater samples have been collected monthly from the bores at AM2B and ARP05 (Figure 3.4). One sample has been collected to date at ARP09, while the standpipes at ARP07 and ARP08 have been consistently dry.

Groundwater levels are monitored by vibrating wire piezometers as listed in Table 3.10 and these data have been used to calibrate the groundwater model. The measured low piezometric pressure is indicative of the free drainage away from the mesa.

Water from the production bore (AM2B-1) is slightly acidic and highly brackish to saline. Dissolved iron, manganese, nickel and zinc concentrations consistently exceed ANZECC/ARMCANZ (2000) default trigger values for the protection of 95% freshwater aquatic ecosystems as well as SSTVs derived for Airly Creek discussed above. Considering the EC and metal concentrations, this groundwater source is suitable only for stock watering and industrial use. Water management systems at Airly Mine ensure that groundwater from the production bore is not discharged directly to Airly Creek.

Monitoring bore ARP05 is located within the alluvium of Gap Creek. Based on groundwater quality monitoring, the water is fresh and slightly acidic. The pH has generally been below the ANZECC/ARMCANZ (2000) lower default trigger value of 6.5. EC has consistently been below the default trigger value of 350 µS/cm. The alluvial groundwater is a sodium-chloride/bicarbonate type water. The water is similar to that of Gap Creek and Genowlan Creek, suggesting that there is a connection between the alluvial groundwater and Gap Creek. All dissolved metal concentrations at ARP05 have been below ANZECC/ARMCANZ (2000) default trigger values with the exception of zinc. This alluvial groundwater meets the protection of 95% freshwater aquatic ecosystems criteria as well as that for domestic and agricultural use.

Monitoring bore ARP09 is located within the alluvium of Genowlan Creek downstream of The Grotto. Based on the one sample collected to date, the groundwater is fresh and slightly acidic and of calcium bicarbonate type. Groundwater pH and EC are within trigger value limits. There is a notable difference in water type between ARP09 and Genowlan Creek surface water, suggesting that there is minimal connection between the two. Dissolved metal concentrations were below default trigger values with the exception of copper and zinc. This groundwater source meets the protection of 95% freshwater aquatic ecosystems criteria as well as that for domestic and agricultural use.

To characterise the quality of the lower Devonian regional aquifer the private registered bore GW103410 was sampled in December 2013 and January 2014. The bore is located to the southeast of the Project Application Area as shown in Figure 2.9. The groundwater at this location is slightly alkaline and slightly brackish, with an EC of 1,600 µS/cm

10.1.3 Water Resources Impact Assessment

10.1.3.1 Introduction

The assessment of potential impacts to surface water and groundwater resources due to the Project comprised several areas of assessment. The following factors were identified as requiring assessment.

- Changes to the local water cycle.
- Changes to regional catchment flows due to subsidence.
- Changes to the geomorphological condition of streams due to subsidence.
- Erosion and sedimentation of waterways from a greater disturbance area.
- Changes in baseflow to watercourses.
- Altered water quality due to mining-related activities and subsidence of creeks and streams.
- Drawdown of groundwater sources.
- Reduced availability of water to other downstream water users due to increased extraction.

- Cumulative impacts of the Project in association with other operations in the region.

The impacts on waterway condition were assessed with consideration of the predicted outcomes of the Subsidence Impact Assessment. Predictions of subsidence, tilts, strains and surface cracking for each of the mining zones (as described in Chapter 8.0) were considered to assess the impacts of mining on waterway and catchment hydrology and hydraulics.

Predicted changes in average annual stream baseflow as predicted in the Groundwater Impact Assessment (GHD, 2014a) have been considered in this assessment.

Modifications to the pit top water management system have the potential to alter the discharge volumes and frequency of discharge from LDP001, LDP002 and LDP003. The Water and Salt Balance Assessment for the Project, (Appendix E) provides predicted flow volumes and rates for discharges and have been considered in the assessment of impacts.

A checklist considering the various IESC requirements is provided in GHD (2014a) and GHD (2014b) and Table 1.5.

10.1.3.2 Surface Water Assessment

Water and Salt Balance

To assess changes in the local water cycle and quantify potential impacts of the Project, a water and salt balance assessment was undertaken, which is provided in the Surface Water Impact Assessment (Appendix F). The water and salt balance assessment involved modelling of existing (scenario 1), approved (scenario 2) and proposed (scenario 3) operations at Airly Mine. Probabilistic modelling, using the Monte Carlo simulation method, estimated the range of possible outcomes as a result of rainfall variation.

Site Water Balance

The results of the water balance, provided in Section 3.11.7 (existing and approved scenarios) and Section 4.11.7 (approved and proposed scenarios) indicated that the largest source of water into the water management system is the inflow of groundwater into the underground workings. Direct rainfall onto surface water storages and captured catchment runoff will continue to be an important source of water at Airly Mine throughout the Project.Shortfalls in water supply occurring when the demand for water use in mining activities exceed the supply from storages will be provided by the production bore. Extractions from the production bore were modelled to be greatest under existing operations and are expected to decrease as mining progresses and increased groundwater inflows are reused within the water management system.

Discharges through LDP001 are expected to occur during large rainfall events and prolonged wet periods. Under existing operating conditions, discharges were modelled to occur for less than 0.3% of days, or one day per year. The maximum predicted discharge through LDP001 under existing conditions was 79 ML/year. For proposed conditions when groundwater inflows are greatest, discharges through LDP001 are expected to occur for less than 6% of days, or 21 days a year. The maximum discharge under proposed conditions was modelled to be 89 ML/year. The maximum discharge under both existing and proposed conditions was modelled to occur on less than 0.1% of days and is not expected to exceed the EPL 12374 limit of 100 ML/day.

Discharges through LDP002, LDP003 and the proposed LDP for the REA dam are minimised by maintaining the water storages at a low level as a result of recirculating water to the 109 ML Dirty Water Dam. Discharges are expected to be small, occur only during large rainfall events and are dependent on operational conditions which cannot be represented with certainty in the water balance model.

Site Salt Balance

A summary of the mean predicted salt inputs and outputs is presented in for the existing (scenario 1), approved (scenario 2) and proposed (scenario 3) scenarios (Section 1.4) is provided in Table 10.3.

Table 10.3:Summary of Mean Predicted Salt Inputs and Outputs

	Existing operations Scenario 1 (ML/yr)	Approved operations Scenario 2 (ML/yr)	Proposed operations Scenario 3 (ML/yr)
INPUTS			
Direct rainfall onto storages and catchment runoff	27.6	58.0	58.0
External water supply	0.0	0.0	0.0
Groundwater inflows into underground workings	0.0	360.8	108.7
Extraction from production bore	410.9	0.0	3.0
In situ coal	27.8	27.8	27.8
TOTAL INPUTS	**466**	**447**	**198**
OUTPUTS			
Dust suppression	200.5	53.1	58.2
Sewage to Ecomax effluent treatment system	1.1	0.4	0.4
Discharge through LDP001	3.6	269.8	34.6
Discharge through LDP002	0.0	0.0	0.0
Discharge through LDP003	0.0	0.0	0.0
Discharge through proposed LDP	N/A	0.2	0.2
Coal product	260.8	83.7	78.3
Retained in rejects		31.1	32.9
TOTAL OUTPUTS	**466**	**445**	**198**
CHANGE IN STORAGE			
Surface water storages	0.3	1.7	-0.3
TOTAL CHANGE IN STORAGE	**0**	**2**	**0**
BALANCE			
Inputs – Outputs – Change in Storage	0	0	0

As seen in Table 10.3 the sources and sinks for the salt balance at Airly Mine are broadly similar to the water balance. Under existing operations the predicted annual mass of salt input into the water management system is 466 tonne. The predicted annual mass of salt discharged under existing operations is predicted to be 261 tonne in product coal for a total of 466 tonne with other outputs.

Table 10.3 shows that under approved operations, the salt input is predicted to be 447 tonne and the predicted annual discharge of salt is 84 t in product coal for a total output of 445 tonne with other outputs.

Table 10.3 shows that under proposed operations, the salt input is 198 tonne and the predicted annual discharge of salt is 78 tonne in product coal for a total output of 198 tonne with other outputs.

The largest source of salt into the water management system is associated with groundwater inflows and extractions from the production bore. The salinity modelled to occur on site under existing conditions was found to be significantly greater than under proposed conditions. This is due to the large input of water extracted from the production bore which is expected to decrease over time as sufficient water for mining associated activities is anticipated to be supplied by water harvested from site and recirculated groundwater inflows into the underground workings.

Discharges from the 35 ML Discharge Dam through LDP001 into Airly Creek are predicted to occur infrequently during high rainfall periods and prolonged wet weather, which will dilute salinity levels in Airly Creek. The salinity levels of LDP001 discharges are predicted to range from 158 µS/cm (10th percentile) and 2,878 µS/cm (90th percentile) over the life of the Project. This is well within the proposed SSTV for the Project's EC (2998 µS/cm).

Salt discharges through LDP001 are predicted to be as follows:

- 3.6 tpa for existing operations
- 269.8 tpa for approved operations
- 35 tpa for proposed operations.

Catchment Hydrology and Hydraulics

New Hartley Shale Mine Potential Interaction Zone Flows

Surface cracking is expected in the New Hartley Shale Mine Potential Interaction Zone (Figure 8.2) due to the interactions with the existing shale workings and the Lithgow Seam extraction as a result of the Project. Surface cracks currently existing due to shale mining most likely intercept a proportion of surface flows and transfer them into the groundwater system. The Project is likely to induce further cracking and/or reactivate old fractures, with potential loss of more water from surface flows to deeper strata.

The catchment above the New Hartley Shale Mine Potential Interaction Zone contributes 5.5% of the catchment to the third order waterway of the tributary to Gap Creek on the west and 4% of the catchment to the third order section of Gap Creek to the east. At the junction of Gap Creek and Genowlan Creek the contribution of the New Hartley Shale Mine Potential Interaction Zone reduces to approximately 2% of the catchment area.

The catchment runoff that may be potentially lost from local waterways due to surface cracking overlying the New Hartley Shale Mine Potential Interaction Zone is expected to reappear downstream within the Gap Creek catchment. Therefore, the overall catchment losses due to proposed mining within this zone are not considered to be measurable.

Limited, if any, baseflow enters the surface water system above the New Hartley Shale Mine Potential Interaction Zone due to the nature of the topography.

The seep at Village Spring is fed by drainage from the old shale mine workings. Cracking may affect the Village Spring system and therefore there is a possibility that discharges from Village Spring may decrease or cease as a result of proposed mining.

All Other Subsidence Zones Flows

Surface cracking is not expected in the remaining proposed mining zones and there is not expected to be any reduction of runoff from these catchments due to the Project. Similarly, due to the absence of surface cracking, losses from drainage lines are not expected.

Table 10.4 presents the changes to baseflow with for two scenarios: the minimum likely change to hydraulic conductivity as a result of mining (Minimum Likely Impact) and the maximum likely change to hydraulic conductivity (Maximum Likely Impact). In addition to the predicted change in baseflow, Table 10.4 provides an indication of the predicted reduction in total annual flows (i.e. including catchment runoff) as a result of changes in baseflow for average rainfall conditions.

Table 10.4 shows that the Gap Creek catchment has the highest predicted annual reduction of flow at 3.4% under maximum likely change. This has little or no impact on the flows of ephemeral Gap Creek. All other maximum predicted flow reductions are smaller and so likewise have little to no flow impact.

The flows in The Oasis are predicted to not be impacted by the Project.

Table 10.4: Changes to Groundwater Baseflow due to Proposed Mining Operations (average rainfall)

Location	Existing (ML/y)	Minimum Likely Impact (ML/yr)	Maximum Likely Impact (ML/yr)	Estimated Reduction of Total Annual Base Flow for the Maximum Likely Impact Scenario
Gap Creek tributary at Project Application Area	15.1	14.8	11.5	2.8%
Gap Creek within Project Application Area	32.1	31.3	25.9	3.4%
Section of Gap Creek within mining footprint	3.8	3.4	1.5	2.2%
Genowlan Creek within Project Application Area.	9.2	9.0	5.4	2.1%
Section of Genowlan Creek within mining footprint	3.0	3.0	1.1	1.4%
Confluence Gap and Genowlan Creek	198.0	196.7	170.9	3.3%
Emu Swamp Creek	99.8	99.8	93.7	3.2%
Dog Trap Creek	85.4	85.4	78.5	2.1%
Malcolms Gully	106.5	106.5	94.1	3.0%
Airly Creek	1.4	1.4	0.6	0.2%
Torbane Creek	26.9	26.8	0.6	1.9%

Cumulative Impact

There are several impacts to waterways which when considered together have the potential to cause a cumulative impact to waterway flow. The following impacts have been considered to estimate the maximum predicted impact on waterway flow.

- Changes to baseflow due to mining.
- Changes to catchment runoff due to surface cracking.
- Changes to catchment runoff due to construction of the REA.
- Changes to LDP001 discharges due to future water management.

The outcomes from the assessment of the cumulative impact on waterway flow for the proposed conditions are presented in Table 10.5.

Table 10.5: Total Change to Waterway Flow due to Proposed Mining Operations

Location	Change due to baseflow (ML/year)	Change due to cracking (ML/year)	Change due to REA catchment loss (ML/year)	Change due to LDP001 discharge (ML/year)	Total predicted change to waterway flow
Gap Creek tributary at Project Application Area	-3.6	-7.7	0.0	0.0	-9.0%
Gap Creek within Project Application Area	-6.2	-5.7	0.0	0.0	-6.5%
Section of Gap Creek within mining footprint	-2.3	-3.4	0.0	0.0	-5.3%
Genowlan Creek within Project Application Area.	-3.8	0.0	0.0	0.0	-2.1%
Section of Genowlan Creek within mining footprint	-1.9	0.0	0.0	0.0	-1.4%
Confluence Gap and Genowlan Creek	-27.1	-13.4	0.0	0.0	-5.0%
Emu Swamp Creek	-6.1	0.0	0.0	0.0	-3.2%
Dog Trap Creek	-6.9	0.0	0.0	0.0	-2.1%
Malcolms Gully	-12.4	0.0	0.0	0.0	-3.0%
Airly Creek*	-0.8	0.0	-14.3	16.0	0.2%
Airly Creek**	-0.8	0.0	-14.3	70.5	14.5%
Torbane Creek	-4.0	0.0	0.0	0.0	-1.9%

* Impact on waterway flow when predicted LDP001 discharges are minimal.

** Impact on waterway flow when predicted LDP001 discharges are maximised and vary most from existing conditions.

As seen in Table 10.5, waterway flow in Gap Creek tributary at the Project Application Area and Airly Creek are predicted to potentially be the most impacted by the Project. It should be noted that the estimated losses caused by surface cracking are very conservative and the maximum predicted impact is unlikely.
The Gap Creek tributary is predicted to experience a 9% cumulative reduction in waterway flow, primarily due to reduced baseflow. The localised impacts in Gap Creek and Genowlan Creek dissipate further downstream. At the confluence of the two creeks the predicted reduction in total average flow is estimated to reduce by a conservative maximum of 5%.

Airly Creek is predicted to experience a maximum cumulative increase of 14.5% in flow. The increases in discharges from LDP001 will counteract reduced runoff from the REA and minor changes to baseflow.The proportional increases to waterway flow along Airly Creek are expected to reduce downstream in the vicinity of the Gardens of Stone National Park as the natural creek flow becomes more continuous. The predicted maximum increase in LDP001 discharges of 70.5 ML/year will occur during moderate to high rainfall events and therefore not have a significant impact on the current waterway condition.

Waterway Geomorphology

A site investigation was undertaken to identify the current physical characteristics of the waterways within the Project Application Area. The investigation focused on assessing the higher Strahler order waterways which are proposed to be directly mined beneath, namely Gap Creek and Genowlan Creek. The potential impacts of the Project on waterway geomorphology were assessed by comparing both the nature and condition of existing waterways against the potential surface subsidence and cracking due to the Project.

Due to the relatively undisturbed nature of the Project Application Area, most of the streamlines assessed are in good condition (approximately 71% of the assessed waterway length). Moderate condition reaches (approximately 25% of the assessed waterway length) generally exhibit moderate channel instability in the form of localised bank erosion, these reaches are typically associated with degraded riparian vegetation conditions and generally display evidence of past channel incision and ongoing localised lateral instability. Poor condition reaches (approximately 4% of the assessed waterway length) were associated with active headcuts.

Most waterways in the Project Application Area are considered to be relatively stable, which is a reflection of the landscape setting and type of waterway systems. Some waterways display existing instabilities in the form of either headward erosion or bank erosion. Headward erosion, as evidenced by a headcut, is erosion which occurs along a channel in the opposite direction to the flow of water. This causes down cutting or incision of the bed of a waterway and can alter the longitudinal profile of the waterway. Erosion can result in increased rates of sediment to be transported downstream.

Surface Water Quality

Subsidence Impacts

Subsidence induced cracking predicted in the New Hartley Shale Mine Potential Interaction Zone may drive a change in water quality due to the exposure of new rock surfaces and subsequent chemical interaction with rainwater. However, these changes are expected to be within the natural range of water quality variability.

In the remainder of the mining area, no surface cracking is predicted and no changes to water quality are predicted.

Localised changes to water quality including elevated suspended solids can occur due to the mobilisation of sediments caused by changes to the surface by surface movements. Due to the very low amount of surface movement these changes are expected to be not measureable and will be temporary.

The limited predicted subsidence is not expected to cause any measureable water quality impacts in the proposed mining area. Due to the minimal subsidence predicted along Gap Creek and Genowlan Creek, it is unlikely that there will be statistically significant changes to water quality within this catchment in the future as a result of underground mining. It is expected that the environmental value of the surface water within this catchment will be maintained.

LDP001 Discharges

The Project includes the construction of a CPP and REA and will therefore result in the generation of more runoff that has been in contact with ROM coal and coal reject materials. Information from other sites in the Western Coalfield has been reviewed to identify any potential water quality issues at LDP001 at Airly Mine in the future.

Proposed mining at Airly Mine will interact with the Lithgow Seam, part of the Western Coalfield located on a thin ‘shelf’ sequence on the western boundary of the Sydney Basin (Hunt and Telfer, 1983). Coal associated with the Sydney Basin were found by Hunt and Holday (1984) to consist of low to medium sulfur (<1.0%) seams in the distal facies and low sulfur (<0.55%) seams in the more proximal facies. Hunt and Holday (1984) reported that the Lithgow and Lidsdale seams contained approximately 0.80% sulfur, with sulfur being mainly organically bound. These findings were reiterated by Hunt (1987), who noted that the sulfur content of Late Permian coal measures including the Illawarra Coal Measures was approximately 0.65%.

Strip sample testing of coal extracted from the Lithgow Seam at Airly Mine indicates that total sulfur is in the order of less than 0.5%. Acid-base analysis used to assess the potential for coal mine waste materials to generate acid when exposed to an oxidised leaching environment has found that generally materials with total sulfur values of 0.5% or less are non-acid forming (Miller and Murray, 1988). Overall, these results indicate that the future operation of the CPP and REA at Airly Mine is unlikely to result in deterioration in water quality at LDP001, due to low pH.

The Project proposes to increase the use of groundwater from the production bore screened within the Shoalhaven sandstone. As discussed in the Groundwater Impact Assessment Report (GHD (2014a),

Appendix E), this groundwater is calcium/magnesium-sulfate type water with an EC in the brackish to saline range. The 50th percentile EC and concentrations of dissolved iron, manganese, nickel and zinc in this groundwater exceeds the Airly Creek SSTVs.

The salinity of discharges from LDP001 for the proposed conditions is predicted to vary between 158 µS/cm and 2,878 µS/cm. This salinity is less than the interim estimated SSTV of 2,998 µS/cm.

Proposed LDP (REA) Discharges

As part of the Project, Cantennial Airly proposes to create an LDP at the spillway of the REA Dam. A water quality analysis has been undertaken in order to assess the likely quality of the water within the dam and the impact of any potential discharges. Discharges through the proposed LDP would only occur during high rainfall events in excess of the 100 year, 72 hour storm event that the storage has been design to capture.

Based on available data for the Retention Dam below the co-disposal REA at Springvale Coal's Springvale Coal Services site, as well as EC predictions for the proposed REA Dam from the salt balance model, the quality of the water that may be discharged through the proposed LDP will be generally consistent with the existing water quality within Airly Creek.

The predicted EC within the proposed REA Dam is likely to be consistently below the SSTV for Airly Creek. In addition, TSS concentration and turbidity are unlikely to be an issue if managed appropriately within the Dam.

The data suggests that dissolved boron, nickel and zinc concentrations within the REA Dam may exceed the Airly Creek SSTVs by up to three times. However, any future discharge from the REA Dam would be associated with an extremely high rainfall event and it is likely that these concentrations would be diluted to concentrations below the SSTVs either prior to discharge or immediately downstream of the proposed LDP.

10.1.3.3 Groundwater Assessment

Groundwater Flow and Levels

A groundwater model has been prepared for the outcrop boundary of the Illawarra Coal Measures and extends into the Shoalhaven Group outcrop area and surrounding hydrogeological environment (Figure 10.2). Numerical modelling used the MODFLOW-NWT solver with the upstream weighting flow package. The model was calibrated under steady state and transient conditions using groundwater data. The calibrated hydrogeological model was used to provide estimates of groundwater interception and zones of drawdown in each groundwater source as a result of the development of the proposed mine workings, changes in baseflow to watercourses, as well as approximate recover times in groundwater levels and baseflow.

Groundwater Inflows

Hydrogeological modelling for the proposed operational condition was undertaken for two scenarios.

- Scenario 1 assumed no changes in hydraulic conductivity in the caving and fracturing zones above the panel and pillar mining zone. This scenario was modelled to provide a lower bound estimate for groundwater inflows and drawdown.
- Scenario 2 assumed increases in the vertical and horizontal hydraulic conductivity up to a height of 75 m above the panel and pillar mining zone, which is the maximum height of the fracture zone predicted by the Subsidence Impact Assessment (Golder Associates (2014), Appendix D). Scenario 2 also considered initial fracturing (active), long-term fracturing (goaf) and average fracturing conditions.

The predicted groundwater inflows that were obtained from hydrogeological modelling are presented in Figure 10.3 for proposed operation condition. Groundwater inflows predicted under Scenario 2 (average fracturing) were considered to be the most likely based on the current mine design. Results from Scenario 2 are presented in detail below for purposes of the impact assessment while results from Scenario 1 provide a sensitivity analysis on the outcomes of the modelling.

As shown in Figure 10.3, predicted inflows under Scenario 2 (proposed conditions) are expected to peak in 2030 at approximately 5.8 L/s (GHD, 2014a). Groundwater inflows into the underground workings under Scenario 1 are predicted to be significantly less, peaking in 2026 at 0.8 L/s (GHD, 2014a).

As a comparison hydrogeological modelling for the currently approved condition (GHD, 2014a) predicted that groundwater inflows into the mine workings would have peaked at approximately 21.1 L/s in year 16 of mining, a factor of 3.6 times higher than the proposed condition. The inflows for the approved condition areconsiderably higher than that predicted for proposed conditions due to the greater extent of fracturing above the full extraction panel mining area and the full extraction of panels in areas of lower depth of cover (Section 3.7.2).

As there is a projected increase in groundwater flow, underground pumping arrangements will need installed and maintained to manage this water inflow. The method of collection and management of the mine inflows is described in Section 4.11.2.

Alluvial/Quaternary Groundwater Sources

Groundwater drawdown within Gap Creek alluvium is predicted to be up to 3.5 m under proposed operations, while drawdown within Genowlan Creek alluvium is predicted to be up to 1.1 m. Predicted recovery times range from 5 to 60 years (with a median of about 20 to 30 years), depending on rainfall.

No drawdown is predicted in The Grotto or The Oasis areas under proposed conditions. The areas where groundwater drawdown due to the Project is predicted to occur within the alluvium / shallow strata are show in Figure 10.4. All drawdown within Gap Creek and Genowlan Creek alluvium is predicted to occur within the Project Application Area.

Under currently approved operations, groundwater drawdown within Gap Creek alluvium would have been up to 9 m with a recovery time of well over 60 years. No drawdown of Genowlan Creek alluvium would have occurred under approved operations as this part of the Project Application Area did not form part of the approved mining area.

Porous and Fractured Rock Groundwater Sources (Less Productive)

Depressurisation of the Narrabeen Sandstone is predicted to be not measureable throughout the majority of the vertical extent of this layer under proposed operations. There may be up to 2 m ofdrawdown at the base of the Narrabeen Sandstone stratum. Further details are provided in the Groundwater Impact Assessment (GHD, 2014a). Under the currently approved operations, depressurisation of the Narrabeen Sandstone would have been up to 12 m due to the increased height of fracturing from full extraction.

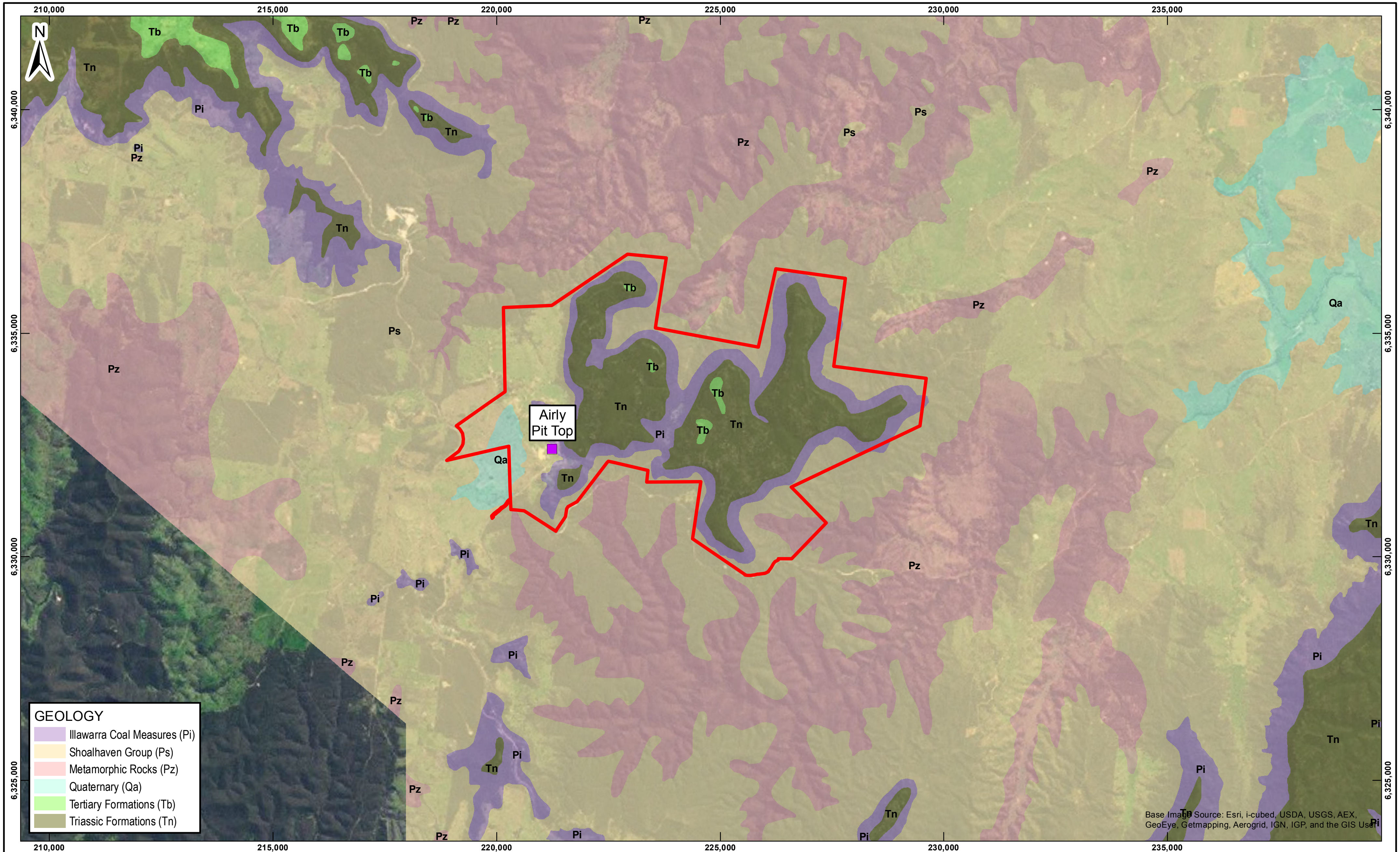
Depressurisation of the Permian strata under proposed operations is predicted to be up to 7.5 m within the fracture zones overlying the Lithgow Seam and up to 6 m within the underlying Marrangaroo Formation. Under currently approved operations, depressurisation would have been up to 12 m within the fracture zones overlying the Lithgow Seam and up to 7 m within the Marrangaroo Formation.

Predicted depressurisation of the underlying Shoalhaven Group regional groundwater source is 0.1 m for both proposed and approved mining scenarios. The areas where groundwater drawdown is predicted to occur due to the Project within the Shoalhaven Group strata are shown in Figure 10.5. Groundwater depressurisation is not predicted to extend to World Heritage Areas, including the Gardens of Stone National Park.

Due to depressurisation of the Permian strata within the New Hartley Shale Mine Potential Interaction Zone, there is potential for the flow at Village Spring to reduce or cease. The groundwater at Village Spring is mining related due to the previous fracturing by the former oil shale mining activities. Any groundwater lost from the Village Spring is likely to report to the proposed Lithgow Seam mine workings. All groundwater drawdown is predicted to be within the Project Application Area.

Porous and Fractured Rock Groundwater Sources (Highly Productive)

No drawdown is predicted for the fresh regional groundwater source that supplies the majority of registered groundwater users to the east of the Project Application Area. No groundwater impacts are predicted within World Heritage Areas, including the Gardens of Stone National Park. This applies for both proposed and approved operational scenarios assessed.



LEGEND

Project Application Area

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	15/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:110,000

Figure 10.2: Geological Map

0 1,000 2,000 3,000 4,000 Metres

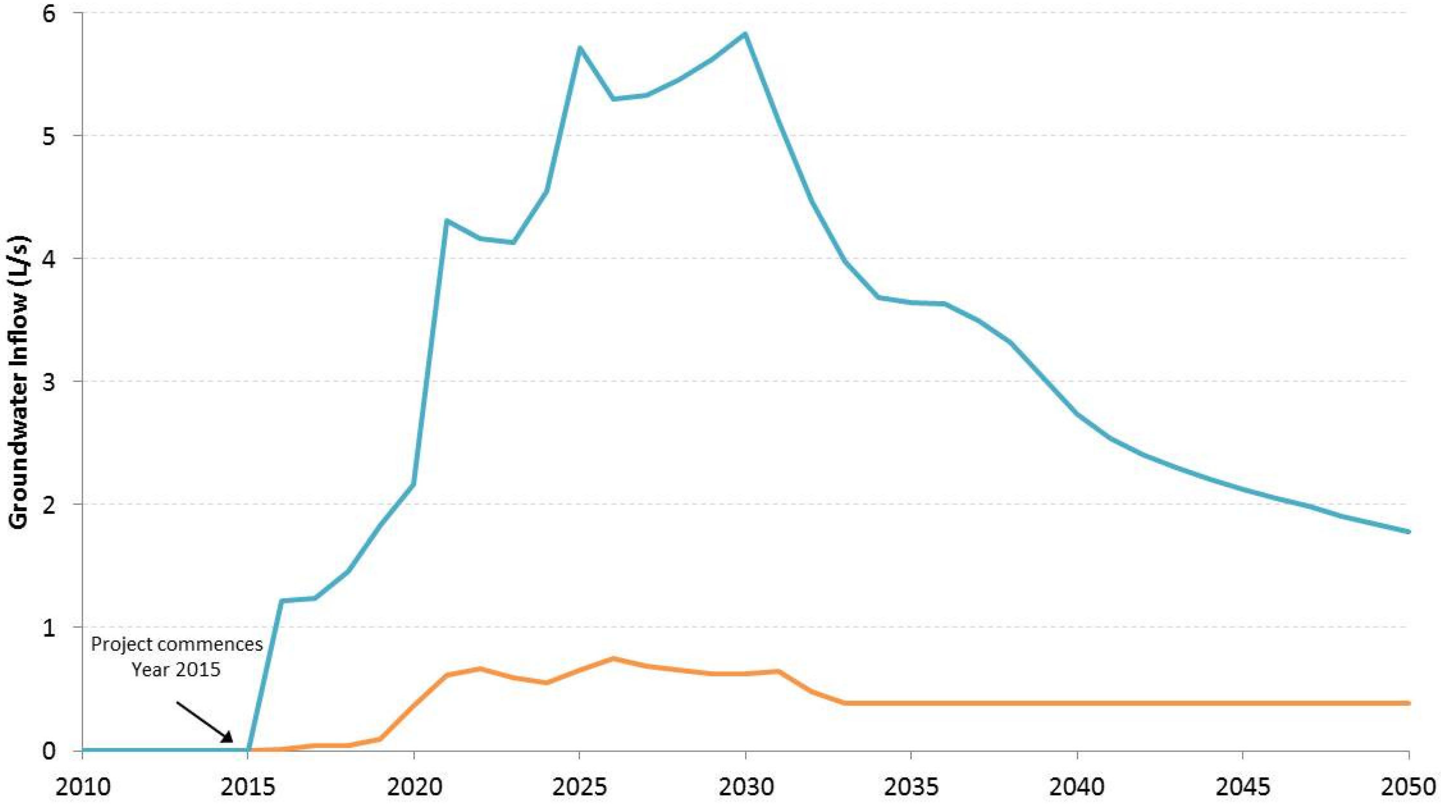
PLOTFILE No.

Centennial Coal

Airly

DRG No. 10-10.2

A4



LEGEND

Scenario 1
Scenario 2

DATE	15/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

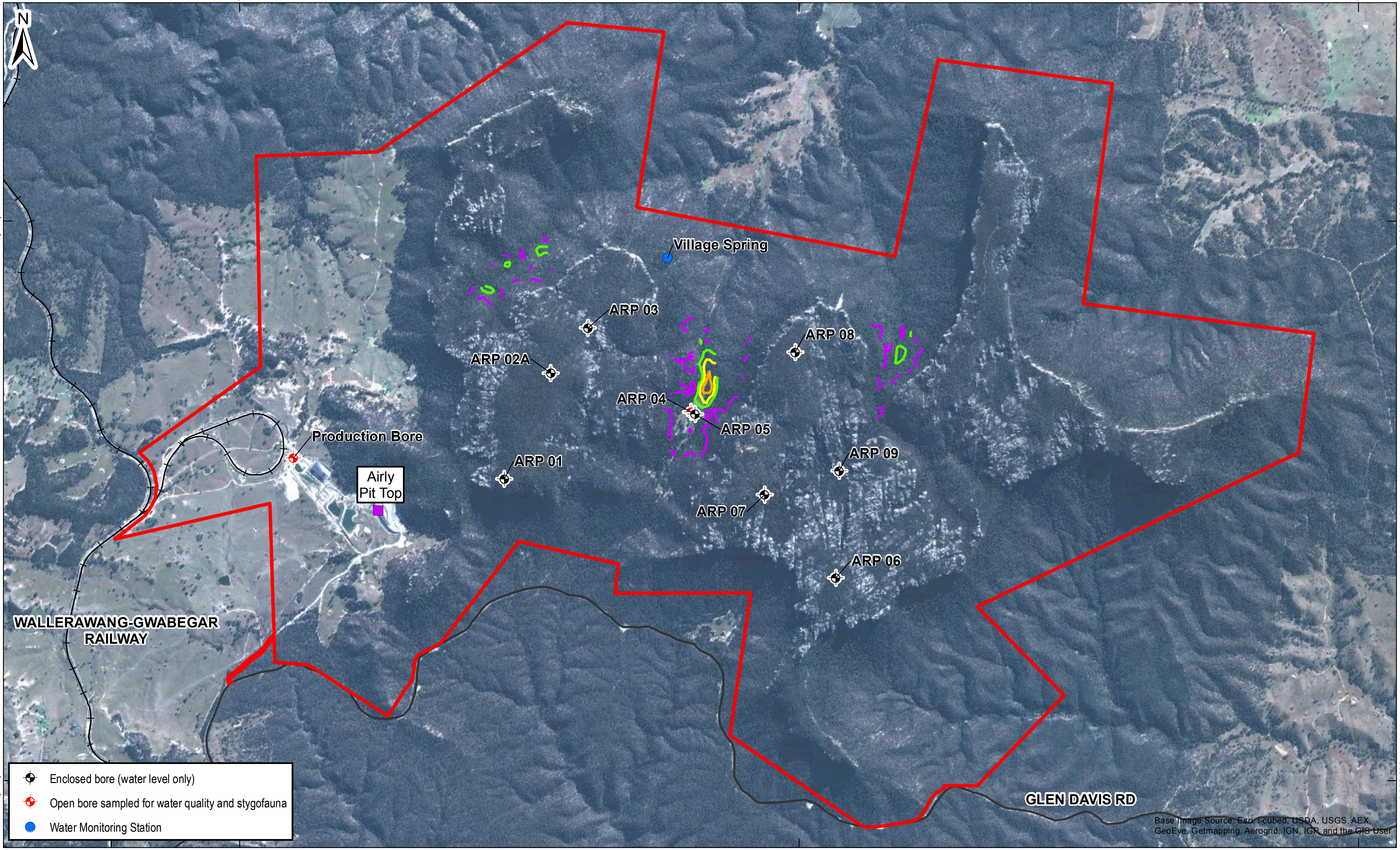
Figure 10.3: Modelled Groundwater Inflows for Proposed Conditions

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.3

A4



LEGEND

Project Application Area

Rail

Main Road

Drawdown

- 3m
- 2m
- 1m
- 0.1m

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:45,000

Figure 10.4: Predicted Drawdown in Shallow Strata-Proposed Scenario

0 500 1,000 1,500 2,000 Metres

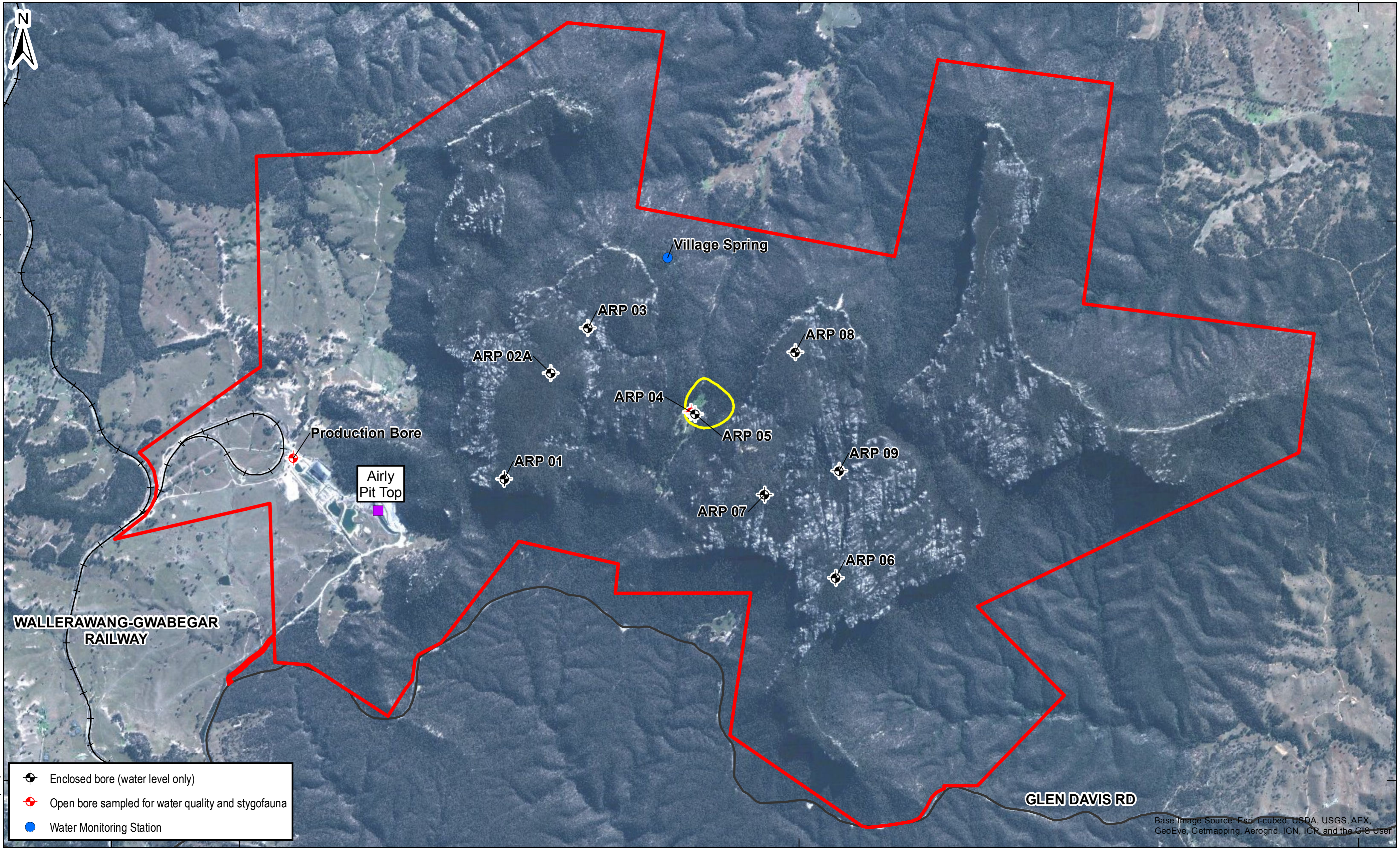
PLOTFILE No.

Centennial Coal

Airly

DRG No. 10-10.4

A4



LEGEND

Project Application Area

Rail

0.1m Drawdown

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:45,000

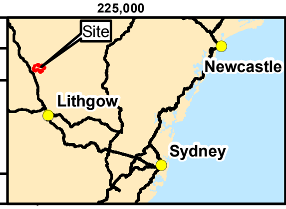


Figure 10.5: Predicted Drawdown in Shoalhaven Group - Proposed Scenario

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal

Airly

DRG No. 10-10.5

A4

Groundwater Quality

Alluvium/Quaternary Groundwater Sources

The alluvium and Quaternary groundwater sources include Gap Creek and Genowlan Creek alluviums as well as the Quaternary groundwater sources in the upper Genowlan Creek area (known as The Oasis). The existing beneficial use categories for Gap Creek and Genowlan Creek alluvium are the protection of 95% freshwater aquatic ecosystems as well as domestic and agricultural use.

Under proposed operations, it is predicted that the localised drawdown will not change these use categories either within the Project Application Area or outside. Between August 2012 and April 2013, the measured groundwater level at ARP05 (Gap Creek alluvium) fell by approximately 3.5 m due to climatic conditions (ie. the same as the predicted drawdown due to mining). Over this time, there was no change in groundwater quality. Therefore, groundwater drawdown is not predicted to result in an increase in salinity in connected surface waters, the Gap and Genowlan Creeks.

Under currently approved operations, fracturing of the Permian strata would have provided a pathway for increased groundwater flow to the Gap Creek alluvium in the short term until the storage in the Permian strata was reduced. The flow of Permian groundwater into the Gap Creek alluvium may have increased pH and EC and there may have been an increase in the salinity in Gap Creek at this point of more than 1%. This would not occur under proposed operations due to the larger separation distance between the panel and pillar mining zone and the alluvium.

Porous and Fractured Rock Groundwater Sources (Less Productive)

The Narrabeen Sandstone, Illawarra Coal Measures and Shoalhaven Group groundwater sources are considered to be ‘less productive’ under the Aquifer Interference Policy since the yields are typically less than 5 L/s and/or the groundwater salinity exceeds 1,500 mg/L. The less productive porous and fractured rock groundwater sources, primarily the Illawarra Coal Measures, are the main fractured rock groundwater sources.

The predicted drawdown in the porous and fractured rock groundwater sources is not expected to increase the interaction between poor quality (i.e. Permian and Shoalhaven Group) and higher quality groundwater located in the alluvium, Narrabeen Sandstone and Devonian regional groundwatersource.

Porous Fractured Rock Groundwater Sources (Highly Productive)

No drawdown or groundwater quality impacts are predicted for the fresh regional groundwater source located in the lower Devonian strata underlying the Shoalhaven formation that supplies the majority of registered groundwater users to the east of the Project Application Area. This applies for both proposed and currently approved operations.

10.1.4 Consequences of Potential Water Management Impacts

10.1.4.1 Flow

Surface Water

As compared to the currently approved operations, the inputs to the water management system under proposed conditions is predicted to be approximately half, primarily due to the lower underground workings inflows, due to the lower height of fracturing of the Project mine design and the consequently lesser change in vertical and horizontal permeability of strata.

Total annual average inputs into the water management system due to the Project are 33% higher than compared to existing operations. The annual average water discharges due to the Project will consequently be 33% higher than the existing situation and approximately 50% less than the approved operations. While modelling predicts that frequency of discharge from LDP001 will increase over the existing operations, discharges will still only occur for less than one month over the course of a year, and hence only minor impacts on flow rates within the ephemeral Airly Creek are expected.

Surface cracking in the New Hartley Shale Mine Potential Interaction Zone is predicted to cause water to enter the groundwater system. However, it is likely that this water will seep to the surface further downstream within the Gap Creek catchment. Therefore, the overall catchment losses due to proposed mining in this zone are not considered to be measurable. Surface cracking is not predicted for the remainder of the mining area, so no flow reductions are predicted.

Table 10.5 specifies the predicted percentage change in waterway flows considering changes to baseflow due to mining, to catchment runoff due to surface cracking and the construction of the REA and to LDP001 discharges. These reductions range from –9.0% to +14.5%, with the flows in Gap Creek tributary at the Project Application Area and Airly Creek respectively predicted to potentially be the most impacted by the Project. The impacts of the Project on waterway flow are predicted to dissipate downstream and are not expected to result in any observable impacts on downstream waterways.

Groundwater

Depressurisation of the Narrabeen Sandstone is predicted to be negligible (not measureable) under proposed operations.

Depressurisation of the Permian strata under proposed operations is predicted to be up to 7.5 m within the fracture zones overlying the Lithgow Seam and up to 6 m within the underlying Marrangaroo Formation.

Predicted depressurisation of the underlying Shoalhaven Group regional groundwater source is 0.1 m for proposed operations.

Up to 3.5 m of groundwater drawdown within Gap Creek and Genowlan Creek alluvium/shallow zone strata is predicted to occur under proposed conditions. Groundwater drawdown is expected to be localised to small sections of the creeks, approximately 300 m in distance, as shown in Figure 10.4.

Since there are no identified high priority groundwater dependent ecosystems (either vegetation or stygofauna) or groundwater supply works in the areas of groundwater drawdown, the predicted impacts are less than the Level 1 minimal impact considerations under the Aquifer Interference Policy and are therefore considered to be acceptable.

10.1.4.2 Water Quality

Surface Water

Localised changes in water quality due to subsidence as a result of underground mining are expected to be temporary and within the natural variability of the catchments.

The future operation of the CPP and REA at Airly Mine are not likely to result in the deterioration in water quality at LDP001, in terms of acidity.

The use of groundwater from the production bore for water supply during dry periods may result in an increase in EC and the concentrations of dissolved iron, manganese, nickel and zinc. However, onsite water management measures discussed in Section 10.1.7 will minimise the risk of discharge of this water to Airly Creek.

Groundwater

The existing beneficial use categories for Gap Creek and Genowlan Creek alluvium are environmental protection as well as domestic and agricultural use. Under proposed operations, it is predicted that these categories will not change in either the Project Application Area or further downstream.

10.1.4.3 Geomorphology

Underground mining can result in differential subsidence and surface cracking, which can change the gradient of waterways resulting in altered channel and floodplain morphology and can lead to bank and bed erosion and a loss of flow underground. The proposed mine design has been developed to prevent potential impacts on stream geomorphology.

Most watercourses overlying the proposed mine layout are first and second order streamlines. The third order streamlines overlying the general mine layout are limited to Gap and Genowlan Creeks, although the mine design has been modified to avoid Gap Creek by applying an exclusion zone of half the depth of cover.

The third order section of Gap Creek is approximately 170 m long and in poor geomorphic condition. No mining is proposed under Gap Creek where the depth of cover is less than 40 m and where it is greater, the fracture zone height is predicted to be less than 10 m and the maximum subsidence is 25.5 mm. Given the poor existing condition of this creek such low levels of subsidence is not expected to result any measurable change in the form or grade of this reach of Gap Creek.

The third order section of Genowlan Creek is approximately 1,200 m long and is in good geomorphic condition. Mining beneath the creek where the depth of cover is greater than 40 m will involve Shallow Zone workings where subsidence of up to 25.5 mm is predicted. This is associated with surface tilting of up to 1.1 mm/m (0.0011 m/m). The gradient of Genowlan Creek in the reach is approximately 0.03 m/m, an order of magnitude greater than the predicted tilt, therefore, any gradient changes are minimal and will have negligible impact on the form and functioning of Genowlan Creek.

Surface cracking is not expected along the third order length of Genowlan Creek overlying the proposed mine layout.

The change in ground level between adjacent areas of the Genowlan and Gap Creeks is expected to be minimal such that any change in creek bed slope or cross section is not expected to result in a significant hydraulic impact. It is therefore not expected that the Project will result in any significant modifications to hydraulic conditions such as flow depths, extents or velocities in the regions above the proposed mining area.

10.1.4.4 Downstream Water Users

Surface Water

Of the three identified licensed surface water users (refer Section 10.1.2.3), only one user (at Lot 5 of DP755786 holding WAL25822) has any potential of being impacted by the Project. The other two users are located at the far downstream extents of waterways interacting with the Project and occur on confluences where the impacted waterways intersect with other waterways, thereby dissipating any impact on the quantity and quality of water resource (if there is to be any potential impact at that location).

The conservative estimate for reduction in flow to the confluence of Gap Creek and Genowlan Creek indicates a maximum reduction in average annual flows at that point of 5% for the proposed Project. This proportion reduces to an estimated 3.8% of average annual flows at Lot 5 of DP755786. Based on the conservative nature of the assessment that assumes only 5% of rainfall is converted to runoff, a worst case scenario of baseflow loss and full loss in catchment above the New Hartley Shale Mine Potential Interaction Zone, the estimated percentage reduction of flows is likely to be a proportion of this estimated loss. This loss is likely to be within the bounds of natural variation.

The assessment of waterway flow found that localised impacts due to changes in baseflow, catchment runoff and discharges through LDP001 due to the Project are not expected to result in any observable impacts to downstream water users due to the small predicted reductions in flow and the ephemeral nature of waterways.

Groundwater

All groundwater impacts are within the Project Application Area for both proposed and approved conditions. As there are no registered groundwater users within the Project Application Area, the Project will not have any impacts on licensed or basic rights groundwater users.

10.1.4.5 Licensing Requirements

Water Management Act 2000

Surface Water

Airly Mine does not currently hold any surface water extraction licences. As part of the Project, a WAL will be required for the use of water in mining activities. According to the guide for the GMRU WSP (NOW, 2011), Centennial Airly will require licensing under the 'Unregulated River' category. Applications for new licences not currently on the water market are only generally considered for local water utilities, domestic purposes and Aboriginal cultural purposes. As a result, any WALs for Airly Mine will need to be obtained through the purchase of licences on the water market.

Exemption from Requirement for Access Licence

As specified by Section 31 of the *Water Management (General) Regulation 2011*, dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice to prevent the contamination of a water source, are considered to be 'excluded works' and are exempt from the requirement for a water supply works approval. The use of water from such dams is also exempt from the requirement for a WAL under Section 18 of the *Water Management (General) Regulation 2011*.

On this basis, coal- and sediment-laden runoff captured in the mine water management system from the site does not require licensing under the WM Act.

Water Used in Mining Activities

As detailed in Section 60I of the WM Act, a WAL is required for water used in mining activities where water is removed or diverted from a water source. Centennial Airly requires WALs as a result of the water reuse strategies in place that extract water from the water management system at the site that would otherwise be discharged into receiving waterways.

The predicted surface water WAL requirement for Airly Mine includes:

- Dust suppression from the Process Water Tank.
- Net use of water in underground mining workings supplied by the Process Water Tank.
- Transfers to the administration buildings from the Process Water Tank for use in toilets.
- Net CPP use from the 35 ML Discharge Dam.

The total predicted maximum mining related surface water usage for the site is 253 ML/year, based on the 90th percentile results of the water balance. It should be noted that due to the circulation of groundwater from the production bore and inflows into the underground mine workings, the volumetric limits specified by surface water licences for water used at Airly Mine may be considerably less than the predicted maximum volume.

Harvestable Rights

As a basic landholder right under the WM Act, landholders are entitled to collect and use a proportion of runoff from their property, known as a 'harvestable right', which is determined from the total contiguous area of land ownership. If the maximum harvestable right for a site is exceeded, licensing for the volume of water extracted from the surface water source exceeding the harvestable right is required under the WM Act.

The capture of clean runoff from undisturbed catchments in the mine water management system is within the maximum harvestable right for Airly Mine. As such, there is no licensing for clean catchment runoff required under the WM Act.

Construction Requirements

There are no licensing requirements for the surface water storages proposed as part of the REA as:

- Surface water storages will be constructed for the purpose of erosion and sediment control.
- Surface water storages will be constructed for the purpose of managing potential water quality contaminants.
- Surface water storages will be constructed without a catchment and hence do not collect runoff.

Groundwater

As discussed above, Section 60I of the WM Act requires a WAL for water used in mining activities where water is removed or diverted from a water source. Centennial Airly requires licensing as a result of predicted groundwater interception within the mine workings and the use of groundwater from the production bore.

Airly Mine currently hold two WALs under the WM Act to extract groundwater from the Sydney Basin North Groundwater Source up to 278 ML/year.

The predicted groundwater WAL requirement for Airly Mine includes:

- Groundwater inflows into the underground workings.
- Groundwater extraction via the existing production bore.
- Coal moisture, which is removed with the ROM coal.

The total predicted groundwater licensing requirement for the site is 260 ML/year, based on the 90th percentile results of the water balance. This volume is well below Centennial Airly's current WAL limit for the Sydney Basin North Groundwater Source of 278 ML/year. The volume of entitlement in the Sydney Basin North Groundwater Source is well below the long term average annual extraction limit (LTAAEL), even when the basic landholder rights component of 722 ML/year is included.

Protection of the Environment Operations Act 1995

As part of the Project, a new discharge location is proposed at the spillway of the REA Dam (Figure 4.2). The results of the water balance indicate that the REA Dam is not predicted to discharge under any of the historic rainfall patterns modelled. Therefore, no volumetric discharge limit is proposed for the LDP, as discharges are only expected to occur as a result of emergency discharges due to extreme rainfall conditions.

The water quality limits for the new LDP at the REA Dam are proposed to be equivalent to limits on LDP002 and LDP003, which are also emergency discharge locations. The recommended limits for water quality at the proposed LDP are provided in Table 10.6.

Table 10.6: Proposed Water Quality Limits for REA Dam LDP

Parameter	Recommended limit
pH	6.5–9.0
TSS concentration	50 mg/L
Oil and grease concentration	10 mg/L

The discharge points of LDP001, LDP002 and LDP003 are proposed to be maintained with the current limits defined by EPL 12374.

10.1.5 Cumulative Impacts

Airly Mine is located away from other significant developments. There are no other known major industries located in the area and therefore there are no other developments to be considered contributing to the cumulative impact of the Project in relation to surface water or groundwater.

Regional Water and Salt Balance

An assessment of the major water users in the Western Coalfield was undertaken in the Western Coalfield Water and Salt Balance (Appendix F). The purpose of the assessment was to provide context to the cumulative impact of coal mining with respect to water demands and distribution in the Western Coalfield over 25 years from year 2013.

Airly Mine is located within the northern study area of the regional water and salt balance and future water management for Airly Mine has been incorporated into the assessment. A focus of the regional water and salt balance of the Western Coalfield was to estimate the likely extractions and discharges of coal mining and power generators in the region.

The future predicted ingress of water into the mine workings at Airly Mine is the only identified coal mine in the study area of the regional water and salt balance that will extract water from the Sydney Basin North Groundwater Source which is covered by the GMR WSP. There are no other mining operations that extract from the Sydney Basin North Groundwater Source. The current entitlement for the water source is 557 ML/year and as such the WAL volume currently held by Centennial Airly represents approximately 50% of the total entitlement for the water source.

The Project Application Area is located within the GMRU WSP, which became operational in July 2011. Airly Mine is located within the Capertee River Management Zone of the Hawkesbury and Lower Nepean Rivers Water Source, covered by the GMRU WSP. Other identified coal mines which have potential to discharge into the Hawkesbury and Lower Nepean Rivers Water Source include Clarence Colliery, Angus Place Colliery and Springvale Mine. However, discharges from Angus Place Colliery and Springvale Mine into the Hawkesbury and Lower Nepean Rivers Water Source are on an emergency basis only and do not occur as part of the normal operations of those sites. Airly Mine is predicted to discharge up to 180 ML/year in high rainfall years toward the end of mine life, whilst discharges into the same water source by Clarence Colliery are expected to be between 3,000 ML/year and 5,000 ML/year until its predicted end of mine life in 2026.

The regional water and salt balance indicates that Airly Mine is the only coal mine or power generator in the region that will be licensed to extract from the Hawkesbury and Lower Nepean Rivers Water Source. The current entitlement for the water source is 120,532 ML/year. As such potential WAL volume for Airly Mine is expected to be less than 0.4% of the total entitlement for the water source.

10.1.6 World Heritage Areas

The 15,100 ha Gardens of Stone National Park adjoins the southern boundary of the Project Application Area, while the 501,700 ha Wollemi National Park is further to the north and east. Together these and other reserves in the region (Blue Mountains, Nattai, Kanangra-Boyd and Thirlmere Lakes National Parks and Jenolan Caves Reserve) make up the Blue Mountains World Heritage Area.

Airly Creek enters the Gardens of Stone National Park immediately south of the Project Application Area. An assessment of flow and quality impacts shows that during the Project the following will occur.

- There will be a maximum increase in water flow under maximum predicted LDP001 discharge of 14.5%. The increases in flow are expected to proportionally decrease downstream as natural creek flows become more continuous.
- In very dry conditions, when the mine relies more on the production bore for process water, there will be increases in EC and concentrations of iron, manganese, nickel and zinc in process water. To minimise the risk of discharge to Airly Creek under these conditions, the 35 ML Discharge Dam will be kept at a low level to provide additional freeboard and dilution with surface water will ensure that metals and salts

will be diluted by more than 50%. The salinity of discharges direct from LDP001 are predicted to range from 158 to 2,878 µS/cm. This maximum is less than the interim SSTV of 2,998 µS/cm.

Gap Creek is in the centre of the proposed mining area and flows into Genowlan Creek north of the Project Application Area. Predictions show that at the point where Gap Creek exits the Project Application Area, flows will reduce by 5.3% and no changes to water quality are predicted.

Genowlan Creek is in the centre of the mining area under Genowlan Mountain and predictions show that at the point at which the creek leaves the Project Application Area, flows will reduce by a 1.4%, No changes to water quality are predicted.

At the confluence of Gap and Genowlan Creeks, the conservative maximum predicted reduction in flows due to the Project is 5%. Actual reductions are likely to be less than this amount and be indistinguishable from the natural variations in the creek flow.

Both Airly Creek and the Gap Creek/Genowlan Creek catchment join the Capertee River, which enters Wollemi National Park approximately 35 km east of the Project Application Area. The sections of these two catchments within the Project Application Area are very small in relation to the catchment area of the Capertee River prior to its entry into Wollemi National Park. The changes in flow and water quality in the Capertee River in the World Heritage Area are expected to be immeasurable.

10.1.7 Water Management and Mitigation Measures

The mine design, and the Project itself, has been formulated to minimise impacts on the surface and groundwater environment. The water management system will operate to maximise reuse and minimise uncontrolled discharges to avoid or reduce the potential impact on the receiving environment.

When the production bore is used for water supply, the EC and concentration of dissolved metals (iron, manganese, nickel and zinc) within the water management system at the Airly Mine surface facilities area will likely increase. In this case, actions will be taken on site to minimise the risk of discharge to Airly Creek. The following actions will be taken.

- Maintain the water level within the 35 ML Discharge Dam at a low management level so there is sufficient freeboard in the case of a significant rain event.
- Ensure that groundwater extracted from the production bore is sufficiently mixed with surface water runoff in the 109 ML Dirty Water Dam. The water and salt balance predicts that the EC of groundwater from the production bore will reduce by more than 50% due to dilution within the water management system. It is expected that metal concentrations will dilute by a similar proportion.
- Maximise recycling of water from the CPP and extract from the production bore only when required.

A Water Management Plan has been developed as part of the Environmental Management System at Airly Mine to ensure the operation of the mine, with respect to water, meets all relevant regulatory requirements. The Water Management Plan will be updated to include formulated actions including remedial measures to be implemented if thresholds are exceeded, along with reporting, training and personnel responsibilities under the plan.

The Water Management Plan will be updated to include an additional four monitoring bores that will be installed in late 2014 by Centennial Airly to improve coverage within areas of predicted groundwater depressurisation in Gap Creek and Genowlan Creek alluvium. These monitoring would include the following.

- Monitoring of the Permian strata in the area of the identified potential draw down zone on Gap Creek.
- Monitoring of alluvium, Permian, Shoalhaven and Devionian strata in the area of the potential draw down zone on Genowlan Creek.
- Monitoring of Permian, Shoalhaven and Devionian strata in the upper reaches of the eastern arm of Genowlan Creek.

- Monitoring of alluvium at the upstream end of the Grotto feature.

GHD (2014a) considered that the spatial coverage of the existing groundwater monitoring bores and those proposed above is adequate for the purpose of predicting and monitoring groundwater impacts associated with the Project. The local groundwater sources are limited in extent by outcrop boundaries, creating a ‘closed’ hydrogeological system of rainfall recharge and seepage within the Project Application Area. This limits the required spatial coverage of groundwater monitoring bores to gain an understanding of the hydrogeological system.

A Groundwater Monitoring and Management Plan (GMMP) will be developed as part of the updated Water Management Plan and will monitor:

- Piezometric height
- Groundwater quality and flow
- Daily groundwater volumes transferred to the surface facilities area from the underground

The GMMP will establish critical threshold levels for groundwater levels and groundwater quality to trigger additional assessment and management, and will define the mechanism for identifying and reporting exceedances. Action will be taken if the Level 1 minimal impact considerations (or other critical threshold levels) are found to be exceeded.

Groundwater monitoring data will be audited on an annual basis and compared to hydrogeological modelling predictions. The GMMP will define the mechanism for identifying and reporting variations from predictions. Should more than 278 ML/year of groundwater flow into the underground mine workings (i.e. more than the existing WALs) due to greater than predicted storage within the Permian strata (particularly within the old shale workings), it will be necessary for Centennial Airly to purchase an additional groundwater WAL to cover the excess groundwater volume.

The Water Management Plan will be updated to include the management of the proposed REA Dam. This structure will be maintained at low levels during normal operations using a pump and pipe arrangement with float operated automatic start and stop functionality. Water from the REA Dam will be recycled to the 109 ML Dirty Water Dam for dilution and use as process water.

An Erosion and Sediment Control Plan specific to construction activities on site will be prepared prior to commencement and will detail relevant erosion and sediment control procedures and methods to manage erosion and sediment during mining operations.

Regular monitoring and reporting will be undertaken, through the Annual Environmental Management Review, which will review the performance of the water management system.

A comprehensive surface water monitoring program has been developed as part of the Environmental Management System at Airly Mine (Section 3.14.4). Prior to the commencement of the Project, the current Water Management Plan will be updated as appropriate to ensure the monitoring program monitors the volume and quality of off-site discharges and surface water flows and quality in surrounding watercourses. The Water Management Plan will include:

- surface water impact assessment criteria, such as the trigger values including EPL 12374 limits and default trigger values defined by ANZECC/ARMCANZ (2000)
- procedures for the investigation and mitigation of identified exceedances of the criteria
- monitoring of both subsidence depths and flow rates at the existing monitoring locations and development of a Trigger Aaction Response Plan for subsidence management
- volumetric water quantity monitoring at LDP001 on a daily basis when discharging and continuously at Village Spring, The Grotto and Gap Creek. An additional flow gauge will be installed on Genowlan Creek in late 2014.

Surface Water quality monitoring will be undertaken as outlined in Table 10.7.

Table 10.7: Proposed Water Quality Monitoring Program

LDP001 LDP002 LDP003 Proposed LDP	Daily (when discharging)	▪ pH, TSS, oil and grease, EC, turbidity
	Monthly (when discharging)	▪ pH, TSS, oil and grease, EC, TDS, turbidity, major cations/anions, total hardness, total nitrogen, total phosphorus, oxidised nitrogen, ammonia ▪ Total metals: Cu, Pb, Ni, Co, Zn, Al, As, B, Ba, Be, Cd, Fe, Mn, Mo, Cr ▪ Dissolved metals: Cu, Pb, Ni, Co, Zn , Al, As, B, Ba, Be, Cd, Fe, Mn, Mo, Cr
Airly Creek Airly Tributary The Grotto Gap Creek	Monthly	▪ pH, TSS, oil and grease, EC, TDS, turbidity, major cations/anions, total hardness, total nitrogen, total phosphorus, oxidised nitrogen, ammonia ▪ Total metals: Cu, Pb, Ni, Co, Zn, Al, As, B, Ba, Be, Cd, Fe, Mn, Mo, Cr ▪ Dissolved metals: Cu, Pb, Ni, Co, Zn , Al, As, B, Ba, Be, Cd, Fe, Mn, Mo, Cr

The following measures will be undertaken to monitor the assessment of groundwater impacts and ensure impacts are minimised.

- Augmentation of the existing groundwater monitoring network with monitoring bores within Gap Creek and Genowlan Creek alluvium in the areas of predicted groundwater drawdown.
- Monitoring of the daily groundwater volumes transferred to the surface facilities area during operations as required.
- Statistical trend analysis of groundwater level monitoring data to be undertaken on an annual basis to identify non-rainfall related trends.
- Should dissolved metal concentrations in Airly Creek exceed SSTVs due to site discharges appropriate toxicity testing of the discharge will be undertaken to determine the size of the downstream mixing zone in accordance with ANZECC/ARMCANZ (2000) methodology.

10.1.8 Conclusions

The mine design and the Project itself have been formulated cognisant of the existing surface and groundwater environment. The mine design limits vertical fracturing and so minimises changes to hydraulic conductivity and surface cracking. The mine design also applies exclusion zones around Gap Creek to avoid unintended subsidence impacts in shallow areas.

The Project is a major potential source of salt input into surface water systems. A site-specific salt balance was therefore undertaken as part of the Water and Salt Balance Assessment (GHD (2014b), Appendix F) based on requirements for assessment by the *Independent Expert Scientific Committee* as detailed in IESC (2014). A summary of the requirements is presented in Appendix F and Table 1.5 of this EIS. The objective of the salt balance is to assess the potential changes in salinity of surface water resources as a result of the mining operations.

The key conclusions of the water impact assessment are that the Project will:

- increase discharges through LDP001, to up to a peak of 21 discharge days in 2030
- given that such discharges will be during high rainfall or prolonged wet weather, any reductions in water quality will be diluted
- result in discharges from LDP001 to be within the relevant SSTVs
- have insignificant consequences to waterway hydraulics or geomorphology
- cause an insignificant reduction in Gap Creek flows due to increased surface cracking in the New Hartley Shale Mine Potential Interaction Zone
- cause the Village Spring to decrease or cease flows
- cause a 3.5 m drawdown in the alluvial groundwater system over approximately a 300 m length of Gap Creek
- cause a 1.1 m drawdown in the Genowlan Creek alluviums for approximately a 300 m length
- not cause a drawdown in the alluvial groundwater of The Oasis or The Grotto
- not affect the fresh-brackish regional groundwater system east of the Project Application Area that supplies the majority of registered groundwater users in the area
- maintain the beneficial use categories for all groundwater systems
- not change surface water quality beyond the current natural variation
- have no cumulative impact with other industries or operations in the region
- cause no groundwater drawdown within the Gardens of Stone National Park
- cause a minimal increase to surface water flow within the Gardens of Stone National Park
- not cause a change to creek geomorphology or water quality is expected within the Gardens of Stone National Park. .

The Project will produce effects less than the Level 1 minimal impact considerations in the Aquifer Interference Policy and will not require additional groundwater Water Access Licence allocations..

10.2 Ecology

This section summarises the Flora and Fauna Impact Assessment (Appendix H) and the Aquatic Ecology and Stygofauna Impact Assessment (Appendix G), which respond to the DGRs and provide the following in regard to biodiversity aspects:

The Director General's requirements

Biodiversity – including:

- measures that would be taken to avoid, reduce or mitigate impacts on biodiversity, particularly Temperate Highland Peat Swamps
- accurate estimates of direct vegetation impacts, such as clearing and subsidence and indirect impacts such as 'edge effects'
- detailed assessment of potential impacts of the development on any
  - terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities, groundwater dependent ecosystems
  - regionally significant remnant vegetation, or vegetation corridors.
- a detailed assessment of the impact of the project on the Mugii Murum-ban State Conservation Area (SCA), with reference to the issues identified in the Draft Plan of Management for the SCA and how subsidence monitoring is proposed to be undertaken with minimal impacts in the SCA
- an offset strategy, which is clearly quantified, to ensure that the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term.

Water Resources– including:

- assessment of impacts on riparian, ecological, geo-morphological and hydrological values of watercourses, including GDEs and environmental flows.

10.2.1 Introduction

This section identifies the potential ecological impacts of the Project. It is informed by the technical assessment *Airly Mine Extension Flora and Fauna Impact Assessment*, July 2014, RPS Australia East Pty Ltd (RPS 2014a, Appendix H) and the *Airly Mine Extension Aquatic Ecology and Stygofauna Assessment*, July 2014, Cardno Pty Ltd (Cardno 2014) (Appendix G).

The purpose of the flora and fauna assessment was to examine the likelihood of the Project having a significant effect on any threatened species, populations, or ecological communities listed under the TSC Act and the EPBC Act. The aquatic ecology and stygofauna assessment focuses on the aquatic ecological attributes of streams and swamps in accordance with the NSW *Fisheries Management Act, 1994* (FM Act).

This section discusses the existing environment, potential impacts, consequences of potential ecological impacts and mitigation measures for terrestrial flora and fauna, swamps, aquatic and stygofauna.

10.2.2 Methodology

10.2.2.1 Terrestrial Ecology

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring within the Project Application Area and wider region (i.e. within 10 km of the Project Application Area).

Databases searched to identify State and Commonwealth records of threatened entities and Commonwealth Matters of National Environmental Significance (MNES) were:

- review of fauna and flora records contained in the NSW BioNet, Office of Environment and Heritage Atlas of NSW Wildlife (Accessed May 2014) within a 10 km radius of the Project Application Area
- review of fauna and flora records contained in the EPBC Act Protected Matters Search Tool accessed in July 2013.

The Project Application Area has been subject to a number of broad regional scale vegetation mapping projects. Mapping by DEC (2006) was used as the basis for developing a preliminary assessment of likely vegetation types within the Project Application Area.

A variety of field survey techniques recorded a representative sample of flora and fauna across the Project Application Area. The surveys included site inspections to identify initial constraints to inform Project design, and various flora and fauna survey methods. Vegetation mapping ground-truthing consisted of rapid data point and quadrat surveys. The impact assessment is based on data from registers, literature reviews, and survey data from RPS (2014a) and the University of Queensland. The survey datasets have been collected for different purposes, with RPS addressing relevant survey guidelines, while the University of Queensland undertook more compliance-focussed survey.

Surveys were undertaken using the methodology for targeting listed threatened species, ecological communities and their respective habitat, including OEH's *Survey and Assessment Guidelines (2009)* and the former SEWPAC *Species - Specific Survey Guidelines for Nationally Threatened Species.* Fauna survey methods included Elliott trapping, harp traps, hair tubes, bat echolocation, spotlighting, call playback, diurnal bird and herpetological surveys, opportunistic surveys and habitat assessments. Targeted searches for threatened flora and fauna species were also undertaken.

Apart from Project specific surveys, seasonal vegetation monitoring has been undertaken at the site. The fauna surveys for the Flora and Fauna Impact Assessment (RPS, 2014a) were carried out over 14 months, between May 2012 and April 2014.

Stratification of fauna surveys was based on the existing vegetation mapping of the Project Application Area (DEC 2006). In accordance with DEC (2004), areas to be surveyed were initially stratified on biophysical attributes (e.g. soil, geology) followed by vegetation structure (e.g. woodland, forest, heath) and then floristics. For the purpose of identifying fauna habitat stratification units, four broader habitat types were established, namely Mountain Top Rocky Heath, Valley Floor Grassy Woodland, Dry Montane Forest and Moist Gully Forest. Whilst fauna surveys used these more broadly defined stratification units, flora surveys utilised each specific identified vegetation community to determine flora survey effort to be undertaken. Table 10.8 shows the survey effort.

Table 10.8: Stratification Units and Suggested Fauna Survey Effort of Survey Methods

Stratification Unit			Mountain Top Rocky Heath (401ha)		Valley Floor Grassy Woodland (70ha)		Dry Montane Forest (2502ha)		Moist Gully Forest (512 ha)		Total Suggested	Total Undertaken
			Suggested	Undertaken	Suggested	Undertaken	Suggested	Undertaken	Suggested	Undertaken		
Small mammals	Terrestrial A	Trap Nights	500	515	200	200	2,600	2,621	600	646	3,900	3,982
Medium sized mammals	Terrestrial B		500	531	200	200	2,600	2,617	600	646	3,900	3,994
Large mammals	Cage		120	114	48	48	624	630	144	156	936	948
Arboreal mammals	Arboreal B		120	122	48	48	624	626	144	156	936	952
Various sized mammals	Hair Tube Terrestrial		180	250	80	150	1020	946	225	230	1,425	1,576
	Hair Tube Arboreal		180	250	80	150	1020	950	225	230	1,425	1,580
	Motion detection Camera		N/A	15	N/A	8	N/A	64	N/A	48	N/A	135
Bats	Harp trap		16	17	4	8	100	85	20	29	140	139
	Ultrasonic detection	Hours	32	64	8	192	200	1008	40	624	280	1888
Various nocturnal mammals and birds	Spotlighting on foot		8	2.2	4	4.8	52	62	12	28	76	97
	Spotlighting in car		0.8	1.2	0.1	1.1	2.5	11.5	1.2	3.7	4.6	17.5
	Call Playback (mammals)		4	8	2	5	25	23	5	5	36	41
	Call Playback (birds)		31 locations at 1km apart across the site.					41 play back sessions undertaken at various sites spread throughout the site				
Diurnal birds	Area Search		N/A	6	N/A	10	N/A	52	N/A	16.7	N/A	84.7
Reptiles	Habitat Search		4	22	1	3	25	26	5	3	35	54
	Spotlighting		4	2.2	1	4.8	25	62	5	28	35	97
Amphibians	Habitat Search		1	16.5	1	2	1	14.5	1	3	5	36

10.2.2.2 Aquatic Ecology

The descriptions of the aquatic ecosystem are based primarily on field investigation of the aquatic habitats, quality of water, aquatic flora and fauna in Dog Trap Creek, Genowlan Creek, the upper reaches of Genowlan Creek, Gap Creek, Torbane Creek and Airly Creek.

The aims of the aquatic ecology sampling were to obtain an adequate representation of aquatic habitats and biodiversity within and around the Project Application Area to describe the existing environment and support the assessment of potential impacts; and to collect specific baseline data for ongoing aquatic ecosystem monitoring.

An initial site visit to assess the availability of permanent aquatic habitat and select sampling sites was completed on 15 April 2013. Baseline monitoring events were undertaken in autumn and spring 2013, and autumn 2014. In autumn 2013, the Project Application Area was visited over two events (May and June), which have been combined to form the autumn season.

Twelve monitoring sites were selected based on available surface water, and to achieve an adequate representation of aquatic habitats present.

The monitoring methodology was as follows:

- description of the surface water habitats and vegetation using the Australian Rivers Assessment System (AusRivAS) habitat assessment (Turak *et al.* 2004), a modified version the River-Creek-Environment developed by *Chessman et al. (1997)* and the fish habitat assessment criteria (DPI (2013))
- measurement of temperature, electrical conductivity, salinity, pH, dissolved oxygen and turbidity just below the surface of the water column and at depth where sufficient water was available, and comparison with ANZECC/ARMCANZ (2000) for south-east Australian upland streams and Site Specific Trigger Values
- water sampling and laboratory analysis of a range of metals, nutrients and other water quality indicators, completed by ALS as part of ongoing water quality monitoring
- sampling, sorting and identification of aquatic macroinvertebrates associated with stream edge habitat in accordance with AusRivAS protocols (Turak *et al.* 2004)
- sampling of fish using a backpack electrofisher. .

10.2.2.3 Stygofauna

Stygofauna samples were collected on 21 May 2013, 11 June 2013 and 4 December 2013 from the existing shallow piezometer (ARP05) near Gap Creek, the Production Bore (AM2B) near the coal handling facility and the Old Production Bore (AM2B-1) (Figure 2.9). Since the spring 2013 sampling event (December), three new bores have been drilled within the project Application Area these additional bores (were sampled in autumn 2014 (2-4 June).

The sampling methods differed for each bore due to their characteristics. The Production Bore (AM2B) is fully enclosed, so water was extracted using a submersible pump and discharged through a small diameter sampling hose under moderate pressure. The detailed sampling methodology to obtain sample from this site and other monitoring site is described in Cardno (2014).

At the ARP05, ARP07, ARP08, ARP09 sites (Figure 3.5), the bores are purged before monthly water quality samples are collected. This process involves removing water using a bailer until consistent pH and EC measurements are collected.

10.2.3 Existing Environment

10.2.3.1 Terrestrial Ecology

This section provides an overview of the results of desktop searches and field surveys, focusing particularly on those species listed under the TSC Act and or the EPBC Act. A full list of species identified is presented in Appendix H.

Flora

Relevant information was reviewed on the ecological values in the Project Application Area and locality. The results of database searches (OEH Atlas of NSW Wildlife and EPBC Act Protected Matters Search Tool) and field surveys indicated that 26 threatened flora species have been previously recorded within 10 km of the Project Application Area and/or have potential habitat within the Project Application Area.

Those threatened plant species identified from literature reviews, field surveys and database searches that have been assessed on the likelihood of occurrence of potentially occurring within the defined Project Application Area based on suitability of habitat are listed in Table 10.9. Three threatened flora species were observed within the Project Application Area during surveys. The locations of these threatened flora species are shown in Figure 10.6.

Table 10.9: Likelihood of Occurrence of Threatened Plant Species within the Project Application Area

Species / Community	TSC Act	EPBC Act	Likelihood of Occurrence within the Project Application Area
Acacia bynoeana Bynoe's Wattle	E	V	possible
Acacia flocktoniae Flockton Wattle	V	V	unlikely
Asterolasia elegans	E	E	unlikely
Astrotricha crassifolia Thick-leaf Star-hair	V	V	unlikely
Callistemon linearifolius Netted Bottle Brush	V		unlikely
Cryptostylis hunteriana Leafless Tongue-orchid	V	V	unlikely
Darwinia peduncularis	V		possible
Eucalyptus aggregata Black Gum	V		unlikely
Eucalyptus cannonii Capertee Stringybark*	V		recorded
Euphrasia arguta	CE	CE	unlikely
Grevillea evansiana	V	V	possible
Grevillea obtusiflora subsp. fecunda Grey Grevillea	E	E	possible
Leionema sympetalum Rylstone Bell	V	V	unlikely
Pelargonium sp. *Striatellum* (G.W.Carr 10345) Omeo Stork's-bill	E	E	unlikely
Persoonia marginata Clandulla Geebung	V	V	possible
Phebalium bifidum	E		possible
Philotheca ericifolia		V	possible

Species / Community	TSC Act	EPBC Act	Likelihood of Occurrence within the Project Application Area
Pomaderris brunnea Brown Pomaderris	V	V	possible
Prasophyllum sp. *Wybong* (C.Phelps ORG 5269) a Leek Orchid		CE	possible
Prostanthera cryptandroides subsp. cryptandroides Wollemi Mint-bush	V	V	possible
Prostanthera stricta Mount Vincent Mint-bush*	V	V	recorded
Pultenaea glabra Smooth Bush-pea	V	V	unlikely to occur
Pultenaea sp. Genowlan Point Genowlan Point Pultenaea*	CE	CE	recorded
Thesium australe Austral Toadflax	V	V	possible
Triplarina imbricate Creek Triplarina	E	E	unlikely
Wollemi nobilis Wollemi Pine	E	E	unlikely

**threatened flora species recorded within the Project Application Area during field surveys*

V: Vulnerable Species; E: Endangered Species; CE: Critically Endangered Species

The three threatened flora species observed within the Project Application Area during flora surveys

- *Eucalyptus cannonii* (listed as Vulnerable under the TSC Act)
- *Prostanthera stricta* (listed as Vulnerable under both the TSC Act and EPBC Act)
- *Pultenaea sp. Genowlan Point* (Critically Endangered under both the TSC Act and EPBC Act).

These species are discussed briefly below.

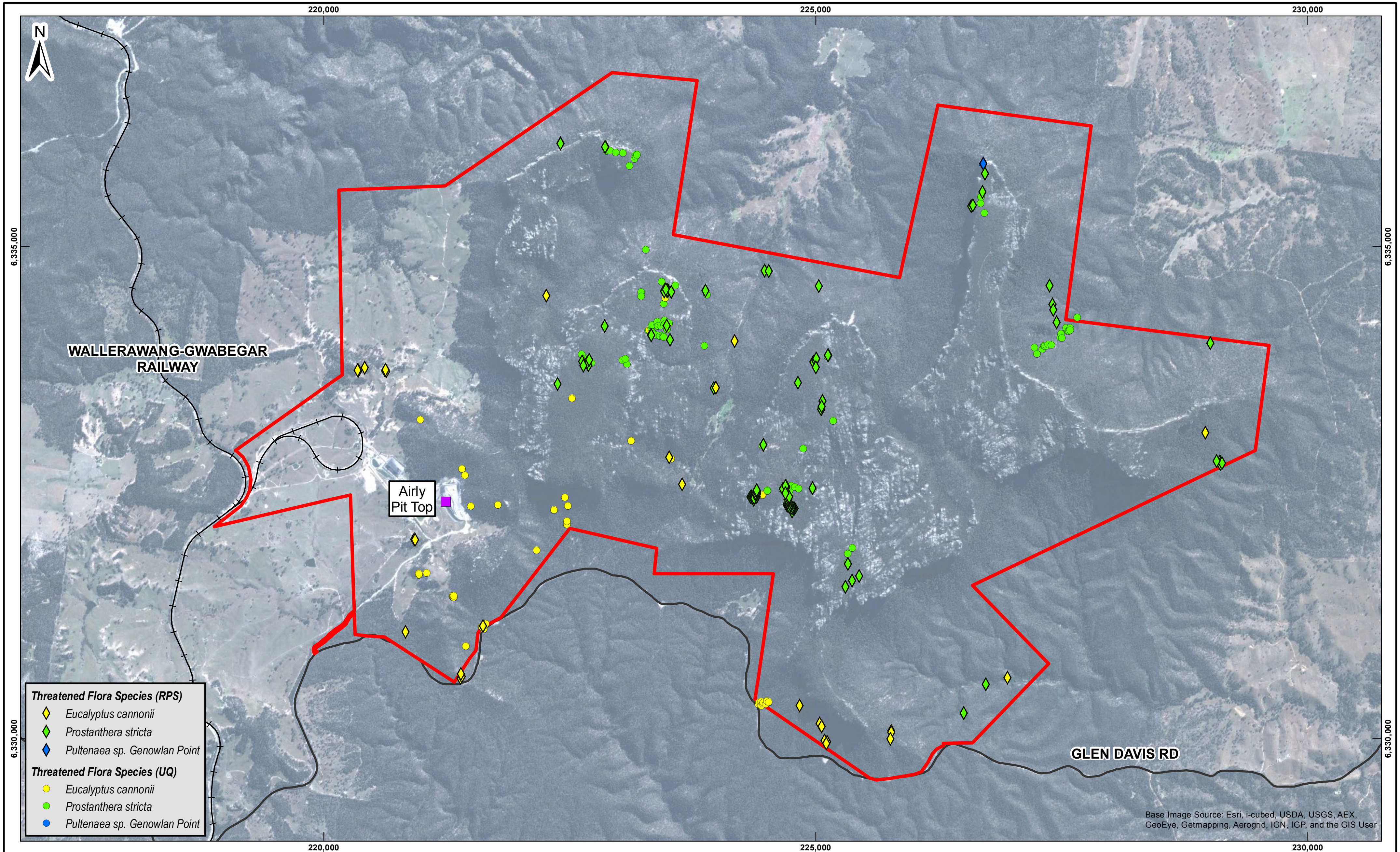
Eucalyptus cannonii (Capertee Stringybark)

Eucalyptus cannonii (Capertee Stringybark) is restricted to a small area in the central tablelands of NSW; there are 114 different locations recorded in the OEH Atlas of NSW Wildlife database for the species and it is likely that populations of *Eucalyptus cannonii* are discontinuous within its range.

A total of 78 records of *Eucalyptus cannonii* were collected within the Project Application Area predominantly in the valley between Mount Airly and Genowlan Mountain and within remnant patches of native vegetation in the west of the Project Application Area.

Prostanthera stricta (Mount Vincent Mint Bush)

Prostanthera stricta occurs from Mount Vincent to Genowlan Mountain in the Central Tablelands. *Prostanthera stricta* is often a locally dominant understory shrub found within heath or scrub communities along cliff edges, or as an understorey species within a range of open forest or tall open forest types and/or adjacent transitional communities.



LEGEND
Project Application Area
Rail
Main Road

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

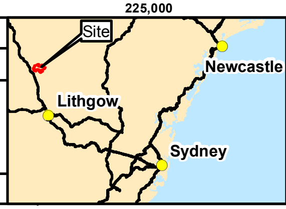


Figure 10.6: Location of Threatened Flora Species

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.6

A4

Large numbers of this species were recorded by RPS (2014a) and the University of Queensland (CMLR 2012) within the Project Application Area on the plateaus of both Mount Airly and Genowlan Mountain and on the lower slopes to the north-east. A total of 220 records have been collected, however, many of these records singularly account for large numbers of the species within the one location, and the high density of individuals within areas of the Project Application Area prevents an accurate estimation of population size.

Pultenaea sp. Genowlan Point (Genowlan Point Pultenaea)

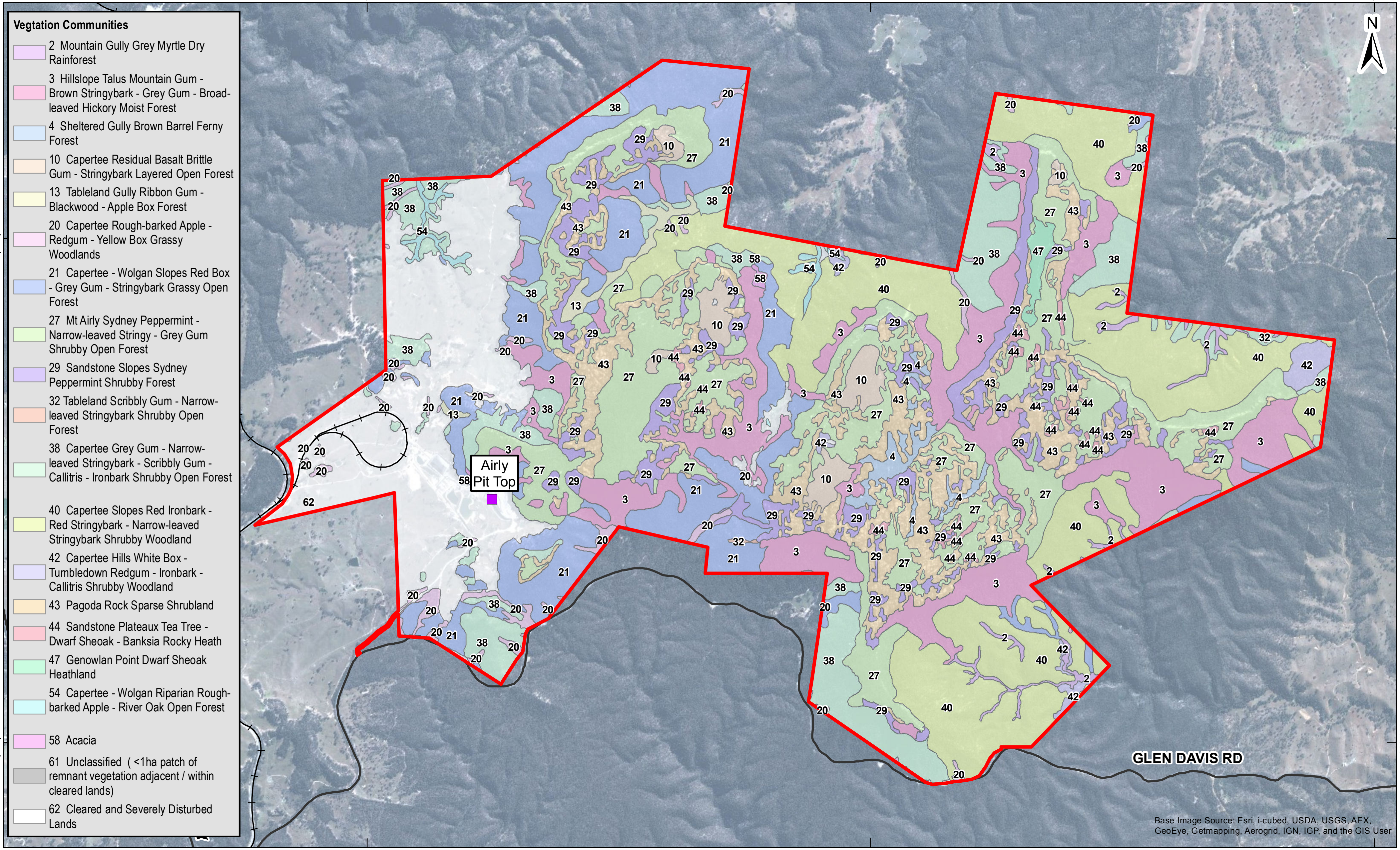
The species occurs as a single population at Genowlan Point. The population of approximately 50 individuals is restricted to a very small area of only 250 square metres. The species occurs on well-drained stony soil near a cliff edge.

Vegetation communities were mapped within the Project Application Area using desktop analysis and vegetation surveys to define and map vegetation communities and to search for threatened flora species.

Table 10.10 lists the vegetation communities within the Project Application Area. Figure 10.7 shows the vegetation communities and the DEC (2006) Mapping Unit (MU) number within the Project Application Area.

Table 10.10: Vegetation Communities within the Project Application Area

Vegetation Map Unit Number and Description	Total Area within the Project Application Area (ha)
MU2 Mountain Gully Grey Myrtle Dry Rainforest	27.74
MU3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest	471.90
MU4 Sheltered Gully Brown Barrel Ferny Forest	30.46
MU10 Capertee Residual Basalt Brittle Gum - Stringybark Layered Open Forest	64.50
MU13 Tableland Gully Ribbon Gum - Blackwood - Apple Box Forest	23.43
MU20 Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands (EEC)	55.28
MU21 Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest	452.68
MU27 Mt Airly Sydney Peppermint - Narrow-leaved Stringy - Grey Gum Shrubby Open Forest	643.44
MU29 Sandstone Slopes Sydney Peppermint Shrubby Forest	206.47
MU32 Tableland Scribbly Gum – Narrow-leaved Stringybark – Shrubby Open Forest	1.39
MU38 Capertee Grey Gum - Narrow-leaved Stringybark - Scribbly Gum - Callitris - Ironbark Shrubby Open Forest	323.09
MU40 Capertee Slopes Red Ironbark - Red Stringybark - Narrow-leaved Stringybark Shrubby Woodland	706.16
MU42 Capertee Hills White Box - Tumbledown Redgum - Ironbark - Callitris Shrubby Woodland	28.48
MU43 Pagoda Rock Sparse Shrubland	371.69
MU44 Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath	23.85
MU47 Genowlan Point Dwarf Sheoak Heathland (EEC)	15.18
MU54 Capertee - Wolgan Riparian Rough-barked Apple - River Oak Open Forest	16.56
MU 58 Acacia Thicket	3.71
MU62 Cleared and Severely Disturbed Lands	514.45
Total	**3980.48**



LEGEND
Project Application Area
Rail
Main Road

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 10.7: Vegetation Communites Within the Project Application Area

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.7

A4

Endangered Ecological Communities

Based on database searches, four EECs (Table 10.11) were likely to occur within the Project Application Area, but only two EECs were recorded during targeted surveys. These were:

- Genowlan Point *Allocasuarina nana* Heathland (TSC Act);
- White Box – Yellow Box – Blakely’s Red Gum Woodland (TSC Act) and White Box –Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).

Table 10.11: Likelihood of Occurrence of EECs within the Project Application Area

Scientific Name	TSC Act	EPBC Act	Likelihood of Occurrence
Genowlan Point *Allocasuarina nana* Heathland	E		occurs
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	E		does not occur
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions. (Listed as Upper Basalt Eucalypt Forests of the Sydney Basin Bioregion under the EPBC Act)	E	E	does not occur
Box Gum Woodland listed as White Box-Yellow Box-Blakely’s Red Gum Woodland (TSC Act) and listedas White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (under the EPBC Act)	E	CE	occurs

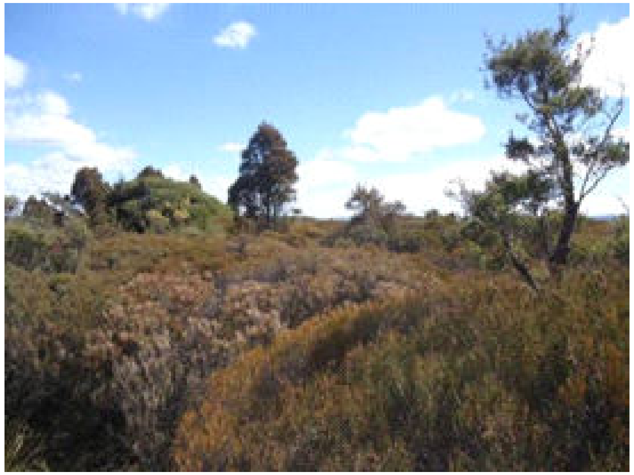
V: Vulnerable Species; E: Endangered Species; CE: Critically Endangered Species

Characteristics of the EECs identified within the Project Application Area are provided below.

Genowlan Point *Allocasuarina nana* heathland

Genowlan Point *Allocasuarina nana* Heathland is listed as an EEC under the TSC Act and covers just over 15 ha on Genowlan Point (Photograph 10.1). The heath is distinct structurally and in species composition from other heathlands in the greater Blue Mountains and corresponds to MU47 Genowlan Point Dwarf Sheoak Heathland. The presence in the heathland of the combination of *Xanthorrhoea johnsonii*, *Micromyrtus sessilis*, *Pseudanthus divaricatissimus*, *Callitris muelleri* and *Isopogon prostratus* is, as far as is known, unique. *Allocasuarina nana* is close to its northern limit of distribution, and *Xanthorrhoea johnsonii* close to its southern limit at Genowlan Point. A number of other species in the community are close to distributional limits (NSW Scientific Committee, 1999).

The entire known occurrence of this EEC is within the Project Application Area (Figure 10.7).



Genowlan Point Allocasuarina nana heathland

MU20 Capertee Rough-barked Apple- Redgum- Yellow Box Grassy Woodlands

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.1: Genowlan Point Allocasuarina nana heathland and MU20 Capertee Rough-barked Apple- Redgum- Yellow Box Grassy Woodlands

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-P10.1

A4

Box Gum Woodland

'Box-Gum Woodland' is the name collectively given to the EEC White Box – Yellow Box – Blakely's Red Gum Woodland (TSC Act) and the CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (under the EPBC Act). Both the TSC Act and EPBC Act communities can also occur in a 'derived grassland' state, where a canopy layer is absent but a dominant native grassy understorey remains. The vegetation community recorded within the Project Application Area that is considered by some authors to correspond to this EEC is MU 20 - Capertee Rough-barked Apple - Redgum - Yellow Box Grassy Woodlands. This community predominately occurs over the low-lying area within the west and south-west of the Project Application Area.

Box-Gum Woodland is characterised by the presence or prior occurrence of *Eucalyptus albens* (White Box), Eucalyptus melliodora (Yellow Box) or *Eucalyptus blakelyi* (Blakely's Red Gum). The understorey in intact sites is characterised by native grasses and a high diversity of herbs; the most commonly encountered include *Themeda australis* (Kangaroo Grass), *Poa sieberiana* (Poa Tussock), *Austrodanthonia spp.* (wallaby grasses), *Austrostipa spp*. (spear-grasses), *Chrysocephalum apiculatum* (Common Everlasting), *Goodenia pinnatifida* (Scrambled Eggs), *Hypericum gramineum* (Small St John's Wort), *Vittadinia muelleri* (Narrow-leafed New Holland Daisy) and *Wahlenbergia spp.* (blue-bells). Shrubs are generally sparse or absent, though they may be locally common. However, the remnants of this community also span a large area and the exact species composition therefore can vary widely from site to site.

Box-Gum Woodland EEC predominantly occurs within the lower slopes and flats on the outskirts of the Project Application Area, totalling 55.28 ha (Figure 10.7). Whilst some areas of MU 20 surveyed fell within the identification criteria of Box-Gum Woodland, not all areas of MU 20 did qualify. MU 20 is often dominated by *Angophora floribunda* and may also contain *Eucalyptus polyanthemos*, *Callitris endlicheri*, *E. cannonii* and *E. punctata* (DEC 2006). MU 20 can also contain scattered shrubs. As with any vegetation community, the species composition and structure will vary spatially due to factors such as topography, hydrology and soil types, as well as where vegetation communities form an ecotone between adjacent vegetation communities. RPS (2014a) concluded that not all areas of MU 20 within the Project Application Area automatically qualify as Box-Gum Woodland.

Within the Project Application Area, areas of vegetation that conform to Box-Gum Woodland are predominately within the lower ephemeral drainage lines and creeks that quickly transition into different vegetation communities. Adjoining flatter slopes have been cleared for agriculture and it is difficult to assess where Box-Gum Woodland may have once occurred. Additionally, vegetation surveys commonly recorded one or more of the species *E. melliodora*, *E. blakelyi* and *E. albens* occurring within and sometimes dominating MU 21 and MU 38. These vegetation communities were often recorded adjacent to MU 20. Where past disturbance may have partially or completely removed and modified the canopy and the shrubby understorey, areas that were historically MU 21 and MU 38 may take the form of Box-Gum Woodland. Recording the natural occurrences of Box-Gum Woodland becomes particularly difficult when determining the possible presence of the derived grassland component. This is further discussed below.

Derived Native Grasslands

Under the TSC Act, White Box Yellow Box Blakely's Red Gum Woodland EEC can exist in a number of states including the following:

- areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the ground layer is predominantly composed of exotic species
- sites where the trees have been removed and only the grassy ground layer and some herbs remain.

In accordance with NPWS (2002), the following criteria have been considered in assessing the potential for the proposed surface facilities to contain derived grasslands.

- the study area is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions;

- the study area has trees, or if treeless is likely to have supported White Box, Yellow Box or Blakely's Red Gum prior to clearing; and
- the study area is predominantly grassy and not dominated by shrubs, excluding pioneer species.

Under the EPBC Act, areas that are part of the listed community must have either:

- an intact tree layer and a predominately native ground layer
- an intact native ground layer with a high diversity of native plant species but no remaining tree layer (DEH 2006).

The area of alternative REA (v) contains 0.79 ha of MU 20, while the proposed REA does not contain any MU 20 or other box gum woodland. However, the patterns of distribution of vegetation map units on the undulating slopes around the proposed REA and on 'Carinya' and 'Airly' properties support at least two vegetation map units MU 20 Capertee Rough-barked Apple – Red Gum – Yellow Box Grassy Woodlands and MU38 Capertee Grey Gum – Narrow-leaved Stringybark – Scribbly Gum – Callitris – Ironbark Shrubby Open Forest. MU 20 is considered by some authors to correspond to the Box-Gum Woodland EEC.

In pasture situations like the proposed REA where the overstorey has been cleared, the composition of the ground layer species and the soil nutrient status are indicators which can help in assessing whether Box-Gum Woodland derived native grassland is present. One soil type within the proposed REA is described by (SLR 2014e) as having a Moderate rating for cation exchange capacity, indicating these soils are relatively fertile in comparison to other soils within the REA. These soils occur within the broad gully drainage lines which flow in a westerly direction across the proposed Reject Emplacement Area. These areas also coincide with patches where a common component of the pasture vegetation is the native species, *Poa labillardierei* (Tussocky Poa), listed as a characteristic species of Box-Gum Woodland in the Final Determination of the Scientific Committee.

Box-Gum Woodland EEC derived native grassland is present within the REA but is confined to drainage lines and adjacent lower slopes. Surveys have recorded 9.15 ha of disturbed/improved land, 25.49 ha of derived native grassland, most likely derived from MU 38, and 3.27 ha of Box-Gum Woodland Derived Native Grassland (EEC). However, it is noted that the delineation of the area of Box-Gum Woodland Derived Native Grassland has been done as a precautionary approach with reference to the dominant groundcover species present and soil fertility results (SLR, 2014e). The proposed REA is highly modified and due to past clearing and the grazing of livestock has resulted in overall low groundcover species diversity and few remaining canopy species. As discussed above, the canopy species indicative of Box-Gum Woodland were also often recorded within other vegetation communities, including MU 21 and MU 38. Additionally, MU 20 can incorporate a species composition that does not confirm to the identification criteria of Box-Gum Woodland. Hence, in a natural state, the 3.27 ha which has been mapped as Box-Gum Woodland Derived Native Grassland may not have had the canopy composition that would qualify it as the listed community.

The Train Refuelling Station and the ROM Stockpile areas are in close proximity of the existing infrastructure and are mostly devoid of any native vegetation. These sites were determined not to contain Box-Gum Woodland derived native grasslands. In the case of the Site Security Gate the site was deliberately positioned at a location that was dominated by the non-native grass species *P. dilatatum*. Therefore, the chosen location is not within an area containing derived native grasslands.

Notable Flora Species

The following species, while not listed under the TSC Act or EPBC Act, are known to occur in the Project Application Area.

- *Acacia asparagoides* is a Rare or Threatened Australian Plant (ROTAP) recorded on the eastern half of Mount Airly and on Genowlan Mountain.
- *Banksia penicillata* grows within the Genowlan Point Heathland vegetation community.

- *Epacris muelleri* is a ROTAP species commonly encountered on Black Mountain, Mount Airly and Mount Genowlan.

Groundwater Dependent Ecosystems

Groundwater modelling suggests that shallow alluvial aquifers are present and therefore facultative groundwater dependent ecosystems (GDEs) that are partially groundwater dependant may occur within the Project Application Area. The vegetation communities which occur within the shallow aquifer zones include:

- MU 3 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum – Broad-leaved Hickory Moist Forest
- MU 13 Tableland Gully Ribbon Gum - Blackwood - Apple Box Forest
- MU 21 Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest
- MU 40 Capertee Slopes Red Ironbark - Red Stringybark - Narrow-leaved Stringybark Shrubby Woodland.

Fauna

A desktop review has assessed the likelihood of threatened species or ecological communities occurring within the Project Application Area. The results of database searches (OEH Atlas of NSW Wildlife and EPBC Protected Matters Search Tool) indicated that 58 threatened fauna species have been previously recorded within 10 km of the Project Application Area and/or have potential habitat within the Project Application Area.

Those species identified from literature reviews, database searches (both TSC Act and EPBC Act listed species) and field surveys that are likely to occur within the Project Application Area, based on suitability of habitat, are listed in Table 10.12 and Table 10.13**.**

Table 10.12: Likelihood of Occurrence of Threatened Fauna within the Project Application Area

Species / Community	**TSC Act**	**EPBC Act**	**Likelihood of Occurrence**
Insects			
*Paralucia spinifera (*Bathurst Copper Butterfly)	E	V	possible
Amphibians			
*Heleioporus australiacus (*Giant Burrowing Frog)	V	V	possible
*Litoria aurea (*Green and Golden Bell Frog)	E		unlikely
*Litoria booroolongensis (*Booroolong Frog)	E	E	unlikely
*Litoria littlejohni (*Littlejohn's Tree Frog)	V		unlikely
*Mixophyes balbus (*Stuttering Frog)	E		unlikely
*Pseudophryne australis (*Red-crowned Toadlet)	V		possible
Reptiles			
*Aprasia parapulchella (*Pink-tailed Worm-lizard)	V	V	possible
*Hoplocephalus bungaroides (*Broad-headed Snake)	E	V	possible
*Suta flagellum (*Little Whip Snake)	V		possible
*Varanus rosenbergi (*Rosenberg's Goanna)	V		known
Avifauna			
*Anthochaera Phrygia (*Regent Honeyeater)	CE	E	known
*Botaurus poiciloptilus (*Australasian Bittern)	E	E	unlikely
*Callocephalon fimbriatum (*Gang-gang Cockatoo)	V		known
*Calyptorhynchus lathami (*Glossy Black-Cockatoo)	V		known
*Chthonicola sagittata (*Speckled Warbler)	V		known
*Circus assimilis (*Spotted Harrier)	V		possible

Species / Community	TSC Act	EPBC Act	Likelihood of Occurrence
Climacteris picumnus victoriae (Brown Treecreeper eastern subspecies)	V		known
Daphoenositta chrysoptera (Varied Sittella)	V		known
Epthianura albifrons (White-fronted Chat)	V		unlikely
Falco subniger (Black Falcon)	V		possible
Glossopsitta pusilla (Little Lorikeet)	V		known
Grantiella picta (Painted Honeyeater)	V		known
Hieraaetus morphnoides (Little Eagle)	V		possible
Ixobrychus flavicollis (Black Bittern)	V		unlikely
Lathamus discolour (Swift Parrot)	E	E	possible
Leipoa ocellata (Malleefowl)		V	unlikely
Lophoictinia isura (Square-tailed Kite)	V		possible
Melanodryas cucullata cucullata (Hooded Robin south-eastern)	V		possible
Melithreptus gularis gularis (Black-chinned Honeyeater eastern)	V		known
Neophema pulchella (Turquoise Parrot)	V		possible
Ninox connivens (Barking Owl)	V		possible
Ninox strenua (Powerful Owl)	V		known
Pachycephala inornata (Gilbert's Whistler)	V		known
Petroica boodang (Scarlet Robin)	V		known
Petroica phoenicea (Flame Robin)	V		known
Polytelis swainsonii (Superb Parrot)		V	unlikely
Pomatostomus temporalis temporalis (Grey-crowned Babbler eastern subspecies)	V		known
Rostratula australis (Australian Painted Snipe)		V	unlikely
Stagonopleura guttata (Diamond Firetail)	V		known
Tyto tenebricosa (Sooty Owl)	V		known
Tyto novaehollandiae (Masked Owl)	V		known
Mammals			
Cercartetus nanus (Eastern Pygmy-Possum)	V		possible
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	known
Dasyurus maculatus maculatus (Spotted-tailed Quoll)	V	E	known
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	V		possible
Miniopterus australis (Little Bentwing-bat)	V		possible
Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)	V		known
Myotis macropus (Southern Myotis)	V		known
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	V		possible
Nyctophilus corbeni (South-eastern Long-eared Bat)		V	unlikely
Petaurus norfolcensis (Squirrel Glider)	V		known
Petrogale penicillata (Brush-tailed Rock-wallaby)	E	V	possible
Phascolarctos cinereus (Koala)	V	V	possible
Potorous tridactylus tridactylus (Long-nosed Potoroo)		V	unlikely
Pseudomys novaehollandiae (New Holland Mouse)		V	possible
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	unlikely
Vespadelus troughtoni (Eastern Cave Bat)	V		possible

V: Vulnerable Species; E: Endangered Species; CE: Critically Endangered Species, Migratory species listed under the EPBC Act have also been considered under this assessment. A Protected Matters Search was undertaken (Accessed June 2013) on the Department of the Environment's website which lists potential migratory species. Table 10.13 lists the potentially occurring migratory species within 10 km of the Project Application Area.

Table 10.13: Potentially Occurring Migratory Species within a 10 km Radius of the Project Application Area

Scientific Name	Common Name
Apus pacificus	Fork-tailed Swift
Ardea alba	Great Egret
Ardea ibis	Cattle Egret
Gallinago hardwickii	Latham's Snipe
Haliaeetus leucogaster	White-bellied Sea-Eagle
*Hirundapus caudacutus**	White-throated Needletail (known to occur)
Leipoa ocellata	Malleefowl
*Merops ornatus**	Rainbow Bee-eater (known to occur)
Monarcha melanopsis	Black-faced Monarch
*Myiagra cyanoleuca**	Satin Flycatcher (known to occur)
Rhipidura rufifrons	Rufous Fantail
Rostratula benghalensis	Painted Snipe

**threatened species*

A total of 177 fauna species were detected within the Project Application Area, comprising 111 bird, 36 mammal, 20 reptile and 10 amphibian species. Of the 177 fauna species detected, 23 were listed under the TSC Act and / or EPBC Act. Locations of the species detected are shown in Figure 10.8. Those species observed within the Project Application Area are discussed briefly below.

Terrestrial Mammals

Open forest communities provide suitable habitat for a number of terrestrial mammals. Eleven native terrestrial mammal species were recorded in the Project Application Area. One threatened mammal species, namely Spotted-tailed Quoll (*Dasyurus maculatus*) was recorded using motion detection camera. In almost all habitats, small terrestrial mammals, including the Bush Rat (*Rattus fuscipes*) and several species of Antechinus were trapped in Elliot traps.

Macropods including the Eastern Grey Kangaroo (*Macropus giganteus*), Red-necked Wallabies (*Macropus rufogriseus*), and the Swamp wallabies (*Wallabia bicolour*) were observed feeding throughout the day and into the night throughout the Project Application Area.

Few wombats (*Vombatus ursinus*) were seen. The Short-beaked Echinda (*Tachyglossus culeatus*), the only monotreme species, was identified in the Project Application Area.

Arboreal Mammals

Canopy tree species and understorey shrubs provide foraging resources such as foliage, seeds, pollen, nectar and invertebrates for possums, gliders and bats. Five arboreal mammals were recorded in the Project Application Area. One threatened arboreal mammal was identified during spotlighting, namely Squirrel Glider (*Petaurus norfolcensis*)..

The Project Application Area supports a high abundance of arboreal mammals, including Sugar Gilder (*Petaurus breviceps*), Greater Glider (*Petauroides volans*), Common Ringtail Possum (*Pseudocheirus peregrinus*), and the Common Brushtail Possum (*Trichosurus vulpecula*).

Bats

Thirteen microchiropteran bat (microbat) species were caught in harp traps in the Project Application Area, including three threatened species, namely the Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and Southern Myotis (*Myotis macropus*).Avifauna

111 bird species, including 109 native species were recorded in the Project Application Area. Eleven threatened and three migratory bird species were recorded.

Of conservation significance is the presence of a number of species that are thought to be in decline across NSW, though they have not been listed on either the TSC or EPBC Acts. Of these species, the following occur within the Project Application Area; Rockwarbler, White-winged Chough, Spotted Quail-thrush, Red-browned Treecreeper, and Flame Robin (DECC 2007).

In addition, a number of species that have been located within the Project Application Area are thought to have declined within the Sydney Basin Bioregion in recent years. These include the Jacky Winter, Wedge-tailed Eagle, Nankeen Kestrel, Dusky Woodswallow, White-backed Swallow, Australian Pipit, Scarlet Robin, and White-throated Needletail (DECC 2007).

Frequently recorded species included White-throated Treecreeper, Grey Fantail Brown Thornbill, Pied Currawong, Superb Fairy Wren, Rufous Whistler, Golden Whistler and a diversity of honeyeaters.

The most abundant and diverse family groups occurring in the Project Application Area are the *Acanthizidae* (gerygones, thornbills, and scrubwrens), *Meliphagidae* (honeyeaters and chats). Parrots were also common throughout the Project Application Area.

Birds of prey identified in the Project Application Area are Brown Goshawk (*Accipiter fasciatus*), Wedge-tailed Eagle (*Aquila audax*), Black-shouldered Kite (*Elanus axillaris*), Nankeen Kestrel (*Falco cenchroides*),Peregrine Falcon (*Falco peregrinus*),Powerful Owl (*Ninox strenua*) and Sooty Owl (*Tyto tenebricosa*).

Herpetofauna

Twenty reptile species were recorded in the Project Application Area; one Eastern Snake-necked Turtle, three geckos, eight skinks, four elapid snakes and four agamid lizards. No threatened reptile species were recorded. Reptiles were most commonly identified during targeted herpetological searches, involving turning over logs, rocks and other debris, and during nocturnal spotlighting surveys.

The Lace Monitor (*Varanus varius*) was frequently encountered throughout the Project Application Area. Snakes were not commonly encountered.

Ten species of frog were recorded in the Project Application Area, none of them threatened. The most widespread and abundant frog species in the Project Application Area is the Common Eastern Froglet (*Crinia signifera*), which was observed or heard calling in dams, ephemeral drainage lines and other damp areas. Other frog species were recorded within the Project Application Area including Peron's Tree Frog (*Litoria peronii*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), Smooth Toadlet (*Uperoleia laevigata*), and Eastern Banjo Frog (*Limnodynastes dumerilii*).

Invertebrates

Targeted surveys were undertaken within potential habitats of the Bathurst Copper Butterfly. No individuals of this species were found during the surveys undertaken within the peak activity period of this species.

During the targeted surveys, species of snail were also opportunistically observed for Capertee Snail (*Sauroconcha caperteeana*). No individuals of the Capertee Snail were recorded.

Exotic species and Pest Animals

Ten species of exotic animals were found within the Project Application Area, eight terrestrial mammal species and two bird species. Small groups of feral goats (*Capra hircus*) were frequently found on Mount

Airly. Feral dogs were seen on several occasions, in cleared areas in proximity to the pit top. Rabbits (*Oryctolagus cuniculus*) were common in cleared, low-lying areas. Black rats (*Rattus rattus*) were infrequently caught in Elliot traps.

Habitat Survey

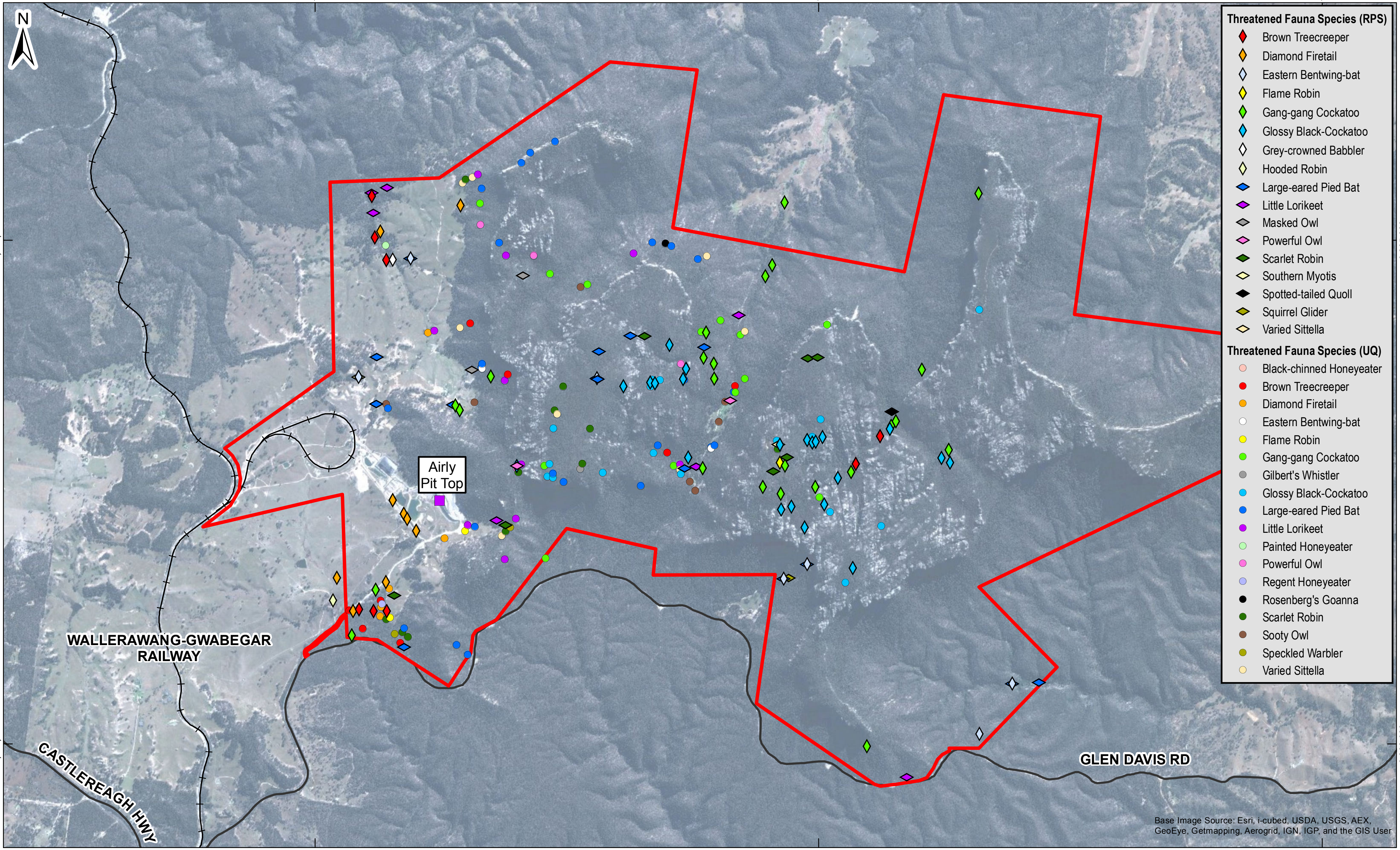
The Project Application Area is located on the western margin of a large system of protected areas (including the Greater Blue Mountains World Heritage Area) that surrounds the western rim of the Sydney Basin, preserving the sandstone-based links between the Sydney, Hunter and Central West regions of New South Wales (DECC 2008). Intact fauna habitats of the Project Application Area, primarily contained within Mugii Murum-ban State Conservation Area, are linked to this system by the Gardens of Stone National Park located to the south, Wollemi National Park in the east. In addition, habitats of the Project Application Area maintain connectivity with Capertee National Park to the north. This huge expanse of continuous habitat facilitates the movement of many fauna species across the landscape.

Fauna habitats have been largely cleared from the west of the Project Application Area. In the wider locality, the landscape to the west of the Project Application Area is characterised by a mosaic of cleared agricultural land and large patches of remnant vegetation. Many of these remnants are linked by riparian vegetation that has been retained in association with drainage lines; others are linked by narrow corridors of native vegetation. For this reason there are no significant barriers to fauna movement surrounding the Project Application Area.

Broad habitat of the Project Application Area is mapped by DECC (2006) and include dry sclerophyll forest, wet sclerophyll forest, grassy woodlands, heath, dry rainforest, riverine forest and cleared and disturbed areas. Dry sclerophyll habitats dominate the Project Application Area, occurring across the Mount Airly-Genowlan Mountain mesa, the steep slopes surrounding the mesa and low-lying, undulated areas. Wet sclerophyll habitats are much more patchily distributed, occurring in sheltered locations on top of the mesa and in gullies surrounding it. Heath is generally restricted to the top of the Mount Airly-Genowlan Mountain mesa, occurring in small patches separated by dry sclerophyll forest. Grassy woodlands are sparsely distributed throughout the Project Application Area, and occur in small patches on top of the mesa in low-lying areas in the north-west of the Project Application Area. A very small area of riverine forest occurs in association with Gap Creek in the north of the Project Application Area.

Hollow-bearing trees are common throughout the Project Application Area, and include a diversity of eucalypt species of various ages. Smaller trees of woodland communities typically supported smaller trunk and branch hollows. Forest communities, particularly those occurring in sheltered gullies, supported some very large trees which contained several large tree and branch hollows. Many isolated paddock trees in the west of the Project Application Area and stags, distributed throughout the Project Application Area, also contained hollows of varying sizes.

Habitat assessments conducted throughout Airly Creek, Coco Creek, The Capertee River, Gap Creek and Genowlan Creek determined that the available habitats were not suitable for Booroolong Frog occupancy. Various habitat features required by the Booroolong Frog such as cobble stone substrates, riparian vegetation and fringing bank vegetation were present at multiple sites, however, the overall lacking element for the majority of sites was the presence of permanent water. Booroolong Frogs are known to avoid habitats that are ephemeral, preferring those with a permanent water supply (OEH, 2012).



LEGEND

Project Application Area

Rail

Main Road

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 10.8: Location of Threatened Fauna Species

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.8

A4

10.2.3.2 Aquatic Ecology

A search for records and distribution of threatened and protected species of fish in the Lithgow LGA Area and Hawkesbury- Nepean Catchment Management Authority area (now now the Central Tablelands Local Land Service (LLS) was undertaken using the online Record Viewer developed by the Threatened Species Unit of the former NSW I&I, now DTIRIS. A second online search facility, NSW BioNet managed by OEH's Wildlife Unit, was used to search for records of flora and fauna sightings within LGA held in the OEH Atlas of NSW Wildlife.

According to the Record Viewer, the Macquarie Perch is the only threatened fish species listed under the FM Act to have been recorded in the Lithgow LGA, with a record for a specimen caught in the Capertee River in 2006 and Colo River in 2007 (approximately 30 and 50 km downstream of the Project Application Area respectively) as well as in other parts of the Hawkesbury-Nepean River system. As such, an Assessment of Significance was undertaken for this species.

The wider geographic search indicated that two other threatened fish species (Silver Perch and Trout Cod) listed under the FM Act have been recorded in the Hawkesbury- Nepean Catchment; however, these records are all from coastal rivers and represent stocked fish (DPI (2006)). As the types of habitat preferred by these species are scarce within the Project Application Area, it is considered unlikely that these species would inhabit waterways close to or within the Project Area. Assessments of significance for these species were therefore not considered necessary because these species have not been recorded within the reaches of watercourses within the Project Application Area, and are considered unlikely to occur due to the mainly ephemeral headwater habitats within the Project Application Area (Appendix G).

The OEH Atlas of NSW Wildlife (Bionet showed that one endangered semi-aquatic invertebrate species, the Giant Dragonfly (*Petalura gigantea*), listed under the TSC Act has been recorded in the Lithgow LGA. This species is typically found in permanent swamps and bogs containing some free water and open vegetation (NSW Scientific Committee, 2004). The expected range of two other dragonfly species, Adams Emerald Dragonfly (*Archaeophya adamsi*) and Sydney Hawk Dragonfly (*Austrocordulia leonardi*) listed as endangered under the *FM Act* includes the Hawkesbury-Nepean Catchment.

There are two records of the Giant Dragonfly (*Petalura gigantean)* from the Wolgan and Ben Bullen State Forest areas in 2008, approximately 15 to 20 km to the south of the Project Application Area. This species has also been recorded within Newnes State Forest to the southeast. It is considered possible, although unlikely, that the Giant Dragonfly occurs within the Project Application Area, as marginal aquatic habitat exists. An Assessment of Significance has been prepared as a precautionary measure (Appendix G).

It is possible that Adams Emerald Dragonfly (*Archaeophya adamsi*) may occur in the Project Application Area, as suitable, albeit limited, habitat exists in Genowlan Creek. The larvae of this species have been found in narrow, shaded riffle zones with moss and abundant riparian vegetation in small creeks with gravel or sandy bottoms (NSW DPI 2012). As the occurrence of Adams Emerald Dragonfly cannot be discounted, an Assessment of Significance has been prepared as a precautionary measure (Appendix G).

The Sydney hawk dragonfly (*Austrocordulia leonardi*) is extremely rare and the predicted distribution of this specie does not extend much beyond Penrith (NSW DPI 2007). Thus, it is highly unlikely to occur in the Project Application Area. The Sydney hawk dragonfly has only ever been collected from deep and shady river pools with cooler water. Larvae are found under rocks where they coexist with the eastern hawk dragonfly (NSW DPI 2007). It is considered highly unlikely that the Sydney hawk dragonfly would occur in the Project Application Area given its known distribution and habitat and it was therefore not deemed necessary to complete an Assessment of Significance for this species.

Four swamp communities are listed as EECs under the *TSC Act*:

- Blue Mountains Swamps in the Sydney Basin Bioregion;
- Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South-East Corner, South-Eastern Highlands and Australian Alps bioregions;

- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

These EECs are considered in RPS (2014a) and Secxtion 10.2.3.1 of this EIS.

Aquatic habitat with the Project Application Area is limited to small ephemeral creeks, draining numerous vegetated sub-catchments originating from Mount Airly and Genowlan Mountain. The following descriptions are provided of the aquatic habitat environment and associated biota at monitoring sites shown on Figure 2.9.

Monitoring Sites

The baseline aquatic ecology monitoring sites that are relevant to this assessment are identified in Figure 2.9.

Airly Creek

The monitoring sites at Airly Creek (AIR1 and AIR2) were directly adjacent to one another between the Glen Davis Road and the Airly Mine access road in a broad valley surrounded by native forest. Both sites had relatively wide, deep pools interspersed by narrow, shallower sections of gently to moderate flowing water. The creek substratum consisted predominantly of angular bedrock, boulder and cobble, with areas of silt and clay. Riparian vegetation consisted of a small stand of tall (greater than 20 m) Casuarina sp. and a variety of grasses, the mat-rush Lomandra sp. and weeds, including patches of blackberry (Rubus fruiticosus sp. agg.). Dense strands of in-stream macrophytes, dominated by cumbungi (Typha sp.) and common reed (Phragmites sp.), were present upstream of AIR1 and downstream of AIR2.

Torbane-Oaky Creek

The monitoring sites at Torbane Creek (TOR1 and TOR2) were approximately 2 km to the north of Carinya in a steep valley surrounded by open forest. Both sites contained small, shallow pools interspersed by narrow, shallow sections with flowing water. The creek substratum consisted of a large proportion of silt, sand and some gravel in pools. Angular bedrock, boulder and cobble substrata were also present, more commonly at bends and constrictions. Riparian vegetation was sparse close to the channel and consisted of grasses and forbs.

Dog Trap Creek

The monitoring sites at Dog Trap Creek (DOG1 and DOG2) were upstream and downstream of a small dam and approximately 200 m upstream of the confluence with Coco Creek. The site upstream of the dam (DGO1) consisted of a chain of small, clear pools with rock substrata separated by some flowing water and several swampy areas. The downstream site (DOG2) consisted of a small running water section over a rocky substratum and a large shallow pool that terminated in a swampy grass ford. The creek substratum consisted of large amounts of silt and detritus, with that in the impounded water being deep and anoxic. Riparian vegetation consisted of eucalyptus- dominated woodland on previously cleared pastoral land.

Gap Creek

The monitoring sites at Gap Creek (GAP1 and GAP2) were directly adjacent to one another. On both sites, no flow was observed in the creek at the adjacent gauging station and limited water was observed in its vicinity. The creek substratum consisted of sand, gravel and silt in pools surrounded by large rounded boulders. Riparian vegetation consisted of Eucalypt- dominated open forest containing a variety of native trees and shrubs including Coachwood (*Ceratopetalum apetalum*) *Cassini asp.*, Teatree (*Leptospermum sp.*) and *Acacia sp.*

Grotto Creek

The sites near The Grotto referred here as the Grotto Creek sites t (GRO1 and GRO2) were directly adjacent to one another on the upper south-west arm of Genowlan Creek. The creek substratum was fairly homogenous, being predominantly sand overlain by fine detritus with some larger rocks present. Riparian vegetation was Eucalyptus- dominated forest with dense understorey of tree ferns and other ferns.

Genowlan Creek

The sites of Genowlan Creek (GEN1 and GEN2) were directly adjacent to one another and a short distance downstream of the confluence with the two upper arms of Genowlan Creek. The creek substratum was relatively heterogeneous, consisting predominantly of sand with small proportions of boulder, cobble, pebble, gravel and silt. Riparian vegetation was Eucalyptus-dominated forest with a large number of tree ferns.

Aquatic Habitat and Fauna

Aquatic habitat was assessed using a modified version of the Riparian, Channel and Environmental (RCE) method (Chessman *et al.* 1997). This assessment involved evaluation and scoring of characteristics of adjacent land, the condition of riverbanks, channel and bed of the watercourse, and degree of disturbance evident at each site. The characteristics and scoring system for this process are outlined in Appendix B of Cardno (2014) provided in Appendix G.

The modified RCE inventory indicated the aquatic habitat in Genowlan Creek was in the best overall condition followed by that in Gap and Grotto creeks. The lower scores for Airly, Torbane and Dog Trap creeks were due to apparent disturbance of the creek channel and riparian zones. Airly scored highly in autumn 2014 due to increase flow and vegetation growth. Most of the creeks were originally classed as highly sensitive, major fish habitat. All creeks, excluding Genowlan were classified as moderate fish habitat once their ephemeral nature became apparent in spring.

A summary of aquatic habitat characteristics within the Project Application Area is provided in Table 10.14.

Table 10.14: Summary of aquatic habitat characteristics

Site	Survey	RCE Score	Fish habitat sensitivity (Type)	Fish habitat class (Class)
Airly Creek	Autumn 2013	37	1	1
	Spring 2013	37	1	2
	Autumn 2014	43	1	2
Torbane Creek	Autumn 2013	38	1	1
	Spring 2013	38	N/A	2
	Autumn 2014	39	1	2
Dog Trap Creek	Autumn 2013	37	1	1
	Spring 2013	37	1	2
	Autumn 2014	38	1	2
Gap Creek	Autumn 2013	43	1	2
Grotto Creek	Autumn 2013	43	N/A	2
Genowlan Creek	Autumn 2013	47	1	1

*Green highlight represents a better aquatic habitat condition than the orange highlight

A summary of aquatic fauna characteristics are provided in Table 10.15 and the scores were classified according to the following thresholds to aid interpretation.

- Macroinvertebrate taxon richness: greater than 20= high taxa diversity
- SIGNAL2 Score: greater than 4= pollution sensitive taxa present and favourable water quality
- AUSRIVAS OE50: greater than 0.81 (band A)= equivalent to reference condition

- Fish: native fish present= healthy fish communities

Table 10.15: Summary of aquatic fauna characteristics

Site	Macroinvertebrate taxa diversity	SIGNAL2 Score	AUSRIVAS OE50 Taxa score	Fish
Autumn 2013				
Airly Creek	13.5	3.26	0.49	Gambusia
Torbane Creek	18	3.5	0.61	Galaxias
Dog Trap Creek	27.5	3.77	0.96	Various Native
Gap Creek	16.5	4.45	0.57	No Fish
Grotto Creek	15	4.95	0.56	No Fish
Genowlan Creek	16.75	5.23	0.61	No Fish
Spring 2013				
Airly Creek	17	3.5	0.57	Gambusia
Torbane Creek	N/A	N/A	N/A	Galaxias
Dog Trap Creek	23	3.3	0.94	Various Native
Autumn 2014				
Airly Creek	14.5	5.0	0.50	Gambusia
Torbane Creek	14.5	2.3	0.64	No Fish
Dog Trap Creek	20	3.3	0.90	Eel

*Green and orange highlights represent healthy and impaired aquatic fauna, respectively.

Throughout all sampling seasons, aquatic invertebrate communities at Dog Trap Creek were more diverse than at any of the other sites and scored better AUSRIVAS scores than the other sites visited. SIGNAL2 scores were greatest at The Grotto, the Gap and Genowlan Creeks in autumn 2013, and in Airly Creek in autumn 2014, meaning more pollution sensitive taxa (primarily *Oligochaeta* and *Ceratopogonidae* being more abundant) were found in these waterways at those times, which is indicative of better water quality.

Thirty four individual fish from six species were captured in Airly, Torbane and Dog Trap Creeks using the backpack electrofisher in autumn 2013. In contrast, over 200 fish were captured in spring 2013 and only two in autumn 2014. No fish were captured at Gap, Grotto Creek or Genowlan Creek. While fish species diversity was greatest in Dog Trap Creek (four species) most individuals were captured in Airly Creek (over 200) in the spring 2013 sampling season. Mountain Galaxias was the most abundant native species and was captured only in Torbane Creek.

All fish were native, except for nine specimens of Eastern Gambusia, caught at Airly Creek. This species is listed as noxious species under the *FM Act*. None of the fish captured are threatened species under *EPBC Act* or the *FM Act*

The aquatic fauna characteristics are indicative of water quality and habitat features measured at each of the creeks visited. For example, generally favourable water quality at Gap, Upper Genowlan Creek and Genowlan Creeks provide the environmental conditions required to support pollution sensitive taxa, as indicated by the SIGNAL2 scores (Table 10.15). Favourable fish habitat was present at Airly, Torbane and Dog Trap Creeks, these being waterways where all fish were captured.

Initial sampling of the aquatic ecosystem indicated that the highest level of biological impairment generally occurred at sites on Airly Creek followed by Torbane Creek. Biological impairment at these sites is likely to be a result of extensive clearing and agriculture activities. Biological impairment observed at sites on Grotto, Gap and Genowlan Creeks may be due to the ephemeral or low flow characteristics of these catchments.

Threatened Species

A summary of relevant aquatic threatened species and communities is provided in Table 10.16 along with an assessment of their likelihood of occurrence within the Project Application Area. Likelihood of occurrence was determined by examining historical species records published distributions and habitat preferences. Assessment of Significance has been completed in Appendix H due to the potential, albeit unlikely occurrence within the Project Application Area.

Table 10.16: Relevant threatened aquatic species and communities

Species of community name	TSC Act Status	FM Act status	EPBC Act status	Likelihood of occurrence
Australian Grayling			V	Unlikely
Murray Cod			V	Unlikely
Trout Cod		E		Unlikely
Silver Perch		V		Unlikely
Macquarie Perch		E	E	Unlikely
Adams Emerald Dragonfly		E		Unlikely
Sydney Hawk Dragonfly		E		Unlikely
Giant Dragonfly	E			Unlikely
Temperate Highland Peat Swamps on Sandstone			E	Unlikely
Blue Mountains Swamps in the Sydney Basin Bioregion	V			Unlikely
Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	E			Unlikely
Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion	E			Unlikely
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	E		CE	Known

V: Vulnerable Species; E: Endangered Species; CE: Critically Endangered Species

10.2.3.3 Stygofauna

Stygofauna was not found in any of the samples collected from eight bores, although this does not necessarily indicate they are absent from the Project Application Area. Sampling effort and representation of subterranean habitats was limited.

It is evident from Tomlinson and Boulton (2010) and Hancock and Boulton (2008, 2009) that alluvial aquifer and the Narrabeen Group aquifer are most likely to harbour stygofauna due to the presence of cavities, fractures and electrical conductivities of less than 1500 µS/cm.

Groundwater in the Shoalhaven Group aquifer is less likely to contain stygofauna than the Alluvial and Narrabeen Group aquifers due to its less favourable depth and water chemistry. Further, any stygofauna that may occur in the Narrabeen Group are less likely to be endemic due to the regional connectivity of this aquifer.

Stygofauna have been found in alluvial and sandstone aquifers in the nearby Angus Place Colliery, Springvale Mine and within the Project Application Area for the Neubeck Coal Project. Due to the limited sampling effort and representation of subterranean habitats, and paucity of information on the distribution of stygofauna within NSW aquifers, the precautionary principle has been adopted. It has been assumed that stygofauna occur in all aquifers below the Project Application Area with the majority occurring in the alluvial and Narrabeen Group aquifers.

10.2.4 Potential Impacts

10.2.4.1 Terrestrial Ecology

Key potential impacts of the Project on terrestrial fauna and their habitats include habitat removal by clearing for surface infrastructure or habitat modification by subsidence.

Clearing

The proposed infrastructure establishment (REA, ROM Stockpile ad CPP, Site Security Gate) and the upgrade of the Train Refuelling Station will require the disturbance of 39.09 ha of pasture land. The area required for the proposed REA contains 9.15 ha of disturbed/improved land, 25.49 ha of derived native grassland, most likely derived from MU 38, and 3.27 ha of Box-Gum Woodland Derived Native Grassland (EEC). All remaining areas for surface infrastructture cover approximately 1.18 ha of disturbed/improved land. These areas provide marginal habitat for most threatened fauna and flora species.

The proposed REA has a significant lack of species diversity and is in a highly modified state. Whilst large areas are dominated by native grasses, the species present are those that are favoured for and/or can tolerate grazing pressure, such as *Microlaena stipoides* and *Poa labillardierei*. Additionally, dense thickets of *Rubus fruticosus* (Blackberry) were recorded, particularly within the areas containing Box-Gum Woodland Derived Native Grassland. Therefore, whilst 3.27 ha of the REA has been mapped as Box-Gum Woodland Derived Native Grassland, the conservation value and importance of this example of the listed community is regarded as considerably low. Consequently, the loss of this area of Box-Gum Woodland Derived Native Grassland cannot be regarded as a significant impact. Similarly, the removal of 25.49 ha low condition non-EEC derived grasslands is not regarded as a significant loss.

Four isolated hollow-bearing trees within the proposed REA locationwill also require removal. The habitat value of these isolated trees is limited to more mobile bird species and those arboreal mammals that commonly travel along the ground, such as the Common Brushtail Possum.

Three threatened flora species and 23 threatened fauna species were recorded within the Project Application Area. No threatened flora or likely habitat of threatened animals will be removed or disturbed as a result of proposed infrastructure establishment. It is not expected that clearing for the Project will have a significant impact on any TSC Act and/or EPBC Act listed threatened flora or fauna species.

Subsidence

Mine-induced subsidence can lead to potential impacts to flora and fauna through surface cracking, accelerated soil erosion, changes to groundwater and surface water, ponding and cliff failure. Due to the very low predicted subsidence, tilts and strains, it is unlikely that these effects would significantly impact upon threatened flora or fauna within majority of the proposed mining zones.

The area of greatest potential subsidence is within the New Hartley Shale Mine Potential Interaction Zone. The ecological surveys (RPS 2014a) have recorded *Prostranthera stricta* (listed as Vulnerable under both EPBC Act and TSC Act) and *Eucalyptus cannonii* (listed as vulnerable under the TSC Act) within the woodland areas of the New Hartley Shale Mine Potential Interaction Zone. Tension cracks and soil destabilisation may cause localised disturbance of the root zone for some plants in this area. Although *P. stricta* and *E. cannonii* individuals may potentially be impacted upon, they are likely to readily recover from disturbance given their natural occurrence within unstable areas such as steep rocky slopes and cliff edges. Notwithstanding the above, any loss of threatened flora would be highly isolated and would be restricted to localised root zone disturbance, and impacts would not be extensive such that any area would become unviable to support threatened flora species. Therefore, it is unlikely that subsidence related ground movements would affect woodland or forest habitats such that they would become unsuitable for any of the potentially occurring threatened flora and fauna.

Caves provide suitable habitats for threatened species as functional roosting sites for cave dwelling bats (including the Large-eared Pied Bat) and den sites for the Spotted-tail Quoll and the Brush-tailed Rock-wallaby. The pagodas and rocky outcrops also provide potential habitat for threatened species such as the Broad-headed Snake and Brush-tailed Rock-wallaby. RPS (2014a) conducted targeted searches within the New Hartley Shale Mine Potential Interaction Zone in order to identify any cave structures with potential to be impacted upon. No cave structures were detected during targeted surveys, however pagodas and rocky outcrops were identified in this area.

Given no surface impacts upon any rock face >20 m in height, even within the Shale mine interaction zone, are anticipated (Golder 2014), major cliffs are likely to provide the most suitable cave habitats and no impacts are expected to these features. Subsequently, no significant impacts would be expected to preferred habitats of threatened species including; the Brush-tailed Rock-wallaby, cave dwelling bats and Broad-headed Snake.

The small numbers of pagodas that occur within the angle of draw boundary are unlikely to experience any adverse impacts resulting from the proposed extraction methods. There is potential for some rock falls as a result of subsidence, however the flat sandstone slabs favoured by the Broad-headed Snake are less likely to be susceptible to subsidence-related rock falls. Given the abundance of pagodas within the Project Application Area and surrounding areas which would not be impacted upon, the minimal impacts upon these structures as a result of subsidence is considered to be relatively insignificant.

The Genowlan Point *Allocasuarina nana* Heathland occurs within the proposed mining area. However, due to the low predicted subsidence levels in the area, the Project is unlikely to impact upon this community, such that it would no longer persist in its current form or extent. Similarly, *Pultenaea* sp. Genowlan Point occurs within the Cliff Line Zone and Zone of First Workings and therefore is unlikely to be impacted upon.

Cracking and drawdown affecting water availability may have an impact on fauna species with low mobility. However, cracking is not expected to greatly divert water and the percentage of water loss to the catchments of the Project Application Area and further downstream is very low, being approximately 3% (GHD 2014b). Consequently, the water security for use by fauna species is unlikely to be significantly affected.

The mine design critera has included consideration of the potential impacts on the Gardens of Stone National Park and thus the Greater Blue Mountains World Heritage Area, The mine design criteria avoid potential impacts and thus the Project is unlikely to have a significant impact upon threatened species, EECs or other MNES.

Offsite Water Discharges and Downstream Impacts

Water discharges from licensed discharge points occur during very high rainfall events. However, site-specific trigger values for water quality derived from Airly Creek monitoring data (GHD 2014b) yield an electrical conductivity of 2998 μS/cm, showing a high salt concentration in the natural state. Any discharges of surface run-off during the high rainfall events into Airly Creek have the effect of lowering the salt concentration of the creek, due to dilution, and are therefore not expected to have an adverse impact on any EECs, threatened flora, threatened fauna or biodiversity in general downstream of the discharge point. Any mine water make will be resed as process water.

The potential impacts from increased mine water discharge include increases in flow and changes to water quality, which both have the potential to impact upon terrestrial flora and fauna that inhabit the affected riparian environments. Mine water discharge will not be of a magnitude such that it would alter the morphology of the affected watercourses and water quality parameters are to be managed to remain within the natural background levels or acceptable levels for mine water discharge. Any potential impacts of the mine water discharge will be minimised through the recycling of the water to meet operational requirements.

Any discharges into Airly Creek subsequently flow into the Gardens of Stone National Park where it joins Coco Creek and eventually flows into the Capertee River. Given that discharges into Airly Creek occur under very high rainfall events means that downstream water quality will not be adversely impacted due to the dilution effect noted above, particularly further downstream in the Gardens of Stone National Park. Water management measures, including appropriately sized water storage dams and maintaining the capacity of the dams at all times, will ensure the discharges will be minimal. Given the implementation of required water management measures it is unlikely that the the Project will impact on the Gardens of Stone National Park.Aquatic

10.2.4.2 Ecology

In the following sections, the potential direct, indirect and cumulative impacts on aquatic habitats, quality of surface water, aquatic biota in general and threatened aquatic species that may arise during the construction, operation, decommissioning and rehabilitation phases of the Project are described.

Construction Phase

The construction phase is defined as initial construction of the proposed surface infrastructure. Construction of the underground infrastructure and all mining activities related to the extraction of coal are covered under operational impacts.

Construction and Project surface activities that take place in the vicinity of watercourses could potentially have the following impacts on in stream ecology:

- the disturbance of soils and sediments by construction equipment, proposed rejects emplacement area, coal stockpiles and runoff from access road and areas where vegetation has been cleared and soils have been stockpiled could temporarily increase the sediment load in the watercourses
- an increase in sediment load could alter the nature of the benthic substratum, smother some aquatic habitats and increase turbidity levels within watercourses, with the latter potentially decreasing the amount of light available for photosynthesis by aquatic plants, clogging the gills and feeding apparatus of aquatic fauna and reducing the visual acuity of some predators
- runoff from cleared areas and stockpiles of soil could also transfer sequestered nutrients, organic matter and contaminants into the watercourses
- the clearing of riparian vegetation could have indirect impacts on abundance, distribution and health of in stream biota that use the vegetation as habitat, refuge or source of food
- sediment mobilisation caused by the construction of the proposed REA dam
- accidental release of lubricating oils, hydraulic fluids and fuel from construction equipment could result in inputs of toxic hydrocarbon and metal contaminants into watercourses.

Operations Phase

The operational phase is defined as activities undertaken for coal extraction, processing and transport and includes potential subsidence related impacts. Mining operations currently undertaken by Centennial Airly extend into the western portion of the Mount Airly mesa only.

<u>Subsidence</u>

Ground movements may cause fracturing of the stream bed and banks, movements of joint and bedding plains in the stream bed, uplift and buckling of strata in the stream bed. In turn the ground movement may result in physically changing and adversely impacting the aquatic environment by:

- diverting surface and sub-surface flows, drainage of pools and increases in groundwater inflows
- tilting of stream beds may result in erosion of the stream bed and banks and increased in stream sediment load, changes in flow rates and migration of stream channels
- loss of aquatic habitat, desiccation of fringing vegetation, reductions in longitudinal connectivity, deterioration of water quality and changes in the diversity of riparian and aquatic plants, aquatic macroinvertebrates and fish.

<u>Water Quality and Sedimentation</u>

An increase in plant and machinery operation, including vehicular movements will occur during mine production and has the potential to impact water quality and sediment mobilisation, suspension and deposition. These processes have been covered under construction related above. Operational processes may lead to increased spill potential, washdown activities, servicing and maintenance requirements, erosion and diffuse sources of contaminants. The most likely water quality constituents that would impact aquatic ecosystems during operation are likely to be sediments, petroleum hydrocarbons (fuel, oil and grease), nutrients and metals.

Coal Management and Reject Material Emplacement

The Project includes the construction of a Site Security Gate, a CPP and an REA and the establishment of a ROM Stockpile area, and will therefore result in the generation of more runoff that has been in contact with coal and coal reject materials. This runoff may contain elevated concentrations of contaminants. These could include increased suspended particulates, acidity and concentrations of metal ions and other compounds. The REA, the ROM Coal Stockpile and the CPP locations all fall within the Airly Creek catchment.

A geochemical assessment was undertaken at Baal Bone Colliery to determine the potential for acid and metalliferous runoff from the proposed REA. As the Lithgow Seam is the main coal seam mined at Baal Bone Colliery, the geochemistry of the mine waste runoff is likely to be representative of that which will be generated at Airly Mine in the future. Given the predominant use of surface water for CPP uses, the assessment suggests that the future operation of the ROM stockpile, the CPP and the proposed REA at Airly Mine is unlikely to result in deterioration in water quality at LDP001, particularly in terms of acidity and metals.

Operations would have minimal impacts on water quality and hydrology and there are unlikely to be detectable impacts on aquatic ecosystems.

Mine Water Make Discharges

Outcomes of the modelling show that discharges from LDP001 currently occur during periods of high rainfall (5.5 ML/year average). Discharges through LDP001 are expected to increase to maximum 76.0 ML/yr due to increased groundwater make. Water make from the mine workings is likely to contain similar constituent concentrations of water of the Permian aquifer, with contribution from overlying (Narrabeen) and underlying (Shoalhaven) aquifers.

Potential impacts arising from the discharge of mine make water on aquatic ecosystems therefore includes:

- hydrological change in Airly Creek through either increased flow, due to an increase in mine make water and the requirement to discharge or reduce flow due to additional operational use of mine make water on site
- reduction in flow in Airly or Torbane Creek through removal of water from the proposed REA catchment area that would be re-used and recirculated on site
- increase in flow to Airly Creek through increased discharge resulting from water obtained from the production bore
- changes in water quality in Airly Creek through increased contribution of mine make water and production bore groundwater at the discharge point.

Rehabilitation and Decommissioning

During the rehabilitation phase (Section 10.9.5), there is a potential for erosion of denuded areas to occur and for soil to be either blown into watercourses or for runoff containing sediments and contaminants such as fertilisers and herbicides to enter watercourses during rainfall events. The potential for such effects would depend on the residence time of the sediment and contaminants within particular areas of the watercourses.

During the decommissioning phase of the Project there is a possibility of impacts on in stream ecology arising if erosion of bare areas results in soil being either blown into watercourses or if sediment- and/or contaminant laden runoff enters watercourses during rainfall events. Aquatic biota could also potentially be impacted when the existing water management structures (e.g. dams and ponds are dismantled, rehabilitated and natural drainage patterns restored.

10.2.4.3 Stygofauna

In the following sections, the potential direct, indirect and cumulative impacts on stygofauna from construction, operation, decommissioning and rehabilitation phases of the Project are described.

Construction Phase

REA and other infrastructure construction is not expected to penetrate potentially stygofauna bearing strata. The construction of monitoring boreholes is the activity most likely to impact on any potentially occurring stygofauna associated with alluvial and Narrabeen Group aquifers. The potential for cross contamination between aquifers depends on the permeability of the strata and quantity of groundwater that may enter the borehole during drilling although the risk of damage to stygofauna is low given the limited drilling planned.

Operations Phase

The Project will though cause limited groundwater drawdown in the Gap and Genowlan Creek alluviums. No stygofauna have been found in the Project Application Area and groundwater impacts are predicted to be minimal in the extent and magnitude throughout the alluvial and Narrabeen Group aquifers. Hence, the loss of potential stygofauna habitat is minimal and the potential loss of populations due to groundwater drawdown in alluvial aquifers is unlikely.

10.2.4.4 Groundwater Dependant Ecosystems

No groundwater dependent ecosystems were recorded within the Project Application Area, however it is noted that aquifers do occur within the Project Application Area. Facultative GDEs have potential to occur within moist sheltered gully forests along creek lines and are not completely reliant on groundwater.

Drawdown of the alluvial aquifer due to mining is predicted to occur in a small number of small locations. These locations were visited to determine any discernible difference in flora species presence or composition to areas not predicted to be affected by drawdown. No differences to the vegetation either upstream or downstream of the modelled drawdown areas were identified. Although there is potential for minimal impacts upon the structure and composition of these GDEs at the local scale, larger areas of these communities (including other potential areas of facultative ecosystems) will not be impacted upon within the Project Application Area. Due to the tolerance of the tree species to persist in the absence of groundwater, effects to these GDEs are unlikely to result in significant modification to species composition. Therefore, it is unlikely that the local extent of these GDEs would be significantly reduced.

10.2.5 Consequences of Impacts

10.2.5.1 Terrestrial and Aquatic Ecology

Table 10.17,

Table 10.18 and Table 10.19 lists those endangered and threatened species and communities, both terrestrial and aquatic, that have been recorded or are expected to occur in the Project Application Area and could potentially be impacted by the Project. Most of these records or expected occurrences are outside of areas to be impacted by proposed surface infrastructure. Those species and communities recorded or expected in these impact areas have been assessed by way of 7 part tests of significance under the TSC Act and/or the assessment of significance under the EPBC Act (Appendix H). The results of these tests are summarised in Table 10.17,

Table 10.18 and Table 10.19.

Table 10.17: Summary of 7 Part Test of Significance (TSC Act)

Group and species	(a)Risk of extinction of local population	(b)Risk of extinction of endangered population	(c) adverse impact on the extent of, or modification to EECs or CECs leading to local extinction	(d)habitats of threatened species, EECs or CEECs			(e)adverse impact on critical habitat	(f)consistence with recovery or threat abatement plan
				(i)extent to which habitat is likely to be removed or modified	(ii)will habitat become isolated	(iii) importance of habitat removed, modified or isolated		
Flora:								
Pultenaea sp. Genowlan Point Genowlan Point Pultenaea	unlikely	na	na	unlikely	no	No impact	na	yes
Acacia bynoeana Bynoe's Wattle	unlikely	na	na	unlikely	no	No impact	na	na
Darwinia peduncularis	unlikely	na	na	unlikely	no	No impact	na	na
Eucalyptus cannonii Capertee Stringybark	unlikely	na	na	unlikely	no	No impact	na	yes
Grevillea evansiana	unlikely	na	na	unlikely	no	No impact	na	na
Grevillea obtusiflora subsp. fecunda Grey Grevillea	unlikely	na	na	unlikely	no	No impact	na	na
Persoonia marginata Clandulla Geebung	unlikely	na	na	unlikely	no	No impact	na	na
Pomaderris brunnea Brown Pomaderris	unlikely	na	na	unlikely	no	No impact	na	yes
Prostanthera cryptandroides subsp. cryptandroides Wollemi Mint-bush	unlikely	na	na	unlikely	no	No impact	na	na
Prostanthera stricta Mount Vincent Mint-bush	unlikely	na	na	unlikely	no	No impact	na	yes

Group and species	(a)Risk of extinction of local population	(b)Risk of extinction of endangered population	(c) adverse impact on the extent of, or modification to EECs or CECs leading to local extinction	(d)habitats of threatened species, EECs or CEECs			(e)adverse impact on critical habitat	(f)consistence with recovery or threat abatement plan
				(i)extent to which habitat is likely to be removed or modified	(ii)will habitat become isolated	(iii) importance of habitat removed, modified or isolated		
Thesium austral Austral Toadflax	unlikely	na	na	unlikely	no	No impact	na	na
Fauna:								
Giant Dragonfly	unlikely	na	na	no	no	na	na	na
Macquarie Perch	unlikely	na	na	unlikely	unlikely	na	na	na
Adams Emerald Dragonfly	unlikely	na	na	unlikely	unlikely	unlikely	na	na
Paralucia spinifera Bathurst Copper Butterfly	unlikely	na	na	unlikely	no	No impact	na	yes
Heleioporus australiacus Giant Burrowing Frog	unlikely	na	na	unlikely	no	No impact	na	na
Pseudophryne australis Red-crowned Toadlet	unlikely	na	na	unlikely	no	No impact	na	na
Aprasia parapulchella Pink-tailed Worm-lizard	unlikely	na	na	unlikely	no	No impact	na	na
Hoplocephalus bungaroides Broad-headed Snake	unlikely	na	na	unlikely	no	No impact	na	na
Suta flagellum Little Whip Snake	unlikely	na	na	unlikely	no	No impact	na	na
Varanus rosenbergi Rosenberg's Goanna	unlikely	na	na	unlikely	no	No impact	na	na
Anthochaera Phrygia Regent Honeyeater	unlikely	na	na	unlikely	no	No impact	na	yes

Group and species	(a)Risk of extinction of local population	(b)Risk of extinction of endangered population	(c) adverse impact on the extent of, or modification to EECs or CECs leading to local extinction	(d)habitats of threatened species, EECs or CEECs			(e)adverse impact on critical habitat	(f)consistence with recovery or threat abatement plan
				(i)extent to which habitat is likely to be removed or modified	(ii)will habitat become isolated	(iii) importance of habitat removed, modified or isolated		
Callocephalon fimbriatum Gang-gang Cockatoo	unlikely	na	na	unlikely	no	No impact	na	yes
Calyptorhynchus lathami Glossy Black-Cockatoo	unlikely	na	na	unlikely	no	No impact	na	yes
Tyto novaehollandiae Masked Owl	unlikely	na	na	unlikely	no	No impact	na	yes
Chthonicola sagittata Speckled Warbler	unlikely	na	na	unlikely	no	No impact	na	yes
Climacteris picumnus victoriae Brown Treecreeper (eastern subspecies)	unlikely	na	na	unlikely	no	No impact	na	yes
Daphoenositta chrysoptera Varied Sittella	unlikely	na	na	unlikely	no	No impact	na	na
Glossopsitta pusilla Little Lorikeet	unlikely	na	na	unlikely	no	No impact	na	na
Grantiella picta Painted Honeyeater	unlikely	na	na	unlikely	no	No impact	na	na
Lathamus discolour Swift Parrot	unlikely	na	na	unlikely	no	No impact	na	yes
Melanodryas cucullata cucullata Hooded Robin (south-eastern form)	unlikely	na	na	unlikely	no	No impact	na	na

Group and species	(a)Risk of extinction of local population	(b)Risk of extinction of endangered population	(c) adverse impact on the extent of, or modification to EECs or CECs leading to local extinction	(d)habitats of threatened species, EECs or CEECs			(e)adverse impact on critical habitat	(f)consistence with recovery or threat abatement plan
				(i)extent to which habitat is likely to be removed or modified	(ii)will habitat become isolated	(iii) importance of habitat removed, modified or isolated		
Melithreptus gularis gularis Black-chinned Honeyeater (eastern subspecies)	unlikely	na	na	unlikely	no	No impact	na	na
Neophema pulchella Turquoise Parrot	unlikely	na	na	unlikely	no	No impact	na	na
Ninox connivens Barking Owl	unlikely	na	na	unlikely	no	No impact	na	yes
Ninox strenua Powerful Owl	unlikely	na	na	unlikely	no	No impact	na	yes
Pachycephala inornata Gilbert's Whistler	unlikely	na	na	unlikely	no	No impact	na	yes
Petroica boodang Scarlet Robin	unlikely	na	na	unlikely	no	No impact	na	na
Petroica phoenicea Flame Robin	unlikely	na	na	unlikely	no	No impact	na	na
Pomatostomus temporalis temporalis Grey-crowned Babbler (eastern subspecies)	unlikely	na	na	unlikely	no	No impact	na	yes
Stagonopleura guttata Diamond Firetail	unlikely	na	na	unlikely	no	No impact	na	yes
Tyto tenebricosa Sooty Owl	unlikely	na	na	unlikely	no	No impact	na	yes

Group and species	(a)Risk of extinction of local population	(b)Risk of extinction of endangered population	(c) adverse impact on the extent of, or modification to EECs or CECs leading to local extinction	(d)habitats of threatened species, EECs or CEECs			(e)adverse impact on critical habitat	(f)consistence with recovery or threat abatement plan
				(i)extent to which habitat is likely to be removed or modified	(ii)will habitat become isolated	(iii) importance of habitat removed, modified or isolated		
Cercartetus nanus Eastern Pygmy-Possum	unlikely	na	na	unlikely	no	No impact	na	na
Chalinolobus dwyeri Large-eared Pied Bat	unlikely	na	na	unlikely	no	No impact	na	yes
Dasyurus maculatus maculatus Spotted-tailed Quoll	unlikely	na	na	unlikely	no	No impact	na	yes
Falsistrellus tasmaniensis Eastern False Pipistrelle	unlikely	na	na	unlikely	no	No impact	na	na
Miniopterus australis Little Bentwing-bat	unlikely	na	na	unlikely	no	No impact	na	na
Miniopterus schreibersii oceanensis Eastern Bentwing-bat	unlikely	na	na	unlikely	no	No impact	na	yes
Petaurus norfolcensis Squirrel Glider	unlikely	na	na	unlikely	no	No impact	na	na
Petrogale penicillata Brush-tailed Rock-wallaby	unlikely	na	na	unlikely	no	No impact	na	yes
Phascolarctos cinereus Koala	unlikely	na	na	unlikely	no	No impact	na	yes
Vespadelus troughtoni Eastern Cave Bat	unlikely	na	na	unlikely	no	No impact	na	na
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	unlikely	na	na	unlikely	no	No impact	na	yes

Group and species	**(a)Risk of extinction of local population**	**(b)Risk of extinction of endangered population**	**(c) adverse impact on the extent of, or modification to EECs or CECs leading to local extinction**	**(d)habitats of threatened species, EECs or CEECs**			**(e)adverse impact on critical habitat**	**(f)consistence with recovery or threat abatement plan**
				(i)extent to which habitat is likely to be removed or modified	**(ii)will habitat become isolated**	**(iii) importance of habitat removed, modified or isolated**		
Myotis macropus Southern Myotis	unlikely	na	na	unlikely	no	No impact	na	na
Endangered Ecological Communities								
Genowlan Point *Allocasuarina nana* heathland	na	na	unlikely	unlikely	no	No impact	na	yes
White Box- Yellow Box- Blakey's Red Gum Woodland	na	na	unlikely	unlikely	no	No impact	na	na

Table 10.18: Summary of Assessment of Significance (EPBC Act) for Species

Species	**Lead to a long-term decrease in the size of an important population.**	**Reduce the area of occupancy of the species or community.**	**Fragment an existing important population.**	**Adversely affect habitat critical to the survival of a species**	**Disrupt the breeding cycle of a population**	**Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.**	**Result in invasive species becoming established**	**Introduce disease that may cause the species to decline.**	**Interfere substantially with the recovery of the species.**
Flora:									
Acacia bynoeana	no	no	no	no	no	no	unlikely	unlikely	unlikely
Grevillea evansiana	no	no	no	no	no	no	unlikely	unlikely	unlikely
Grevillea obtusiflora subsp. fecunda Grey Grevillea	no	no	no	no	no	no	unlikely	unlikely	unlikely
Persoonia marginata Clandulla Geebung	no	no	no	no	no	no	unlikely	unlikely	unlikely
Philotheca ericifolia	no	no	no	no	no	no	unlikely	unlikely	unlikely
Pomaderris brunnea Brown Pomaderris	no	no	no	no	no	no	unlikely	unlikely	unlikely
Prasophyllum sp. *Wybong*	no	no	no	no	no	no	unlikely	unlikely	unlikely
Prostanthera cryptandroides subsp. cryptandroides Wollemi Mint-bush	no	no	no	no	no	no	unlikely	unlikely	unlikely
Prostanthera stricta Mount Vincent Mint-bush*	no	no	no	no	no	no	unlikely	unlikely	unlikely
Pultenaea sp. Genowlan Point Genowlan Point Pultenaea*	no	no	no	no	no	no	unlikely	unlikely	no

Species	Lead to a long-term decrease in the size of an important population.	Reduce the area of occupancy of the species or community.	Fragment an existing important population.	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of a population	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Result in invasive species becoming established	Introduce disease that may cause the species to decline.	Interfere substantially with the recovery of the species.
Thesium australe Austral Toadflax	no	no	no	no	no	no	unlikely	unlikely	unlikely
Fauna:									
Aprasia parapulchella Pink-tailed Worm-lizard	unlikely	no	no	no	no	no	unlikely	unlikely	unlikely
Pseudomys novaehollandiae New Holland Mouse	no	no	no	no	no	no	unlikely	unlikely	unlikely
Anthochaera Phrygia Regent Honeyeater	unlikely	unlikely	unlikely	no	no	no	unlikely	unlikely	unlikely
Chalinolobus dwyeri Large-eared Pied Bat*	no	no	no	no	no	no	unlikely	unlikely	unlikely
Dasyurus maculatus maculatus Spotted-tailed Quoll	unlikely	no	no	no	no	no	unlikely	unlikely	unlikely
Heleioporus australiacus Giant Burrowing Frog	unlikely	no	no	no	**no**	no	unlikely	unlikely	unlikely
Hoplocephalus bungaroides Broad-headed Snake	no	unlikely	no	no	no	no	unlikely	unlikely	unlikely
Lathamus discolour Swift Parrot	unlikely	unlikely	unlikely	no	no	no	unlikely	unlikely	unlikely
Phascolarctos cinereus Koala	unlikely	no	no	no	unlikely	no	unlikely	unlikely	unlikely

Species	Lead to a long-term decrease in the size of an important population.	Reduce the area of occupancy of the species or community.	Fragment an existing important population.	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of a population	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Result in invasive species becoming established	Introduce disease that may cause the species to decline.	Interfere substantially with the recovery of the species.
Paralucia spinifera Bathurst Copper Butterfly	unlikely	no	unlikely	no	unlikely	unlikely	unlikely	unlikely	unlikely
Petrogale penicillata Brush-tailed Rock-wallaby	no	no	no	no	no	no	unlikely	unlikely	unlikely

Table 10.19: **Summary of Assessment of Significance (EPBC Act) for Endangered Ecological Communities**

Community	Reduce the extent community.	Fragment the community.	Adversely affect habitat critical to survival	Modify non living factors	Cause a substantial change in composition.	Cause a substantial reduction in quality or integrity	Interfere with the recovery of the community.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	no	no	no	no	no	no	no

With regards to the questions to be addressed in the TSC Act 7 part tests, it can be seen from Table 10.17 that the Project will cause the following consequences.

- *Is there a risk of the extinction of a local population?* Unlikely in each case
- *Is there a risk of the extinction of an endangered population?* Not applicable in each case as no populations are listed
- *Will there be an adverse impact on the extent of, or modification to EECs and CECs leading to local extinction?* Not applicable for all plant and animal species, and unlikely for EECs
- *In relation to the habitat of a threatened species, population or ecological community, what is the extent to which habitat is likely to be removed or modified as a result of the action proposed?* Unlikely for all threatened species and EECs
- *In relation to the habitat of a threatened species, population or ecological community, will an area of habitat is likely to become fragmented or isolated?* No or unlikely in all cases
- *In relation to the habitat of a threatened species, population or ecological community, what is the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival in the locality?* No impact for all threatened species and EECs
- *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)?* Not applicable all cases as no critical habitats are present;
- *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan?* In most cases, this is not applicable as such plans do not exist. For those species with such plans and or priority actions the action is not inconsistent with the plans.

With regards to the questions to be addressed in the EPBC Act assessment of significance (

Table 10.18) shows that the Project will cause the following.

- *Lead to a long-term decrease in the size of an important population?* Unlikely or no in all cases
- *Reduce the area of occupancy of the species?* Unlikely or no in all cases
- *Fragment an existing important population?* Unlikely and or no in all cases
- *Adversely affect habitat critical to the survival of a species?* Unlikely and or no in all cases
- *Disrupt the breeding cycle of a population?* Unlikely or no in all cases
- *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?* Unlikely and or no in all cases
- *Result in invasive species becoming established?* Unlikely in all cases
- *Introduce disease that may cause the species to decline?* Unlikely in all cases
- *Interfere substantially with the recovery of the species?* Unlikely in all cases.

With regards to the questions to be addressed in the EPBC Act assessment of significance (Table 10.19**)** shows that the Project will cause the following in relation to Box Gum Woodland EEC.

- *Reduce the extent community?* No
- *Fragment the community?* No

- *Adversely affect habitat critical to survival?* No
- *Modify non-living factors?* No
- *Cause a substantial change in composition?* No
- *Cause a substantial reduction in quality or integrity?* No
- *Interfere with the recovery of the community?* No.

10.2.5.2 Stygofauna

Consequences to stygofauna, should they be present, are unlikely because the mine design limits vertical fracturing and consequently limits groundwater impacts.

10.2.5.3 Key Threatening Processes

An additional part of the 7 part test process under the TSC Act is the consideration of whether any Key Threatening Processes listed under Schedule 3 of the TSC Act will be triggered by the Project. The following seven Key Threatening Processes have the potential to be triggered by the Project:

- *alteration of the natural flow regimes of rivers, streams, floodplains and wetland:* The Project is predicted to have an insignificant incremental affect due to alluvial aquifer drawdown and alteration of natural flow regimes due to water discharges
- *loss of hollow-bearing trees*: The proposed REA will require removal of four hollow-bearing trees. The loss of tree hollows will trigger this KTP for several species that have been recorded or have potential to occur within the Project Application Area
- *removal of dead wood and dead trees*: The removal of dead wood and dead trees is limited to a small number of dead stags and fallen limbs within the REA footprint. This loss is negligible in the context of the large areas containing this habitat feature within the Project Application Area
- *clearing of native vegetation*: The Project will remove 0.03 ha of MU38 Capertee Grey Gum - Narrow-leaved Stringybark - Scribbly Gum - Callitris - Ironbark Shrubby Open Forest, as well as a few scattered shrubs and paddock trees. This loss incrementally contributes to this KTP for several species that have been recorded or have potential to occur within the Project Application Area. However, in relation to the large areas of intact vegetation within the Project Application Area, this loss is negligible
- *anthropogenic climate change*: The Project will insignificantly contribute to this process
- *invasion of native plant communities by exotic perennial grasses:* The Project is likely to incrementally contribute to this process
- *degradation of native riparian vegetation along NSW watercourses.* The Project is unlikely to result in a decline or loss of extent of groundwater dependent species or those that occur within riparian habitats.

10.2.5.4 World Heritage Area

The boundary of the Gardens of Stone National Park (part of the Greater Blue Mountains Area World Heritage Area) is directly south of the Project Application Area. Potential impacts from the Project have been considered for their potential to directly or indirectly affect the World Heritage Area.

The pit top infrastructure both existing and proposed are approximately 2.3 km from the World Heritage Area and no impacts are expected.

Subsidence will be limited to zones within the Project Application Area and will not extend to the World Heritage Area.

Both Airly Creek and the Gap Creek/Genowlan Creek catchment join the Capertee River, which enters Wollemi National Park approximately 35 km east of the Project Application Area. The sections of these two catchments within the Project Application Area are very small in relation to the catchment area of the Capertee River prior to its entry into Wollemi National Park. The changes in flow and water quality in the Capertee River in the World Heritage Area are expected to be immeasurable. Accordingly no measurable consequential changes on ecological systems are expected.

10.2.6 Cumulative Impacts

10.2.6.1 Terrestrial Ecology

Airly Mine is a considerable distance from other projects, including Charbon Colliery 20 km to the north and Baal Bone Colliery 13 km to the south. Therefore, the cumulative impact upon locally occurring flora and fauna species is minimal. Additionally, the proposed mine design in the Project is conservative, such that all predicted impacts will be negligible. Therefore, the Project is unlikely to result in cumulative impacts to local biodiversity, including threatened species and EECs.

10.2.6.2 Aquatic Ecology

Subsidence related impacts at Airly Mine are predicted to be minimal for the majority of the Project Application Area. The next nearest underground coal mine is well outside the Project subsidence area and so cumulative subsidence related impacts will not occur.

Due to the relatively small anticipated discharge and retention of water at the pit top the cumulative hydrological and water quality impacts on the receiving waters of the Colo River are anticipated to be minor to negligible.

Track management for mining and recreation in the Mugii Murum-ban SCA can cumulatively cause erosion and deposition, which in turn can degrade aquatic habitat.

10.2.6.3 Stygofauna

A considerable distance separates the Airly Mine from other mines and quarries within the region and the level of extraction from the regional aquifer at Airly is low in a regional context. Cumulative impacts of this nature are therefore expected to be minimal.

10.2.7 Biodiversity Offset Strategy

10.2.7.1 Introduction

In deciding whether an offset is warranted for this Project, the seven principles of the *Draft NSW Biodiversity Offsets Policy for Major Projects* (OEH 2014) were reviewed. In addition, this Section has considered the requirements EPBC Act *Environmental Offsets Policy* (SEWPAC 2012). This review has concluded that an offset is not warranted for this Project.

10.2.7.2 Draft NSW Biodiversity Offsets Policy for Major Projects

Principle 1: Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.

As detailed in Section 6 of the Flora and Fauna Assessment (Appendix H) and Section 12.5.4.2 in this EIS, avoidance measures have been considered throughout the Project. This has included avoidance of threatened flora, namely *Eucalyptus cannonii* and all areas of woodland vegetation, including the Box-Gum Woodland listed community.

Vegetation within the originally considered REA location (Section 12.4.3) contains 5.84 ha of woodland vegetation, including 0.79 ha of the Box-Gum Woodland listed community with a complete overstorey. This alternate REA location also contains 16 hollow-bearing trees consisting of 15 small (2 - 10 cm diameter) hollows, ten medium (11 - 20 cm) hollows and two large (<20 cm) hollows. In contrast, the proposed REA location (Section 4.8.3) contains four hollow-bearing trees, consisting of seven small hollows, one medium hollow and two large hollows. Therefore selecting the proposed REA location over the alternate REA assessed and rejected has resulted in significantly higher impacts for vegetation, flora and fauna being avoided.

Due to the requirement of surface facilities to meet the needs of the Project, some impacts are unavoidable. These impacts are however minor or negligible due to the positioning of the proposed facilities in areas containing low biodiversity values. Mitigation measures, as listed in Section 8 of the Flora and Fauna Assessment and Section 10.2.8 of the EIS, have sought to ameliorate potential direct and indirect impacts. In addition, the Decommissioning and Rehabilitation Strategy (SLR 2014d) (Appendix O) demonstrates that the impacts will be further mitigated. This is further discussed under Principle 3 below.

Principle 2: Offset requirements should be based on a reliable and transparent assessment of losses and gains.

This section of the report has been prepared to provide a reliable and transparent discussion on the topic of offsets for this project. A Flora and Fauna Assessment (Appendix H) has been undertaken to assess the potential impacts of the Project on the biodiversity of the Project Application Area. The outcomes of this assessment are also discussed in Section 10.2 of this EIS.

Principle 3: Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

As detailed in Section 4.4.3 of the Flora and Fauna Assessment (Appendix H) and Section 4.6 of this EIS, all proposed infrastructure footprints, with the exception of the proposed REA and the Site Security Gate, occur over areas that are unvegetated or are dominated by exotic species. The proposed REA contains areas of derived native grasslands in low condition.

Section 7.1.2 of the Flora and Fauna Assessment (Appendix H) and Section 10.2.4.1 provides a discussion on the conservation significance of the derived native grasslands within the REA location. The proposed REA contains 3.27 ha of Box-Gum Woodland Derived Native Grassland and 25.49 ha of derived native grassland from a non-EEC community. The vegetation within the REA can be regarded as having low habitat value for flora and fauna, low species diversity and is likely to increase in weed infestation in a do-nothing scenario. It also offers poor connectivity across the landscape and does not contain rare, declining or threatened species.

The 28.76 ha of derived native grassland within the REA occurs in low condition. Hence, the starting biodiversity values being lost are equally low.

It is important to note that the intended use of these impacted sites is not permanent. The Decommissioning and Rehabilitation Strategy (SLR 2014) details the final proposed land use of all surface facility sites. It is proposed that REA is reverted to grazing pasture as part of the rehabilitation. Therefore, there will be no net loss of biodiversity values for this area in the long term.

Open forest native vegetation is proposed for areas disturbed for infrastructure establishment adjacent to the Muggi Murum-ban SCA, including the CHPP, box cut and underground portals, workshops, administration buildings and car parks. Areas will be rehabilitated with species commensurate with the adjacent native vegetation and be managed in accordance with the objectives of the Mugii Murum-ban SCA Plan of Management. These areas are currently unvegetated or are dominated by exotic species. Therefore, there will an overall net gain in biodiversity values for the Project.

Due to there being no long-term loss of biodiversity values within the proposed REA and a net gain in biodiversity values for the Project overall, an offset is not warranted in this instance.

Principle 4: Offsets must be additional to other legal requirements.

As no offsets are deemed necessary for the Project, this principle is no longer applicable.

Principle 5: Offsets must be enduring, enforceable and auditable.

As no offsets are deemed necessary for the Project, this principle is no longer applicable.

Principle 6: Supplementary measures can be used in lieu of offsets.

As no offsets are deemed necessary for the Project, this principle is no longer applicable.

Principle 7: Offsets can be discounted where significant social and economic benefits accrue to NSW as a consequence of the proposal.

As no offsets are deemed necessary for the Project, this principle is no longer applicable.

10.2.7.3 EPBC Act Environmental Offsets Policy

Offsets under the EPBC Act are aimed to achieve long-term environmental outcomes for matters protected under the EPBC Act. Consideration of the need for offsets therefore applies to the 3.27 ha of Box-Gum Woodland Derived Native Grassland within the proposed REA.

The offsets policy notes that offsets are not required for all approvals under the EPBC Act. Offsets are not required where the impacts of a proposed action are not thought to be significant or could reasonably be avoided or mitigated. Section 7.1.2 of the Flora and Fauna Report provides the following:

> *The listing under the EPBC Act considers that the larger and more diverse a patch is, the more important it is. Additionally, patches that link remnants in the landscape, that occur in depauperate areas, that contain rare, declining or threatened species and, that encompass the entire range of the ecological community, are important to the viability of the ecological community into the future (Threatened Species Scientific Committee 2006). The vegetation within the proposed REA has exceptionally low species diversity, offers poor connectivity across the landscape, does not contain rare, declining or threatened species and does not encompass the entire range of the ecological community. Therefore, whilst 3.27 ha of the REA has been mapped as Box-Gum Woodland Derived Native Grassland, the conservation value and importance of this example of the listed community is regarded as considerably low. Consequently, the loss of this area of Box-Gum Woodland Derived Native Grassland cannot be regarded as a significant impact.*

Whilst proposed rehabilitation of the REA does not commit to restoring the areas as Box-Gum Woodland, rehabilitation is likely to provide habitat condition and species diversity that is similar to what currently exists. This mitigation measure further reduces the already low impacts of the establishment of the REA.

10.2.7.4 Conclusion

The above discussion has found that the Project will restore and/or improve the biodiversity values of those areas proposed to be impacted upon by surface facilities. The Project is therefore consistent (where relevant) with the seven principles of the Draft NSW Biodiversity Offsets Policy for Major Projects and the EPBC Act Environmental Offsets Policy. Due to the proposed rehabilitation strategy, the Project provides a strong maintain or improve outcome for the Project.

10.2.8 Mitigation and Management Measures

The primary mitigation measure associated with the Project is the selected mining technique of partial extraction across various mining zones. The mine design minimises subsidence.

Table 10.20 summarises mitigation measures for both terrestrial and aquatic ecology.

Table 10.20: Mitigation Measures for Terrestrial and Aquatic Ecology

Impact	Mitigation Measures
Direct Impacts	
Impacts to flora (loss of species and habitat)	Rehabilitate following infrastructure decommissioning.
Impacts to fauna (loss of species and habitat)	Where possible, clearing will be timed to avoid removal of hollow-bearing trees during breeding season of threatened species.
	Employment of best practice methods for felling of hollow-bearing trees.
Impacts to aquatic ecology	Using measures specified in the Erosion and Sediment Control Plan to protect aquatic habitats and biota downstream of construction areas.
	Establishing a bunded area for storage of fuels, oils, refuelling, oils, refuelling and appropriate maintenance of vehicles and mechanical plant.
Impacts to stygofauna	Ongoing monitoring of groundwater level and quality to ensure any unforeseen changes are identified and mitigated. Stygofauna sampling should also be continued twice annually with further spatial replication, if available, for a period of two years prior to mining, after which the program could be discontinued if no fauna are detected.
	Operational water quality impacts will be mitigated through the capture and treatment of runoff arising from site related plant and machinery use.
Indirect Impacts (reduction in quality of habitats)	
Erosion and Sedimentation	Implementation of an Erosion and Sediment Control Plan.
	Clearing of vegetation is not to be undertaken during overland flow events.
	Locate soil or mulch stockpiles away from watercourses and key stormwater flow paths to limit potential transport of these substances into the watercourses via runoff.
	Limiting the amount of exposed surfaces that may become eroded by weather and operations.
	Installation of erosion and runoff control measures around cleared and operation areas.
Dust	Implementation of dust control measures to protect adjacent retained vegetation.
Weed Incursion	Implementation of a weed management plan, considering : weed management, monitoring and control practices to minimise the spread of exotic species into un-accessed areas of the Project Application Area.
Exploration drill holes	As the required exploration drill holes are determined, undertake a series of due diligence assessments to consider ecological impacts as relevant.

With regards to *Pultenaea sp. Genowlan Point* (Genowlan Point Pultenaea) no State Recovery Plan exists for this species. However, there is a National Plan with defined objectives and there are currently 18 Priority Actions for the recovery of this species:

Monitoring for this species is being coordinated by NSW National Parks and wildlife Service. While the Project will not impact on this species Centennial Airly will continue to be in consultation with NSW National Parks and wildlife Service and assist in any monitoring efforts, if required. Centennial Airly will work with State and Federal authorities to support the objectives of the recovery plan and priority actions.

10.2.9 Conclusion

Eleven threatened plant species listed under the TSC Act and/or EPBC Act have potential to occur within the Project Application Area and three of these, *Eucalyptus cannonii*, *Prostanthera stricta* and *Pultenaea* sp. Genowlan Point were detected above the proposed mining area. Due to the low predicted subsidence levels, the Project is unlikely to have a significant effect on these species or their habitats, such that they would no longer persist in their current extent. No threatened flora species were recorded within proposed surface infrastructure footprint.

Two EECs occur in the Project Application Area, namely:

- Genowlan Point *Allocasuarina nana* Heathland (TSC Act)
- White Box – Yellow Box – Blakely's Red Gum Woodland (TSC Act), and White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act).

Construction and operations will remove 40 ha of highly modified grasslands with scattered paddock trees and shrubs from within the proposed REA footprint. Neither EEC is predicted to be impacted by infrastructure or mining.

Numerous State and Federally listed fauna species occur in the Project Application Area and there are no significant impacts predicted to any of them, due to the limitation of proposed clearing of modified grasslands and the low impact mining method proposed in the Project.

The site supports facultative GDEs and the limited groundwater drawdown predicted is not expected to significantly reduce the functioning or area of these GDEs.

Sampling to date has not found any stygofauna. However, should they be present in the upper aquifers, the limited extent and severity of groundwater drawdown is such that impacts to any undiscovered stygofauna would be minimal.

10.3 Heritage

This section specifically summarises the Heritage Impact Assessment (Appendix J), which respond to the DGRs and provide the following in regard to Aboriginal and historic heritage:

The Director General's requirements

Heritage – including:

- an Aboriginal cultural heritage assessment (including both cultural and archaeological significance) which must:
  - demonstrate effective consultation with the Aboriginal community in determining and assessing impacts, and developing and selecting mitigation options and measures
  - outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures).
- a Historic Heritage assessment (including archaeology) which must:
  - include a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items
  - outline any proposed mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures).

10.3.1 Introduction

This section identifies the potential impact of the Project on Aboriginal and historic heritage values and how these will be managed to minimise consequences. It is informed by the technical assessment, *Airly Mine Extension Project, Cultural Heritage Impact Assessment*, August 2014, RPS Australia East Pty Ltd (RPS 2014b), which is provided in full in Appendix J. The report considers the potential for Aboriginal archaeological sites to occur and the location of any registered sites within the Project Application Area. It reports on the actual Aboriginal archaeological sites that have been identified during surveys, and the implications for the Project on these recorded sites.

An historical heritage assessment has been completed as part of the Cultural Heritage Impact Assessment including a review of relevant Commonwealth, State and local historic heritage registers. The review of relevant registers included the Australian Heritage Database, Heritage databases maintained by the NSW Heritage Branch, Schedule 1 'Heritage Items' of Lithgow LEP 1994.

10.3.2 Aboriginal Heritage

10.3.2.1 Consultation

Details of Aboriginal community consultations undertaken are provided in Appendix J and have been conducted in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents*, (DECCW 2010b).

As there are a number of concurrent projects being undertaken across the Centennial Coal Western Operations, the consultation process has been streamlined to include all active projects, rather than running multiple individual consultation processes. Fifteen Aboriginal community groups were identified as potentially having an interest in Project of which ten registered their interest in the Project. All registered Aboriginal groups were sent information regarding the proposed heritage assessment methodology and strategy for collecting information on cultural heritage significance. Six groups returned their comments on the methodology by the closing date.

Registered Aboriginal groups were invited to attend an information session on the Project, of which five groups, listed below, attended and were invited to participate in a field survey between 24 and 27 July 2012, and between 30 July and 3 August 2012.

- Warrabinga Native Title Claimants Aboriginal Corporation
- Bathurst LALC
- North East Wiradjuri Company Ltd
- Mingaan Aboriginal Corporation
- Gundungurra Tribal Council Aboriginal Corporation.

As part of the impact assessment, a copy of the draft report was sent to the Aboriginal stakeholders and an opportunity was provided to comment on the significance of the Aboriginal sites identified. Nine stakeholders responded to the draft report (Appendix 2 and 3 of Appendix J). The Aboriginal stakeholders who responded to the draft agreed with the assessment and the recommended mitigation measures.

10.3.2.2 Existing Environment- Aboriginal Heritage

A search of AHIMS identified six recorded Aboriginal sites within and immediately adjacent the Project Application Area. Of these six sites three were in the Project Application Area (Table 10.21 and Figure 10.9). No Aboriginal places were identified in the Project Application Area.

Table 10.21: AHIMS Sites

AHIMS Number	AHIMS Name	Site Type
45-1-0167	Genowlan Creek 1	Shelter with Deposit
45-1-0168	Dog Trap Creek	Artefact Unspecified
45-1-2544*	Carinya (C-ST-1); Hillcroft*	Scarred Tree

*This site is no longer present and a request has been made with AHIMS to change this site's status from valid to invalid.

Previous archaeological studies undertaken in and around the Project Application Area and dated back to 1998 were reviewed as follows:

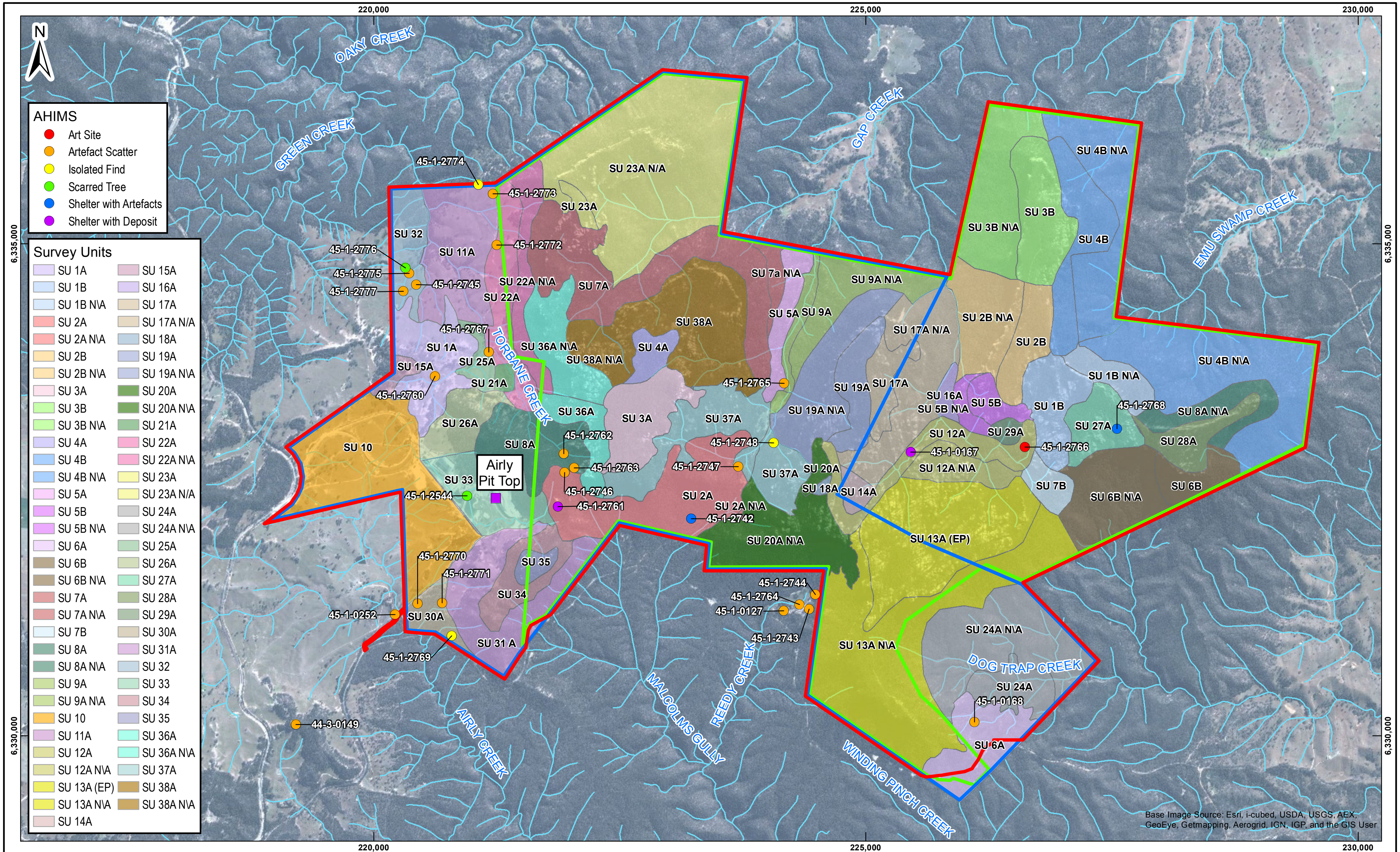
- Brayshaw, 1990, Airly Mine (Authorisation Area A232) archaeological assessment for Environmental Impact Statement
- Brayshaw, 1991, Airly Mine (Authorisation Area A232) follow up archaeological assessment to assess potential impacts, for Environmental Impact Statement
- Mills, 1998 Airly Mine, archaeological survey for the realignment of the access road to the Airly Mine
- Hiscock & Attenbrow, 2004, re-analysis of artefact assemblage from a site called Capertee 3
- RPS (HSO), 2008, Proposed Railway Loop Airly Mine, due diligence inspection of two areas for the installation of rail infrastructure at the Airly Mine Pit Top for Centennial Airly Pty Limited
- RPS (HSO), 2009, Proposed Powerline Airly Mine, an archaeological assessment over land holdings at Airly Mine for Centennial Airly Pty Limited.

The site predictive model suggested the following:

- the most likely site type would be artefact scatters, rockshelters with artefact scatters, and scarred trees
- rockshelters would be expected at higher elevations, where sandstone outcropping and pagodas are likely to be present. It is also predicted that the rockshelters will be near or at the head of drainage lines and would contain artefacts
- artefact scatters would be expected in the lower slopes and valley floors close to creek lines
- scarred trees could not be located anywhere in the Project Application Area
- artefacts would comprise flaked stone artefacts made from chert, quartz, quartzite and mudstone
- if rockshelters are identified they would have potential archaeological deposit (PAD), artefacts or both.

RPS archaeologists and Aboriginal stakeholders conducted a survey of the Project Application Area in accordance with the requirements set out in the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a) and the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011).

The sampling strategy targeted all landforms which may be impacted by the Project and, where possible, targeted landforms with archaeological potential. Where possible these landforms were subject to pedestrian survey. The Project Application Area was surveyed in survey units and targeted the landforms identified in the survey strategy (Figure 10.9 and summarised in Table 10.22). Areas predicted to be impacted by the Project were included in the field survey to be ground-truthed.



LEGEND

Project Application Area

ML1331 Current Lease Boundary (Offset for Clarity)

A232 Authorisation Boundary (Offset for Clarity)

Watercourse

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 10.9: Survey Units and Aboriginal Heritage Sites

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.9

A4

Table 10.22: Summary of Survey Units

Unit	Landform	Area (sq m)	Exposure (%)	Visibility(%)	Coverage(m^2)	Sample
1A	Lower slopes and valley floors	690,097	10	30	20,703	3
1B	Mountain slopes	500,600	10	30	15,018	3
2A	Mountain slopes and steep slopes	1,269,795	20	30	76,188	6
2B	Mountain slopes	385,429	10	30	11,563	3
3A	Mountain slopes	611,911	10	30	18,357	3
3B	Mountain slopes	685,918	20	30	41,155	6
4A	Mountain slopes	181,190	10	30	5,436	3
4B	Steep Hills	638,730	10	30	19,162	3
5A	Steep Gullies	297,237	30	30	26,751	9
5B	Mountain slopes and steep Hills	185,469	10	20	3,709	2
6A	Steep Gullies and steep hills	644,245	10	30	19,327	3
6B	Steep hills	297,861	10	30	8,936	3
7A	Steep hills	1,442,262	10	30	43,268	3
7B	Steep hills	187,312	10	20	3,746	2
8A	Steep hills	634,220	20	30	37,993	6
9A	Steep gullies	155,010	10	30	4,650	3
10A	Lower slopes and valley floors	1,830,899	10	30	54,927	3
11A	Lower slopes and valley floors	951,737	20	30	57,104	6
12A	Mountain slopes and steep gullies	558,269	30	30	50,244	9
13A	Mountain slopes and tops	1,632,762	20	30	97,966	6
14A	Mountain slopes	107,825	10	30	3,235	3
15A	Lower slopes and valley floors	96,077	20	30	5,765	6
16A	Steep gullies and Steep hills	84,988	20	30	5,099	6
17A	Mountain slopes	272,598	60	80	130,847	48
18A	Mountain slopes	2,229	20	20	889	40
19A	Mountain slopes	374,094	20	30	22,446	6
20A	Mountain slopes	85,778	40	50	17,156	20
21A	Lower slopes and valley floors	54,308	20	20	2,172	4
22A	Lower slopes and valley floors	599,260	60	80	287,645	48
23A	Mountain slopes and tops	78,514	10	10	785	1
24A	Steep gullies	343,589	50	80	137,436	40
25A	Lower slopes and valley floors	139,703	40	40	22,352	16
26A	Mountain slopes	369,015	10	10	3,690	1
27A	Mountain slopes	407,637	40	40	65,222	16
28A	Mountain slopes and tops	335,877	40	40	53,740	16
29A	Mountain slopes	68,490	20	30	4,109	6
30A	Lower slopes and valley floors	240,471	30	50	36,071	15
31A	Mountain slopes	85,037	20	30	59,102	6
32A	Steep gullies	430,197	40	50	86,039	20
33A	Mountain slopes	647,934	20	60	77,752	12
34A	Mountain slopes	62,797	40	60	87,071	24
35A	Mountain tops	107,714	30	40	12,926	12
36A	Steep hills	309,401	30	40	37,128	12
37A	Steep hills	309,580	30	50	4,644	2
38A	Steep hills	1,198,732	30	50	179,810	15

The survey found 22 new Aboriginal sites (Figure 10.9), and Table 10.23 summarise the type and archaeological significance of all known Aboriginal sites in the Project Application Area.

Table 10.23: Archaeological Site Significance

AHIMS Site ID	Site type	Significance scale	Rarity	Representativeness	Integrity	Connectedness	Complexity	Research Potential	Education Potential	Total	Overall Significance
45-1-2760	Artefact Scatter	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2761	Shelter with Deposit	Local	2	2				2	1	7	Moderate
		Regional	2	1				1	1	5	Low
45-1-2762	Artefact Scatter	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2763	Artefact Scatter	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2765	Artefact Scatter	Local	2	2				1	1	6	Low
		Regional	1	1				1	1	4	Low
45-1-2766	Art Site	Local	3	3				2	3	11	High
		Regional	2	2				2	2	8	Moderate
47-1-2767	Artefact Scatter	Local	1	2				1	1	5	Low
		Regional	1	1				1	1	4	Low
45-1-2768	Shelter with Artefacts	Local	2	3				3	2	10	High
		Regional	2	2				2	1	7	High
45-1-2769	Isolated Find	Local	2	2				1	1	6	Low
		Regional	1	1				1	1	4	Low
45-1-2770	Artefact Scatter	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2771	Artefact Scatter	Local	1	2				1	1	5	Low
		Regional	1	1				1	1	4	Low
45-1-2772	Artefact Scatter	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2773	Artefact Scatter	Local	2	2				1	1	6	Low
		Regional	1	1				1	1	4	Low

AHIMS Site ID	Site type	Significance scale	Rarity	Representativeness	Integrity	Connectedness	Complexity	Research Potential	Education Potential	Total	Overall Significance
45-1-2774	Isolated Find	Local	2	2				1	1	6	Low
		Regional	1	1				1	1	4	Low
45-1-2775	Artefact Scatter	Local	3	3				2	3	11	High
		Regional	1	2				1	1	5	Low
45-1-2776	Scarred Tree	Local	2	2				2	2	8	Moderate
		Regional	2	2				1	1	6	Low
45-1-2777	Artefact Scatter	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2745	Artefact Scatter	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2746	Artefact Scatter	Local	2	2				2	2	8	Moderate
		Regional	1	1				1	1	4	Low
45-1-2747	Artefact Scatter	Local	1	2				2	1	6	Low
		Regional	1	1				1	1	4	Low
45-1-2748	Isolated Find	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2742	Shelter with Artefacts	Local	2	1				2	1	6	Low
		Regional	1	1				1	1	1	Low
Previously recorded AHIMS Assessment of Archaeological Significance											
45-1-0167	Shelter with Deposit	Local	2	3				3	2	10	High
		Regional	2	2				2	1	7	High
45-0168	Artefact Scatter	Local	1	1				1	1	4	Low
		Regional	1	1				1	1	4	Low
45-1-2544*	Scarred Tree	Local	-	-				-	-	-	-
		Regional	-	-				-	-	-	-

*Scarred Tree 45-1-2544 is no longer present at its recorded location. An application to change its status from valid to not valid is currently being lodged.

The significance of these sites was assessed based on cultural and/or scientific reasons. Most have low overall archaeological significance. A summary of those sites within the Project Application Area with moderate to high significance follows:

- site 45-1-2761 is a shelter with deposit with moderate local and low regional significance
- site 45-1-2766 is an art site with high local and moderate regional significance
- site 45-1-2768 is a shelter with artefacts with high local and regional significance
- site 45-1-2775 is an artefact scatter with high local and low regional significance
- site 45-1-2776 is scarred tree with moderate local significance

- site 45-1-2746 is an artefact scatter with moderate local and low regional significance
- site 45-1-0167 is a shelter with deposit with high local regional significance.

10.3.2.3 Aboriginal Heritage Impact Assessment

The activities associated with the Project, with potential to impact on Aboriginal heritage sites are mining induced subsidence and construction of surface infrastructure.

Impact Assessment of Subsidence on Aboriginal Heritage

Most Aboriginal sites are outside the proposed mining area and the potential impact to the nine sites above the mining area is summarized as follows:

- two sites are located within the Panel and Pillar Mining Zone, these being a rockshelter with art (45-1-2766) and a rockshelter with artefacts (45-1-2768). Predicted subsidence in this zone is 40 mm to 106 mm with tilts of <2 mm/m. No surface cracking is predicted
- one rockshelter with deposit (45-1-0167) is in the Cliff Line Zone and First Workings. Predicted subsidence is 10 mm to 65 mm with tilts of 0.6- 1.1 mm or less; on this basis (and the 140 m depth of cover) it is expected that there will be no appreciable impact upon the site
- four Aboriginal sites are in the Partial Pillar Extraction Zone, one rockshelter with deposit (45-1-2761) and three artefact scatters (45-1-2746, 45-1-2762 and 45-1-2763. Predicted subsidence is between <50 mm, with tilt at <2 mm/m and strains <1 mm/m and therefore no surface impacts are predicted
- two sites in the shallow zone, an artefact scatter 45-1-2747 and an isolated find 45-1-2748. This zone will experience the lowest level of subsidence in the Project Application Area with subsidence predicted to be between 3.5 and 25.5 mm and with tilts 6 to 1.1 mm. It is predicted that there will be no impact on these sites

On the basis of subsidence predictions as listed in Table 10.24 none of the sites above the mining area are at risk of harm from potential subsidence impact.

Table 10.24: Levels of Subsidence and Effect on AHIMS Sites

Mining Zone	Predicted maximum Subsidence (mm)	Predicted Tilt (mm)	Site Numbers	Site Type	Potential Impact
Panel and Pillar Mining Zone	106 mm	0-3 mm	45-1-2766; 45-1-2768	Art Site and Shelter with Artefacts	Negligible
Cliff Line Zone and First Workings	65 mm	0.6-1.1 mm	45-1-0167	Rockshelter with Deposit	Negligible
Partial Pillar Extraction Zone	<50 mm in vicinity of Sites	0.5-2.6 mm, but <2 mm/m in vicinity of Aboriginal sites	45-1-2761; 45-1-2762; 45-1-2763; 45-1-2746;	Artefact Scatters and Shelter with Deposit	Negligible
Shallow Zone	25.5 mm	0.6-1.1 mm	45-1-2747; 45-1-2748	Isolated Find	Nil

Impact Assessment of Surface Disturbance on Aboriginal Heritage

Scarred Tree 45-1-2544 was close to the pit top and would have been impacted by construction, but is no longer exists. An application to change its status from valid to not valid is currently being lodged.

There is only one Aboriginal site which lies within a potential surface disturbance area namely, 45-1-2760 (artefact scatter), located at the alternative REA investigated in the Project. However, since the alternate REA location will not be constructed the site 45-1-2760 (artefact scatter) will not be impacted.

There are four artefact scatters (45-1-2767, 45-1-2772, 45-1-2773, 45-1-2747) that are adjacent to vehicle tracks inside the Project Application Area. One art site (45-1-2766) is in close proximity to the track on Genowlan Mountain

The Project is not predicted to impact on any of these sites due to surface disturbance.

10.3.2.4 Consequences of Potential Aboriginal Heritage Impacts

There are 25 Aboriginal sites located in the Project Application Area and potential impacts from subsidence and surface disturbance have been assessed. Of the 25 sites, 9 sites are located above the proposed mining area, but the low levels of subsidence, tilt and strain predicted does not pose a risk of harm to these sites.

The four artefact scatters (45-1-2767, 45-1-2772, 45-1-2773 and 45-1-2747) and one art site (45-1-2766) located adjacent to roads within the Project Application Area may be impacted by both mine and public vehicle movements.

10.3.2.5 Aboriginal Heritage Management and Mitigation Measures

Airly Mine has previously identified a number of mitigation strategies that have been implemented in order to minimise and manage the impact from its operation upon Aboriginal Heritage. These are:

- consideration of previous specialist archaeological assessments (including mitigation and management measures)
- minimising clearing
- appropriate mine design.

Although there is no identified risk of harm to Aboriginal objects as a result of the low levels of predicted subsidence, contingency measures will be included in the Cultural Heritage Management Plan (CHMP) which will be prepared. The CHMP will address potential impacts from vehicle movements near registered Aboriginal sites. Specifically the CHMP will contain the following precautionary measures.

- In the unlikely event that skeletal remains are found, work will cease immediately in the vicinity of the remains and the area will be cordoned off. The local police will be contacted to make an initial assessment to ascertain whether the remains are part of a crime scene or possible Aboriginal remains. If this is the case, the local police will contact OEH so that they can determine if the remains are Aboriginal.
- If unrecorded Aboriginal object/s are identified in the Project Application Area during works, then all works in the immediate area will cease and the area will be cordoned off. OEH will be notified by ringing the Enviroline 131 555 so that the site can be adequately assessed and managed.

10.3.3 Historical Heritage

10.3.3.1 Existing Environment- Historical Heritage

The following heritage registers have been searched as part of the Cultural Heritage Impact Assessment.

- Australian Heritage Database maintained by the Department of the Environment; contains places of international, national and Commonwealth level heritage significance.
- Heritage Databases maintained by the NSW Heritage Branch; contains international, Federal, state and local heritage listings. Principal source of information on places included on the NSW State Heritage Register (SHR).

- Schedule 1 'Heritage Items' of Lithgow LEP 1994: provides a list of items which have been recorded by Lithgow City Council as having local heritage value.

19 items from the Airly Village have been listed in Schedule 5 in the Draft Lithgow LEP 2013 which in its draft from offers no statutory protection to the items. The Airly Village site is included within the Mugii Murum-ban SCA.

A preliminary heritage assessment of "Airly Shale Oil Mining Complex' was prepared by Robynne Mills in 1998 for Centennial Airly (Mills 1998). The report identified eighteen individual sites or complexes. Airly Shale Oil Mining Complex comprises the Airly Village and the Torbane processing site, located near the pit top in a location called Carinya.

Mills describes the Airly shale mining complex as having State Heritage Significance and recommended the preparation of a Conservation Management Plan. This level of significance was justified on the basis of the considered 'potential of the site and its individual components to provide historical and technical evidence of shale mining industry in NSW in the period from 1895 to 1913' (Mills 1998).

Oil shale mining at Airly dates back to 1883. Airly Village was officially laid out in September 1897. Buildings known to have existed include a post office, stores, pay office, school dance hall, billiard room, hotel and stables. Although some buildings were constructed on the planned subdivision, the majority of Airly Village residents lived beyond the planned village close to the main oil shale working areas wherever level ground could be found or created.

Typical dwellings ranged from freestanding sandstone huts to cave houses in natural sandstone overhangs supplemented with dry stone walls and other materials. Many of the dwellings would have been very makeshift with clay or earthen floors. Estimates on the number of former residents in the village and surrounding area range from 400 to 620.

Evidence of Airly Village dwellings is largely confined to remnants of rubble stone walls. All that remains at Torbane are two circular brick structures that supported the crude oil storage tanks and remains of the power house. However, there is considered to be a high likelihood that there are below ground archaeological items throughout the site.

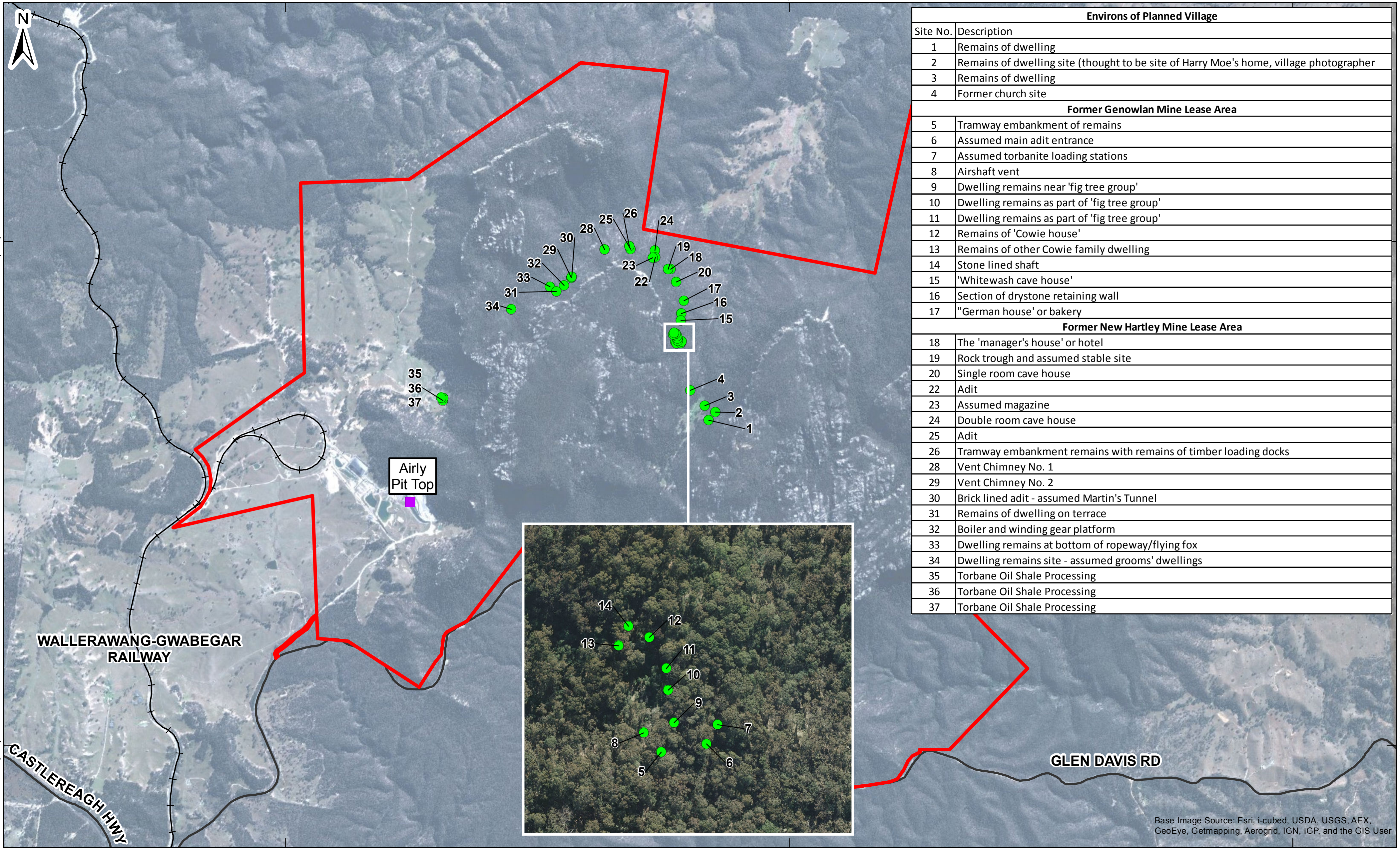
Four adits have been identified previously, however, there are understood to be many more associated with early shale and coal mining activities throughout the mountain.

Thirty seven sites have been identifies as illustrated in Figure 10.10 and contained within Appendix 2 of Appendix J, Sheets 1-12 and Plates 108- 141).

Within the immediate vicinity of the planned Airly Village a number of building remains have been identified including (Photograph 10.2 to Photograph 10.9):

- Dwelling and Church remains within the Airly Planned Village Environs (Sites 1-4) - Plate 108-111
- Tramway Embankment remains (Sites 5, 16, 21, 26 and 27)
- Adits & Airshaft Vents (Sites 6) Site 6 - Plate 112
- Torbanite Loading Stations (Site 7) - Plate 113
- Fig Tree dwelling remains group (Sites 9-11) - Plate 115-117
- Cowie House (Site 12) - Plate 118
- Other Cowie House (Site 13) - Plate 119
- Cave House Dwellings & Magazine (Sites 15, 20, 23 and 24) - Plate 121,126, 127, and 128
- German House/Bakery (Site 17) - Plate 123

- Manager's House/Hotel and trough (Site 18) - Plate 124
- Vent Chimneys 1 & 2 (Sites 28 and 29) - Plate 131-132
- Brick lined adit (assumed 'Martin's tunnel') sits alongside Ventilation Chimney No. 2 (Site 30) - Plate 133
- Miscellaneous dwelling remains mainly consisting of sections of dry stone walling (Sites 31, 33 and 34)- Plate 134, 136 and 137
- Boiler & winding gear platform (Site 32) - Plate 135
- Torbane power house and crude oil tank stands - Plate 138-141.



Site No.	Description
Environs of Planned Village	
1	Remains of dwelling
2	Remains of dwelling site (thought to be site of Harry Moe's home, village photographer
3	Remains of dwelling
4	Former church site
Former Genowlan Mine Lease Area	
5	Tramway embankment of remains
6	Assumed main adit entrance
7	Assumed torbanite loading stations
8	Airshaft vent
9	Dwelling remains near 'fig tree group'
10	Dwelling remains as part of 'fig tree group'
11	Dwelling remains as part of 'fig tree group'
12	Remains of 'Cowie house'
13	Remains of other Cowie family dwelling
14	Stone lined shaft
15	'Whitewash cave house'
16	Section of drystone retaining wall
17	"German house' or bakery
Former New Hartley Mine Lease Area	
18	The 'manager's house' or hotel
19	Rock trough and assumed stable site
20	Single room cave house
22	Adit
23	Assumed magazine
24	Double room cave house
25	Adit
26	Tramway embankment remains with remains of timber loading docks
28	Vent Chimney No. 1
29	Vent Chimney No. 2
30	Brick lined adit - assumed Martin's Tunnel
31	Remains of dwelling on terrace
32	Boiler and winding gear platform
33	Dwelling remains at bottom of ropeway/flying fox
34	Dwelling remains site - assumed grooms' dwellings
35	Torbane Oil Shale Processing
36	Torbane Oil Shale Processing
37	Torbane Oil Shale Processing

LEGEND
- Project Application Area
- Rail
- Main Road
- Historical Heritage Site

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 10.10: Historical Heritage Sites

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.10

A4

Plate 108 Site 1

Plate 109 Site 2

Plate 110 Site 3

Plate 111 Site 4

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.2: Dwelling and Church Remains within the Airly Planned Village Environs

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-P10.2

A4

Plate 92 Tramway Bridge at Airly (ref LDHS0658, from the Lithgow District Historical Society (LDHS) held at Lithgow Library Learning Centre (Date unknown)

Plate 94 Tramway at Airly (ref LDHS0667, from the LDHS Collection held at the Lithgow Library Learning Centre) (Date unknown)

Plate 120 Site 16

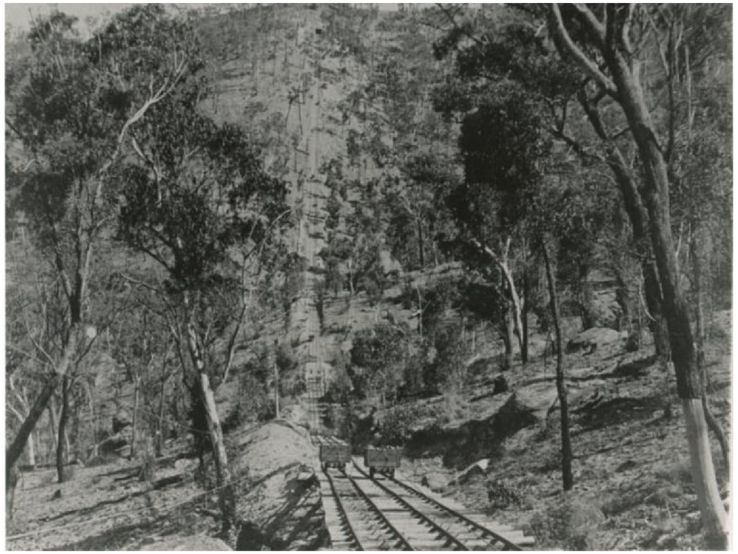


Plate 93 Tramway at Airly (ref LDHS0669, from the LDHS held at the Lithgow Library Learning Centre (Date unknown)

Plate 129 Site 26

Plate 130 Site 27

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.3: Tramway Embankment Remains

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-P10.3

A4

Plate 112 Site 6

Plate 114 Site 8

Plate 120 Site 14

Plate 133 Site 30

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.4: Adits & Airshaft Vents

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-P10.4

A4

Plate 113 Site 7

Torbanite Loading Stations

Plate 118 Site 12

Cowie House

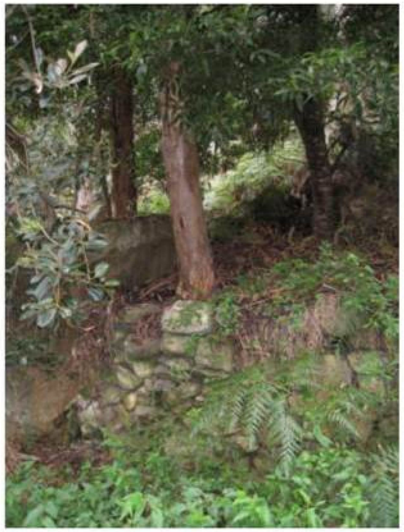


Plate 119 Site 13

Other Cowie House

Plate 115 Site 9

Plate 116 Site 10

Plate 117 Site 11

Fig Tree Dwelling Remains Group

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.5: Fig Tree Dwelling Remains Group, Torbanite Loading Stations, Cowie House and Other Cowie House

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-P10.5

A4

Plate 121 Site 15

Plate 126 Site 20

Plate 123 Site 17

German House/Bakery

Plate 127 Site 23

Plate 128 Site 24

Cave House Dwellings & Magazine

Plate 124 Site 18

Managers House/Hotel and trough

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.6: Managers House/Hotel and trough, German House/Bakery and Cave House Dwellings & Magazine

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-P10.6

A4

Plate 131 Site 28

Plate 133 Site 30

Brick Lined Adit (assumed 'Martins's tunnel) sits alongside Ventilation Chimney No. 2

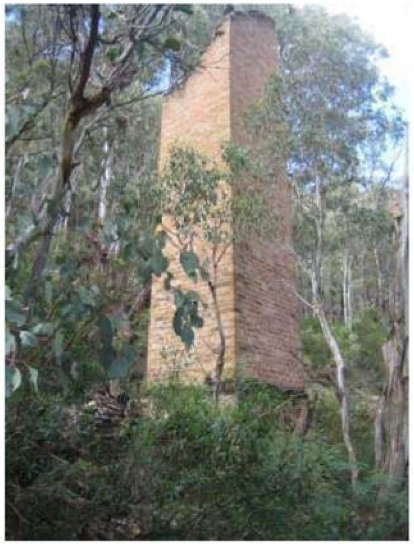


Plate 132 Site 29

Vent Chimneys 1 & 2

Plate 135 Site 32

Boiler & Winding Gear Platform

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.7: Brick Lined Adit, Boiler & Winding Gear Platform and Vent Chimneys 1 & 2

PLOTFILE No.

Centennial Coal

Airly

DRG No. 10-P10.7

A4

Plate 134 Site 31

Plate 136 Site 33

Plate 137 Site 34

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.8: Miscellaneous Dwelling Remains Mainly Consisting of Sections of Dry Stone Walling

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-P10.8

A4

Plate 138 Site 35

Plate 139 Site 36

Plate 140 Site 37

Plate 141 Sites 35-37

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	NOT TO SCALE

Photograph 10.9: Torbane Power House and Crude Oil Tank Stands

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-P10.9

A4

10.3.3.2 Historical Impact Assessment

The Airly and Torbane sites within the Airly Shale Oil Mining Complex have been assessed against the NSW State heritage significance criteria, Assessing heritage significance (NSW Heritage Office, 2001).

Each of the principal buildings and structures within the complex are described in Section 10.3.3.1. Rather than assessing the heritage significance of each of the sites, they are grouped by type. Table 10.25 provides a summary of the assessment ranking.

Table 10.25: Contribution of Individual Features to Overall Significance

Feature/Group of Features	Contribution	Significance
Dwelling and Church remains within the Airly Planned Village Environs (Sites 1-4)	Moderate-High	Local
Tramway Embankment remains (Sites 5, 16, 21, 26 and 27)	Moderate	Local
Adits & Airshaft Vents (Sites 6, 8, 14, 22, 25 and 30)	Moderate - High	Local
Torbanite Loading Stations (Site 7)	Low	Local
Fig Tree dwelling remains group (Sites 9-11)	Moderate - High	Local
Cowie House (Site 12)	High	Local
Other Cowie House (Site 13)	Low-Moderate	Local
Cave House Dwellings & Magazine (Sites 15, 20, 23 and 24)	High	Local
German House/Bakery (Site 17)	High	Local
Manager's House/Hotel and trough (Site 18)	High	Local
Vent Chimneys 1 & 2 (Sites 28 and 29)	High	Local
Miscellaneous dwelling remains mainly consisting of sections of dry stone walling (Sites 31, 33 and 34)	Moderate	Local
Boiler & winding gear platform (Site 32)	High	Local
Torbane power house and crude oil tank stands	High	Local

In summary the Airly Shale Mining Complex meets a number of the NSW heritage significance criteria. The site has historic, aesthetic, technical, social and rarity values as well as being a good example of a type with high research/archaeological potential. The level of heritage significance is local based on current research and investigations. Specifically, the wider mining complex is a cultural landscape embodying historical values. It exemplifies mining practices and community life in a remote location dating from the late 19th Century.

The site has high aesthetic value as a result of the scenic surrounding landscape. Technical achievement is shown by the remains of transportation and processing systems as well as the ingenuity of creating working and living places in what would have been a remote environment.

Impact Assessment of Subsidence on Historical Heritage

Sites (1-34) of the Airly Shale Mining complex are located in the Shallow Zone (Table 10.26). The Shallow Zone will be undermined using partial extraction mining methods and predicted to have between 3.5 to 25.5 mm of subsidence and as such there will be negligible impact on surface structures.

Depth of cover below Sites 1-34 varies from 21 to 60 m. For the deeper sites, the shallow mining zone has been extended beyond the 50 m depth contour, with protection around the heritage sites defined by half the cover of depth (i.e. an angle of draw of 26.5 degrees. Two sites, Site 3 (a dwelling) and Site 24 (a cave house) will not be undermined (due to depths of cover of less than 30 m) and have been avoided by the mine plan.

Sites 35-37 in the Torbane processing site in the west of the Project Application Area in the vicinity of the pit top are located outside the mining area and therefore these will not be affected by subsidence.

Table 10.26 outlines the historical items in the predicted subsidence zones.

Table 10.26: Historical Items in Subsidence Zones

Subsidence Zone	Expected Subsidence (mm)	Predicted Tilt (mm)	Historical Items	Potential Impacts
Panel and Pillar Mining Zone	40 to 106 mm	0-3 mm	Nil	None
Cliff Line Zone and First Workings	10 to 65 mm	0.6-1.1 mm	Nil	None
Partial Pillar Extraction Zone	25 to 65 mm	0.5-2.6 mm	Nil	None
Shallow Zone	3.5 to 25.5 mm	0.6-1.1 mm	Airly shale mining complex Sites 1-34	Negligible
New Hartley Shale Mine Potential Interaction Zone	200 to 500 mm	6.2-16.7 mm	Nil	None

No historical heritage items occur in surface disturbance areas.

10.3.3.3 Consequences of Potential Historic Heritage Impacts

The consequences of the Project on cultural heritage are negligible given the location of the identified heritage sites, are either outside of disturbance areas or are located within mining zones where subsidence impact is not expected. As detailed in Section 4.2, as the required exploration drill holes are determined, Centennial Airly will undertake a series of due diligence assessments to consider heritage impacts as relevant. The general approach of the due diligence assessments will be to conduct site investigations to ensure that significant impacts are avoided.

10.3.3.4 Cultural Heritage Management and Mitigation Measures

Centennial Airly will abide by the SCA Plan of Management produced by the NSW National Parks and Wildlife Service in relation to the Airly shale mining complex.

If, during the course of development works, suspected historic cultural heritage material is uncovered, work will cease in that area immediately. The Heritage Branch, Office of Environment & Heritage will be notified and works only recommence when an approved management strategy has been developed.

10.3.4 Conclusion

There are 25 Aboriginal sites located in the Project Application Area. Potential impacts on these sites from subsidence and surface disturbance have been assessed. Of the 25 sites, 9 sites are located within the proposed mining zones and have the potential to be subsided, however the low levels of subsidence and tilt do not pose a risk of harm to these sites. Sixteen of the 25 sites are located outside the subsidence area and therefore will not be affected.

Four artefact scatters (#45-1-2767, #45-1-2772, #45-1-2773 and #45-1-2747) and one art site (45-1-2766) are adjacent to roads within the Project Application Area. These sites are not predicted to be impacted by the Project.

The Project Application Area contains the Airly Shale Mining Complex comprising 34 sites at Airly Village and 3 sites within the Torbane processing site at Carinya. The Airly Village sites sit wholly inside the Mugii Murum-ban SCA managed by the NSW National Parks and Wildlife Service.

Although the Airly Village will be undermined, the low levels of subsidence do not pose a risk to remnant structures.

In conclusion the Project is not expected to adversely affect Aboriginal or historical heritage sites, and management and mitigation methods to be implemented will ensure any risk to known and undiscovered sites are minimised.

10.4 Road Traffic and Transport

The Traffic Impact Assessment (Appendix I) specifically responds to the Director General's Requirements (DGRs), which provide the following in regard to road traffic and transport:

The Director-General's Requirements

Traffic & Transport – including:

- an assessment of potential traffic impacts on the capacity, efficiency and safety of the road network;
- a description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road network in the surrounding area over the life of the development;

This section is informed by the technical assessment, *Airly Mine Extension Traffic Impact Assessment*, April 2014, Barnson Pty Ltd (Barnson 2014), which is provided in full in Appendix I. The scope of this assessment was to review the existing traffic conditions at Airly Mine, assess the likely changes to traffic and the potential impact upon the road as a result of the Project and identify mitigation measures as required.

Additional information has been sought by the Roads and Maritime Service (RMS) for the proposal with regard to traffic and transport. A synopsis of the requirements has been addressed within the Traffic Impact Assessment (Appendix I).

10.4.1 Existing Road Traffic Environment

Access to the Airly Mine pit top is from Glen Davis Road, via the Castlereagh Highway, at Capertee. The Annual Average Daily Traffic (AADT) on the Castlereagh Highway at the Ben Bullen railway crossing was 1,959 vehicles per day (vpd), measured in a survey conducted in 2005. For the purposes of analysis, it was assumed there has been 3% cumulative growth over 8 years using a base figure of 1,959 vpd. This equates to 2,480 vpd, or 248 vph (vehicles per hour) at Ben Bullen railway crossing.

The AADT on the Glen Davis Road, 0.5 km east of the Capertee general store was 114 vpd in 2005. Assuming a 3% cumulative growth over 8 years, this corresponds to 144 vpd, or 14 vph. Assuming the current 120 personnel arrive and leave over a four hour period each day, it is an additional 240 vpd movement, or 60 vph.

The intersection of the Castlereagh Highway and Glen Davis Road is at Capertee. The speed environment at the intersection is 50 km/hr. From Glen Davis Road, sight distances exceed 500 m in both directions and the pavement is in good condition. The intersection complies with a channelized right and left arrangement in accordance with the AustRoads Guide to Road Design.

Glen Davis Road has centreline markings and guideposts. The sealed pavement width varies between 3.5 m to 4 m per lane with a 0.5 m - 1 m wide unsealed shoulder on both sides of the road. The road width generally complies with the AustRoads Guide to Road Design.

The intersection of the Glen Davis Road and Mine Access Road to Airly Mine was upgraded in January 2002. The intersection complies with AustRoads Guide to Road Design.

Data for traffic accident history is available for a five year period between 2007 and 2012. In Capertee, there have been two minor accidents, but none near the existing Glen Davis Road intersection. On Glen Davis Road, there has been one accident on a narrow bridge, east of the Project Application Area.

10.4.2 Road Traffic Impact Assessment

Operations

Coal will be transported from the site via the existing rail load out facilities. No coal will be transported off site using roads. An increase in the workforce from an existing 120 personnel to approximately 135 full time employees and up to 20 contractors is proposed for the Project.

As per Section 10.4.2, traffic volumes on Castlereagh Highway are 2, 480 vpd, or 248 vph. An additional 15 full time employees and up to 20 contractors are expected. The proposed shifts are 3 x 8 hr (weekdays) and 2x12 hr shifts (weekends). This equates to an additional 70 vpd, or 18 vph assuming they arrive over a 4 hour period.

During decommissioning of the Project, there will be 2 permanent employees, with associated vehicles movements of 4 vpd for those employees.

Table 10.27 provides a summary of the proposed traffic volumes during the operation phase of the Project.

Table 10.27: Summary of general traffic volumes during operation

Location	Existing/Proposed vpd	Existing/Proposed vph
Castlereagh Highway	2,480/2,550	248/255
Glen Davis Road	384/454	74/92

Construction

During the construction phase, it is expected that an additional 30 vpd will access the site (60 vpd combined entry/exist movements) over a 6 month period. The majority of construction activities will occur between 7.00 am – 5.00 pm (Monday to Saturday). Assuming all construction vehicles enter and leave the site over a 4 hour period, the hour rate is 15 vph.

There are many types of vehicles (telehandler, mobile cranes, heavy trucks, a concrete pump, a water cart, portable compressor, generator, water pumps, rattle guns and grinders), that would access the site, but remain during the length of the construction and so reduce road impact movements per day.

Table 10.28 provides a summary of general traffic volumes during the construction phase of the Project.

Table 10.28: Summary of general traffic volumes during construction

Location	Existing/Proposed vpd*	Existing/Proposed vph*
Castlereagh Highway	2,480/2,550	248/255
Glen Davis Road	144/214	14/32

**combined movements both directions*

Parking

Sufficient parking at the pit top during construction and operation will be provided within a compound at the site.

10.4.3 Cumulative Impacts

There are no other major developments planned in the area relating to road works and therefore there will be no cumulative impact to traffic generation other than normal growth.

10.4.4 Consequences of Potential Road Traffic Impacts

There will be no additional traffic generated at the pit top with no significant impact on the Castlereagh Highway or local access roads as a result of the Project. However, Glen Davis Road would be operating at approximately 103% of capacity during the construction period.

10.4.5 Road Traffic Management and Mitigation Measures

No additional safety mitigation measures are recommended as impacts, on road traffic, will be minor. However a Construction Traffic Management Plan be developed prior to construction to negate the interaction with operational traffic.

10.4.6 Conclusion

The only impact of the Project on the existing traffic environment would be due to a 12.5% increase in staff numbers. The existing intersections have sufficient capacity to accommodate this increase at Castlereagh Highway and Glen Davis Road. However, Glen Davis Road would be operating at approximately 103% of capacity during the construction period.

10.5 Noise Management

This section specifically summarises the Noise and Vibration Impact Assessment (Appendix K), which responds to the DGRs and provide the following in regard to noise aspects:

The Director General's requirements

Noise – including a quantitative assessment of the potential:

- construction, operational and off-site transport noise impacts;
- reasonable and feasible mitigation measures, including evidence that there are no such other available measures; and
- monitoring and management measures, in particular real-time and attended noise monitoring.

10.5.1 Introduction

This section is informed by the technical assessment, *Airly Mine Extension Noise and Vibration Impact Assessment*, March 2014, SLR Consulting Australia Pty Ltd (SLR 2014a), which is provided in full in Appendix K. The report identifies and assesses the potential noise impacts of the Project (including construction, operational, cumulative and off-site transport noise impacts) and provides advice with regard to effective management and mitigation measures to address potential noise impacts.

The report has referenced and addressed relevant guidelines and assessment criteria as noted within the DGRs and has been prepared with reference to Australian Standard AS1055: 1997 'Description and Measurement of Environmental Noise' (Parts 1, 2 and 3) and in accordance with:

- Environment Protection Authority (EPA) 1999 NSW Industrial Noise Policy (INP)
- DECCW 2011 NSW Road Noise Policy (RNP)
- EPA 2013 Rail Infrastructure Noise Guidelines (RING)
- EPA 1999 and 2008 Environmental Noise Management- Assessing the EPA Environmental Noise Management – Assessing Vibration: a technical guide, DIN 4150 Part 3:1999 Structural Vibration: effects of vibration on structures and BS *6472-1:2008 guide to evaluation of human exposure to vibration in buildings - Vibration sources other than blasting, 2008*.

10.5.2 Existing Environment

There are a number of rural/residential properties in the vicinity of the Project. Centennial Airly maintains a substantial holding of land around the Project Application Area and within the western portion of Project Application Area. The closest sensitive residential receptors to the Project are shown and Figure 2.9. The receptors assessed for potential noise impacts are listed in Table 10.29.

Table 10.29: Nearest Sensitive Receptors

Receptor ID	Receptor Type	Receiver Location	
		Easting	**Northing**
R1	Residential	222595	6332095
R2	Residential	218907	6332949
R3	Residential	218648	6333227
R4	Residential	218292	6333516
R5	Residential	217893	6332797
R6	Residential/ Stone Cottage Airly Gap	223867	6332572
R7	Residential	219316	6329436
R8	Residential	778894	6328246
R17	Passive Recreation/ Camp Ground Airly Gap	224016	6333253
R18	Passive Recreation/ Nissen Hut Genowlan Mountain	224592	6332947

Background noise levels were monitored at four locations, considered to be representative of the nearest sensitive receivers. The pre-mining background noise levels are summarised in Table 10.30**.**

Table 10.30: Pre-Mine Rating Background Levels

Receiver Identification	Daytime LA90(15minute) (0700-1800 hours)	Evening LA90(15minute) (1800-2200 hours)	Night-time LA90(15minute) (2200-0700 hours)
Location A - Glen Davis Road	30 dBA	30 dBA	30 dBA
Location B - Parr Residence (R2)	30 dBA	30 dBA	30 dBA
Location C - Rail Loop	30 dBA	30 dBA	30 dBA
Location D - Near Leishman Residence (R7)	30 dBA	30 dBA	30 dBA

Note: Background noise levels were measured at equal to or less than 30 dBA. When noise levels are less than 30 dBA, the INP nominates that the Rating Background Level should be assumed to be 30 dBA.

Operator attended noise measurements conducted in 2009 at five locations surrounding the site are given in Table 10.31**.**

Table 10.31: Operator Attended Noise Survey Results (February/March 2009)

Location	Date/ Start time/ Period/ Weather	Primary Noise Descriptor (dBA)					Description of Noise Emission Typical Maximum Levels (LAmax)
		L_{Amax}	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}	
Location A Glen Davis Road	23/02/2009 Day 14:15 Wind N 1-2 m/s Temp 27°C	70	60	51	29	47	Birds 35 to 44 dBA Traffic on Glen Davis Road up to 70 dBA Wind in trees 30 to 38 dBA
Location B Parr Residence (R2)	23/02/2009 Day 14:40 Wind N 0-2 m/s Temp 27°C	65	54	41	28	42	Birds 35 to 55 dBA Traffic on Glen Davis Road up to 38 dBA Wind in trees 30 to 38 dBA Resident noise 38 dBA Insects 34 to 36 dBA
Location C Rail Loop	23/02/2009 Day 13:00 Wind N <1 m/s Temp 27°C	56	49	43	28	39	Birds 31 to 56 dBA Cow up to 46 dBA Wind in trees 32 to 41 dBA
Location D Near Leishman Residence (R7)	23/02/2009 Day 13:40 Wind N 1-2 m/s Temp 27°C	66	51	45	30	42	Birds 30 to 46 dBA Wind in trees 32 to 49 dBA
Location E Airly Property	23/02/2009 Day 12:25 Wind N <1 m/s Temp 27°C	65	48	39	29	38	Birds 31 to 51 dBA Wind in trees 25 to 36 dBA Resident Noise up to 65 dBA

The noise character is typical of a rural residential area at the nearest residential receivers. No significant industrial development, other than Airly Mine, has occurred in the vicinity of these residences since the surveys in 2009, hence, results of the 2009 noise monitoring are relevant to the current assessment.

10.5.3 Methodology

Background noise at and around the pit top was measured before mining commenced and for annual noise compliance monitoring since 2009.

Operational noise has been assessed in accordance with Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and the Environment Protection Authority (EPA) NSW Industrial Noise Policy (INP) (including application notes) and the Road Noise Policy (RNP).

Construction noise impacts have been assessed with reference to the NSW Interim Construction Noise Guideline (DECC 2009).

Rail noise impacts have been assessed with reference to the EPA Rail Infrastructure Noise Guideline (RING) May 2013. The calculation of L_{Aeq} and the maximum passby levels have used the Nordic Rail Prediction Method (1994). Only the offsite rail haulage has been considered as part of the rail traffic noise impact assessment. Rail noise from the rail loop has been assessed as part of the operational INP assessment.

The project specific noise criteria for the Project have been established with reference to the Industrial Noise Policy. The background noise levels adopted are the minimum background noise levels recommended by the INP. The project specific noise criteria for the identified nearest receptors are contained within Table 10.32**.**

Table 10.32: Operational Noise Criteria- Project Specific Noise Criteria

Location	Period	Adopted RBL	Sleep Disturbance Noise Goal $L_{A1(1minute)}$ (dBA)	Intrusive Criteria LAeq(15minute) dBA	Amenity Criteria L_{Aeq}(period) dBA	Project Specific Noise Criteria $L_{Aeq(15minute)}$ dBA
R1 to R8	Day	30	45	35	50	35
	Evening	30		35	45	35
	Night	30		35	40	35
R17 and R18	When in use	N/A		N/A	N/A	50

Construction noise goals have been set with reference to the ICNG. Table 10.33 presents the noise goals for construction.

Table 10.33: Construction Noise Goals

Location	Period	Adopted RBL	Management Level $L_{Aeq(15minute)}$ (dBA)	
			Noise Affected	Highly Noise Affected
R1 to R8	Day	30	40	75
R17 and R18	When in use	N/A	60	N/A

Construction may only occur between the hours of 7.00 am and 6.00 pm Monday to Friday, Saturday 8 am to 1 pm. No construction work is to take place on Sundays or Public Holidays.

Table 10.34 provides the relevant project specific off site rail noise goals.

Table 10.34: Rail Noise Assessment Trigger Levels for Rail Traffic Generating Developments

Descriptor	Residential noise trigger levels (dBA)
LAeq(15hour)	60 dBA
LAeq(9hour)	55 dBA
Maximum Passby LAmax (95th percentile)	80 dBA

Note: 95th percentile equates to the 5% exceedance value.
A project-related noise increase is an increase of more than 0.5 dB over the day or night periods

Noise levels were predicted at all nearest potentially affected residential locations from the approved DA 162/91) and proposed operation of the Airly Mine. The following scenarios were modelled:

- Scenario 1: Existing Airly Mine operations excluding any reject emplacement activities.
- Scenario 2: Approved Airly Mine operations including reject emplacement at the approved Tailings Dam / REA location referred to as the alternate REA in this EIS (Section 12.4.3).
- Scenario 3: Proposed Airly Mine operations including REA at the proposed location (Section 4.8.3).

10.5.4 Noise Impact Assessment

10.5.4.1 Operational Noise

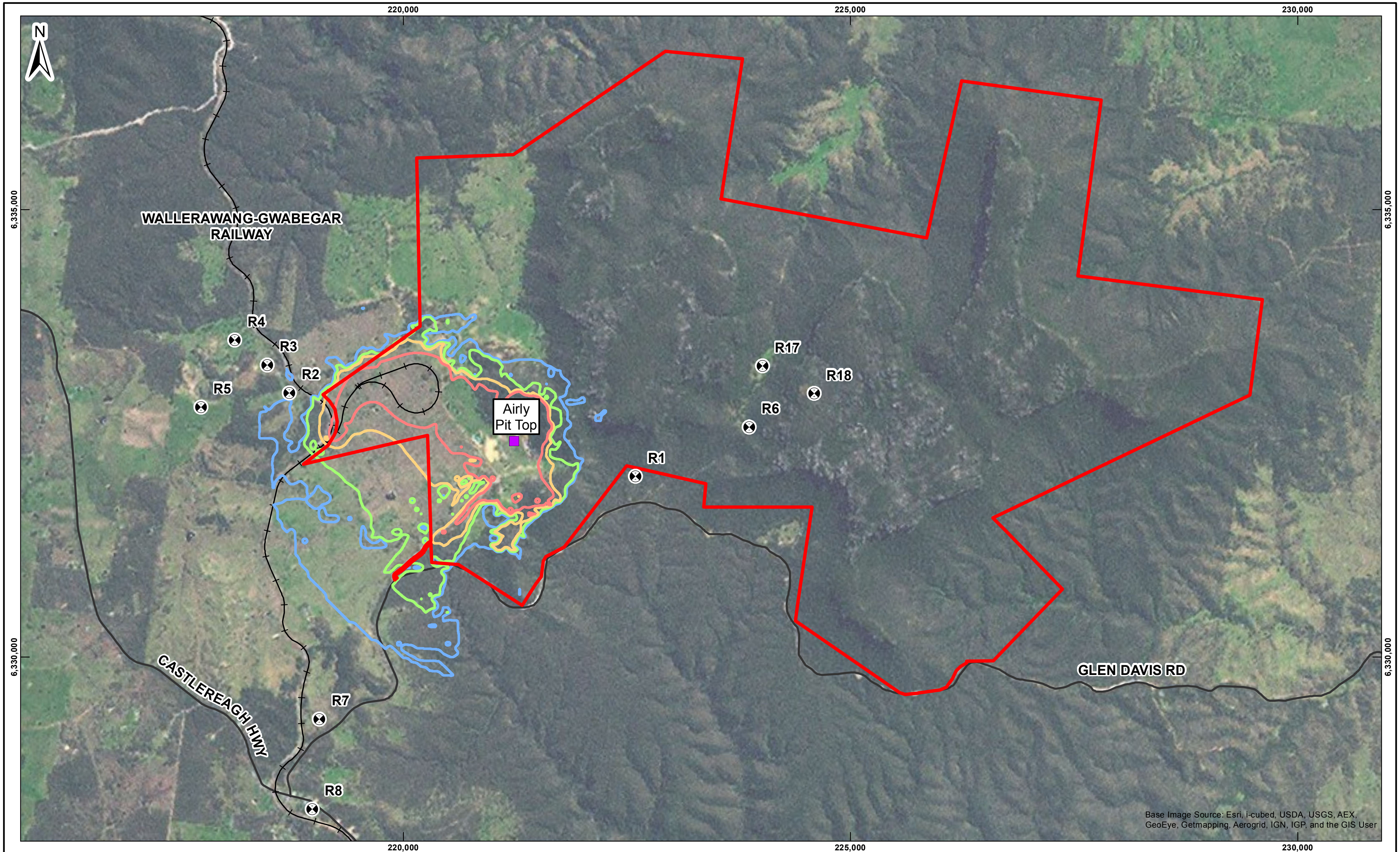
Noise predictions for operations at sensitive receivers are presented in Table 10.35**,** with reference to the relevant Project specific noise criteria during calm weather and for temperature inversions.

Predicted operational noise contours are provided in Figure 10.11, Figure 10.12 and Figure 10.13 below.

Table 10.35: Operational Noise Modelling- Predicted Noise Levels for the Project

Location	Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)									Project Specific Noise criteria
		Existing Operation			Approved Operation			Proposed Operation			
		Calm	Temp Inv.	Prev. winds	Calm	Temp Inv.	Prev. winds	Calm	Temp Inv.	Prev. winds	
R1	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	35 dBA
R2	Day	<35	N/A	<35	<35	N/A	35	<35	N/A	35	35 dBA
	Evening	<35	N/A	<35	<35	N/A	35	<35	N/A	35	35 dBA
	Night	<35	<35	<35	<35	35	35	<35	35	35	35 dBA
R3	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	35 dBA
R4	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	35 dBA
R5	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	35 dBA
R6	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	35 dBA
R7	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	35 dBA
R8	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	35 dBA
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	35 dBA
R17	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	50 dBA when in use
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	
R18	Day	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	50 dBA when in use
	Evening	<35	N/A	<35	<35	N/A	<35	<35	N/A	<35	
	Night	<35	<35	<35	<35	<35	<35	<35	<35	<35	

Results presented in Table 10.35 (and the associated noise contour plots) indicate that noise levels from the modelled operational scenarios are predicted to be below the project specific noise criteria at all privately owned residential assessment locations under all considered meteorological conditions. Predicted noise levels, with regards to sleep disturbance analysis are provided in Table 10.36.



LEGEND

- Project Application Area
- Rail
- Main Road
- Sensitive Noise Receiver
- Iso Value 35 dBA
- Iso Value 40 dBA
- Iso Value 45 dBA
- Iso Value 50 dBA

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.11: Predicted Existing Operational Noise LAeq (15min) - Night time Prevailing Winds

0 500 1,000 1,500 2,000 Metres

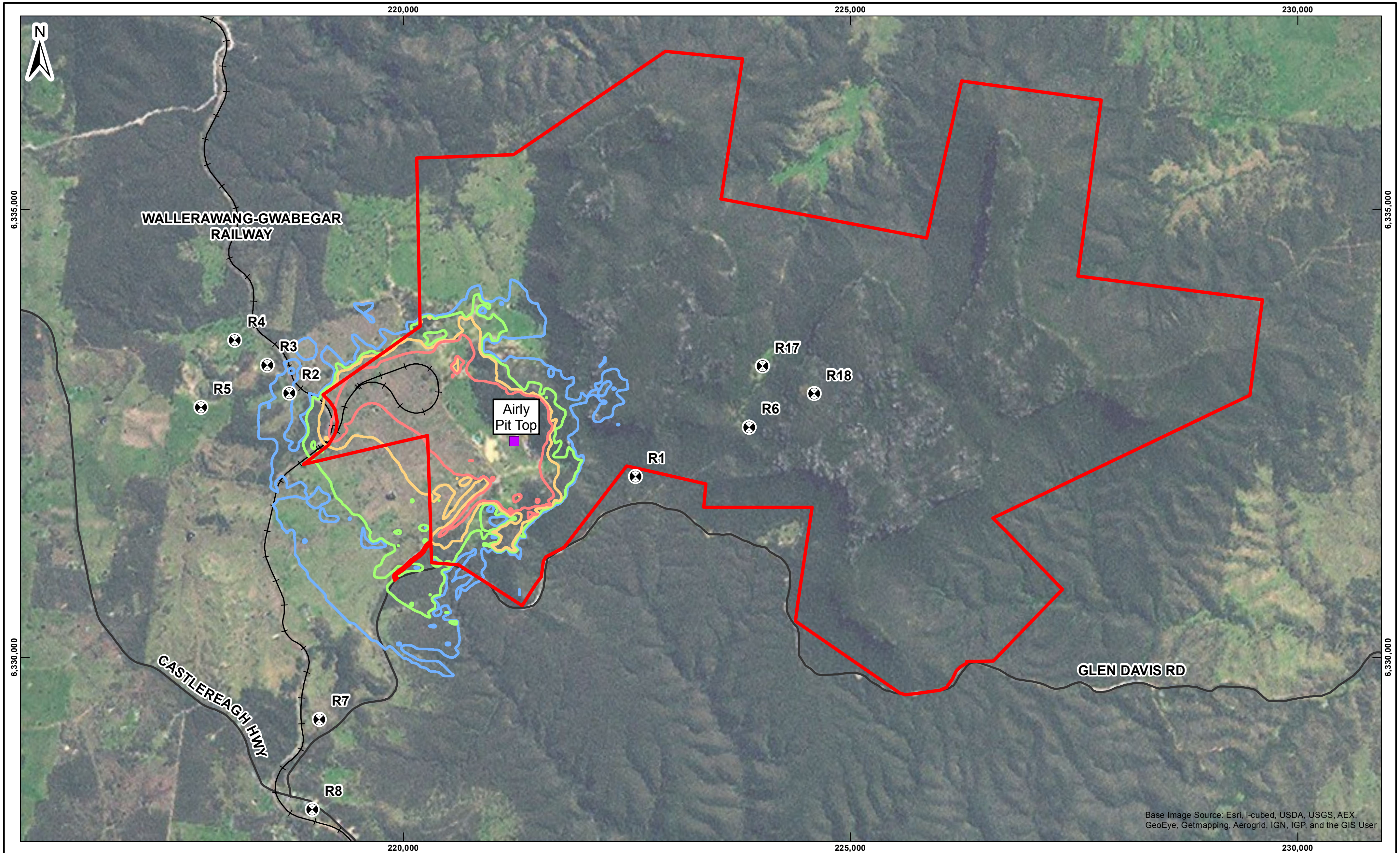
PLOTFILE No.

Centennial Coal

Airly

DRG No.10-10.11

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- Sensitive Noise Receiver
- Iso Value 35 dBA
- Iso Value 40 dBA
- Iso Value 45 dBA
- Iso Value 50 dBA

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.12: Predicted Approved Operational Noise LAeq (15min) - Night time Prevailing Winds

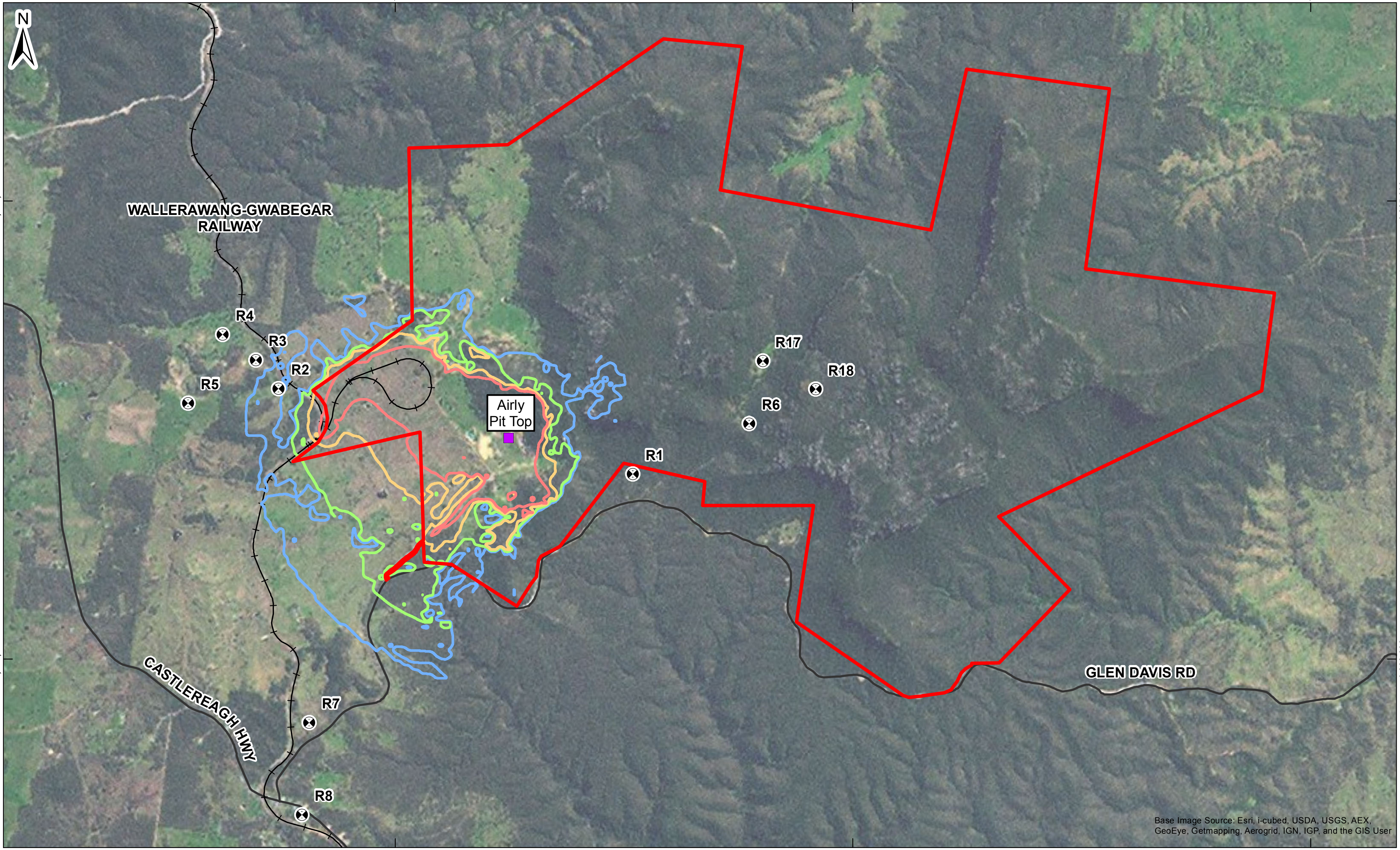
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No.10-10.12

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- Sensitive Noise Receiver
- Iso Value 35 dBA
- Iso Value 40 dBA
- Iso Value 45 dBA
- Iso Value 50 dBA

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.13: Predicted Proposed Operational Noise LAeq (15min) - Night time Prevailing Winds

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No.10-10.13

A4

Table 10.36: Predicted Sleep Disturbance Noise Levels

Location	Period	Existing Operation (Scenario 1)	Approved Operation (Scenario 2)	Proposed Operation (Scenario 3)	Sleep Disturbance Noise Goal $L_{A1(1minute)}$ (dBA)
R1	Night	<45	<45	<45	**45 dBA**
R2		<45	<45	<45	
R3		<45	<45	<45	
R4		<45	<45	<45	
R5		<45	<45	<45	
R6		<45	<45	<45	
R7		<45	<45	<45	
R8		<45	<45	<45	
R17		<45	<45	<45	
R18		<45	<45	<45	

The predicted LAmax noise levels in Table 10.36 are below the project specific sleep disturbance noise goal during existing, approved and proposed operations surrounding the Project Application Area under prevailing weather conditions (worst case scenario) for privately owned residential receptors.

10.5.4.2 Construction Noise

Noise levels generated from the proposed construction activities associated with the reject emplacement area, and CPP were predicted at all potentially affected residential receptor locations. It is noted that the construction of the proposed REA and the CPP will not occur concurrently. A summary of the results of these predictions is contained within Table 10.37.

Table 10.37: Predicted Construction Noise Levels at Residential Receivers

Residential Receiver Location	Predicted LAeq(15minute) Noise Level (dBA)	Construction Design Goal $L_{Aeq(15minute)}$ (dBA)	
		Noise Affected	Highly Noise Affected
Proposed Reject Emplacement Area			
R1	<40	40 dBA	75 dBA
R2	<40		
R3	<40		
R4	<40		
R5	<40		
R6	<40		
R7	<40		
R8	<40		
R17	<40	External Noise Level 60 dBA	
R18	<40		
Coal Preparation Plant			
R1	<40	40 dBA	75 dBA
R2	<40		
R3	<40		
R4	<40		
R5	<40		
R6	<40		
R7	<40		
R8	<40		
R17	<40	External Noise Level 60 dBA when in use	
R18	<40		

Note: Construction may only occur between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. No construction work is to take place on Sundays or Public Holidays

The modelling results in Table 10.37 indicate that the predicted $L_{Aeq(15minute)}$ noise levels from proposed construction activities associated with the reject emplacement area and the CPP are below the 'Noise Affected' construction noise goal (40 dBA) at all residences and significantly below the noise management level of 60 dBA for each assessed recreation area.

Exploration Drilling

Noise emission associated with exploration activities has been assessed as construction activity given the relatively short-term nature (typically less than 3 weeks) of the potential noise impacts associated with drilling activities. It has been assumed that exploration drilling would occur during the daytime only so a construction noise criteria of $L_{Aeq(15minute)}$ 40 dBA would apply. Previously measured noise emission levels of exploration drilling were undertaken at Centennial Mandalong and determined a sound power level of 104 dBA of such activity. Assuming a similar rig would be utilised for Airly Mine then it is unlikely that the relevant noise goal (of 40 dBA) would be exceeded if drilling occurred at a distance of greater than 665 m from noise-sensitive receptors. This distance will be less when intervening topography shields receptors from drill-rig noise.

10.5.4.3 Road Traffic Noise

Operation

Table 10.38 provides the modelling results for the operational road traffic noise levels associated with the Project.

Table 10.38: Operational Road Traffic Noise Prediction Results

Scenario	Receiver Type	Road Description	Speed Limit (km/h)	Approx. Distance from Road edge (m)	Prediction Results, L_{Aeq} (dBA)		Criteria, L_{Aeq} (dBA)	
					Day (15 hour) 7am to 10pm	Night (9 hour) 7am to 10pm	Day (15 hour) 7am to 10pm	Night (9 hour) 7am to 10pm
Scenario 1 2013 Existing Traffic Volumes wit hout Airly Mine (two way traffic)	Residential	Castlereagh Highway	50	10	55.5	45.4	60	55
	School		40	26	52.2 external <40 Internal[1]	N/A	40 (internal) when in use	1 hour
			50	26	53.3 external <40 Internal[1]			
	Residential	Glen Davis Road	50	10	43.1	42.8	55	50
			100	150	<35	<35		
Scenario 2 2013 Existing Traffic Volumes wit h Airly Mine (two way traffic)	Residential	Castlereagh Highway	50	10	55.9	46.3	60	55
	School		40	26	53.2 external <40 Internal[1]	N/A	40 (internal) when in use	1 hour
			50	26	54.3 external <40 Internal[1]			
	Residential	Glen Davis Road	50	10	47.4	42.9	55	50
			100	150	<35	<35		

Scenario	Receiver Type	Road Description	Speed Limit (km/h)	Approx. Distance from Road edge (m)	Prediction Results, L_{Aeq} (dBA)		Criteria, L_{Aeq} (dBA)	
					Day (15 hour) 7am to 10pm	Night (9 hour) 7am to 10pm	Day (15 hour) 7am to 10pm	Night (9 hour) 7am to 10pm
Scenario 3 2013 Existing Traffic Volumes wit h proposed Airly Mine Operations (two way traffic	Residential	Castlereagh Highway	50	10	56.0	46.3	60	55
	School		40	26	53.4 external <40 Internal[1]	N/A	40 (internal) when in use	1 hour
			50	26	54.5 external <40 Internal[1]			
	Residential	Glen Davis Road	50	10	48.1	43.0	55	50
			100	150	<35	<35		

1 As a conservative estimate, the difference between external to internal noise levels of a building comprising of standard construction and windows closed is 25 dB. It has been assumed that windows are closed at the school since it is air-conditioned.

The day time and night time operational road traffic noise levels presented in Table 10.38 are predicted to meet the criteria detailed in the RNP under all prediction scenarios at the nearest roadside receptors.

Construction

The Project construction related vehicle movements (both directions) on the Castlereagh Highway and Glen Davis Road is 16 delivery vehicles per day and 30 personnel vehicle per day.

Construction related road traffic noise predictions are provided in Table 10.39**.**

Table 10.39: Construction Road Traffic Noise Prediction Results

Scenario	Receiver Type	Road Description	Speed Limit (km/h)	Approx. Distance from Road edge (m)	Predicted Results, L_{Aeq} (dBA)	Criteria, L_{Aeq} (dBA)
					Day (15 hour) 7am to 10pm	Day (15 hour) 7am to 10pm
2013 Existing Traffic Volumes in cluding Airly Mine Constructio n (two way traffic)	Residential	Castlereagh Highway	50	10	56	60
	School		40	26	53.8 external <40 Internal[1]	40 (internal) 1 hour when in use
			50	26	54.9 external <40 internal[1]	
	Residential	Glen Davis Road	50	10	53.2	55
			100	150	<35	

1. As a conservative estimate, the difference between external to internal noise levels with a dwelling comprising of standard construction and windows closed is 25 dB.

All reported noise levels are “facade-corrected”. The predicted noise levels have been adjusted upwards to include a notional 2.5 dBA reflection within the noise model computation.

The day time construction road traffic noise level presented in Table 10.39 are predicted to meet the criteria detailed in the RNP (and noted in Table Table 10.39) under all prediction scenarios at the nearest roadside receptors.

10.5.4.4 Rail Traffic Noise

Approved rail traffic volumes will not change as a result of the Project. Hence, rail traffic noise levels currently experienced by residences in the vicinity of the rail corridor will not change.

The day-time $L_{Aeq(15hour)}$, Night-time $L_{Aeq(9hour)}$ and maximum (L_{Amax}) noise levels for the assumed train movements are presented in Table 10.40 and Table 10.41 for various set back distances from the Main Western Rail line.

Table 10.40: Scenario 1 Predicted Rail Traffic Noise Levels (without Airly Mine)

Distance to Receiver	Rail Line	Predicted Noise Level			Residential noise trigger levels (dBA)		
		$L_{Aeq(15hour)}$ Daytime	$L_{Aeq(9hour)}$ Night-time	Passby LAmax	$L_{Aeq(15hour)}$ Daytime	$L_{Aeq(9hour)}$ Night-time	Passby L_{Amax}
25	Main Western Rail Line	57.3	**59.8**	**86.8**	60	55	80
50		54.2	**56.7**	**83.6**			
100		51.1	53.6	**80.2**			
150		49.4	51.9	78.1			
200		48.1	50.6	76.6			
250		47.1	49.6	75.3			
500		44.1	46.6	70.8			
1000		41.1	43.6	65.5			
25	Wallerawang-Gwabegar	48.7	50.9	**86.8**			
50		45.5	47.8	**83.6**			
100		42.5	44.7	**80.2**			
150		40.7	42.9	78.1			
200		39.4	41.7	76.6			
250		38.5	40.7	75.3			
500		35.5	37.7	70.8			
1000		32.4	34.7	65.5			

Table 10.41: Scenario 2 Predicted Rail Traffic Noise Levels (including Airly Mine)

Distance to Receiver	Rail Line	Predicted Noise Level			Residential noise trigger levels (dBA)		
		$L_{Aeq(15hour)}$ Daytime	$L_{Aeq(9hour)}$ Night-time	Passby LAmax	$L_{Aeq(15hour)}$ Daytime	$L_{Aeq(9hour)}$ Night-time	Passby L_{Amax}
25	Main Western Rail Line	57.8	**60.4**	**86.8**	60	55	80
50		54.7	**57.3**	**83.6**			
100		51.6	54.3	**80.2**			
150		49.8	52.5	78.1			
200		48.6	51.2	76.6			
250		47.6	50.3	75.3			
500		44.6	47.2	70.8			
1000		41.6	44.2	65.5			
25	Wallerawang-Gwabegar Rail Line	51.3	54.4	**86.8**			
50		48.1	51.2	**83.6**			
100		45.1	48.2	**80.2**			
150		43.3	46.4	78.1			
200		42.0	45.1	76.6			
250		41.1	44.2	75.3			
500		38.0	41.1	70.8			
1000		35.0	38.1	65.5			

As indicated in Table 10.40 and Table 10.41 predicted existing rail traffic noise levels with and without Airly Mine trains comply with the $L_{Aeq(15\ hour)}$ trigger levels for residences more than 25 m from the Main Western and Wallerawang-Gwabegar Rail Lines.

Rail traffic noise levels without Airly Mine-related trains are predicted to exceed the night-time $L_{Aeq(9\ hour)}$ trigger levels for residents at or within 50 m of the Main Western Rail Line. Furthermore, the existing maximum rail pass-by noise level is predicted to exceed the relevant trigger levels at residences within 100 m of each line.

Airly Mine rail traffic increases rail noise by 0.5 and 0.6 dBA during the day and night respectively. This negligible noise level increase would not be audible. Furthermore, the rail noise passby noise levels will not increase as a result of the Project.

Rail traffic volumes will not change as a result of the proposed project and rail noise currently experienced by residences will not increase as a result of the Project.

10.5.5 Vibration Impact Assessment

The amplitude of vibrations from construction equipment diminishes with distance from the source. This attenuation of vibration is due to both geometrical spreading and dissipation of energy within the ground.

The Project is not proposing any mining methods that will cause large scale fracturing and collapse of the Triassic sandstone. The Subsidence Impact Assessment for Airly Mine (Appendix D) states that rock mass movements are predicted to remain within the highly friable Permian strata and be limited in extent. Also, there is no blasting proposed at the site.

The major vibration generating activities during construction of the Project will occur during the site establishment for the reject emplacement area, the ROM Coal Stockpile area and the CPP. Due to the separation distance to the nearest affected residential receptors, the level of vibration caused by construction activities is predicted to be below the level of human perception at any of the nearest premises and therefore below the criteria for “minimal risk of cosmetic damage” at surrounding residential premises.

10.5.6 Cumulative Noise

The INP prescribes “Project-specific” $L_{Aeq(15minute)}$ intrusive criteria and $L_{Aeq(period)}$ amenity criteria calculation methods). Potential cumulative noise impacts are considered in INP procedures by ensuring that the appropriate noise emission criteria are established to maintain acceptable noise amenity for residences.

A potential source of industrial noise in the vicinity of the Project is the Excelsior Limestone Quarry, approximately 5.5 km northwest of the Airly pit top.

During the operator-attended noise surveys at the Project, no contribution was detected from the Excelsior Limestone Quarry. No other industrial facilities are known or planned. Therefore, the calculated amenity level for the Project site already accounts for cumulative noise.

10.5.7 Consequences of Potential Noise Impacts

10.5.7.1 Operational Noise

Project operational noise emissions will be within the Project specific noise criteria for all residential receptors.

10.5.7.2 Construction Noise

The predicted construction noise levels are significantly below the construction noise goals at the nearest sensitive receiver and therefore the potential construction noise impacts of the Project are negligible.

10.5.7.3 Cumulative Noise

There are no existing or planned industrial noise sources within audible range of Airly Mine and therefore, there are no cumulative noise consequences.

10.5.7.4 Rail Traffic Noise

Rail traffic volumes will not change as a result of the proposed Project. Hence, rail traffic noise levels currently experienced by residences in the vicinity of the rail corridor will not increase as a result of the project.

10.5.8 Noise Management and Mitigation Measures

While noise modelling has indicated that there will be negligible noise impacts, the following noise mitigation and management measures will be implemented.

- Minimise the sound power level of construction equipment where possible.
- Position construction plant and equipment in such a way that any 'high-noise' side is directed away from the noise sensitive receivers where possible given that noise emissions of these plant and equipment can be directional in nature.
- Educate operators/contractors with regard to potential noise issues and encourage the implementation of quiet work practises, including avoiding use of PA systems and loud stereos outside.
- Arrange traffic flow at the site to minimise the need for reversing.
- Turn off trucks and construction plant when not in use.
- Position tipping actions at stockpiles as far away from neighbours as possible.
- Restrict high noise activities to between the hours of 8.00 am and 4.00 pm Monday to Friday and between 9.00 am and 1.00 pm Saturday.
- Consult with potentially-affected residences regarding the timing of acoustically significant events. This could result in conducting the noisiest activities during the least sensitive times of the day.
- Ensure a prompt response to any complaint with regard to noise.
- Undertake noise monitoring on site and within the community.
- Address community issues of concern promptly.

The following noise measures will be implemented to reduce the potential impact of noise from exploration sites.

- Construction of temporary noise barriers in the unlikely event that the drill rig is located within 665 m from a sensitive receptor (Section 10.5.4.2).
- Educate operators with regard to potential noise issues and encourage the implementation of quiet work practices.

10.5.9 Conclusion

Operational noise modelling indicate that noise predictions from the Project are below the project specific noise criteria at all privately owned nearest residential receptors (Table 10.29 and Figure 2.6) under all considered meteorological conditions, including adverse temperature inversion conditions. The predicted operational noise level will also meet the project specific noise criterion at the Airly Camp Ground in the Airly Gap.

The L_{Amax} noise levels are predicted to be below the project specific sleep disturbance noise goal during existing, approved and proposed operations under prevailing weather conditions (worst case scenario) at all privately owned residential receptors.

The calculated day time and night time operational road traffic noise level are predicted to meet the criteria detailed in the RNP under all prediction scenarios at the nearest roadside receivers.

Predicted $L_{Aeq(15minute)}$ noise from construction activities are below the construction noise goals at all residences.

The calculated day time construction road traffic noise levels are predicted to meet the criteria detailed in the RNP under all prediction scenarios at the nearest roadside receivers.

Vibration generated from both construction and operational activities in the Project will be significantly below the criteria for “minimal risk of cosmetic damage” at the nearest residences.

Predicted rail traffic noise levels with and without Airly Mine comply with the $L_{Aeq(15\ hour)}$ trigger levels for residences more than 25 m from both the Main Western and Wallerawang-Gwabegar Rail Lines. However, existing rail traffic noise levels without Airly Mine trains already exceed the night-time $L_{Aeq(9\ hour)}$ trigger levels for residents within 50 m of these rail lines. Further, the existing rail noise maximum passby noise level is predicted to exceed the relevant trigger levels at residences within 100 m of the both the rail lines.

Inclusion of approved Airly Mine rail traffic results in a negligible and inaudible increase to existing rail noise of 0.5 dBA and 0.6 dBA during the day and night respectively. Rail passby noise levels will not increase as a result of the Project. Rail traffic volumes will not change as a result of the proposed Project and noise levels currently experienced by residences in the vicinity of the rail corridor will not increase as a result of the Project.

10.6 Air Quality Management

This section specifically responds to the DGRs, which provide the following in regard to air quality aspects:

The Director-General’s Requirements

Air Quality - including a quantitative assessment of potential:

- construction and operational impacts, with a particular focus on dust emissions including PM2.5 and PM10 emissions and dust generation from coal transport;
- an investigation of methods to control dust lift-off from coal wagons;
- reasonable and feasible mitigation measures to minimise dust emissions, including evidence that there are no such other available measures; and
- monitoring and best practice management measures, in particular real-time air quality monitoring.

10.6.1 Introduction

This section is informed by the technical assessment, *Airly Mine Extension Air Quality and Greenhouse Gas Impact Assessment*, March 2014, SLR Consulting Australia Pty Ltd (SLR 2014b), which is provided in full in Appendix L and has been prepared in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC 2005), (Approved Methods).

The scope of the assessment in accordance with the DGRs was to quantify the air quality impacts associated with the Project on surrounding sensitive receivers during construction and operation and also to estimate greenhouse gas emissions for the Project.

Air quality criteria for the Project as identified within the relevant policy is presented in Table 10.42.

Table 10.42: Air Quality Criteria

Particulate Matter	Averaging Time	Criteria (µg/m^3)	Source
Total Suspended Particulate (TSP)	Annual mean	90	Approved Methods
PM_{10}	24-hour maximum	50	Approved Methods
	Annual mean	30 (NSW EPA)	
	Annual mean	20 WHO)	
$PM_{2.5}$	24-hour maximum	25	NEPM
	Annual mean	8	
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)	Approved Methods

The following four operational scenarios were assessed:

- existing infrastructure and operations
- construction of a CPP (including the ROM stockpile) and a Proposed REA (with existing activities operational)
- approved infrastructure and operations
- proposed infrastructure and operations.

A summary of the scenarios assessed are shown in Table 10.43.

Table 10.43: Summary of the Operational Scenarios Modelled

Scenario	Description	Purpose of this Scenario
Scenario 1a (Existing Infrastructure)	No CPP or REA; 1.8 Mtpa production	To assess the air quality impacts due to operations using existing infrastructure
Scenario 1b (Construction)	Construction of CPP and REA	To assess the air quality impacts due to construction of CPP (including the ROM stockpile) and REA
Scenario 2 (Approved Infrastructure)	CPP, REA and ROM stockpile to be located on the hard stand area near the Administration offices; 1.8 Mtpa production	To assess the air quality impacts due to operations using approved infrastructure
Scenario 3 (Proposed Infrastructure)	CPP, REA and ROM stockpile to be located on the hard stand area near the product stockpile; 1.8 Mtpa production	To assess the air quality impacts due to operations using proposed infrastructure

10.6.2 Existing Environment

10.6.2.1 Suspended Particulate Matter

No on-site monitoring of TSP, PM_{10} , or $PM_{2.5}$ is conducted at Airly Mine.

The nearest NSW EPA monitoring station measuring continuous PM_{10} concentrations is in Bathurst, approximately 50 km south-west of the Project Application Area. The mean PM_{10} 24-hour concentration for 2010, 2011 and 2012 range between 9.5 µg/m^3 and 13.5 µg/m^3. The maximum PM10 24-hour concentration for 2010 (43.3 µg/m^3) is significantly higher than that in 2011 (24.3 µg/m^3) but approximately 12 µg/m^3 lower than for 2012.

No ambient background monitoring data for TSP is available in the local area or at the nearest OEH monitoring sites. In the absence of background TSP levels, the regional TSP concentrations are assumed to be twice that of the monitored PM_{10} concentrations.

No ambient background monitoring data for $PM_{2.5}$ is 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.

10.6.2.2 Deposited Dust

Since January 2009, dust deposition monitoring has been performed at Airly Mine (Figure 3.5). From January 2009 to October 2013, the mean deposition rate was in the order of 1.2 to 0.7 g/m^2/month.

10.6.2.3 Adopted Background Air Quality

The adopted background data are presented in Table 10.44.

Table 10.44: Adopted Background Air Quality Levels

Pollutant	Averaging Period	Background Concentration (µg/m³)	Basis
PM_{10}	24-hour	Daily varying background	Monitoring data at Bathurst (2010)
	Annual	9.4	Monitoring data at Bathurst (2010)
$PM_{2.5}$	24-hour	None	NA
	Annual	None	NA
TSP	Annual	22.8	Assumed TSP to PM_{10} ratio of 2
Dust Deposition	Annual	1.2 g/m²/month	Average of dust deposition monitoring data in 2010

NA – Not available

10.6.2.4 Sensitive Receptors

The sensitive receptors for the Project are shown in Figure 2.6. However, 8 representative residential receptors, including a passive recreational receptor of R17 (Airly Camping Ground) was assessed for potential air quality impacts.

10.6.3 Air Quality Impact Assessment

Atmospheric pollutants likely to be generated by the potential activities include the following fugitive emissions:

- deposited dust
- total suspended particulates (TSP), which refers to all suspended particles in the air and are typically less than 30 µm in diameter
- $PM_{10,}$ which is a subset of TSP and have a diameter of 10 µm or less
- $PM_{2.5,}$ which is a subset of PM_{10} and have a diameter of 2.5 µm or less
- those generated through the combustion of fuel in vehicle engines (NO_X, SO_2, VOCs, CO, PM_{10}).

In regards to construction and operational activities, the following emission-sources have been identified at the Airly Mine:

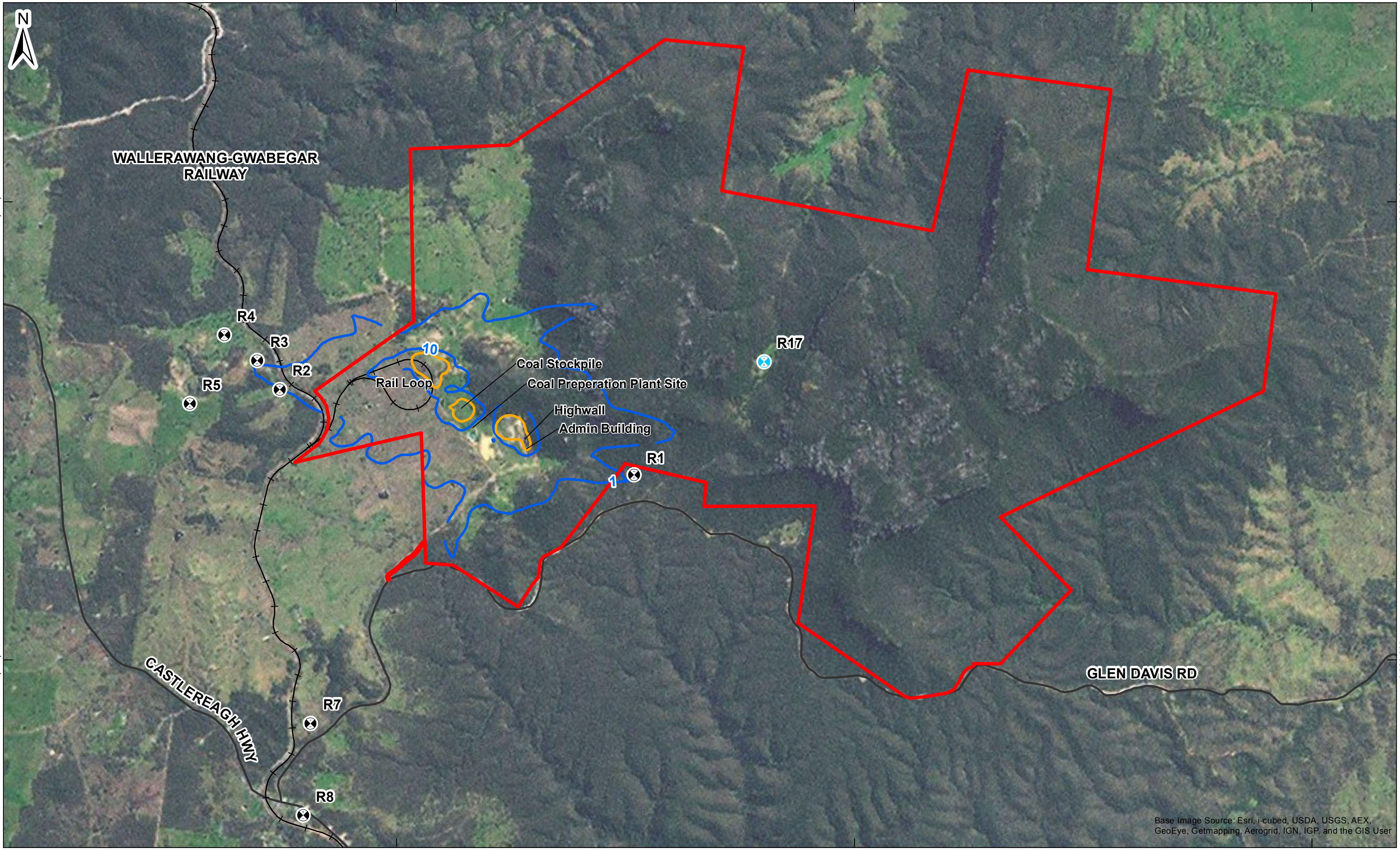
- handling, processing and transportation of ROM coal and product coal
- handling and transportation of coal rejects

- wind erosion from open and exposed areas such as stockpiles and rejects emplacement areas
- ventilation fans
- activities associated with the construction of the CPP and the Proposed REA.

Operational dust sources include coal handling facilities (conveyor transfer points), coal crushing; wheel generated dust on unpaved roads; ventilation shaft emissions; and wind erosion from cleared land and stockpiles.

Rehabilitation activities that will be sources of dust include demolition and removal of roads, buildings and footings; excavation activities; reshaping of landforms; and spreading of topsoil.

Figure 10.14 to Figure 10.37 provide predicted contour plots of incremental dust deposition, TSP annual average concentration, PM_{10} annual average and 24 hour average concentrations and $PM_{2.5}$ annual average and 24 hour average concentrations for operational scenarios. From these figures it is evident that there is no difference between air quality parameters between the approved (scenario 2) and proposed (scenario 3) conditions.



LEGEND

Project Application Area

Rail

Main Road

25 µg/m3

Sensitive Receptor

Airly Camping Ground (Passive Recreation)

Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.14: Existing PM2.5 - 24 Hour Average Scenario 1a

0 500 1,000 1,500 2,000 Metres

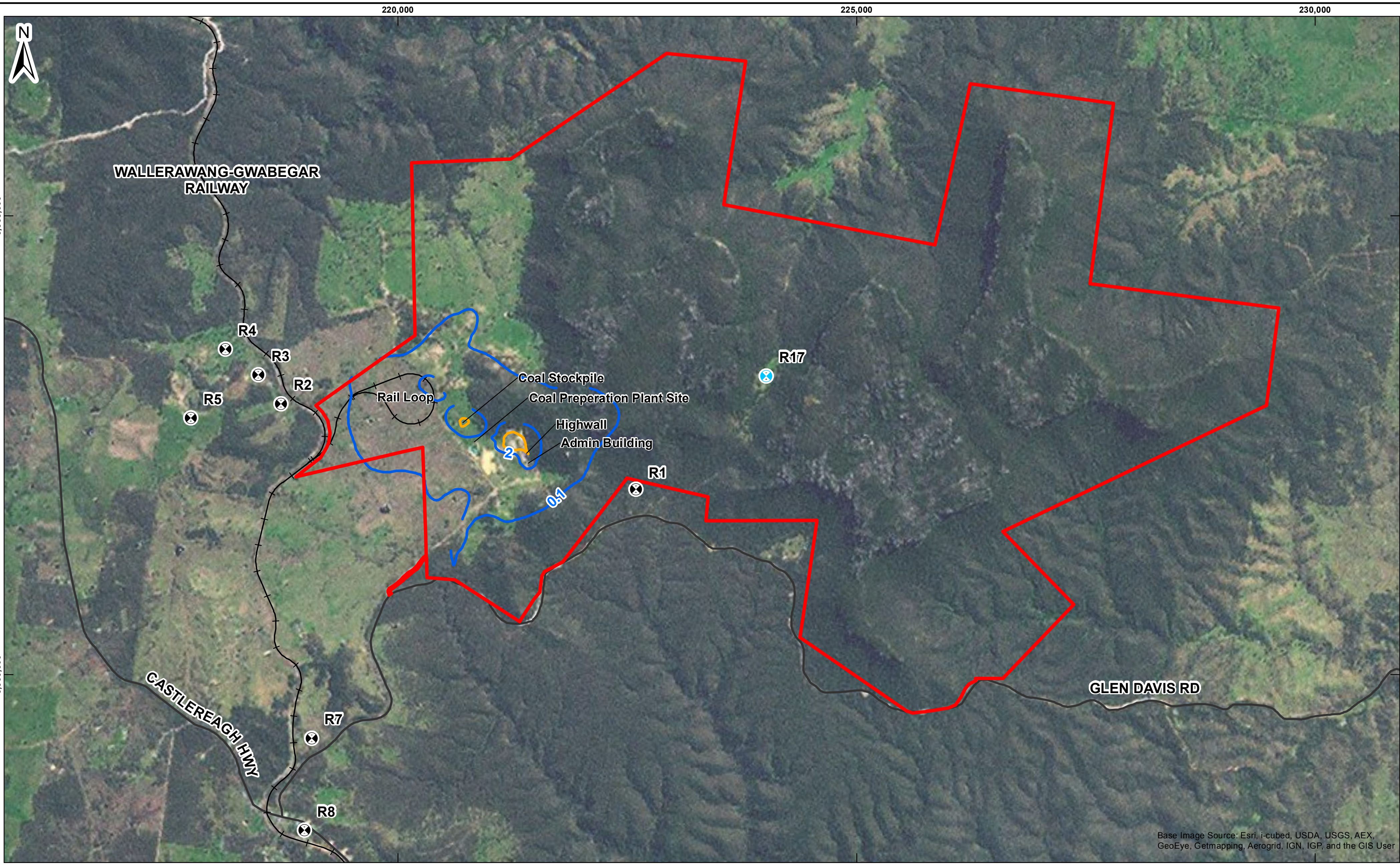
PLOTFILE No.

Centennial Coal

Airly

DRG NO. 10-10.14

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 8 µg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.15: Existing PM2.5 - Annual Average Scenario 1a

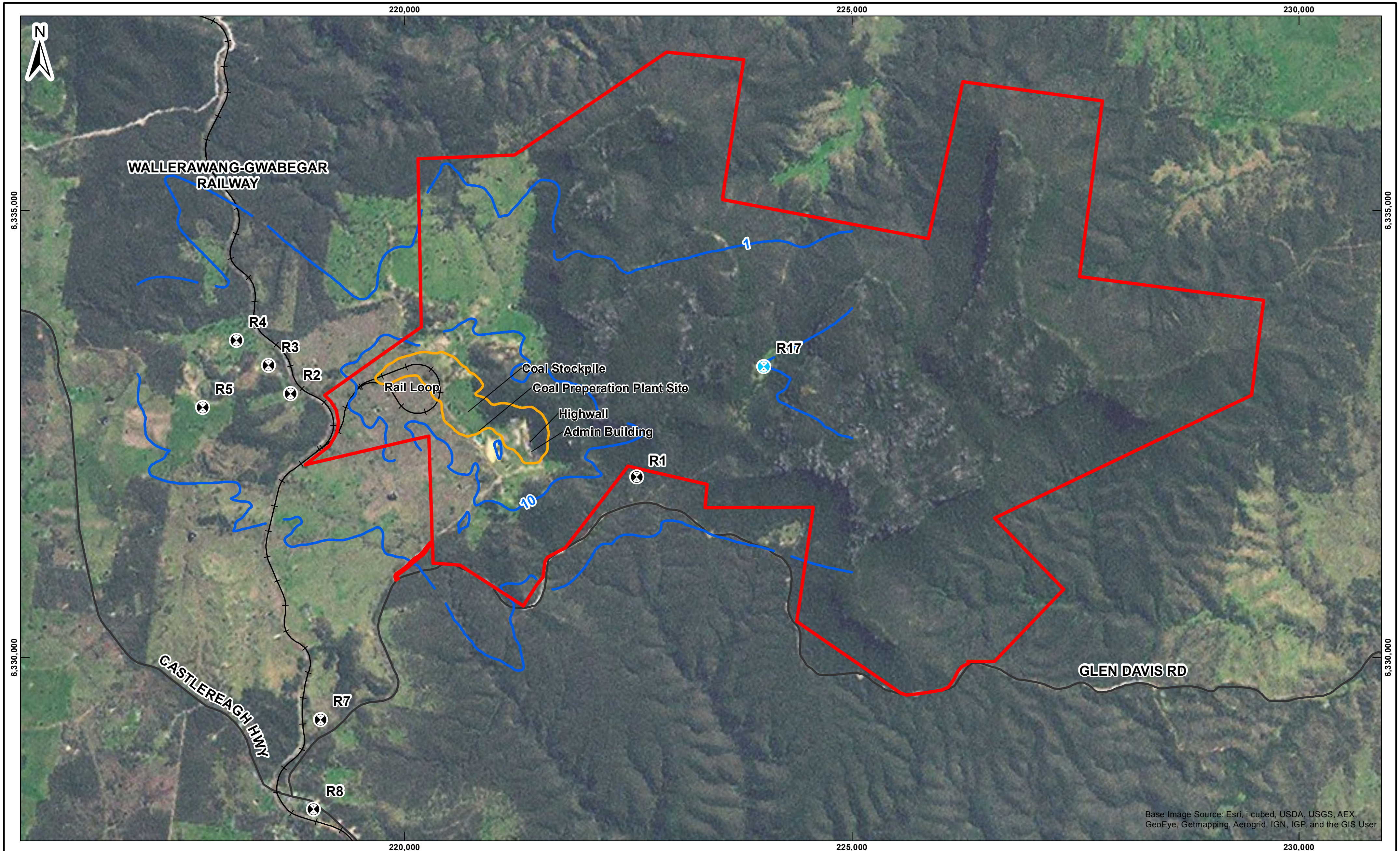
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.15

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 50 µg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.16: Existing PM10 - 24 Hour Average Scenario 1a

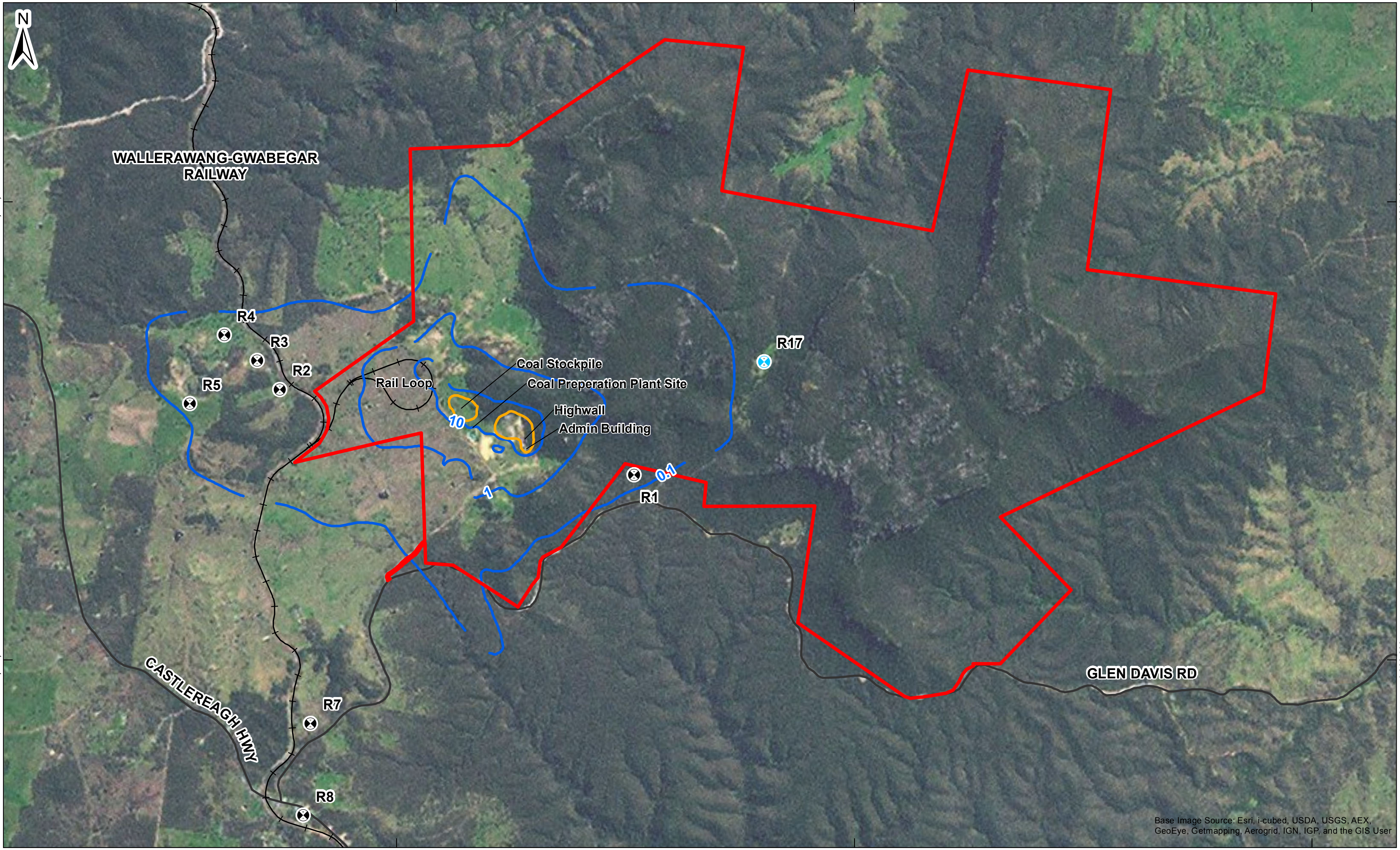
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.16

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 30 µg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.17: Existing PM10 - Annual Average Scenario 1a

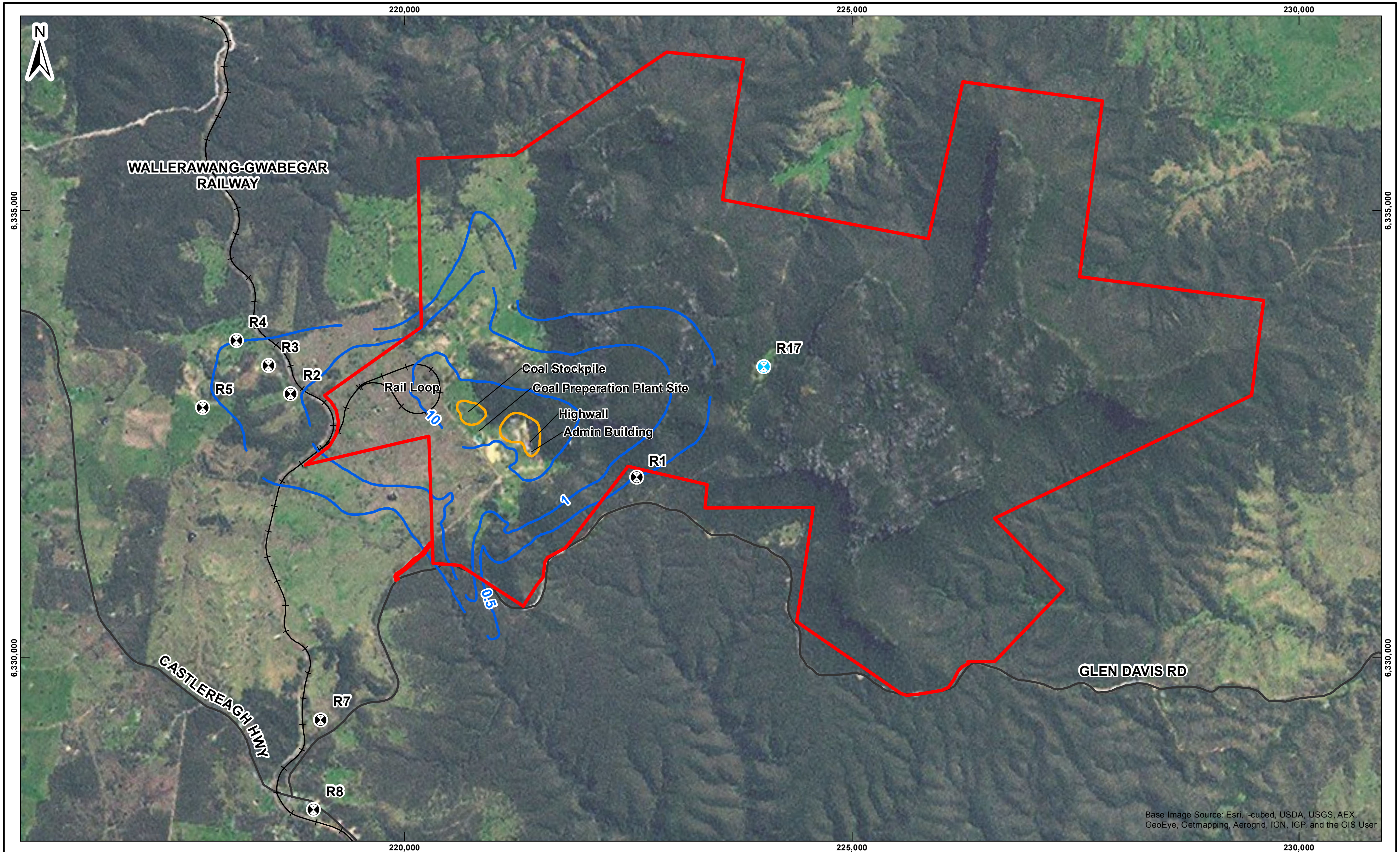
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.17

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 90 µg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

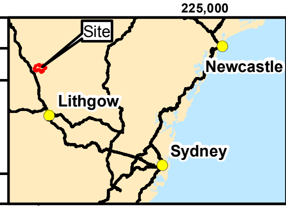


Figure 10.18: Existing TSP - Annual Average Scenario 1a

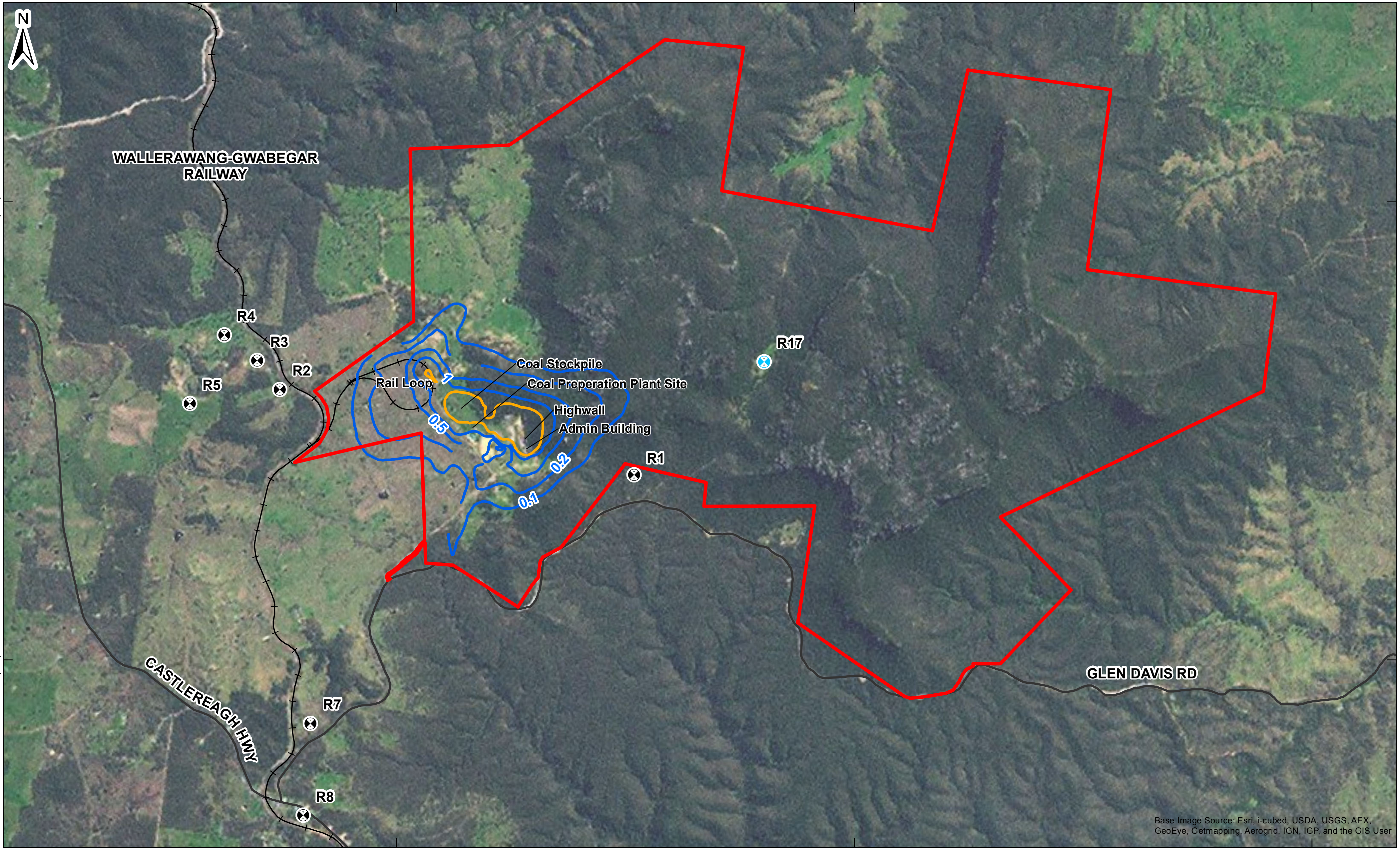
PLOTFILE No.

Centennial Coal

Airly

DRG NO. 10-10.18

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 2 g/m2 / month

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.19: Existing Dust - Annual Average Scenario 1a

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal

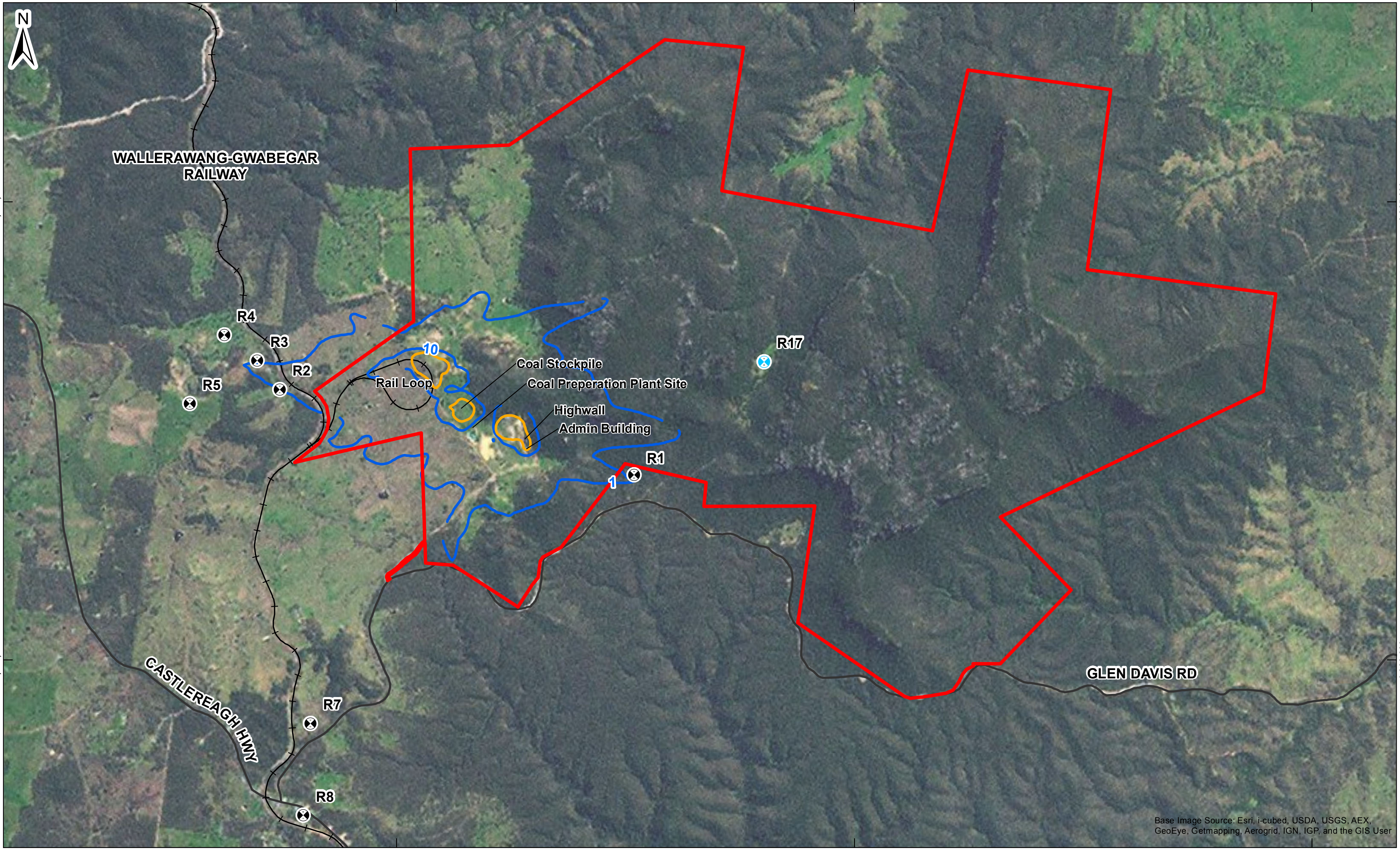
Airly

DRG NO. 10-10.19

A4

220,000 225,000 230,000

6,335,000 6,330,000



220,000 225,000 230,000

LEGEND

- Project Application Area
- Rail
- Main Road
- 25 µg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.20: Construction + Existing PM2.5 - 24 Hour Average Scenario 1b

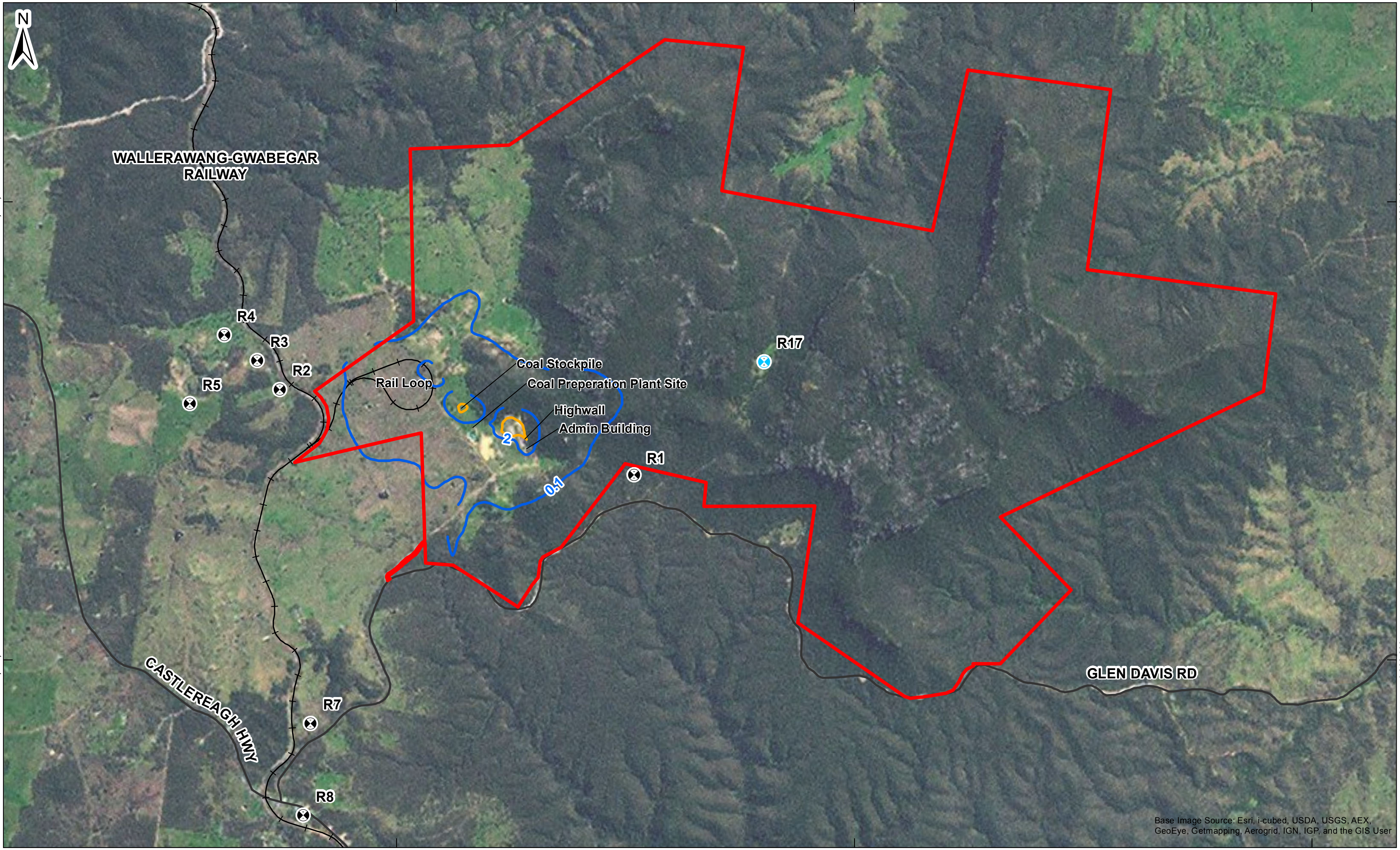
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.20

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 8 µg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.21: Construction + Existing PM2.5 - Annual Average Scenario 1b

0 500 1,000 1,500 2,000 Metres

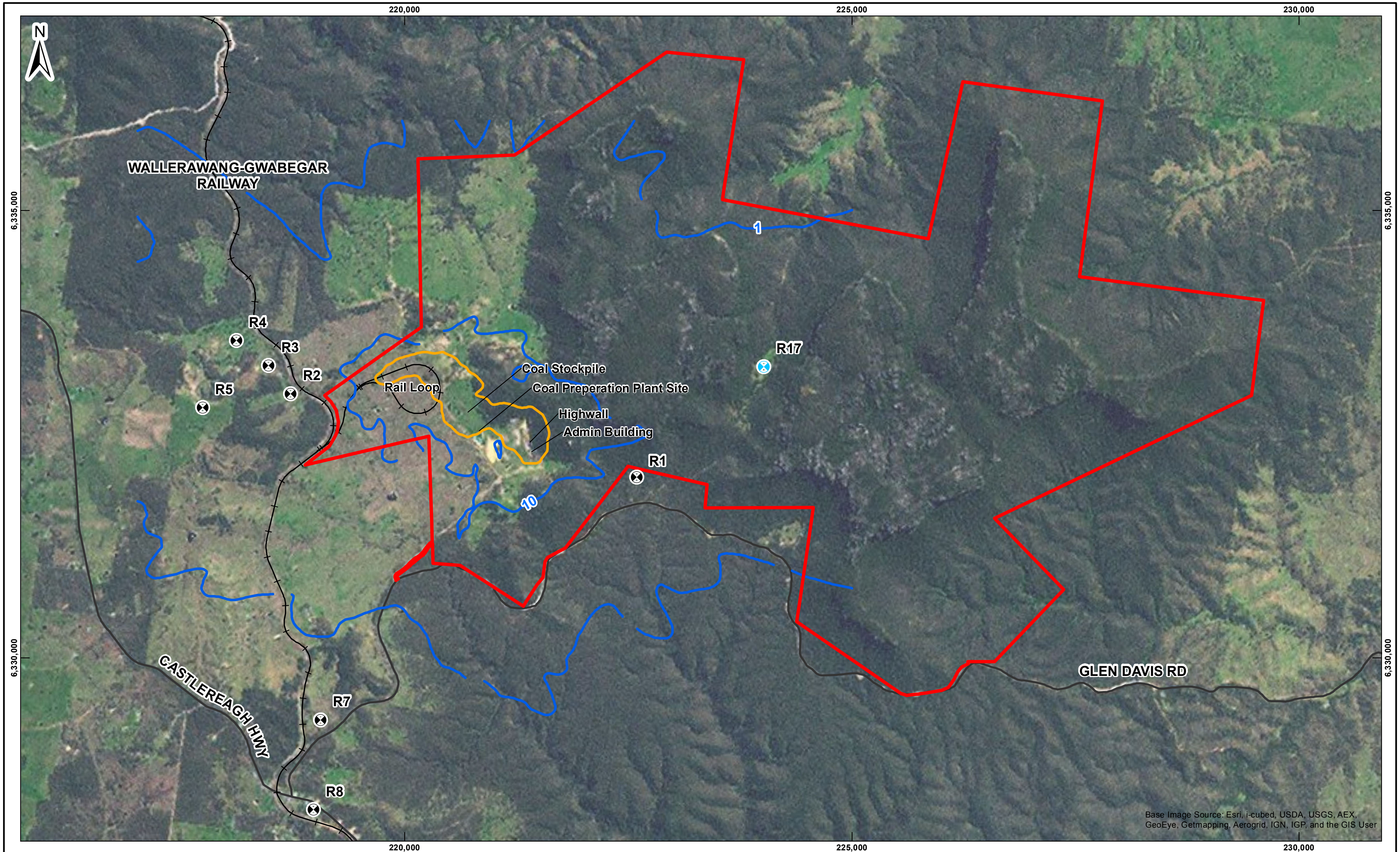
PLOTFILE No.

Centennial Coal

Airly

DRG NO. 10-10.21

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 50 µg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

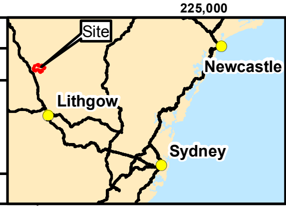


Figure 10.22: Construction + Existing PM10 - 24 Hour Average Scenario 1b

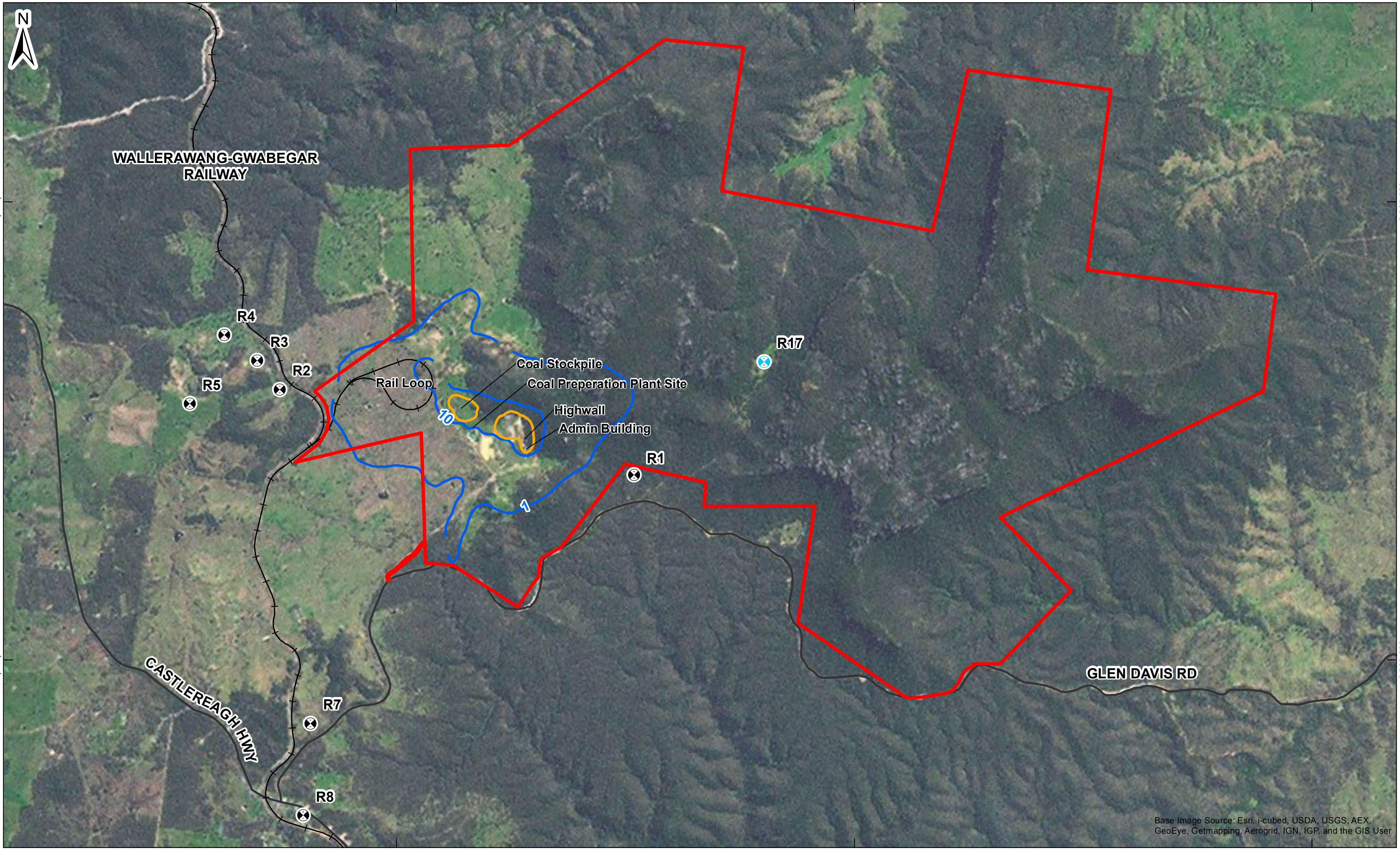
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.22

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 30 µg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.23: Construction + Existing PM10 - Annual Average Scenario 1b

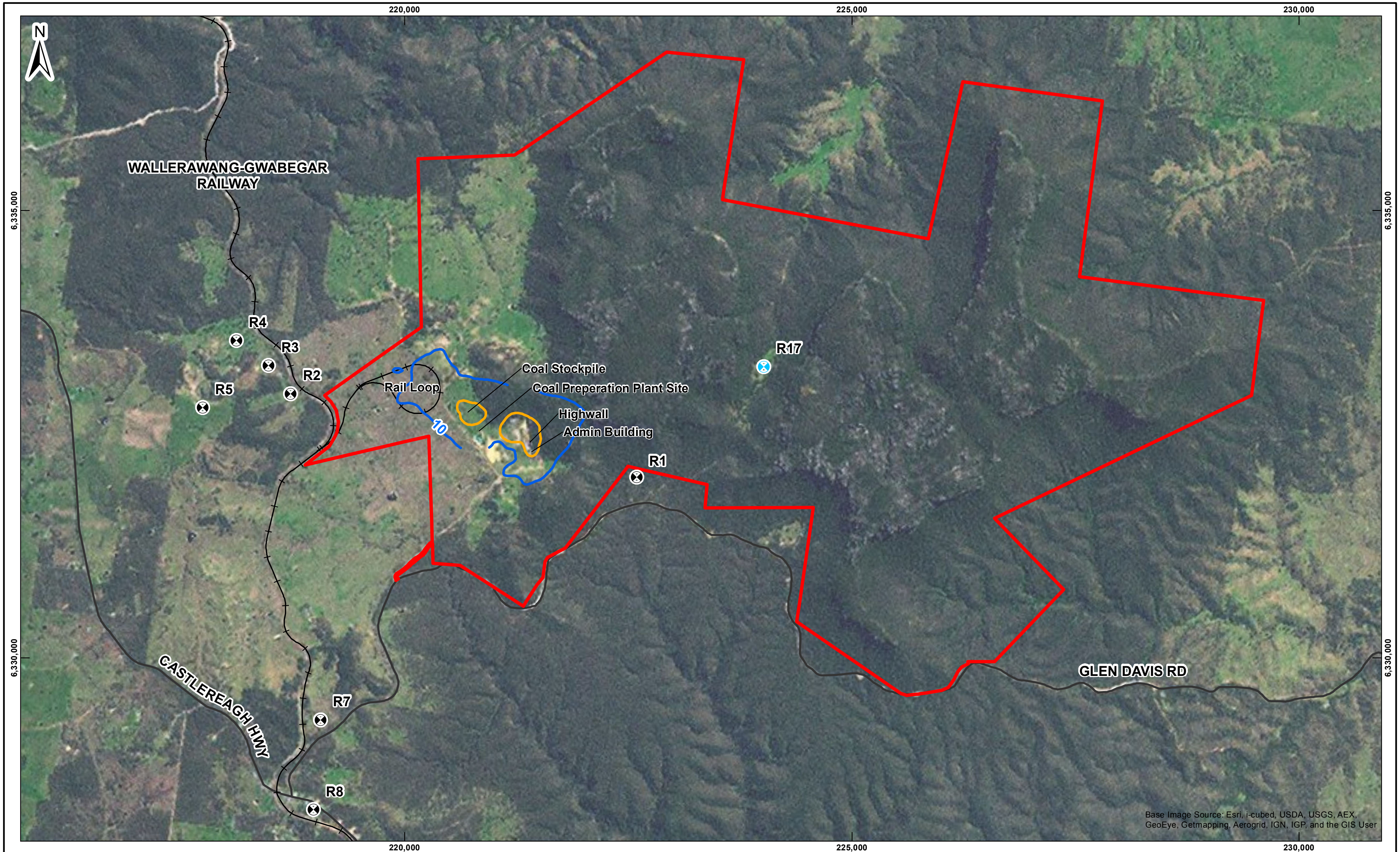
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.23

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 90 μg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.24: Construction + Existing TSP - Annual Average Scenario 1b

0 500 1,000 1,500 2,000 Metres

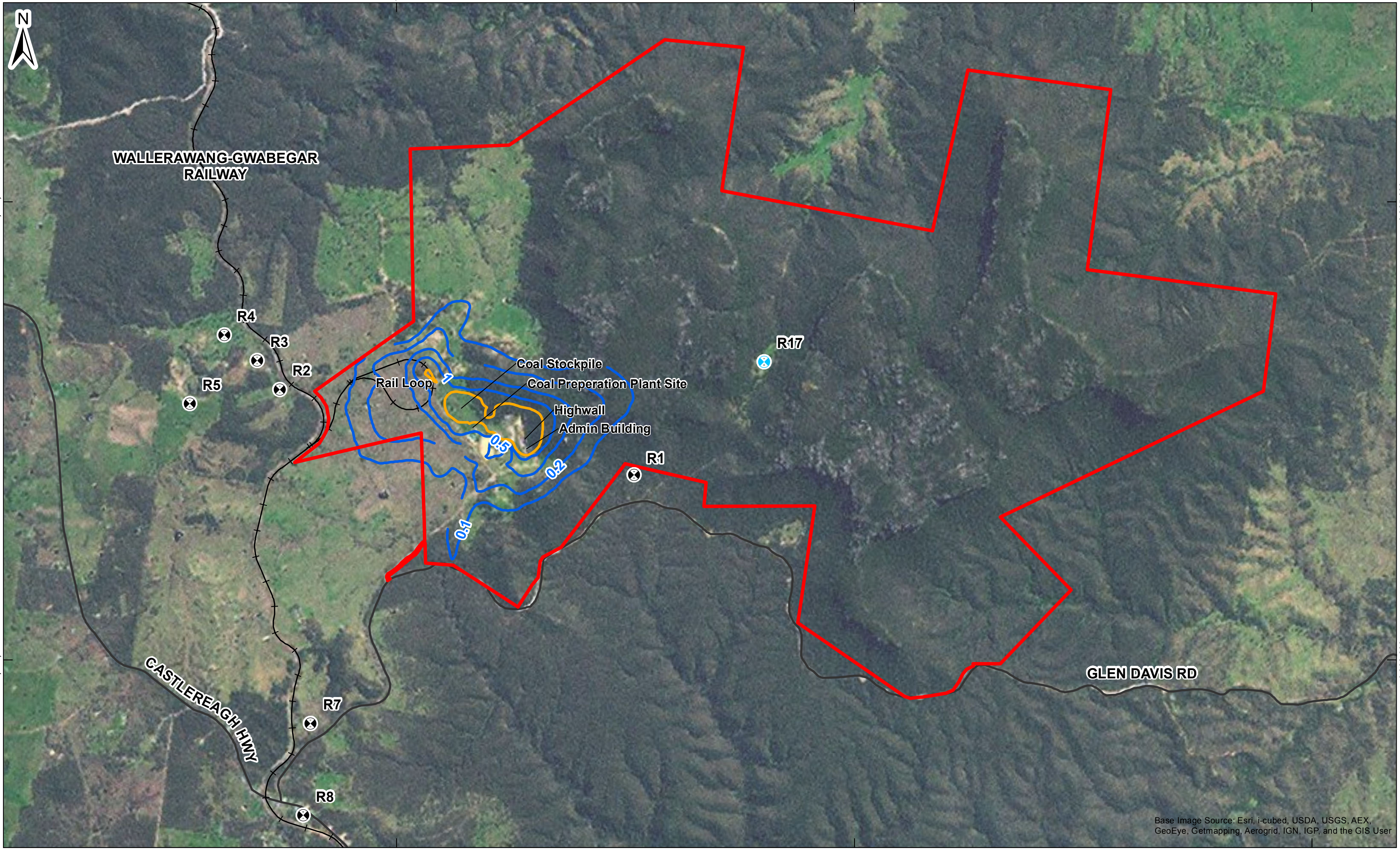
PLOTFILE No.

Centennial Coal

Airly

DRG NO. 10-10.24

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 2 g/m2 / month

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

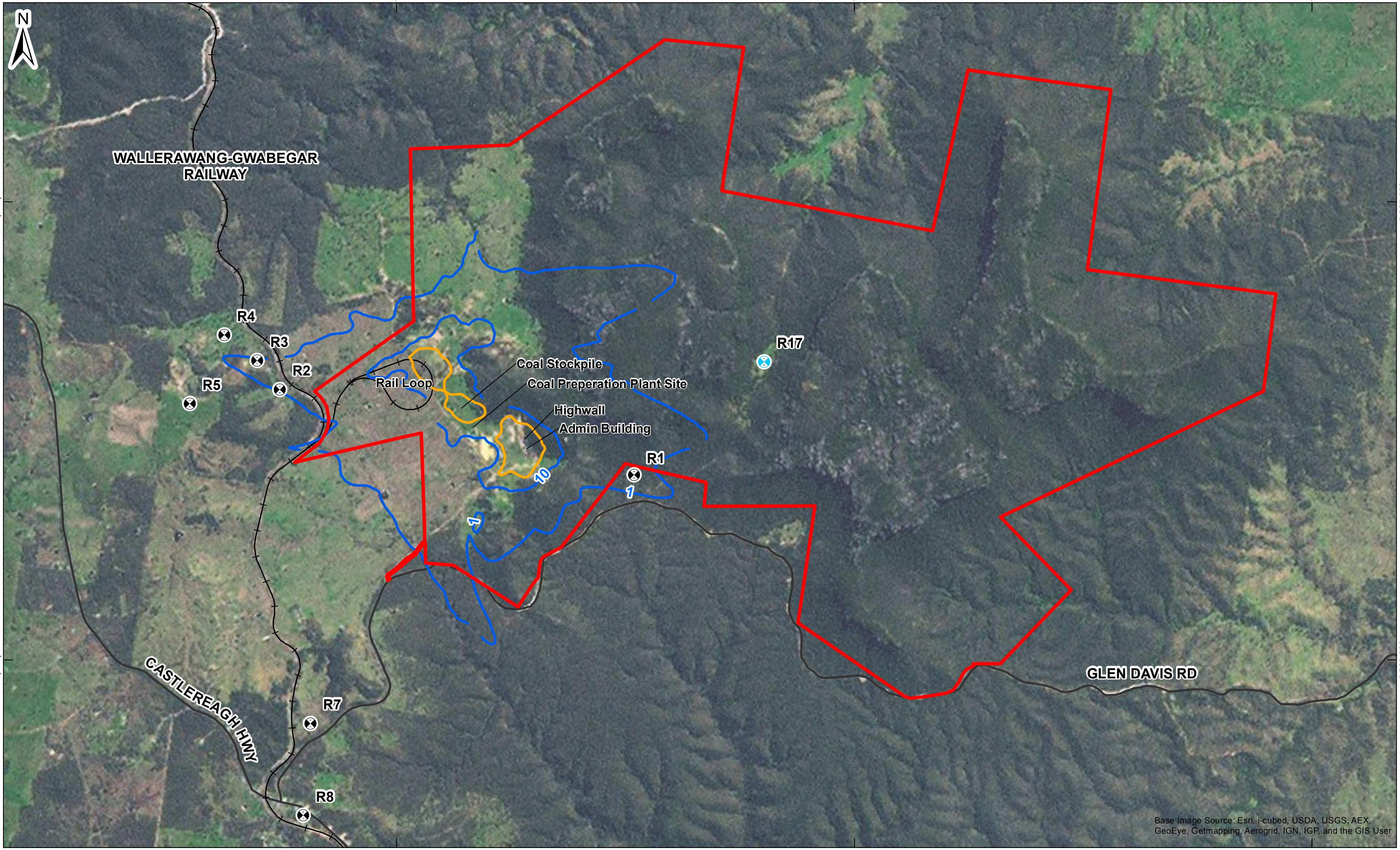
Figure 10.25: Construction + Existing Dust - Annual Average Scenario 1b

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.25

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 25 µg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.26: Approved (DA162/91) PM2.5 - 24 Hour Average Scenario 2

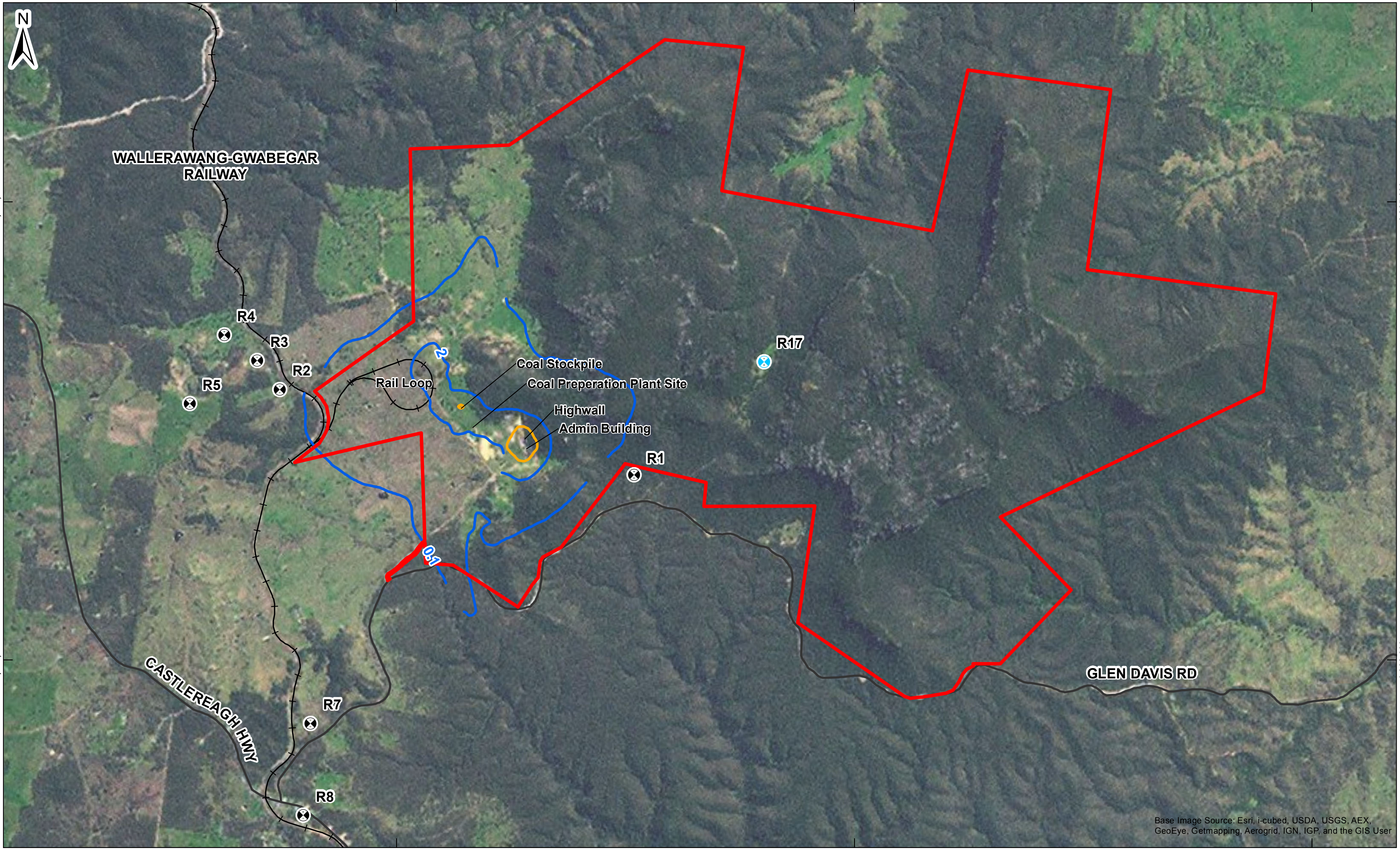
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.26

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 8 μg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.27: Approved (DA162/91) PM2.5 - Annual Average Scenario 2

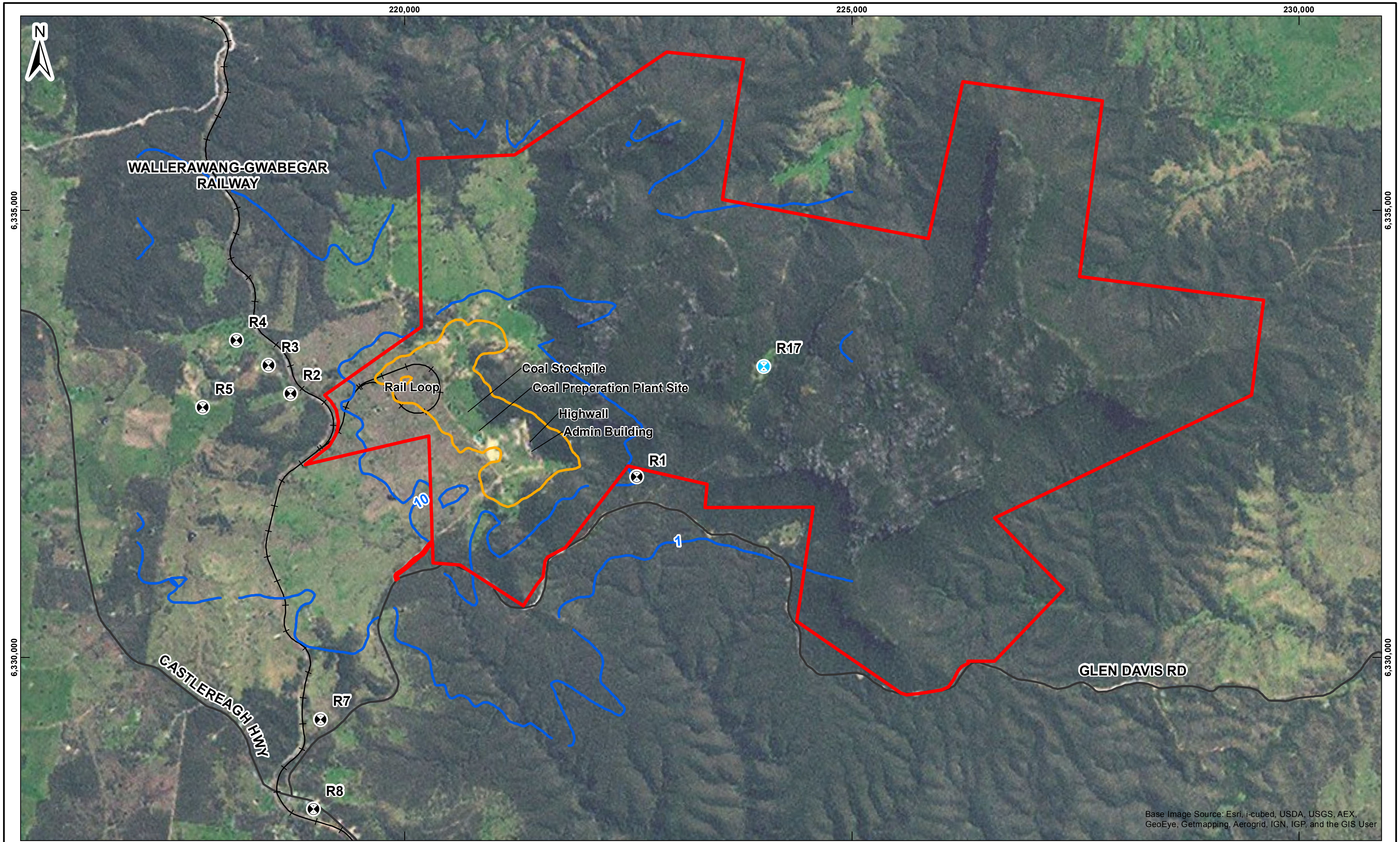
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.27

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 50 µg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

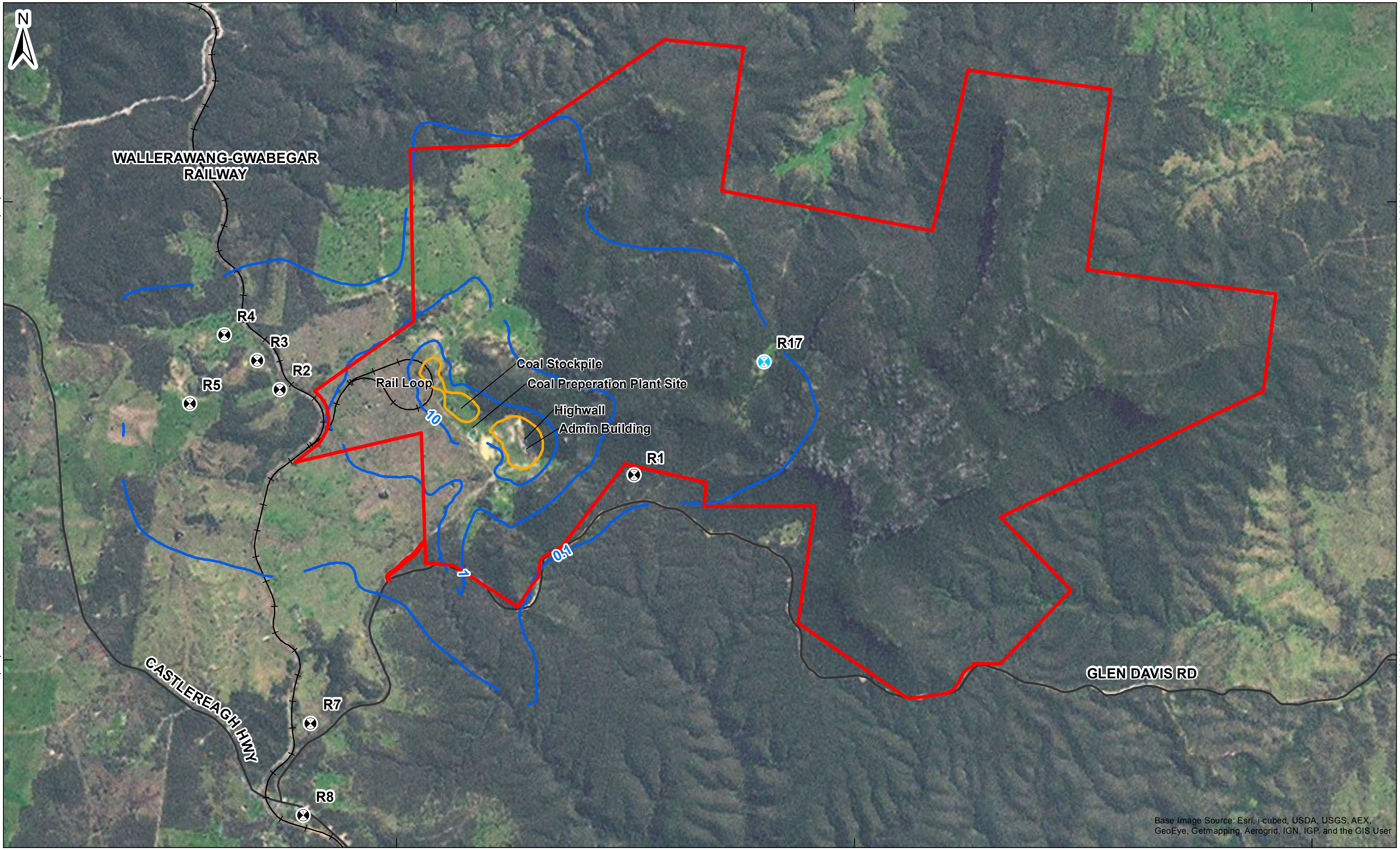
Figure 10.28: Approved (DA162/91) PM10 - 24 Hour Average Scenario 2

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.28

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 30 µg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.29: Approved (DA162/91) PM10 - Annual Average Scenario 2

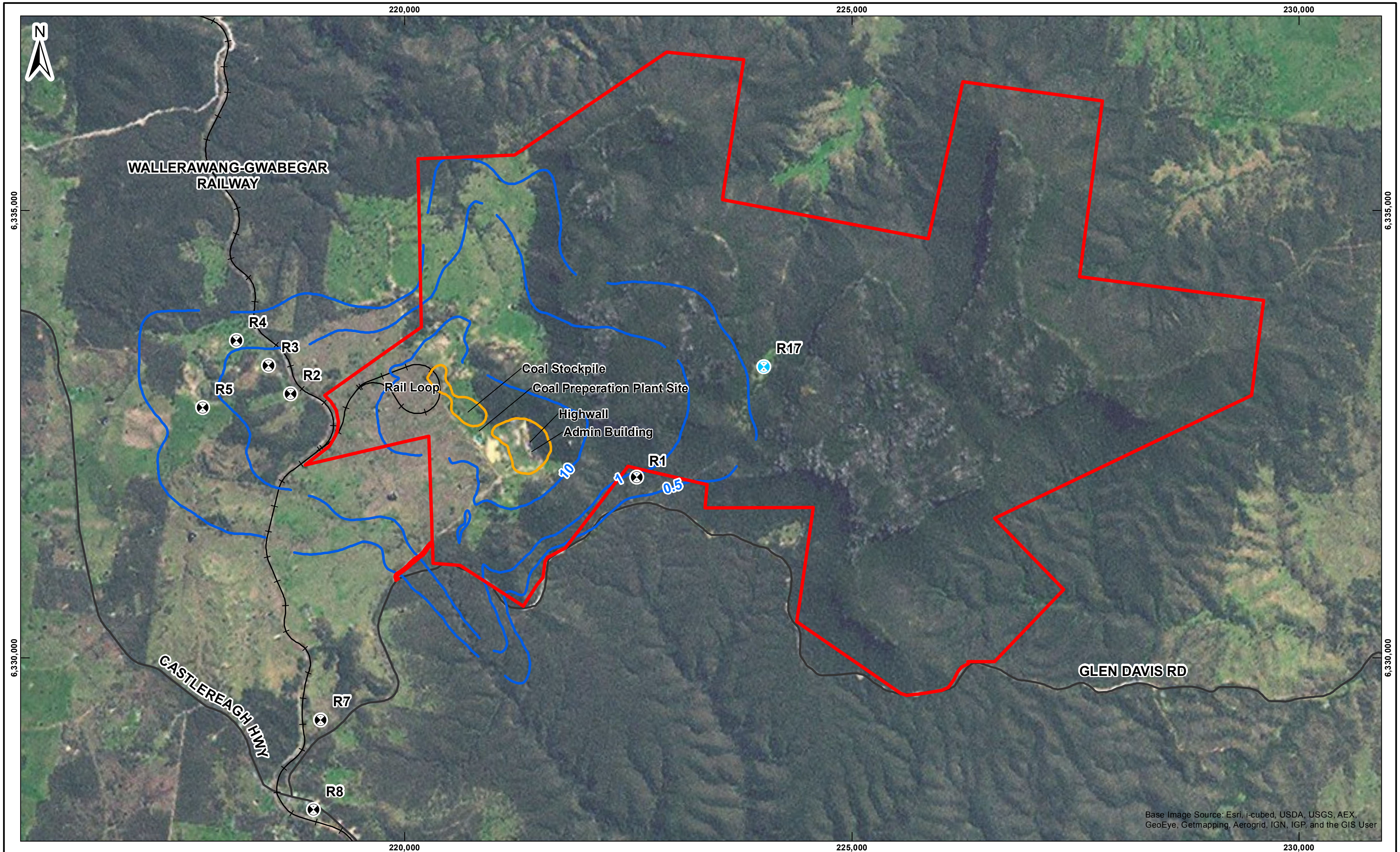
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.29

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 90 μg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.30: Approved (DA162/91) TSP - Annual Average Scenario 2

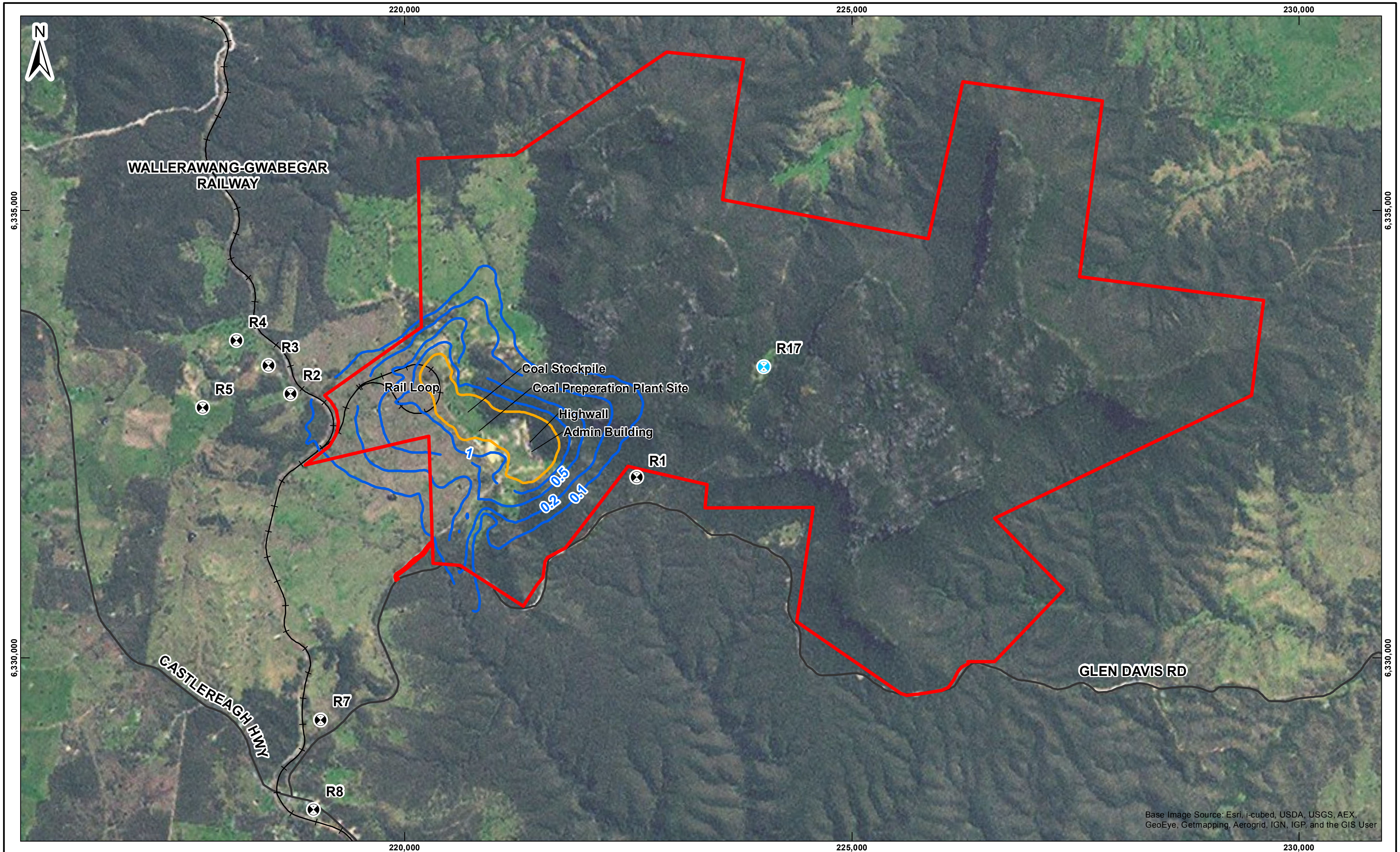
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.30

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 2 g/m2 / month

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.31: Approved (DA162/91) Dust - Annual Average Scenario 2

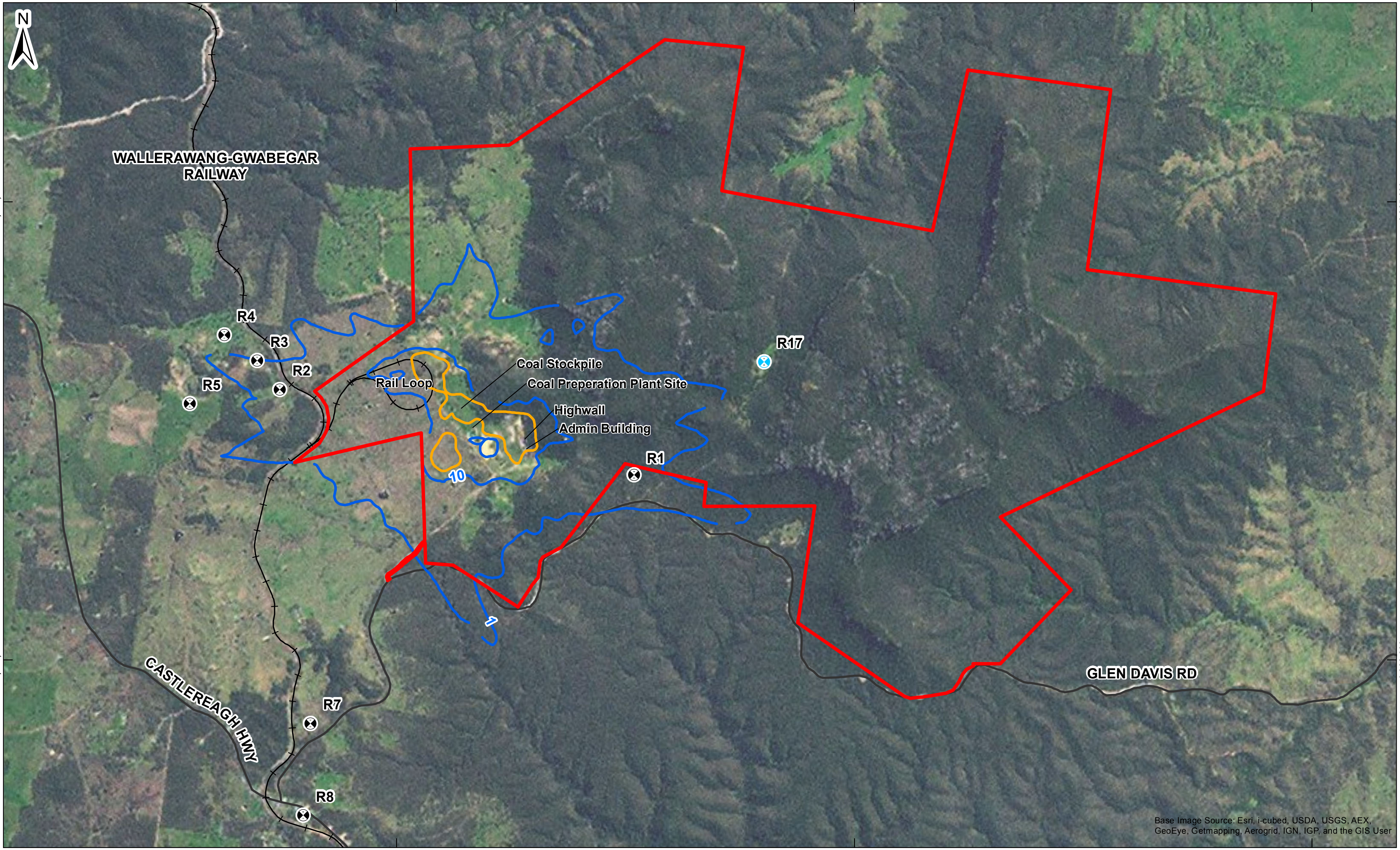
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.31

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 25 µg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.32: Proposed PM2.5 - 24 Hour Average Scenario 3

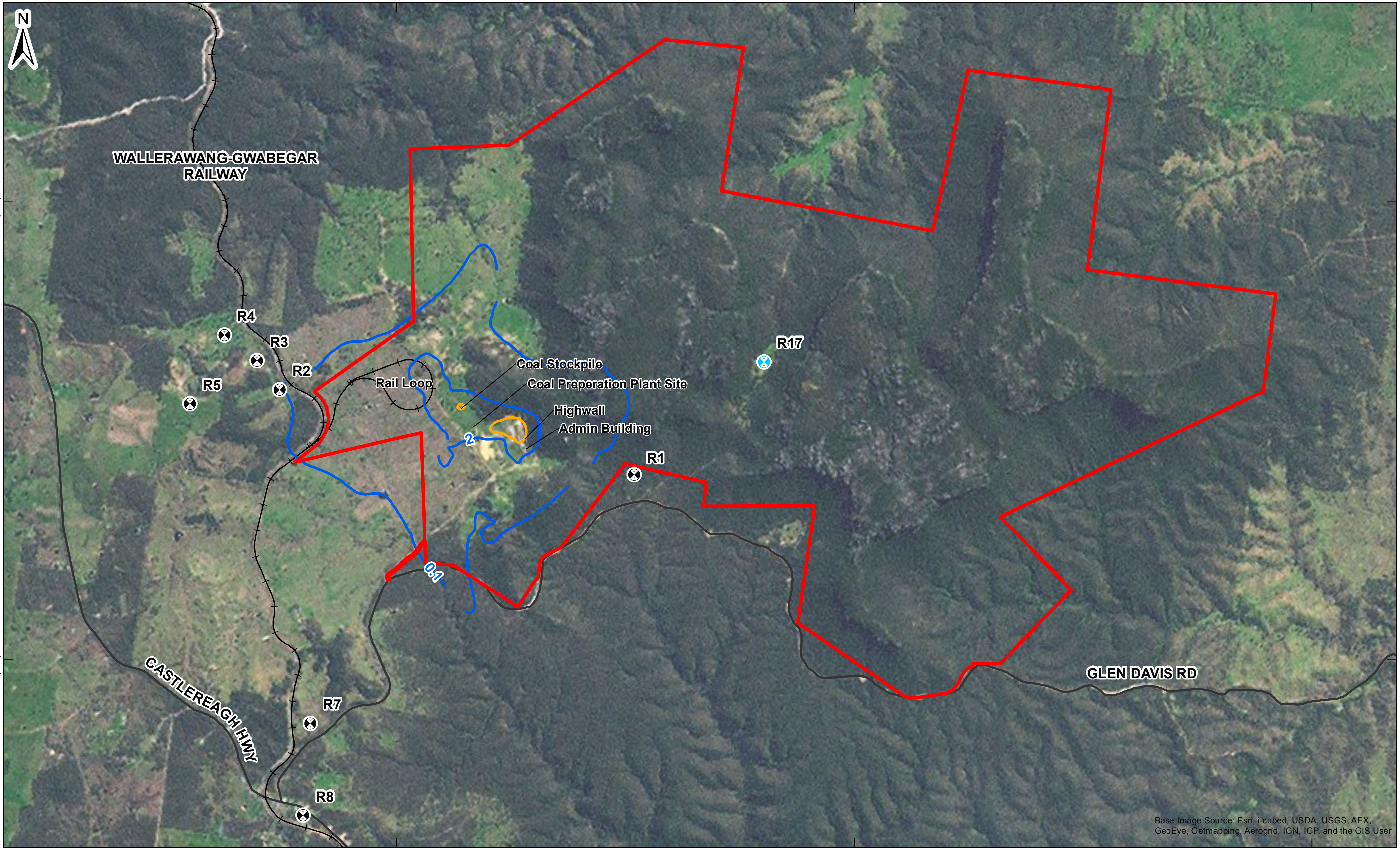
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.32

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 8 μg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.33: Proposed PM2.5 - Annual Average Scenario 3

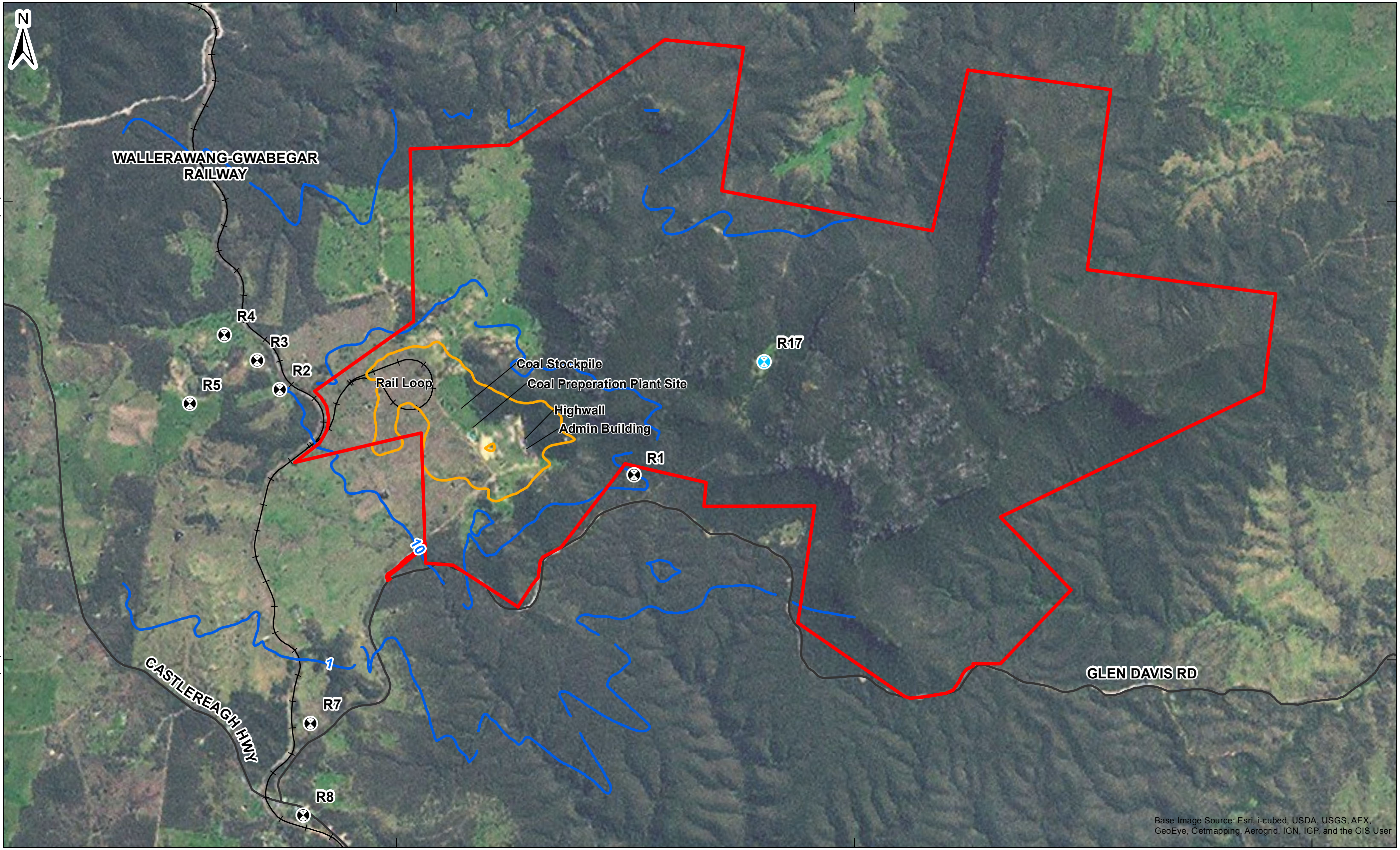
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.33

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 50 µg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.34: Proposed PM10 - 24 Hour Average Scenario 3

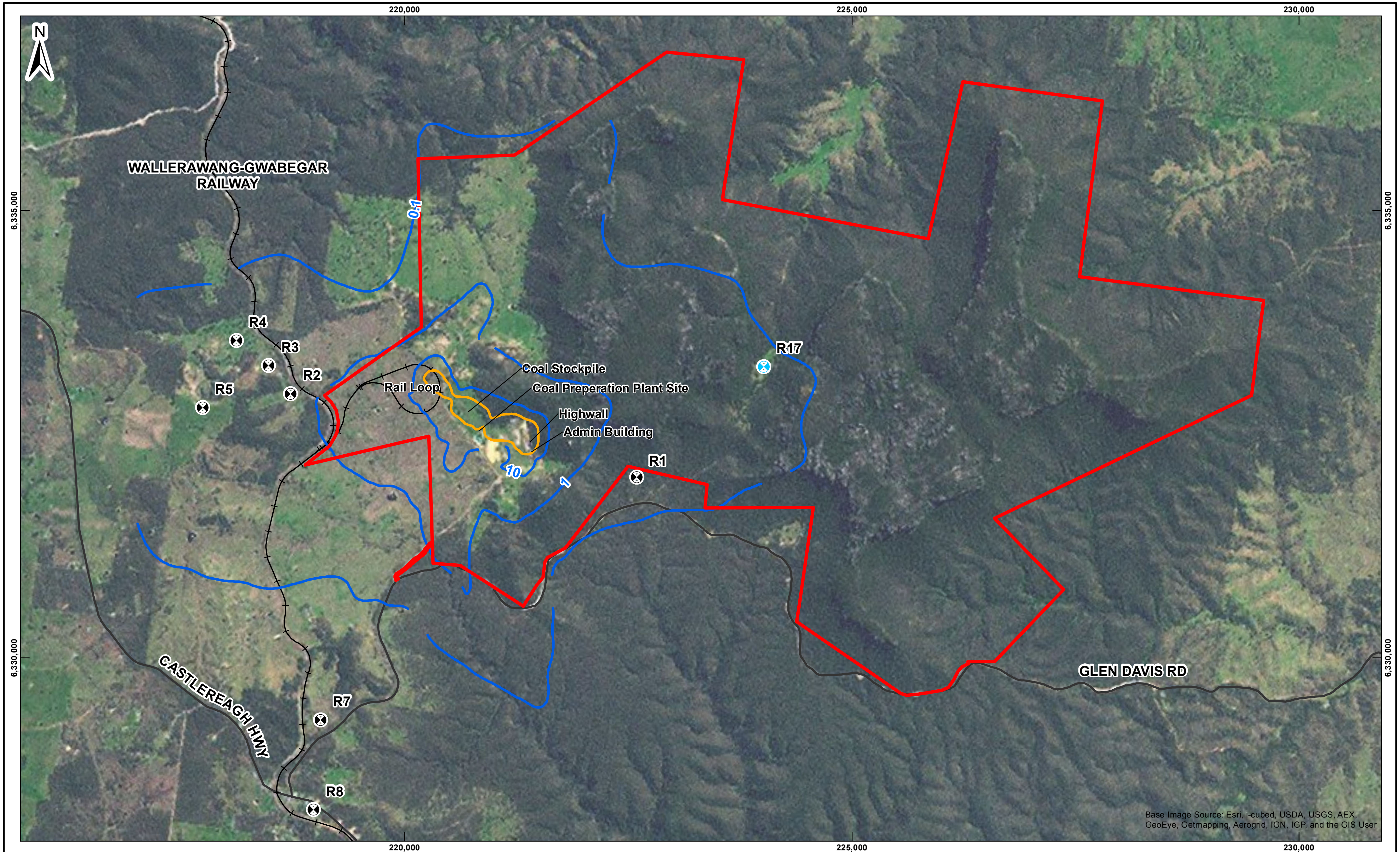
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.34

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 30 µg/m3

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.35: Proposed PM10 - Annual Average Scenario 3

0 500 1,000 1,500 2,000 Metres

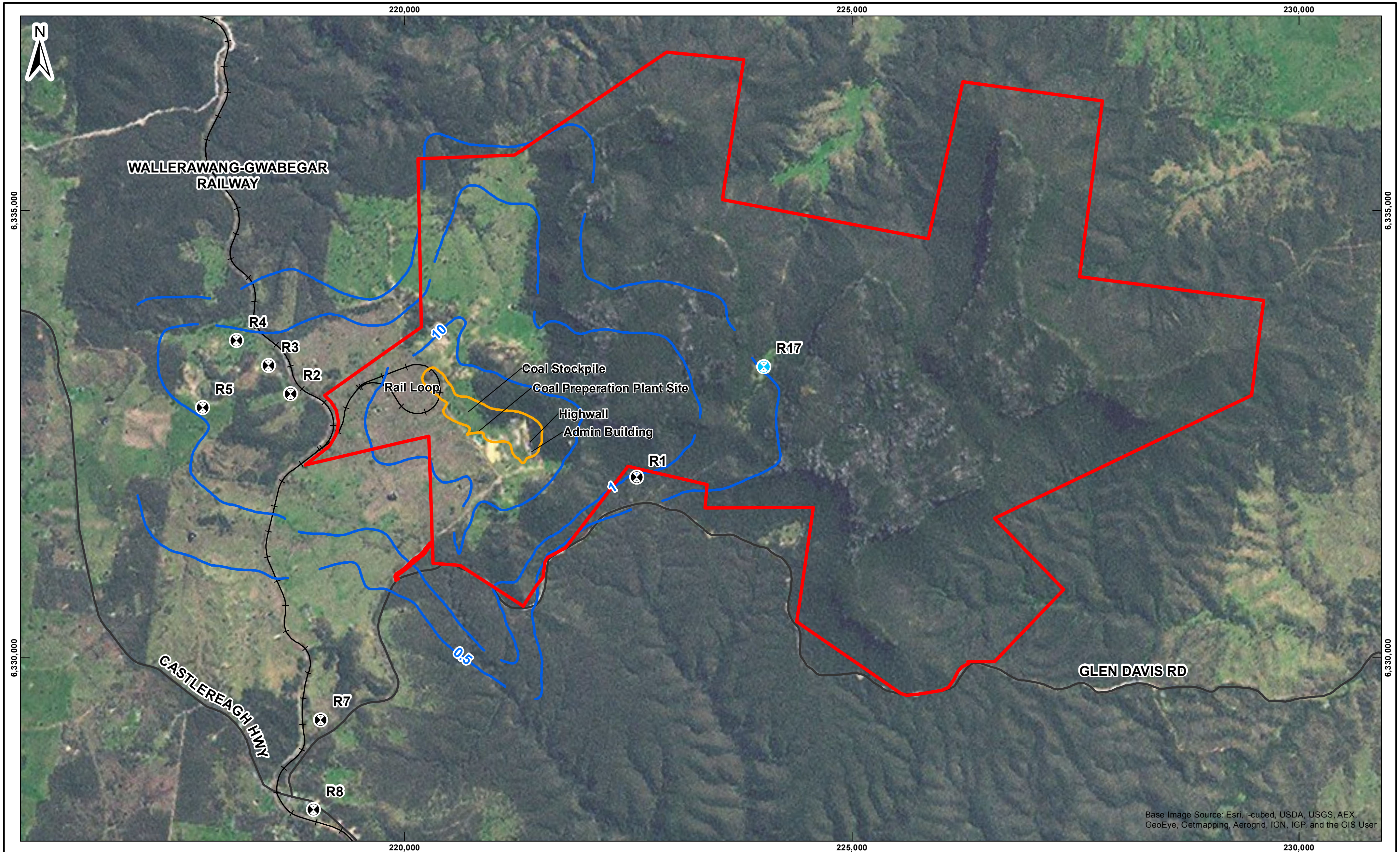
PLOTFILE No.

Centennial Coal

Airly

DRG NO. 10-10.35

A4



LEGEND
- Project Application Area
- Rail
- Main Road
- 90 μg/m3

Sensitive Receptor
- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.36: Proposed TSP - Annual Average Scenario 3

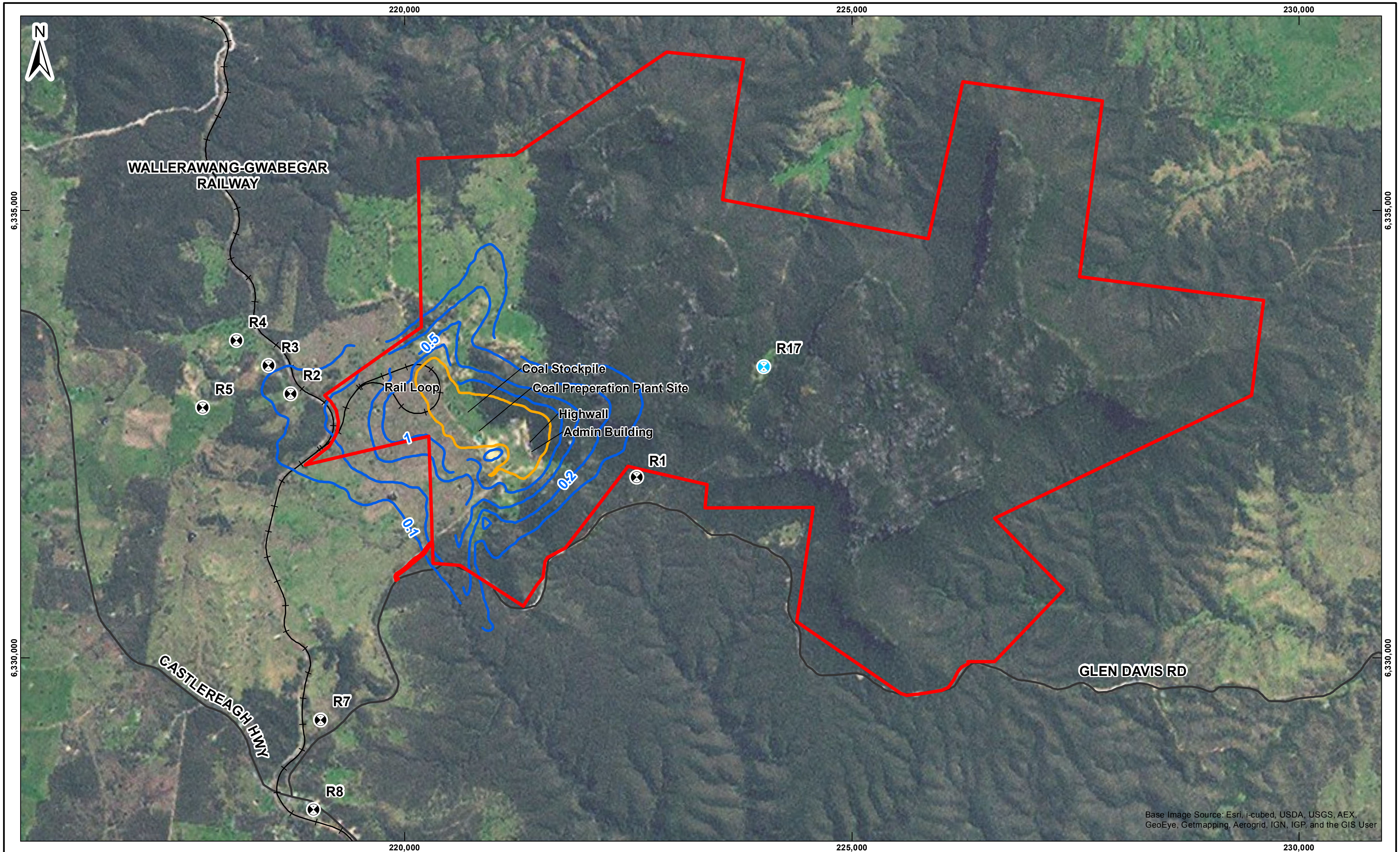
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.36

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- 2 g/m2 / month

Sensitive Receptor

- Airly Camping Ground (Passive Recreation)
- Residential

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.37: Proposed Dust - Annual Average Scenario 3

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.37

A4

Deposited Dust

The estimated emissions from Project components were incorporated into an atmospheric dispersion model to predict impacts upon identified sensitive receptors. These results are summarised in Table 10.45 to Table 10.53.

The predictions in Table 10.45 show that incremental and total (incremental plus background) annual average dust deposition rates at all sensitive receptors and during all scenarios are well below the criterion of 2 g/m^2/month (incremental increase in dust deposition) and 4 0 g/m^2/month (cumulative dust deposition).

TSP

The predictions in Table 10.46 of annual average TSP concentrations are well below the criterion of 90 µg/m^3 at all sensitive receptors for all scenarios.

Table 10.45: Predicted Annual Average Dust Deposition Rate

Sensitive Receptors	Annual Average Dust Deposition Rate (g/m^2/month)								
	Background	Existing Operation Scenario 1a		Construction + Existing Operation Scenario 1b		Approved Operation Scenario 2		Proposed Operation Scenario 3	
	Regional	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
R1	1.2	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3
R2	1.2	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3
R3	1.2	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3
R4	1.2	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3
R5	1.2	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3
R8	1.2	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3
R17	1.2	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3	<0.1	<1.3

Note: Criteria – 2 g/m2/month (incremental), 4 g/m2/month (cumulative)

Table 10.46: Predicted Annual Average TSP Concentration (µg/m^3)

Sensitive Receptors	Annual Average TSP Concentration (µg/m3)								
	Background	Existing Operation Scenario 1a		Construction + Existing Operation Scenario 1b		Approved Operation Scenario 2		Proposed Operation Scenario 3	
	Regional	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
R1	18.8	0.6	19.3	0.7	19.5	1.1	19.8	1.1	19.8
R2	18.8	1.0	19.7	1.5	20.3	1.9	20.6	2.9	21.7
R3	18.8	0.6	19.4	1.0	19.7	1.2	19.9	1.8	20.5
R4	18.8	0.4	19.2	0.6	19.4	0.7	19.5	1.1	19.8
R5	18.8	0.4	19.2	0.6	19.4	0.8	19.6	1.2	20.0
R7	18.8	0.1	18.8	0.1	18.8	0.1	18.9	0.1	18.9
R8	18.8	<0.1	<18.9	<0.1	<18.9	<0.1	<18.9	0.1	18.8
R17	18.8	0.3	19.1	0.5	19.3	0.4	19.2	0.5	19.3

Maximum 24-Hour Average PM_{10} Concentration

Table 10.47 and Table 10.48 show that the 24-hour average PM_{10} concentrations are predicted to be below the EPA criterion of 50 µg/m^3 at all identified sensitive receiver locations.

Table 10.49 shows that the 24-hour average PM_{10} concentrations are predicted to be below the EPA criterion of 50 µg/m^3 at all identified sensitive receiver locations.

Table 10.50 shows that the 24-hour average PM_{10} concentrations are predicted to be below the criterion of 50 µg/m^3 at all identified sensitive receiver locations.

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Table 10.47: Predicted Maximum 24-Hour Average PM_{10} Concentrations – Existing Infrastructure (Scenario 1a)

Receptor	Maximum Cumulative Impact (µg/m³)				Maximum Incremental Impact (µg/m³)			
	Date	Background	Increment	Maximum Cumulative	Date	Background	Maximum Increment	Cumulative
R1	13-01-2010	43.3	<0.1	<43.4	26-08-2010	3.0	3.8	6.8
R2	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	5.6	18.1
R3	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	3.5	16.0
R4	13-01-2010	43.3	<0.1	<43.4	1-03-2010	7.8	2.8	10.6
R5	13-01-2010	43.3	<0.1	<43.4	3-10-2010	1.4	1.8	3.2
R7	13-01-2010	43.3	<0.1	<43.4	15-06-2010	9.9	0.2	10.1
R8	13-01-2010	43.3	<0.1	<43.4	8-08-2010	10.4	0.1	10.5
R17	13-01-2010	43.3	<0.1	<43.4	26-08-2010	3.0	2.8	5.8
Criterion				**50**				**50**

Table 10.48: Predicted Maximum 24-Hour Average PM_{10} Concentrations – Construction + Existing Infrastructure (Scenario 1b)

Receptor	Maximum Cumulative Impact (µg/m³)				Maximum Incremental Impact (µg/m³)			
	Date	Background	Increment	Maximum Cumulative	Date	Background	Maximum Increment	Cumulative
R1	13-01-2010	43.3	<0.1	<43.4	26-08-2010	3.0	3.8	6.8
R2	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	5.6	18.1
R3	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	3.5	16.0
R4	13-01-2010	43.3	<0.1	<43.4	1-03-2010	7.8	2.8	10.6
R5	13-01-2010	43.3	<0.1	<43.4	3-10-2010	1.4	1.8	3.2
R7	13-01-2010	43.3	<0.1	<43.4	15-06-2010	9.9	0.2	10.1
R8	13-01-2010	43.3	<0.1	<43.4	8-08-2010	10.4	0.1	10.5
R17	13-01-2010	43.3	<0.1	<43.4	26-08-2010	3.0	2.8	5.8
Criterion				**50**				**50**

Table 10.49: Predicted Maximum 24-Hour Average PM_{10} Concentrations –Approved Infrastructure (Scenario 2)

Receptor	Maximum Cumulative Impact (µg/m³)				Maximum Incremental Impact (µg/m³)			
	Date	Background	Increment	Maximum Cumulative	Date	Background	Maximum Increment	Cumulative
R1	13-01-2010	43.3	<0.1	<43.4	26-08-2010	3.0	8.5	11.5
R2	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	6.8	19.3
R3	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	4.3	16.8
R4	13-01-2010	43.3	<0.1	<43.4	2-02-2010	17.7	3.9	21.6
R5	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	3.0	15.5
R7	13-01-2010	43.3	<0.1	<43.4	17-07-2010	5.7	0.4	6.1
R8	13-01-2010	43.3	<0.1	<43.4	8-08-2010	10.4	0.2	10.6
R17	13-01-2010	43.3	<0.1	<43.4	26-08-2010	3.0	7.5	10.5
Criterion				**50**				**50**

Table 10.50: Predicted Maximum 24-Hour Average PM_{10} Concentrations – Proposed Infrastructure (Scenario 3)

Receptor	Maximum Cumulative Impact (µg/m³)				Maximum Incremental Impact (µg/m³)			
	Date	Background	Increment	Maximum Cumulative	Date	Background	Maximum Increment	Cumulative
R1	13-01-2010	43.3	<0.1	<43.4	26-08-2010	3.0	8.6	11.6
R2	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	7.9	20.4
R3	13-01-2010	43.3	<0.1	<43.4	12-03-2010	11.9	6.1	18.0
R4	13-01-2010	43.3	<0.1	<43.4	2-02-2010	17.7	4.5	22.2
R5	13-01-2010	43.3	<0.1	<43.4	25-02-2010	12.5	3.9	16.4
R7	13-01-2010	43.3	<0.1	<43.4	21-10-2010	10.3	0.5	10.8
R8	13-01-2010	43.3	<0.1	<43.4	30-10-2010	9.9	0.2	10.1
R17	13-01-2010	43.3	<0.1	<43.4	26-08-2010	3.0	7.6	10.6
Criterion				**50**				**50**

Annual Average PM_{10} Concentration

Table 10.51 presents the annual average PM_{10} concentration predicted by the dispersion modelling at the nominated sensitive receptors for all scenarios modelled.

The results indicate that the cumulative annual average PM_{10} concentration at receptors are predicted to be well below the criterion of 30 µg/m^3 during all scenarios.

Table 10.51: Predicted Annual Average PM_{10} Concentrations

Receptor	Annual Average PM_{10} Concentration (µg/m^3)								
	Background	Existing Operation Scenario 1a		Construction + Existing Operation Scenario 1b		Approved Operation Scenario 2		Proposed Operation Scenario 3	
	Regional	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
R1	9.4	0.2	9.5	0.2	9.6	0.3	9.7	0.3	9.6
R2	9.4	0.3	9.7	0.5	9.8	0.6	9.9	0.7	10.1
R3	9.4	0.2	9.6	0.3	9.7	0.4	9.7	0.5	9.8
R4	9.4	0.1	9.5	0.2	9.6	0.2	9.6	0.3	9.7
R5	9.4	0.1	9.5	0.2	9.6	0.2	9.6	0.3	9.7
R7	9.4	<0.1	<9.5	<0.1	<9.5	<0.1	<9.5	<0.1	<9.5
R8	9.4	<0.1	<9.5	<0.1	<9.5	<0.1	<9.5	<0.1	<9.5
R17	9.4	<0.1	<9.5	<0.1	<9.5	0.1	9.5	0.1	9.5

Note: Project criterion – 30 µg/m^3

Maximum 24-Hour Average $PM_{2.5}$ Concentration

Table 10.52 presents the maximum 24-hour average $PM_{2.5}$ concentrations predicted by the dispersion modelling at each of the nominated receptors using the emissions rates for all scenarios.

The maximum 24-hour average $PM_{2.5}$ concentrations (increment) are predicted to be below the criterion of 25 µg/m^3 at all identified sensitive receiver locations during all scenarios.

It is noted that no $PM_{2.5}$ concentrations are available for Bathurst monitoring station and therefore only incremental concentrations are assessed.

Table 10.52: Predicted Maximum 24-Hour Average $PM_{2.5}$ Concentrations

	Regional Background	Existing Operation Scenario 1a	Construction + Existing Operation Scenario 1b	Approved Operation Scenario 2	Proposed Operation Scenario 3
	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)
R1	NA	0.7	0.7	1.3	1.4
R2	NA	1.1	1.1	1.2	1.4
R3	NA	0.7	0.7	0.9	0.8
R4	NA	0.5	0.5	0.6	0.6
R5	NA	0.3	0.3	0.5	0.7
R7	NA	<0.1	0.1	0.1	0.1
R8	NA	<0.1	<0.1	<0.1	<0.1
R17	NA	<0.1	<0.1	<0.1	<0.1

Annual Average $PM_{2.5}$ Concentration

Table 10.53 presents the annual average $PM_{2.5}$ concentrations predicted by the dispersion modelling at each of the nominated receptors using the emission for all scenarios. Annual average $PM_{2.5}$ concentrations are predicted to be below the criterion of 8 µg/m^3 at all identified sensitive receiver locations during all scenarios.

Table 10.53: Predicted Annual Average $PM_{2.5}$ Concentrations

	Regional Background	Existing Operation Scenario 1a	Construction + Existing Operation Scenario 1b	Approved Operation Scenario 2	Proposed Operation Scenario 3
	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)
R1	NA	<0.1	<0.1	0.1	<0.1
R2	NA	<0.1	<0.1	0.1	0.1
R3	NA	<0.1	<0.1	0.1	0.1
R4	NA	<0.1	<0.1	<0.1	<0.1
R5	NA	<0.1	<0.1	<0.1	<0.1
R7	NA	<0.1	<0.1	<0.1	<0.1
R8	NA	<0.1	<0.1	<0.1	<0.1
R17	NA	<0.1	<0.1	<0.1	<0.1

Note: Project criterion – 8 µg/m^3

10.6.4 Cumulative Impacts

Considering the separation distance of 6.5 km between the Excelsior Limestone Mine and the Airly Mine, it is not considered that the two operations will result in significant cumulative impacts.

10.6.5 Consequences of Potential Air Quality Impacts

The Project is predicted to comply with all relevant air quality criteria at representative receptors during all scenarios and with regard to potential cumulative impacts.

10.6.6 Air Quality Management

Construction

The following procedures and requirements will be followed during the life of the Project to minimise the impact of dust generated during operational and construction activities.

- Watering of unsealed roads will be undertaken on windy days.
- Truck speed on unsealed roads will be restricted to 40 km/hour.
- Trucks will be maintained in accordance with the manufacturer's specification to comply with all relevant regulations.
- Trucks will be restricted to designated roadways.
- All disturbed areas will be stabilised as soon as practicable.
- Cleared vegetation and other waste material will not be burnt on site.

Operation

Operational management measures proposed for the Project include the following.

- Continue to implement the use of Tier 3 engines.
- Continue to implement an underground dust suppression system, which involves the use of water sprays on coal cutting machinery and rubber conveyor belts. This is likely to control the fugitive particulate emissions from the ventilation fan.

Air Quality Monitoring

The existing dust deposition monitoring programme will be revised following Project determination.

Considering the predicted short-term fine particulate (PM_{10} and $PM_{2.5}$) concentrations and no exceedances predicted at any of the identified sensitive receptors it is considered that real time monitoring of any air quality parameters will not be necessary.

10.6.7 Conclusion

Predicted dust deposition and TSP, PM_{10} and $PM_{2.5}$ concentrations arising from Project construction and operation would be below relevant criteria at all identified sensitive receptors.

10.7 Greenhouse Gas

10.7.1 Introduction

This section specifically responds to the DGRs, which provide the following in regard to greenhouse gas aspects:

The Director-General's Requirements

Greenhouse Gas – including:

- a quantitative assessment of potential Scope 1, 2 and 3 greenhouse gas emissions;
- a qualitative assessment of the potential impacts of these emissions on the environment; and
- an assessment of reasonable and feasible measures to minimize greenhouse gas emissions and ensure energy efficiency.

This section is informed by the technical assessment, *Airly Mine Extension Air Quality and Greenhouse Gas Impact Assessment*, March 2014, SLR Consulting Australia Pty Ltd (SLR 2014b), which is provided in full in Appendix L.

The report has been performed with reference to the *National Greenhouse Accounts Factor,* Australian Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICCSRTE 2011), the *Guidelines for Energy Savings Action Plans*, NSW Department of Energy, Utilities and Sustainability (DEUS 2005), the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) the *Centennial Coal Greenhouse Gas Assessment Guidance Notes* (Centennial 2012a) and Climate Change Response Policy (Centennial 2010).

The definitions used for scope 1 and scope 2 emissions are within the *National Greenhouse and Energy Reporting Regulations 2008*. Scope 3 emissions are not defined within the NGER Act, therefore these estimates have been undertaken in accordance with the National Greenhouse Accounts factors.

Quantification of Scope 1, 2 and 3 GHG emissions has been undertaken in relation to both carbon dioxide (CO_2) and other greenhouse gases. 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 using a global warming potential index. The non-CO_2 gases of relevance to this assessment are:

- methane (CH_4): with a global warming potential of 21; and
- Sulphur hexafluoride (SF_6): with a global warming potential of 23,900.

10.7.2 Existing Environment

Data for the period of July 2011 to June 2012 was used as it is the most recent full year of data and is presented in this report for emissions is directly extracted from Airly Mine NGER reports for the July 2011 to June 2012 period and utilises NGER emission factors, and other acceptable NGER emission calculation methodologies.

A summary of the potential Project GHG emission sources is provided in Table 10.54**.**

Table 10.54: Summary of Potential GHG Sources

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 mining.	N/A	N/A
Diesel	Emissions from the combustion of diesel at the Project (Includes internal coal transport and transport of reject materials where applicable)	N/A	Estimated emissions attributable to the extraction, production and transport of diesel consumed at Airly mine. 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.

Project Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
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 Airly Mine and the electricity lost in delivery through 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.

Table 10.55 provides a summary of activity emissions in relation to existing, approved and proposed infrastructure.

Table 10.55: Summary of Emissions Data

Activity	Quantity (ML/yr)			
	Base Case (2011-2012)	Existing Infrastructure Scenario 1	Approved Infrastructure Scenario 2	Proposed Infrastructure Scenario 3
Annual ROM Production (Mt)	0.67	1.8	1.8	1.8
Annual Electricity Consumption (kWh)	5,255,040	5,255,040	14,092,063[1]	14,092,063[1]
Annual Diesel Consumption – underground Airly (litres)	217,389	217,389	582,956[1]	582,956[1]
Annual Diesel Consumption – Contractor (litres)	1,955	1,955	5,243[1]	5,243[1]
Annual Diesel – road transport (litres)	419.8[2]	419.8[2]	689.9[2]	525.6[2]
Annual TOTAL Diesel Consumption (litres)	219,764	219,764	588,889	588,725
Annual Fugitive Emissions from Mine Ventilation Shaft (Million m^3)	4,360	9,461	9,461	9,461
Solid Waste to Landfill (tonnes)	319	319	319	319
Sulphur Hexafluoride (SF_6) (kg)	0.4	1.2	1.2[1]	1.2[1]
Liquid Petroleum Gas (LPG) (kg)	0.0	0.0	0.0	0.0
Petroleum Based Oil/Greases (litres)	1,310	3,513	3,513[1]	3,513[1]
Employee Vehicle Movements (number/year)	40,440	40,440	45,495[1]	45,495[1]

1 A scaling factor of 2.7 is applied, to reflect the increase in total coal throughput from 0.67 Mtpa to 1.8 Mtpa.

2 Calculated based on the vehicle kilometres travelled and assumed mileage of 10 L/100 km for the total on site fleet (heavy and light vehicles).

10.7.3 Greenhouse Gas Impact Assessment

Calculated Scope 1, Scope 2 and Scope 3 emissions of greenhouse gas for the existing operations (July 2011 to June 2012, 0.67Mtpa), scaled to the approved infrastructure (1.8 Mtpa) and proposed infrastructure (1.8Mtpa) are presented in Table 10.56**.**

Table 10.56: Scope 1, 2 and 3 GHG Emissions

	Base Case 2011-2012	Existing Infrastructure Scenario 1	Approved Infrastructure Scenario 2	Proposed Infrastructure Scenario 3
SCOPE 1				
Fugitive Emissions (tonnes CO_2-e)	4,171	9,050.7	9,050.7	9,050.7
Diesel Combustion (tonnes CO_2-e)	587.6	1,574.8	1,574.8	1,574.3
SF_6 (tonnes CO_2-e) (tonnes CO_2-e)	0.4	0.4	0.4	0.4
Oil and Grease Consumption (tonnes CO_2-e)	1.4	3.8	3.8	3.8
Sub Total (tonnes CO_2-e)	*4,760.4*	*10,629.7*	*10,629.7*	*10,629.2*
SCOPE 2				
Electricity Consumption (tonnes CO_2-e)	4,572	12,260.1	12,260.1	12,260.1
Sub Total (tonnes CO_2-e)	*4,572*	*12,260.1*	*12,260.1*	*12,260.1*
SCOPE 3				
Product Coal Combustion (tonnes CO_2-e)	158,398	424,764	424,764	424,764
Diesel Combustion (tonnes CO_2-e)	45	120.5	120.5	120.5
Oil and Grease Consumption (tonnes CO_2-e)	0.3	0.7	0.7	0.7
Electricity Consumption (tonnes CO_2-e)	998.5	2,677.5	2,677.5	2,677.5
Waste Disposal (tonnes CO_2-e)	382.5	430.3	430.3	430.3
Employee Travel (tonnes CO_2-e)	61.5	61.5	69.2	69.2
Sub Total (tonnes CO_2-e)	*159,885.8*	*428,054.5*	*428,062.2*	*428,062.2*
TOTAL (tonnes CO_2-e)	**169,218**	**450,944**	**450,952**	**450,952**

The Project will result in the following.

- Direct (Scope 1) GHG emissions (CO_2-e) resulting from Project operations using existing, approved and proposed infrastructure are estimated to be approximately 10,630 tonnes per annum, an increase of approximately 5,800 tonne per annum on base case year (2011-2012).

- Indirect (Scope 2) GHG emissions (CO_2-e) resulting from Project operations using existing, approved and proposed infrastructure are estimated to be approximately 12,260 tonnes per annum, an increase of approximately 7,688 tonnes per annum on base case year (2011-2012). It is noted that there is no net difference between the Scope 2 emissions for existing, approved and proposed infrastructure operations.

- Indirect (Scope 3) GHG emissions (CO_2-e) resulting from Project operations using existing, approved and proposed infrastructure are estimated to be 428,060 tonnes per annum, an increase of approximately 268,174 tonnes per annum on base case year (2011-2012). The increased emissions for the existing, approved and proposed infrastructure operations are due to increases in electricity consumption and combustion associated with the product coal.

The greatest emission sources associated with the Project are those related to the downstream combustion of the coal (Scope 3), the management of which is not in Centennial Airly's control.

10.7.4 Consequences of Potential Air GHG Impacts

GHG emissions in NSW were reported to be 157.4 million tonnes in 2010, representing 28% of the Australian total GHG emissions of 560.8 million tonnes (DCCEE 2011). Comparison of the emissions attributable to the Project with NSW and Australian emission totals is presented in Table 10.57**.**

Table 10.57: Comparison of Proposed Project GHG Emissions with State and National Totals

Emission Scope	Estimated Emissions (tonnes CO_2-e/annum)	Percentage of NSW 2010 GHG Emission Total	Percentage of Australian 2010 GHG Emission Total
Scope 1	10,629.2	0.007%	0.002%
TOTAL (Scopes 1,2 and 3)	446,080	0.29%	0.08%

Table 10.57 shows that the Project's contribution to Australian emissions would be relatively small. Estimated annual Scope 1 emissions will represent approximately 0.007% of NSW GHG emissions and 0.002% of Australia's total GHG emissions.

It is widely accepted that increased GHG emissions exert a warming influence on climate. Atmospheric temperature increases can result in: changes in ocean levels (due to melting of glaciers and polar ice caps) and water temperatures; greater humidity; and changes in weather patterns which lead to effects such as more droughts in some areas and more flooding in others. The Project will directly and indirectly generate GHG emissions, which will contribute to these associated global environmental effects. However, the increase in GHG emissions resulting from the Project will not substantially increase the total Australian emissions. In addition, due to the uncertainties and complexities of the climate system, quantification of the likely environmental effects associated with project incremental greenhouse gases cannot be made.

10.7.5 Greenhouse Gas Mitigation Measures, Management and Monitoring

Centennial Airly currently implements an Energy and Greenhouse Management System that monitors and reports energy usage. Key performance indicators including energy demand and GHG emissions per tonne of ROM coal produced are tracked.

Additional measures that Centennial Airly will implement will include:

- cost effective measures to improve energy efficiency
- regular maintenance of plant and equipment to minimise fuel consumption
- consideration of energy efficiency in plant and equipment selection.

Centennial Coal is currently investigating at a corporate level measures that may be taken to offset Scope 1 emissions from their operations. This work is ongoing, but measures may, but not be limited to, alignment with biodiversity offsets, purchase of greenpower and switching to biodiesel fuel. 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 2010).

10.7.6 Conclusion

The total lifetime direct (Scope 1) emissions from the Project (using proposed infrastructure) are estimated to be approximately 10,629 tonnes CO_2-e per annum, which is relatively small as this represents approximately 0.007% of NSW GHG emissions and 0.002% of Australia's total GHG emissions.

10.8 Soils, Land Capability and Agricultural Suitability

This section specifically summarises Agricultural and Land Use Impact Assessment (Appendix Q), which responds to the DGRs and requires the following in regard to Land Resources:

The Director-General's Requirements

Land Resources– including: a detailed assessment of impacts to:

- soils and land capability (including erosion and land contamination);
- landforms and topography, including 'the Grotto', cliffs, rock formations, steep slopes, etc; and
- land use, including agricultural, forestry, conservation and recreational use.

10.8.1 Introduction

This section is informed by the technical assessment, *Airly Mine Extension Agricultural and Land Use Impact Assessment*, July 2014, SLR Consulting Australia Pty Ltd (SLR 2014c), which is provided in full in Appendix Q.

The assessment was undertaken to:

- classify and determine the soil types in the Project Application Area
- identify pre and post-mining rural land capability and agricultural suitability
- identify any potentially unfavourable soil material which may pose high environmental risks if disturbed
- provide any relevant management and mitigation measures to minimise any potential impacts identified.

10.8.2 Existing Environment

10.8.2.1 Soils

The Soil Landscapes within the Project Application Area have been mapped by the former NSW Department of Land and Water Conservation, incorporating the NSW Soil Conservation Service (now part of the DPI), at the scale of 1:100,000 (Soil Landscape of the Wallerawang; King, 1993) and 1:250,000 (Soil Landscapes of the Bathurst; Kovac et al, 1989).

The majority of the Project Application Area is comprised of the Hassans Walls Soil Landscape. The REA Location 2 is almost completely mapped as Rowans Hole Soil Landscape. .

The Hassans Walls Soil Landscape consists of cliffs derived from Narrabeen Group sandstones and steep colluvial talus sideslopes developed over the Illawarra Coal Measures and the Shoalhaven Group. Open forest and open woodland is associated with this landscape. Soils are typically dominated by shallow, discontinuous Lithosols (Rudosols) on rocky ledges and cliffs, moderately deep stony Lithosols and Siliceous Sands (Rudosols, Tenosols) on upper slopes; and moderately deep Yellow and Brown Podzolic Soils (Chromosols, Kurosols) on lower slopes.

Limitations to this Soil Landscape include severe rock-fall hazard, steep slopes, extreme water erosion hazard, mass movement hazard, severe foundation hazard, rock outcrop and localised shallow soils, high run-on, and localised non-cohesive soils. This Soil Landscape is generally unsuitable for cultivation or grazing due to severe limitations; however some gentler slopes and narrow drainage flats are capable of light grazing.

Rowans Hole Soil Landscape

The Rowans Hole Soil Landscape consists of broad, level to gently inclined rises and valley flats in the Capertee Valley on Shoalhaven Group sediments. The soils are typically dominated shallow to moderately deep Yellow Podzolic Soils (Kurosols, Chromosols) and Structured Loams on crests and gently inclined sideslopes; shallow to moderately deep Red Podzolic Soils in areas of rapid drainage on upper slopes; and moderately deep Yellow Solodic Soils (Sodosols) in areas of slow drainage.

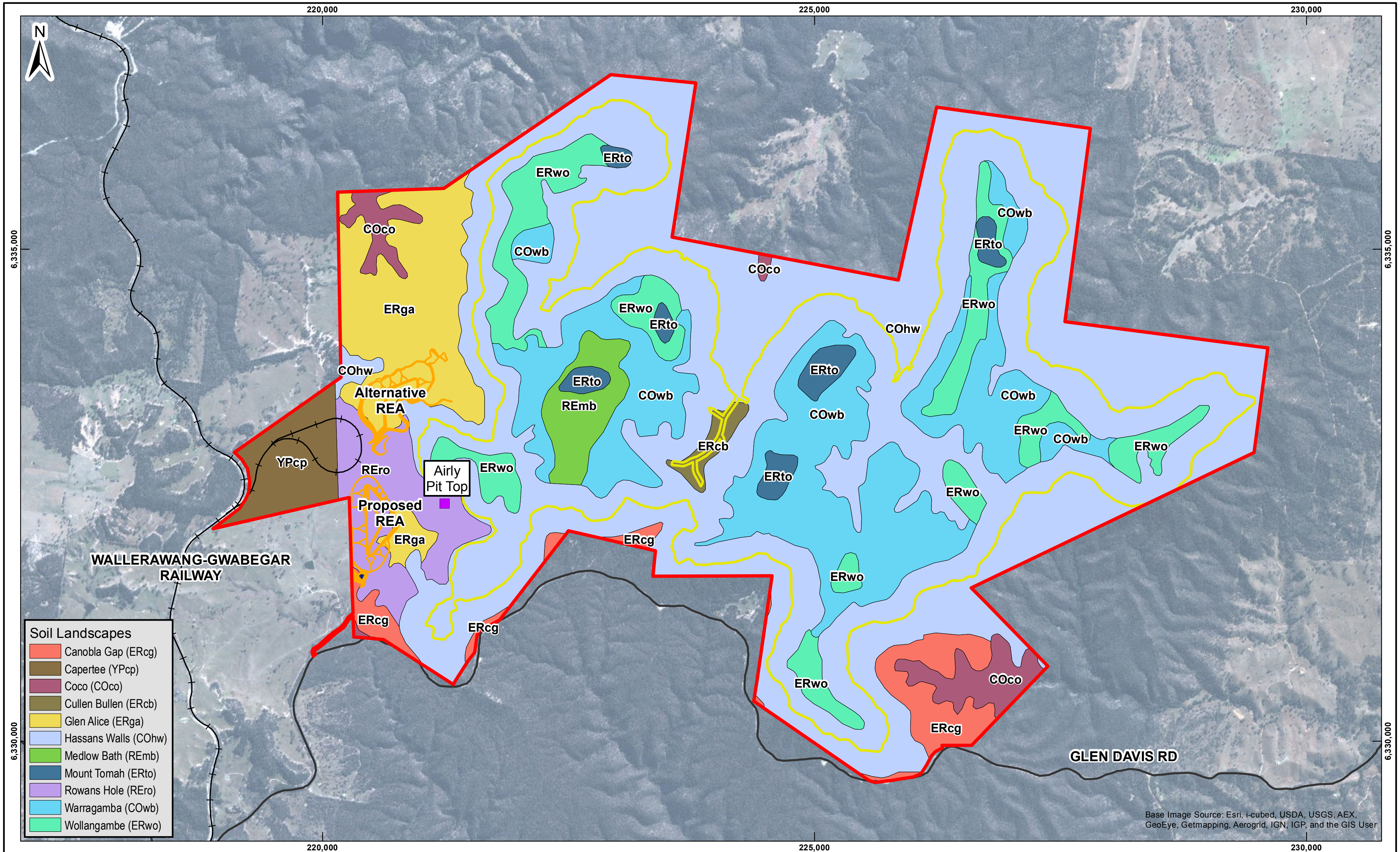
Limitations to this soil landscape include high water erosion hazard and localised flood hazard. It has moderate limitations to grazing and cultivation.

All eleven Soil Landscapes within the Project Application Area are identified in Table 10.58 and Figure 10.38.

Table 10.58: Soil Landscapes

Soil Landscape	Dominant Soil Type (Great Soil Group)	Project Application Area		Proposed REA and Water Management Structures	
	Order	ha	%	ha	%
Canobla Gap	Red Earths / Red Podzolic Soils	118	2.9	1	2.7
Capertee	Yellow Podzolic Soils	97	2.4	-	-
Coco	Earthy Sands	86	2.2	-	-
Cullen Bullen	Yellow Earths / Yellow Podzolic Soils	23	0.6	-	-
Glen Alice	Red Podzolic Soils / Yellow Podzolic Soils	279	7.0	3	8.1
Hassans Walls	Lithosols	2,176	54.7	-	-
Medlow Bath	Yellow Earths	72	1.8	-	-
Mount Tomah	Krasnozems	64	1.6	-	-
Rowans Hole	Red Podzolic Soils / Yellow Podzolic Soils	158	4.0	33	89.2
Warragamba	Lithosols	625	15.7	-	-
Wollangambe	Earthy Sands	285	7.1	-	-
Total		**3,983**	**100.0**	**37**	**100.0**

The dominant soil types are shown in (Figure 10.39). The majority of the Project Application Area is comprised of soils with low to moderately low inherent fertility as the majority of the Soil Landscapes are dominated by a combination of Lithosols and Earthy Sands or Red and Yellow Earths and Podzolic Soils, covering a total area of 3,172 ha (79.7%). The one exception is the Mount Tomah Soil Landscape with moderately high inherent fertility; however, this Soil Landscape has limitations associated with steep slopes and mass movement, and covers a very small proportion of the Project Application Area. The proposed REA is located primarily on Red/ Yellow Podzolic Soils.



LEGEND

- Project Application Area
- Limit of Mining
- Water Management Area
- Reject Emplacement Area

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

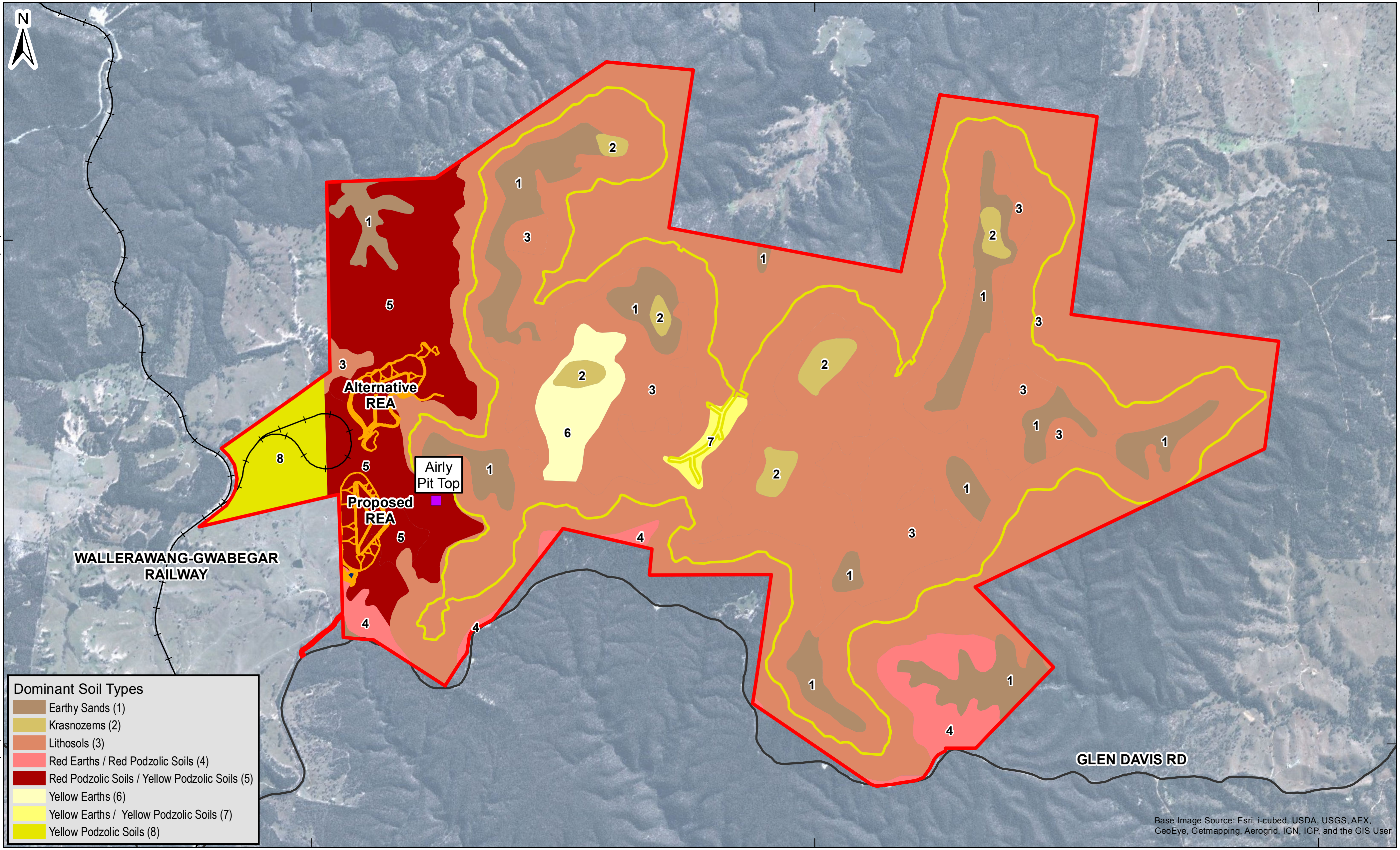
Figure 10.38: Soil Landscapes

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.38

A4



LEGEND

- Project Application Area
- Limit of Mining
- Water Management Area
- Reject Emplacement Area

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 10.39: Dominant Soil Types

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.39

A4

10.8.2.2 Land Capability

In NSW, rural lands are mapped according to an eight class land classification system classified based on the severity of long-term limitations.

Table 10.59 details the areas of the various Rural Land Capability classes within the Project Application Area. These are also shown on Figure 10.40.

The majority of the Project Application Area is Class 8 (unsuitable for rural production and should not be cleared, logged or grazed), covering a total 2,805 ha or 70.5% of the Project Application Area. There are some areas of land suitable for grazing enterprises and occasional cultivation (Class 4 and 5) covering a total of 532 ha or 13.3% of the Project Application Area.

The proposed REA location covers approximately 37 ha of which 100% is Rural Land Capability Class 5, which is land suitable for grazing only with occasional cultivation.

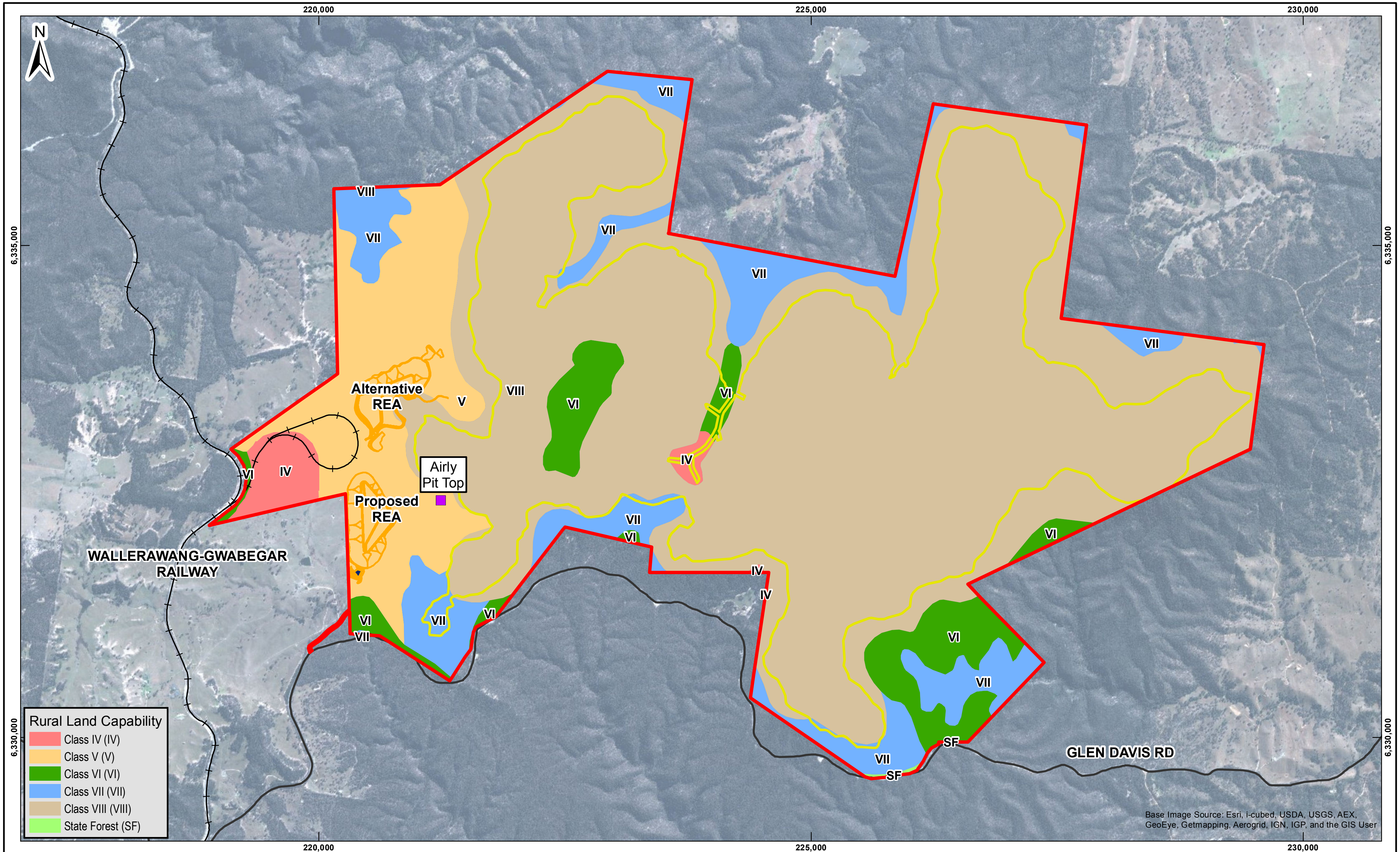
Table 10.59: Project Application Area and Proposed REA Rural Land Capability

Rural Land Capability Class	Project Application Area		Proposed REA and Water Management Structures	
	ha	%	ha	%
4	68	1.7	-	-
5	464	11.6	38	100.0
6	239	6.0	-	-
7	405	10.2	-	-
8	2,805	70.5	-	-
Total	**3,981**	**100.0**	**38**	**100.0**

The best Land Capability Class present from an agricultural production viewpoint is Class 4, which if cleared, has moderate agricultural capability and can be used for restricted cropping, pasture cropping and grazing.

Class 5 land has moderate to low agricultural capability and can be used for a variety of land uses such as grazing, some horticulture, forestry and nature conservation.

Class 8 land, the predominant Land Capability class in the Project Application Area, has extremely low agricultural capability.



LEGEND

Project Application Area

Limit of Mining

Water Management Area

Reject Emplacement Area

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 10.40: Rural Land Capability

0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.40

A4

10.8.2.3 Agricultural Suitability

The NSW Strategic Regional Land Use Policy (DP&I, 2012) aims to assist the development of a long-term strategy for continued progress of the mining industry that also ensures local community sustainability and on-going viability of existing agricultural industries. Seven regions within NSW have been identified as applying under this Policy and each of these regions will progressively have a Strategic Regional Land Use Plan (SRLUP) developed or alternatively a similar plan incorporated into the relevant proposed Regional Growth Plans. Part of the Policy addresses the determination of Biophysical Strategic Agricultural Land (BSAL), which is defined by the Policy as "areas with unique natural resource characteristics highly suited for agriculture".

The SRLUP and/or Regional Growth Plan covering the Project Application Area has not been released at the time of the assessment, however, BSAL mapping was released for the general area surrounding and including the Project Application Area in October 2013. These maps indicate that the Project Application Area does not contain BSAL.

10.8.2.4 Land Use

The Project Application Area is located primarily within the Mugii Murum-ban State Conservation Area, and as such the majority of the land use is conservation. However, there are approximately 480 ha of land currently available for cattle grazing.

10.8.3 Soil and Land Capability Impact Assessment

10.8.3.1 Soils

The proposed construction of the CPP and the establishment of the ROM coal and the soil stockpile areas will occur on already disturbed land at the pit top surface facilities area (Figure 4.2). The proposed REA location will be subject to surface disturbance. The pre-disturbance land for the proposed REA is mapped as Rural Land Capability Class 5**.**

The rehabilitation objectives of the proposed REA according to the *Airly Mine Extension Project - Decommissioning and Rehabilitation Strategy* (SLR, 2013d) are as follows:

- The final landform will be safe, stable, non-polluting and free draining.
- All coarse and fine rejects will be encapsulated under non-saline and low sodicity inert material in accordance with a capping design specification.
- The proposed REA will be constructed to a maximum height of 765 m AHD to be compatible with nearby adjacent topography (forested crests to the west of the REA location have local high points up to 790 m AHD).
- The indicative batter slopes will be no more than 14 degrees (24.4%). Outer batters of the REA will be progressively shaped and re-vegetated through the life of mine.

10.8.3.2 Land Capability

The area of the proposed REA has an existing Land Capability class 5, which after completion of rejects emplacement and rehabilitation will be class 6.

No changes to Rural Land Capability are predicted within the proposed Limit of Mining (Figure 4.1). The area designated as the 'New Hardly Shale Mine Potential Interaction Zone' has the potential for subsidence impacts. However, this zone is within Rural Land Capability Class 8, the lowest possible class. Therefore, no impact on Rural Land Capability is predicted due to underground mining activities associated with the Project.

Clearing for surface infrastructure will temporarily remove small areas of soil resources, although staged rehabilitation, using the stockpiled soil from the initial excavation works, is expected to recover these resources.

10.8.3.3 Agricultural Suitability

According to the current BSAL maps released by the DP&I in October 2013 there is no BSAL within the Project Application Area. Therefore no BSAL will be impacted.

10.8.3.4 Land Use

As previously outlined, the surface disturbance associated with the construction of the proposed REA will remove 37.09 ha of land available for agriculture, which will have a negligible and impact on land use.

The majority of land uses within the Project Application Area are associated with the Mugii Murum-ban SCA and consist of conservation and recreation. As there are no significant impacts to surface topography or surface and groundwater systems in the Project Application Area, RPS (2014) concluded that there would be no significant impact on flora and fauna values in the SCA. Therefore there will be no change to the current conservation land use of the SCA due to the Project.

The Decommissioning and Rehabilitation Strategy for the Project (Appendix O, Section 10.9) includes the rehabilitation of the surface facilities area and REA to a combination of rural land use or native bushland commensurate with the adjacent SCA. The removal of some agricultural land during the life of the Project will be temporary. No permanent loss of agricultural land use will be incurred once rehabilitation is complete.

There will be no mining impacts, including on the landofrms and topography (Section 10.8.3.5), that would create a hazard to public safety or cause areas of the SCA to be closed to mining impacts. Therefore there will be no impact on the current land use for recreation.

10.8.3.5 Landforms and Topography

A detailed assessment including the potential impacts on landforms and topography is detailed in the Subsidence Predictions and Impact Assessment (Appendix D). Based on the subsidence predictions SLR (2014c) assessed the potential impacts of subsidence on the current land use due to the Project.

Golder (2014) did not predict any surface cracking or other subsidence impacts in previously unmined areas. The New Hartley Shale Mine Interaction Zone may experience limited dilation of existing fractures and formation new minor fracturing on the plateau section of Mount Airly in this zone. No damage to cliffs or other features is predicted in this area due to mine design being adopted for this zone, where increased set back distances from cliff lines were implanted to account for the interaction of the Lithgow seam workings with the old shale mine workings.Table 10.60 provides a summary of the potential subsidence impacts in the proposed proposed mining zones and potential impacts on land resources. No impacts on land use within all mining zones (except the New Hartley Shale Mine Interaction Zone) are predicted. Minimal additional impact to cliffs and rock formations due to presence or pre-existing damage are predicted for the New Hartley Shale Mine Interaction Zone. The proposed mining in this zone is not predicted to further impact the current land use.

Table 10.60: Summary of Subsidence Impacts on Landforms and Topography

Mining Zone	Landform Features within Mining Zone	Management Methodology	Predicted Subsidence	Predicted Impact	Current Land Use	Impact on Land Use
Cliff Line Zone and Zone of First Workings	Deeply Incised Gorges (The Grotto & The Oasis)	Cliff Line Zone will extend 30 m beyond crest and toe of any cliff. No secondary	Fracture zone height <10m. Minimal predicted subsidence (10 to 65 mm).	No fracturing of surface rock structure. No collapse of features	Conservation and recreation	None
	Cliffs					

Mining Zone	Landform Features within Mining Zone	Management Methodology	Predicted Subsidence	Predicted Impact	Current Land Use	Impact on Land Use
	Rock Formations (including pagodas) Steep Slopes	extraction.		including deeply incised gorges, cliffs, rock formations or steep slopes.		
Panel and Pillar Zone	Cliffs Rock Formations (including pagodas)	Maximum void width of 61 m. Stable long-term pillars post mining (FOS >1.6)	Limitation of fracture zone height 60-70 m. Subsidence typically <100 mm, although ranging from 40-60 mm.	No fracturing of surface rock structure. No collapse of features including, cliffs or rock formations.	Conservation and recreation	None
Partial Pillar Extraction Zone	Steep Slopes	Stable long-term pillars post mining (FOS >1.6)	Limitation of fracture zone height 20-35 m. Minimal predicted subsidence (25 to 65 mm). Tilt: 0.5-2.6 mm/m Tensile strain: 0.2-1.1 mm/m Compressive strain: 0.2-1.9 mm/m.	No fracturing of surface rock structure. The predicted tilt and strain indicates there is negligible risk of generating landslides on the steep slopes.	Conservation and recreation	None
Shallow Zone	Steep Slopes	Stable long-term pillars post mining (FOS >1.6) No secondary extraction.	Limitation of fracture zone height <10 m. Minimal predicted subsidence (3.5-25.5 mm). Tilt: 0.6-1.1 mm/m Tensile strain: 0.1-0.4 mm/m Compressive strain: 0.2-0.6 mm/m.	No fracturing of surface rock structure. The predicted tilt and strain indicates there is no risk of generating landslides on the steep slopes.	Conservation and recreation	None

Mining Zone	Landform Features within Mining Zone	Management Methodology	Predicted Subsidence	Predicted Impact	Current Land Use	Impact on Land Use
New Hartley Shale Mine Interaction Zone	Cliffs	Maximum void width restricted to 61 m. Increased set back from the cliffs to half the mining depth.	New subsidence impacts have been predicted based on the presence of sub-critical and super-critical voids in previous workings. New subsidence predictions Sub-critical Voids: 500 mm Super-critical Voids: 200 mm	No predicted impact in areas not previously mined. Reactivation of existing fractures and additional fracturing may occur in area associated with previous shale mine workings.	Conservation and recreation	Minimal additional impact to cliffs and rock formations due to presence or pre-existing damage. Not predicted to further impact current land use.

10.8.4 Consequences of Potential Soil and Land Capability Impacts

The minor changes to land surface predicted from mining, staged clearing, construction and rehabilitation of surface infrastructure, will have negligible consequences on soil resources, land capability and agricultural suitability, and recreational use of the Mugii Murrum-ban SCA. The Project Application Area covers approximately 3,982 ha while the Project will disturb approximately 38 ha due to the construction of the proposed REA, which is not expected to have a measurable consequence on land use.

10.8.5 Management and Mitigation Measures

Proposed Mine Design Criteria

Due to the presence of different geotechnical mining environments within the proposed mining area, specific mining systems have been designed t in order to minimise subsidence and potential surface disturbance.

Erosion and Sediment Control

A detailed Erosion and Sediment Control Plan will be developed prior to the commencement of construction and rehabilitation works in accordance with NSW industry guidelines *Managing Urban Stormwater Volume 1: Soils and Construction* (Landcom 2004) and *Managing Urban Stormwater Volume 2E: Mines and Quarries* (DECCW 2008).

The *Decommissioning and Rehabilitation Strategy* (SLR 2013d) provides general soil management practices to minimise the impact of the Project on soil resources. These practices include the following.

- Identification and quantification of potential soil resources for rehabilitation.
- Optimisation and recovery of useable topsoil and subsoil during stripping operations.
- Management of soil reserves in stockpiles so as not to degrade the resource.
- Establishment of effective soil amelioration procedures to maximise the availability of soil reserve for future rehabilitation works.

Contamination

Considering that the following management procedures will be implemented by Centennial Airly (Centennial 2012c) there is minimal risk of contamination.

- Plant and equipment will be inspected daily in accordance with the Airly Mine Mechanical Engineering Management Plan prepared under the requirements of *Coal Mines Health and Safety Act 2002* for fuel, oil or hydraulic fluid leakage, damaged or deteriorated hydraulic lines and other areas of potential failure.
- Any leakages or deteriorated hoses or similar areas of potential failure will be repaired before the plant or equipment is permitted to be used.
- Servicing of plant and equipment will be undertaken in a designated area.
- Where possible road registered vehicles will be fuelled and serviced off site. Any refuelling at the pit top will be undertaken in a bunded area.
- The operator of the plant and equipment will be in attendance at all times during the fuelling process.
- Emergency response spill kits will be available at all servicing, hydrocarbon storage and refuelling areas.
- All incidents or uncontrolled spillages will be reported immediately to the relevant supervisors and the Airly Mine Environmental Coordinator.
- Fuel containers will be available in a designated and bunded fuel storage area.

Should a major spill occur, it will be handled in accordance with the Airly Mine Pollution Incident Response Management Plan.

10.8.6 Conclusion

The Project Application Area is located primarily within the Mugii Murum-ban State Conservation Area, and as such the majority of the land use is conservation. However, there are approximately 480 ha of the Project Application Area, primarily owned by Centennial Airly, currently available for cattle grazing.

There will be no land permanently removed from agriculture as a result of the Project, either due to mining or ancillary infrastructure. The Project will only have a minimal impact due to land that will be temporarily removed from agriculture for the establishment of a REA.

The vast majority of the Project Application Area is Class 8 Rural Land Capability, covering a total 2,805 ha or (70.5% of the Project Application Area). This land is unsuitable for agricultural production. There are some areas of land suitable for grazing (Rural Land Capability classes 4 and 5) covering a combined total of 532 ha or 13.3% of the Project Application Area.

The predominant soils within the Project Application Area have extremely low agricultural capability and the Project will have negligible to minimal impacts on soil, land and agricultural resources.

Given the mining methods proposed and no predicted impact on the land use in previously unmined areas, the progressive and life of mine rehabilitation proposed in the Project there will be no impact on the recreational use of the general area of Airly Mine, including the Mugii Murrum-ban SCA.

10.9 Decommissioning and Rehabilitation Strategy

This section summarises the Decommissioning and Rehabilitation Strategy (Appendix O), which responds to the DGRs and provides the following in regard to rehabilitation aspects:

The Director-General's Requirements

Rehabilitation – including the proposed rehabilitation strategy for the site, having regard to the key principles in Strategic Framework for Mine Closure, including:

- rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria;
- nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies;
- a conceptual final landform design, including a detailed figure depicting relevant site features; and
- the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.

10.9.1 Introduction

This section is informed by the technical assessment, *Airly Mine Extension Project: Decommissioning and Rehabilitation Strategy*, July 2014, SLR Consulting Australia Pty Ltd (SLR 2014d), which is provided in full in Appendix O.

The Decommissioning and Rehabilitation Strategy has been prepared to be consistent with the regulatory requirements for rehabilitation of the currently approved Airly Project.

The report is provided in full in Appendix O and is the basis of this section. The report was prepared in accordance with the following relevant land use planning and mine rehabilitation guidelines and policies:

- the Strategic Framework for Mine closure (ANZMEC & MCA, 2000)
- leading Practice Sustainable Development Program for Mining Industry (DRET 2011)
- NSW Department of Trade and Investment Guidelines (specific to features of mine rehabilitation and closure planning)
- Centennial Coal Environment and Community Policy, 2012
- Lithgow City Council Local Environmental Plan 1994
- Lithgow City Council Draft Local Environmental Plan 2013
- Lithgow Draft Land Use Strategy, 2010-2030.

10.9.2 General Rehabilitation Principles and Objectives

The key rehabilitation objectives for the Project are to:

- successfully rehabilitate existing disturbed areas and disturbance that will result from the Project
- create a final landform that is:
  - self-sustaining and stable which poses no long term environmental hazard
  - free draining and preserves downstream water quality

    - commensurate with the applicable land zonings proposed in the Draft Lithgow LEP 2013

- integrate, where applicable, biodiversity values with the final land use options for the site
- develop a re-vegetation program for rehabilitation areas
- develop preliminary success criteria for decommissioning and rehabilitation
- develop an effective monitoring program to assess performance of the rehabilitated areas.

10.9.3 Conceptual Post-Mining Land Use

The Project Application Area has been categorised into five primary domains and four secondary domains. These are illustrated in Figure 10.41 and Figure 10.42.

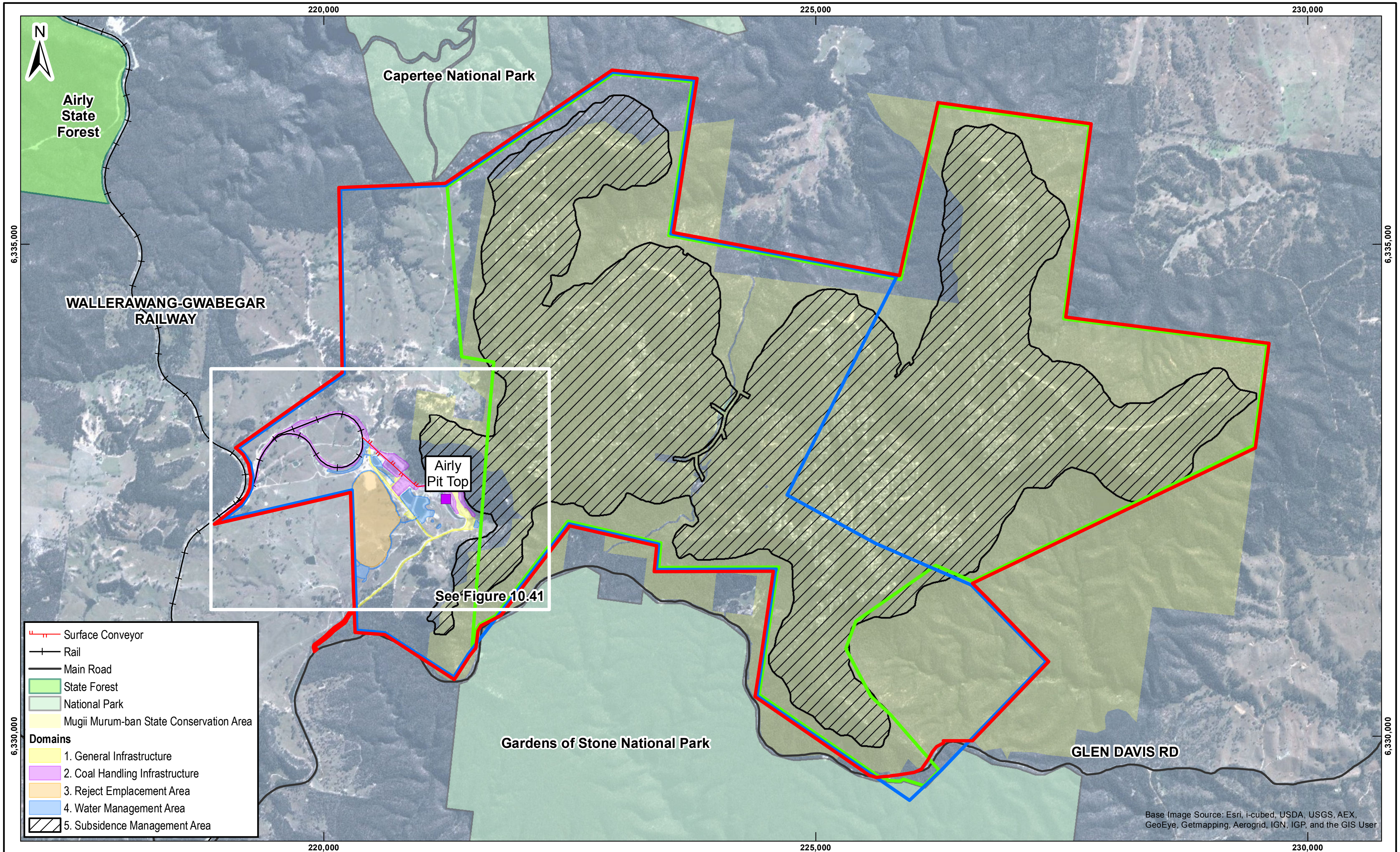
Primary domains are discrete land management units with similar operational function and/or similar geophysical features. There are five primary rehabilitation domains and these are summarised below.

- **Domain 1**: General Infrastructure Area, which includes existing and proposed infrastructure and facilities including administration buildings, bath-house, workshops and stores, roads and access tracks (sealed and unsealed) the box cut and underground mine access portal, power lines (overhead and trenched), pipelines (trenched), substations, car parks, sewage treatment plant and associated irrigation area, hardstand/laydown areas, ventilation shafts.
- **Domain 2**: Coal Handling and Processing Infrastructure, which includes existing and proposed coal handling, processing and transport infrastructure and facilities including; CHPP, ROM pad, ROM coal conveyors, ROM and product coal stockpile areas, coal load out facility and loading bin, and rail loop.
- **Domain 3:** REA, the footprint of the area disturbed for rejects emplacement.
- **Domain 4**: Water Management Area, the network of dams and associated water management structures.
- **Domain 5**: Subsidence Management Areas, which is above the underground workings.

Secondary domains (Figure 10.43 and Figure 10.44) are post mining land management units characterised by a similar post mining land use.

There are four secondary rehabilitation domains.

- **Domain A**: Open Forest, native vegetation for rehabilitation of areas disturbed for infrastructure including the CHPP, box cut, portals, workshops, administration buildings and car parks
- **Domain B**: Pasture – Grazing, comprises the areas disturbed for infrastructure including the rail loop, ROM and product coal conveyors, access roads and dams not retained in the final landform
- **Domain C**: Pasture Restricted Grazing, the REA
- **Domain D**: Water Management Area, the existing dams and water management structures, and the proposed REA Dam proposed to be retained in the final landform.



LEGEND

Project Application Area

ML1331 Current Lease Boundary (Offset for Clarity)

A232 Authorisation Boundary (Offset for Clarity)

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 10.41: Airly Mine Primary Domains

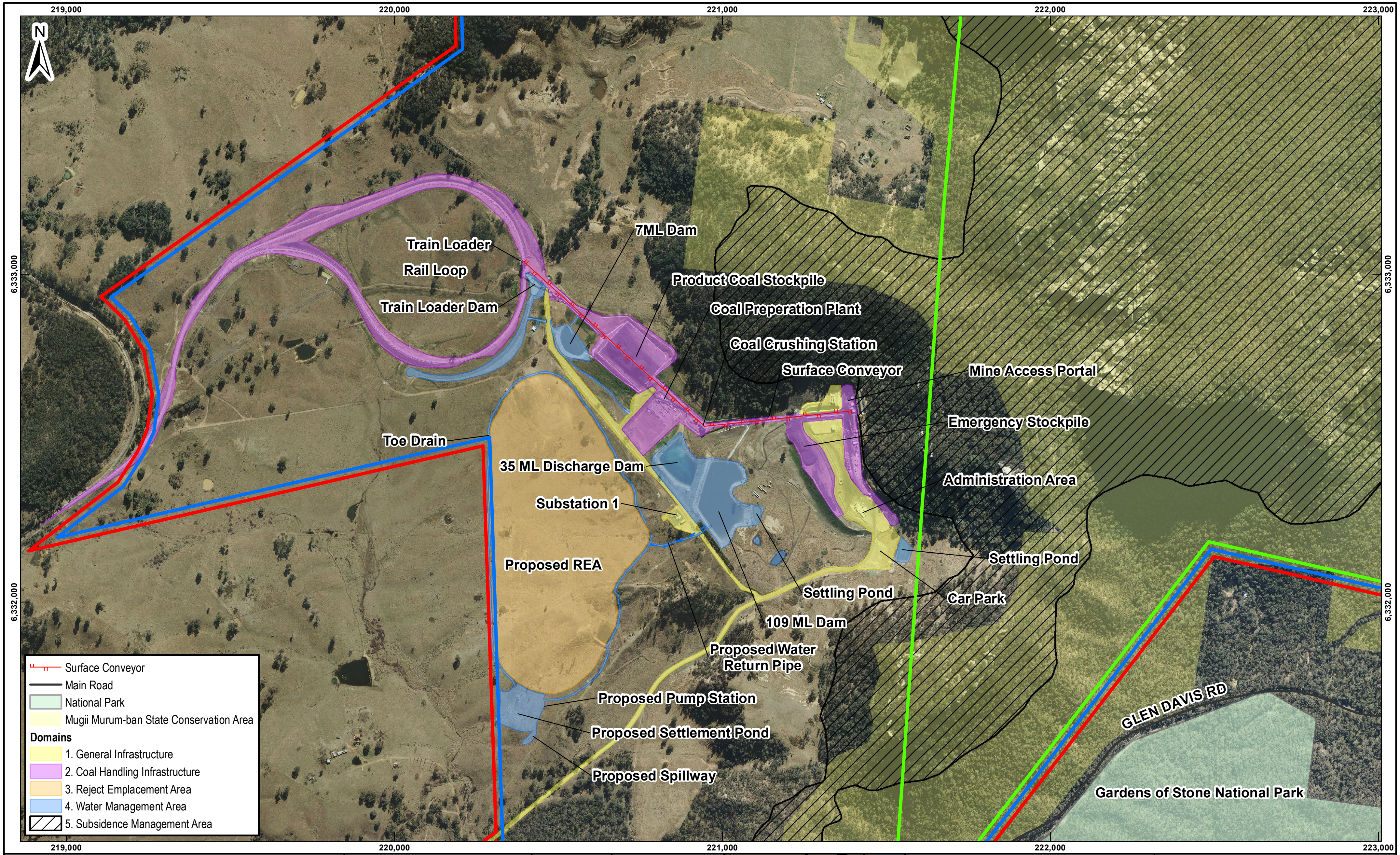
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.41

A4



LEGEND

Project Application Area

ML1331 Current Lease Boundary (Offset for Clarity)

A232 Authorisation Boundary (Offset for Clarity)

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:15,000

Figure 10.42: Airly Mine Primary Domains (Infrastructure Area)

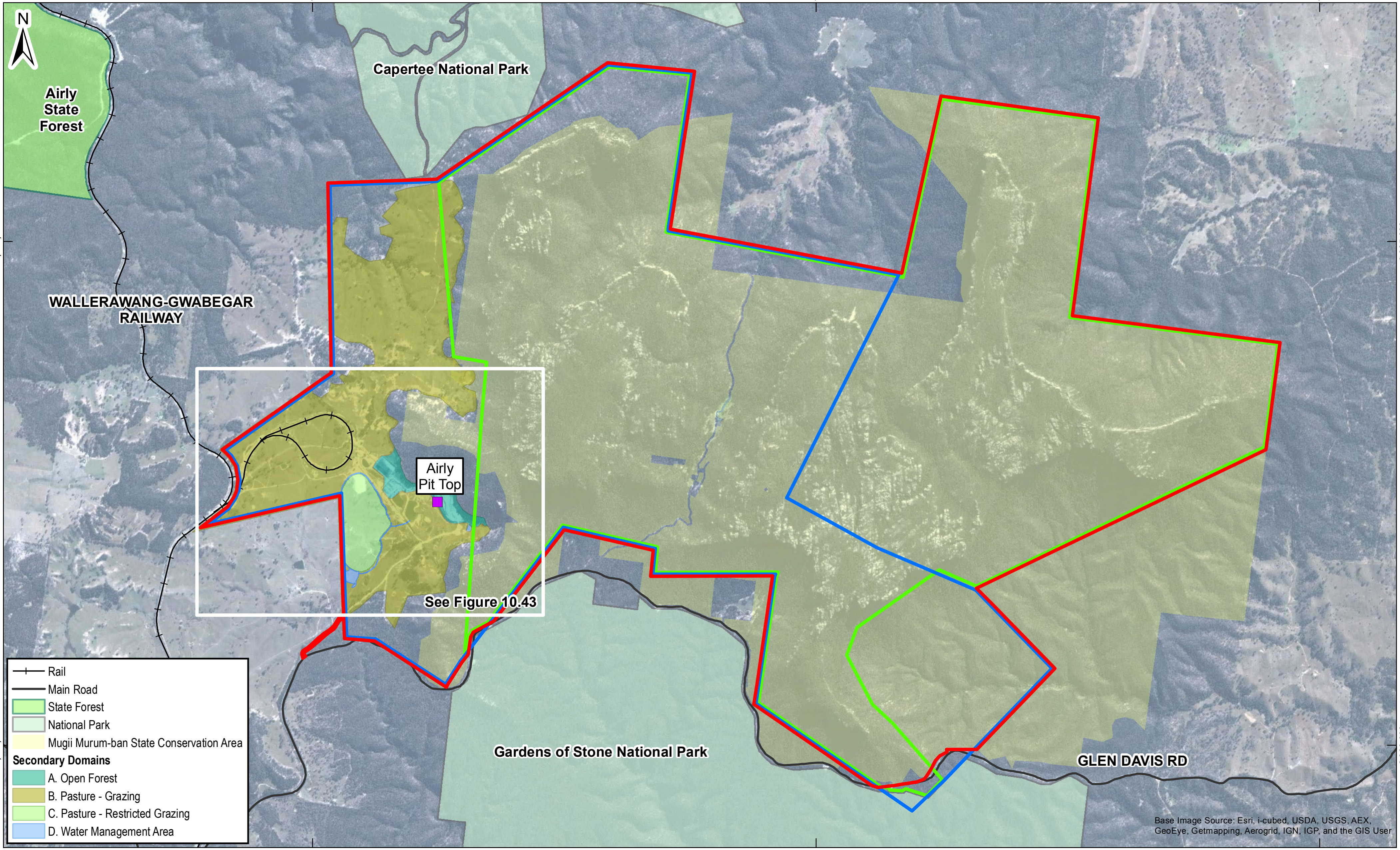
0 100 200 300 400 500 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.42

A4



LEGEND

Project Application Area

ML1331 Current Lease Boundary (Offset for Clarity)

A232 Authorisation Boundary (Offset for Clarity)

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:50,000

Figure 10.43: Airly Mine Secondary Domains

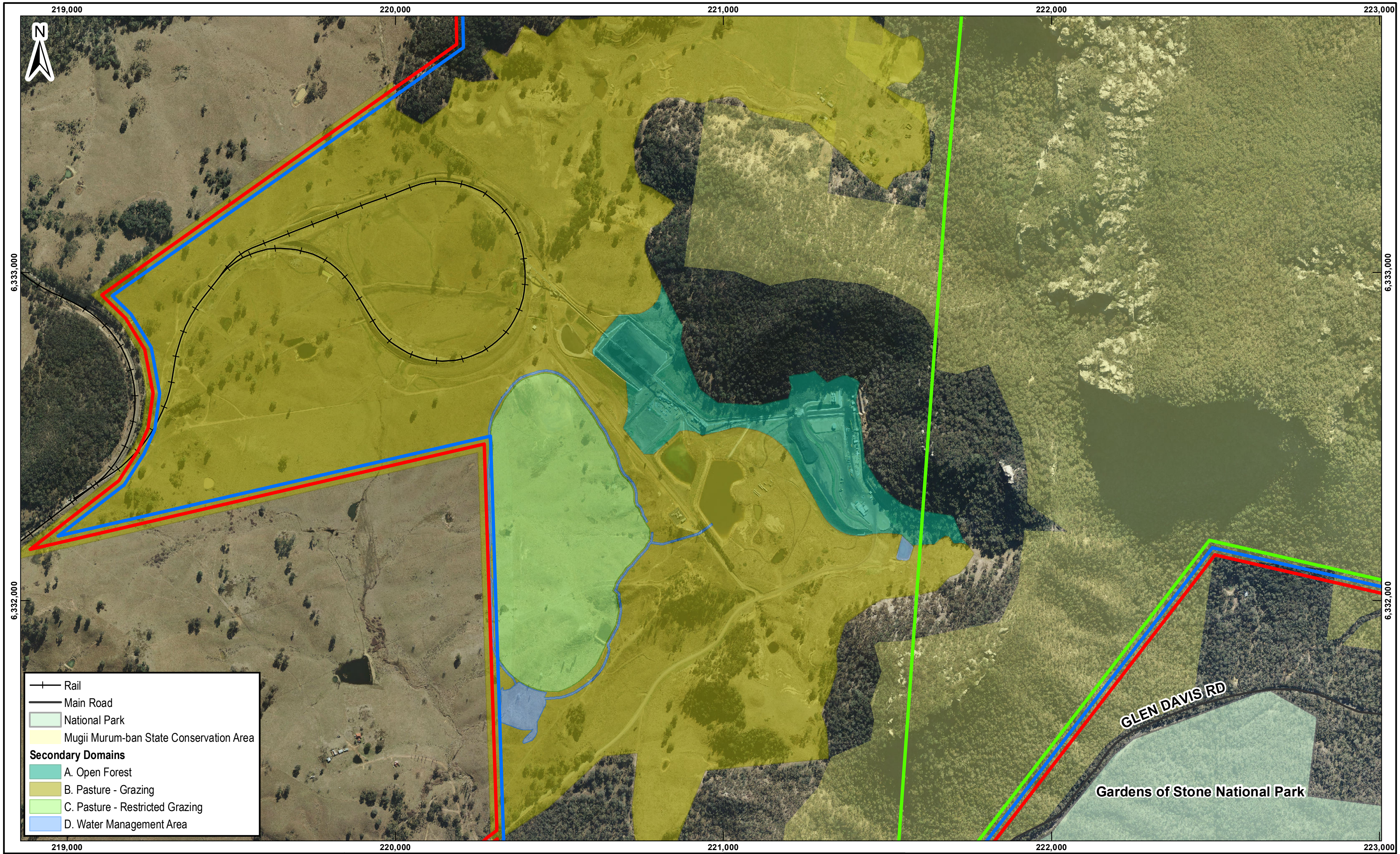
PLOTFILE No.

Centennial Coal

Airly

DRG No. 10-10.43

A4



LEGEND

Project Application Area

ML1331 Current Lease Boundary (Offset for Clarity)

A232 Authorisation Boundary (Offset for Clarity)

Coordinate System: GDA 1994 MGA Zone 56

CENTENNIAL AIRLY PTY. LTD.

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:15,000

Figure 10.44: Airly Mine Secondary Domains (Infrastructure Area)

PLOTFILE No.

Centennial Coal

Airly

DRG No. 10-10.44

A4

Table 10.61 lists the domain rehabilitation objectives.

Table 10.61: Domain Rehabilitation Objectives

Domain	Rehabilitation Objective
Primary Domains	
Domain 1: General Infrastructure Area	■ All services and infrastructure will be decommissioned and removed on closure. ■ The final landform will be safe, stable, adequately drained and suitable for the final land use.
Domain 2: Coal Handling and Processing Infrastructure	■ All services and infrastructure will be decommissioned and removed on closure. ■ All hazardous materials and contaminated materials will be removed or remediated on site. ■ The final landform will be safe, stable, non-polluting, adequately drained and suitable for the final land use.
Domain 3: REA	■ The final landform will be safe, stable, non-polluting and free draining. ■ All coarse and fine rejects will be encapsulated under non-saline and low sodicity inert material in accordance with a capping design specification. ■ The Proposed REA will be constructed to a maximum height of 760 m AHD to be compatible with nearby adjacent topography (forested crests to the west of the Proposed REA have local high points up to 790 m AHD). ■ Batter slopes will be no more than 14 degrees unless otherwise approved. ■ Outer batters of the Proposed REA will be progressively shaped and revegetated.
Domain 4: Water Management Area	■ Clean water will be diverted around operational areas where practical. ■ Mine water and sediment laden (dirty) water runoff from disturbance areas will be captured and diverted to mine water and dirty water dams. ■ Mine water and dirty water will be preferentially used for operational requirements such as the CPP, dust suppression and earthworks. ■ Dirty water will be treated before discharge from site in accordance with regulatory requirements. ■ Water management structures will be designed and built in in accordance with Best Practice and "the Blue Book". ■ Sediment dams and water management structures will remain until the catchment is rehabilitated and discharge water quality is similar to comparable undisturbed landforms.
Domain 5: Subsidence Management Areas	■ All boreholes will be sealed and rehabilitated in accordance with DTI requirements. ■ Subsidence related impacts will be remediated in accordance with the approved Subsidence Management Plan.
Secondary Domains	
Domain A: Open Forest	■ Open forest will be established on areas disturbed by mining adjacent to the SCA. ■ Open forest rehabilitation areas will be comparable with adjacent undisturbed remnant native vegetation including areas commensurate with Box Gum Woodland EEC.
Domain B: Pasture – Grazing	■ Pasture suitable for grazing (Land Capability Class VI or better) will be established on areas disturbed for Domains 1 and 2.
Domain C: Pasture Restricted Grazing	■ Pasture suitable for grazing (Land Capability Class VI or better) will be established on the footprint of the Proposed REA. ■ A management plan for restricted grazing will be developed and implemented to minimise potential for erosion due to overgrazing.
Domain D: Water Management Area	■ The final landform drainage will integrate with the surrounding catchments and will achieve long term geomorphic stability and minimise erosion. ■ Sediment dams identified for retention will be decontaminated and preserved as farm dams.

Land zoning at all infrastructure areas proposed to be rehabilitated will change to a combination of RU1 (Rural Primary Production) and RU2 (Rural Landscape) zonings under the provisions of the Draft Lithgow LEP 2013. Activities permitted without consent under these zones include grazing of livestock, beekeeping and dairying (pasture based). Preliminary post mining land use options identified are discussed below.

Preliminary post mining land use options identified are discussed as follows.

- **Domain A**: Open Forest comprises portions of the rehabilitated infrastructure area at the pit top integrated with adjacent native vegetation and the Mugii Murum-ban SCA.
- **Domain B**: Grazing is permitted without consent under the provisions of the Draft LEP 2013. The pre-mining land use for the majority of land in the infrastructure area was grazing as it is for large areas of land surrounding the Project Application Area. Pasture areas within the Project Application Area (primarily around the pit top) not proposed to be disturbed by the Project will be retained through the life of the Project and opportunistically grazed where appropriate.
- **Domain C**: Pasture (Restricted Grazing) comprises the Proposed REA, which will be vegetated with pasture species that will assist in stabilising the constructed landform. Grazing in Domain C will be managed to minimise the impact of grazing on the Proposed REA engineered cap. The preferred land use for the Proposed REA is consistent with the considerations for Secondary Domain B, being to meet the objectives of the Draft LEP 2013.
- **Domain D**: Water Management Area comprises the water management structures retained in the final landform. Dams, banks and channels will be retained to preserve downstream water quality and to provide water storages for agricultural use. The objectives of both the RU1 and RU2 zones under the provisions of the Draft Lithgow LEP 2013 have been taken into consideration.

10.9.4 Conceptual Post-Mining Landform

The landform, during and after mining will be little changed from that which exists now. Being an underground mine, only very minor landform changes will occur, and all of these will be at the pit top. The major landform change will be the box cut (already existing) and the Proposed REA. Neither will significantly change landuse.

In most of the proposed mining area, maximum predicted subsidence will be nominally 100 mm, which is not predicted to generate any surface cracking of noticeable change in landform. The New Hartley Shale Mine Potential Interaction Zone will experience additional subsidence up to 500 mm and the Project has the potential to cause the reopening of existing cracks, and possibly the formation of new cracks, some of which would be visible at close distances. Expected receptors in this zone will be off-track bushwalkers. Given the thickly vegetated nature of the zone and the limited visibility of predicted cracking, the visibility of such cracking (should it occur) is expected to be low. No changes to the existing landform or land use are predicted.

10.9.5 Decommissioning and Rehabilitation Implementation

10.9.5.1 Progressive Rehabilitation

Disturbed areas at the pit top will be progressively rehabilitated as assets are no longer required, although it is expected that the majority of the pit top will be required for the life of mine. Exploration boreholes will be sealed.

The outer batters of the proposed REA will be progressively trimmed, capped and vegetated following completion of each lift.

Domain 5 is not anticipated to require any rehabilitation works however there are any unpredicted subsidence related impacts that require remediation, this will be undertaken in accordance with an approved Subsidence Management Plan.

10.9.5.2 Life of Mine Rehabilitation

On completion of mining and associated activities, all disturbed areas will be rehabilitated, through the five phase as follows:

- decommissioning: removing plant and equipment
- landform establishment: shaping unformed rock, earthworks and drainage construction
- growth medium development: topsoiling and application of ameliorants
- ecosystem establishment: revegetation
- ecosystem sustainability: rehabilitation maintenance and adaptive management.

These phases are outlined below.

Decommissioning

Infrastructure will be decommissioned and demolished including site services, buildings and foundations, bitumen roads, tracks, car parks and hardstands, hydrocarbon and chemical storage areas, monitoring piezometers and production bore, conveyors, stockpile areas, mine dewatering infrastructure, CHPP, coal stockpiles, soil stockpile Effluent Treatment Facility, and rail loading infrastructure. Mine ventilation shafts and mine entries will be decommissioned and rehabilitated in accordance with relevant guidelines and practice in place at time of closure.

Internal access roads may be retained for ongoing access for rehabilitation monitoring and maintenance, firefighting or farm use.

Fixed or mobile assets will be sold reused or scrapped.

Landform Establishment

Domain 1 General Infrastructure

Following decommissioning disturbed areas will be re-graded to be stable and free draining. Fill won from the original box cut will be placed back on the box cut.

Concrete foundation and fill from infrastructure areas in Domains 1 and 2 will be placed into the box cut. An assessment will be conducted during detailed mine closure planning to determine the extent to which the box cut can be feasibly backfilled. Only inert waste materials will be placed in the box cut. All other material will be remediated on site or transported to an appropriately licensed facility.

Disturbed areas will be shaped to achieve final grades consistent with pre-mining landform and surface water flows where possible.

Domain 2 Coal Handling and Processing Infrastructure

Coal handling infrastructure area will have similar landform establishment activities as those for Domain 1.

The rail loop will be regraded to reinstate the pre-mining land capability and surface water flows.

Concrete foundations and fill removed from Domain 2 will be placed into the box cut or recycled at a licensed waste facility.

Domain 3 Rejects Emplacement Area

The proposed REA will be built up during the mining phase to design specifications. An engineered cap will encapsulate rejects and surface drainage including rock lined channels and earthen contour bank formation.

Detailed specifications for capping materials will be confirmed following development consent to ensure favourable pH, exchangeable sodium percent (ESP) and salinity.

The entire perimeter of the rehabilitated REA will be fenced to control access by grazing stock and native fauna. Fencing will be retained and grazing restricted until it can be demonstrated that the landform is stable and the potential for grazing animals to cause erosion is minimal.

Domain 4 Water Management Area

Contour banks and catch drains will be built to collect surface runoff from all rehabilitation areas, which will be shaped to be free draining. Drainage structures will be designed and constructed to meet the relevant guideline and best practice criteria applicable at the time of closure.

Clean water, dirty water and mine water dams not to be retained will be demolished.

Table drains and catch drains not required in the final landform will be filled in.

Domain 5 Subsidence Management Area

No landform establishment is required for Domain 5.

Growth Media Development

Topsoil will be stripped from all areas disturbed for the Project and stockpiled until sections of the REA are ready to be topsoiled. Soils stockpiled for extended periods will be seeded with pasture species.

Topsoils will be characterised for any required ameliorants (e.g. lime, gypsum, fertiliser and organics) and will be spread at the appropriate depth for the intended final land use.

Ecosystem Establishment

Seed mixes will be based on assessment of suitable species that are representative of the desired final land use vegetation communities. Rehabilitation areas will be sown with sterile cover crops in addition to the specified seed mixes for the intended final land use.

Open forest seed mix will include groundcover, mid-storey and over-storey species representative of the target vegetation community. Short lived 'pioneer species' such as wattles may also be included to improve nitrogen levels in the soil profile.

Secondary Domains B and C will be revegetated with both native and exotic pasture species including legumes to assist develop soil nitrogen, annuals and perennials to develop a sustainable pasture.

Land management activities to be undertaken at rehabilitation areas will include erosion and sediment control, feral animal and weed management and bushfire management. Detailed procedures will be developed following development consent and documented in management plans and the MOP.

Ecosystem Sustainability

The key activities of this phase include monitoring, maintenance and adaptive management. Key activities include the following.

- Assessment and reporting of progress against criteria, identifying triggers for remedial work and continually improving rehabilitation methodologies.
- Developing and maintaining rehabilitation methodology records to provide context for rehabilitation monitoring results and assist the continuous improvement process.
- Reporting results of rehabilitation monitoring in the Annual Review which discusses rehabilitation performance and identifies trends.
- Rehabilitation maintenance where rehabilitation monitoring indicates that land management practices are not compliant with management plans, or rehabilitation progress is not consistent. Intervention and adaptive management, where monitoring results reveal that key parameters of rehabilitation are not trending towards the nominated completion criteria in the desired timeframe, to achieve the desired rehabilitation outcomes.

10.9.6 Preliminary Rehabilitation Success Criteria

Preliminary rehabilitation completion criteria guide the development of specific completion criteria to demonstrate the successful completion of each phase of rehabilitation for each domain. Completion criteria will be further developed following detailed design of the final landform and stakeholder consultation regarding final land use during the detailed mine closure planning process and documented in successive MOPs. Detailed mine closure planning for the Project will be completed no later than five years prior to closure. Table 10.62 outlines the preliminary rehabilitation success criteria for the five phases identified in Section 10.9.5.2**.**

Table 10.62: Conceptual Rehabilitation Success Criteria

Rehabilitation Element	Domain	Preliminary Completion Criteria
Decommissioning Phase		
Infrastructure	Domain 1 (General Infrastructure Area) and Domain 2 (Coal Handling Infrastructure)	■ all buildings, plant and equipment decommissioned and removed unless agreed with stakeholders. ■ all demolition work carried out in accordance with AS2601-2001: The Demolition of Structures or its latest version. ■ all site services removed (electricity, telecommunications etc.).
	Domain 4 (Water Management Area)	■ dams not to be retained in the final landform are de-watered and all sediments and contaminants removed and disposed of in accordance with regulatory requirements.
	Domain 5 (Subsidence Management Zone)	■ all boreholes (except those retained for monitoring) sealed and casings near the surface removed in accordance with regulatory standards and guidelines.
Contamination	Domain 1 (General Infrastructure Area) and Domain 2 (Coal Handling Infrastructure)	■ a Phase 2 contamination assessment undertaken at all coal handling and processing infrastructure, workshops and hydrocarbon storage areas.
	All Primary Domains	■ all contaminated materials and hazardous materials removed or remediated in situ in accordance with legislation. ■ all rubbish and wastes removed.
Public Safety	All Primary Domains	■ the site is secured with perimeter fencing and lockable gates.
	Domain 2 (Coal Handling Infrastructure)	■ all vent shafts and the mine portal sealed in accordance with DTI guidelines.
Landform Establishment Phase		
Landform Stability	All Primary Domains	■ the final landform is graded to be free draining. ■ there is no evidence of significant erosion.
	Domain 3 (Rejects Emplacement Area)	■ the final landform is geotechnically stable with batter slopes not exceeding 14 degrees unless otherwise approved by the DRE (or relevant regulatory body). ■ all rejects are capped with inert select capping material in accordance with the approved capping design.
	Domain 4 (Water Management Area)	■ decommissioned dams and drains backfilled to a free draining, stable landform. ■ final landform drainage structures built in accordance with the Blue Book and approved erosion and sediment control plan. ■ drainage structures stable with no significant erosion.
Water Quality	All Primary Domains	■ all discharge water to meet regulatory requirements including EPL 12374.

Rehabilitation Element	Domain	Preliminary Completion Criteria
Growth Media Development Phase		
Topsoil Resource	Domain 1 (General Infrastructure), Domain 2 (Coal Handling Infrastructure) and Domain 3 (Rejects Emplacement Area)	■ topsoil salvaged and stockpiled in accordance with the MOP. ■ all topsoil characterised to assess suitability for rehabilitation
Topsoil Re-instatement	All secondary domains	■ topsoil (or approved topsoil substitute) re-spread at the specified depth appropriate for the intended final land use in accordance with the procedures documented in the MOP. ■ topsoils (or approved topsoil substitute) ameliorated in accordance with specifications documented in the MOP.
Ecosystem Establishment Phase		
Vegetation	Domain A (Open Forest), Domain B (Pasture – Grazing), Domain C (Pasture – Restricted Grazing)	■ approved seed mixes for the final land use sown at the specified rate per hectare in accordance with the MOP.
Ground Cover Secondary	Domain A (Open Forest), Domain B (Pasture – Grazing), Domain C (Pasture – Restricted	■ minimum of 70% ground cover is present at Year 1.
Weeds and Pest Animal Control	All Secondary Domains	■ weeds managed in accordance with legislation and the MOP. ■ pest animal species controlled in accordance with legislation and the MOP.
Bushfire Risk Management	All Secondary Domains	■ bushfire mitigation actions including managing fuel loads, maintaining fire breaks, firefighting access and water resources are implemented on all lands owned by Centennial Airly.
Ecosystem Sustainability Phase		
Rural Land Capability	Domains B (Pasture – Grazing) and C (Pasture – Restricted Grazing)	■ lands rehabilitated for a grazing post mining land use are assessed to have a Rural Land Capability Class 6 or better.
Self-sustaining Soil Profile	Domain A (Open Forest), Domain B (Pasture – Grazing), Domain C (Pasture – Restricted	■ ground cover and or leaf litter is comparable to analogue sites. ■ salinity (EC), pH, ESP and soil fertility is comparable to analogue sites.

10.9.7 Conclusion

A rehabilitation and decommissioning strategy has been prepared for the various landscape domains across the Project Application Area in consideration of the proposed land zonings in the Draft Lithgow LEP 2013.

Staged and final rehabilitation will ensure that there will be little change to the landform of the Project Application Area during and after mining compared to current conditions. Existing and proposed components of the Project will be decommissioned and rehabilitated once they have performed their functions, to ensure minimal disturbance areas within the Project Application Area. Rehabilitation of the pit top area will mitigate the largest area of surface disturbance.

10.10 Visual Amenity

The EIS must address the following specific issues relating to visual impacts:

The Director-General's Requirements

Visual – including:

- a detailed assessment of the potential visual impacts of the development on private landowners in the surrounding area as well as from key vantage points in the public domain, in particular, those available to recreational users from State forests, State conservation areas and national parks
- a detailed description of the measures that would be implemented to minimise the visual impacts of the development.

10.10.1 Introduction

This section describes the existing aesthetic environment of the Project Application Area, identifies the sensitive receptors and viewshed, assesses the potential visual impacts for each receptor, and provides mitigation measures. This section is informed by the technical assessment, *Airly Mine Extension Project: Visual Impact Assessment*, August 2014, Green Bean Design (GBD 2014), which is provided in full in Appendix P.

10.10.2 Methodology

The assessment of visual impact of the project is based upon the *Guidelines for Landscape and Visual Impact Assessment* published by the Landscape Institute (LI 2013). The potential visual impacts as a result of the Project are assessed in chronological order as follows:

- the identification of representative viewpoints and/or receptors
- a site visit and photo survey
- an assessment of visual sensitivity and significance of visual change
- an assessment of magnitude of change and formulation of mitigation measures.

The Visual Impact Assessment consisted of the following tasks:

- a desktop study addressing the visual character and identification of view locations within the surrounding area
- fieldwork and photography to determine the potential extent of visibility of the Project
- assessment and determination of landscape effects on surrounding residential view locations
- assessment and determination of visual significance on surrounding residential view locations
- determination of potential mitigation measures.

10.10.3 Existing Environment

Land use in the vicinity of the Airly Mine consists of rural residential land, grazing, underground coal mining, coal handling infrastructure, transport infrastructure, commercial forestry, and recreation and nature conservation. An operational limestone mine, Excelsior Limestone Mine operated by Sibelco Australia is 5 km northwest of the Airly pit top.

The area around Airly Mine was an important oil shale mining district in the early 1900s and during the world wars, with several torbanite mines feeding the oil shale retorts at Torbane (Figure 10.10). The area has also been mined intermittently for diamonds and gold.

The landscape within and surrounding the Project Application Area contains the following (Figure 1.1):

- Capertee National Park, located to the north of the Project Application Area
- Gardens of Stone National Park and Ben Bullen State Forest lie almost immediately to the south of the Project Application Area
- Turon National Park, located to the southwest of the Project Application Area
- Mugii Murum-ban SCA, majority of which is located within the Project Application Area
- Airly State Forest, located northwest of the Project Application Area
- Wollemi National Park, which is located to the east of the Project Application Area.

There are sixteen residential properties, three of which are owned by Centennial Airly, (Figure 2.6) located in the immediate area surrounding the Project Application Area. Distances and directions from the pit top are illustrated in Figure 2.6.

The Project Application Area is steep and rugged, with Mount Airly to the west and Genowlan Mountain to the east. The surrounding area consists of cleared undulating agricultural land, National Parks, a State Conservation Area and State Forest. The summits of Mount Airly and the Genowlan Mountain provide extensive views across the Project Application Area and surrounding areas.

The two prominent mesas (Mount Airly and Genowlan Mountain) are separated by a low saddle known as Airly Gap. The perimeter of the mesas is characterized by intermittent sheer and benched cliffs abutted by talus slopes. There are a number of rock formations including pagodas or beehives. The views and landscape features are available to recreational users through the Mugii Murum-ban State Conservation Area and nearby National Parks.

The area within the Project Application Area, surrounding National Parks and State Forest landscapes contain moderate to dense tree cover which in combination with surrounding mountains and ridgelines provide an enclosed visual character.

Given the extent and combination of existing tree cover and undulating landform within and surrounding the Project Application Area, the capability of the landscape to absorb the key components of the Project is high. The high visual absorption capability is likely to reduce the potential magnitude of visual significance.

10.10.4 Visual Impact Assessment

The key components of the Project which are relevant to the visual impact are:

- completion and operation of the CHPP
- establishment of a ROM Coal Stockpile in the vicinity of the proposed CPP
- construction of a REA
- upgrading of surface infrastructure
- subsidence effects.

A larger number of sensitive receptors were assessed for potential visual impact than in the noise and air quality impact assessments. The receptors are shown in Figure 2.2.

10.10.4.1 Magnitude of Landscape Effects

The potential visual impacts of the Project were assessed by evaluating the magnitude of visual change as a result of the Project in the context of areas from which the Project may be visible.

The magnitude of change in visual amenity is measured as an expression of the scale of change or the level of visual contrast between the Project and the existing visual environment. The visual sensitivity is a measure of how critically a change to the existing landscape is viewed from various use areas, and is a function of both land use and duration of exposure (i.e. individuals generally view changes to the visual setting of their residences more critically than changes to transient visual settings during travel).

Magnitude of visual change of each of the sensitive receptors was assessed against criteria in Table 10.63.

Table 10.63: Magnitude of visual change assessment criteria

High	Total loss or major change to pre-development view or introduction of elements which are uncharacteristic to the existing landscape features.
Medium	Partial loss or alteration to pre-development view or introduction of elements that may be prominent but not necessarily uncharacteristic with the existing landscape features.
Low	Minor loss or alteration to pre-development view or introduction of elements that may not be uncharacteristic with the existing landscape features.
Negligible	Very minor loss or alteration to pre-development view or introduction of elements which are not uncharacteristic with the existing landscape features (resulting in a no change situation).

All receptors including residential properties, roads and lookouts were rated a negligible magnitude of change. Negligible magnitude is defined as very minor loss or alteration to pre-development view or introduction of elements, which are not uncharacteristic with the existing landscape features.

The magnitude of potential landscape effect associated with the Project is considered to be low given the extent and purpose of contemporary mining operations. Existing landscape characteristics within and surrounding the Project Application Area are generally robust and would have the ability to absorb any significant change without altering the existing landscape character.

10.10.4.2 Visual Significance

Viewshed modelling was performed to identify areas that potentially will be able to be viewed from the Project. Vegetation heights were not included for input into all models of the viewshed, therefore, a bare earth digital elevation model was used to determine the Project visibility across the landscape which is the more conservative approach. The screening influence of vegetation was determined for the REA by modelling tree height at an average of 12 m. The contrast in the identified areas of screened and un-screened models illustrate the significance of screening vegetation. (Figure 10.45 and Figure 10.46)

The viewshed has been set at a distance of 15 km from the Project Application Area, which is likely to exceed the distance at which key project component would be visible in direct line of sight. Potentially visible infrastructure, without screening influence of surrounding cover, includes the administration building and the REA. Viewpoints from which the infrastructure would potentially be visible without screening are illustrated in Figure 10.47.

The results of the viewshed model were used to identify the significance of visual impact resulting from the construction and operation of the Project. Influencing factors include the distance of the view, location of project element pathways, duration of the view, predicted impact of the project on existing visual amenity, nature of predicted impacts and receptor sensitivity. Each receptor’s sensitivity was rated against the criteria in Table 10.64.

Table 10.64: Receptor Sensitivity Assessment Criteria

High	Residential locations, National Park or State Conservation Area
Medium	Public open space or State Forest
Low	Main highways and local access roads

The following indicators have been adopted to define the sensitivity of individual receptors at specific viewpoints:

- High sensitivity: people with proprietary interest and prolonged viewing opportunities, such as residents and users or visitors to attractive and/or well-used recreational facilities. Views from a regionally important location whose interest is specifically focussed on the landscape.
- Medium sensitivity: people with an interest in their environment e.g. visitors to environmental areas, such as bush walkers and horse riders, or a larger number of travellers with an interest in their surroundings.
- Low sensitivity: people with a passing interest in their surroundings e.g. those travelling along principal roads. Viewers whose interest is not specifically focused on the landscape e.g. farm workers or commuters.

The visual impact significance is a combination of the sensitivity of the receptor and the viewpoint type or location (Table 10.65)

Table 10.65: Receptor Visual Significance Assessment Criteria

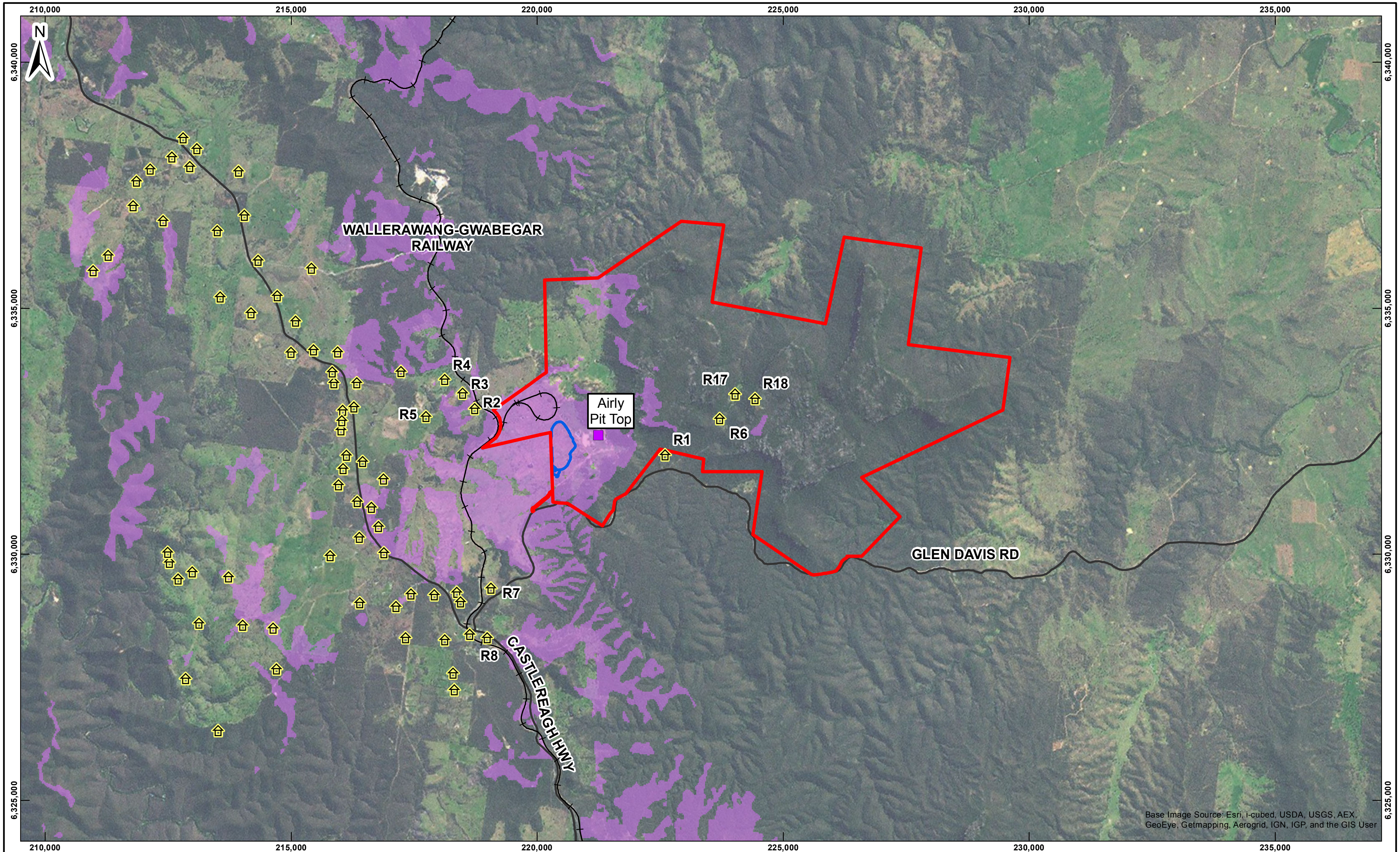
High Significance	A significant and dominant feature within the surrounding landscape and at complete variance with the landform, scale and pattern of the landscape, with the capacity to cause a significant deterioration in the existing view. The visual effects may not be minimised by mitigation measures and cumulative impacts may result in an increased level of impact.
Medium Significance	A recognisable feature, but not dominate views within the surrounding landscape. Features would be out of scale and discordant with the landform, scale and pattern of the landscape and would have the capacity to cause noticeable deterioration in the existing view. The visual effects may be partially mitigated through appropriate measures.
Low Significance	A visible element within the surrounding landscape but is unlikely to constitute a marked effect on existing views. The elements would complement the scale, landform and pattern of the surrounding landscape and would not create a noticeable deterioration in existing view. The visual effects would be positively mitigated through appropriate measures.
Negligible Significance	No discernible deterioration in the existing view.

Table 10.66 illustrates the sensitivity and significance ratings assigned to the residential, road corridors, lookout, National Parks, State Conservation Area and State Forest.

Table 10.66: Visual Sensitivity and Effects

Receptor No.	Receptor Sensitivity	Significance of Visual Effects
R1	High	Negligible
R2	High	Negligible
R3	High	Negligible
R4	High	Negligible
R5	High	Negligible
R6	High	Negligible
R7	High	Negligible
R8	High	Low
R9	High	Negligible
R10	High	Negligible
R11	High	Negligible
R12	High	Negligible
R13	High	Negligible
R14	High	Negligible
R15	High	Negligible
R16	High	Low
R17 Airly Gap Campground	High	Negligible
R18 Nissen Hut Genowlan Mountain	High	Negligible
Castlereagh Highway	Low	Negligible
Glen Davis Road	Low	Negligible
Pearson's Lookout	High	Negligible
Capertee, Gardens of Stone and Turon National Parks	High	Negligible
Mugii Murum-ban SCA	High	Negligible
Airly State Forest	High	Negligible

The identified receptor locations have a negligible to low visual impacts significance with regard to the Project. The negligible and low visual significance are a result of a combination of existing sloping and ridgeline landforms that surround the Project Application Area, together with moderate to dense tree cover within and surrounding the Project Application Area and residential dwellings. The predicted impact on existing view of the Project on receptors is expected to be neutral.



LEGEND
- Project Application Area
- Rail
- Main Road
- Private Residential Dwelling
- Proposed REA
- Visibility

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:100,000

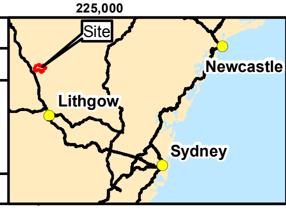


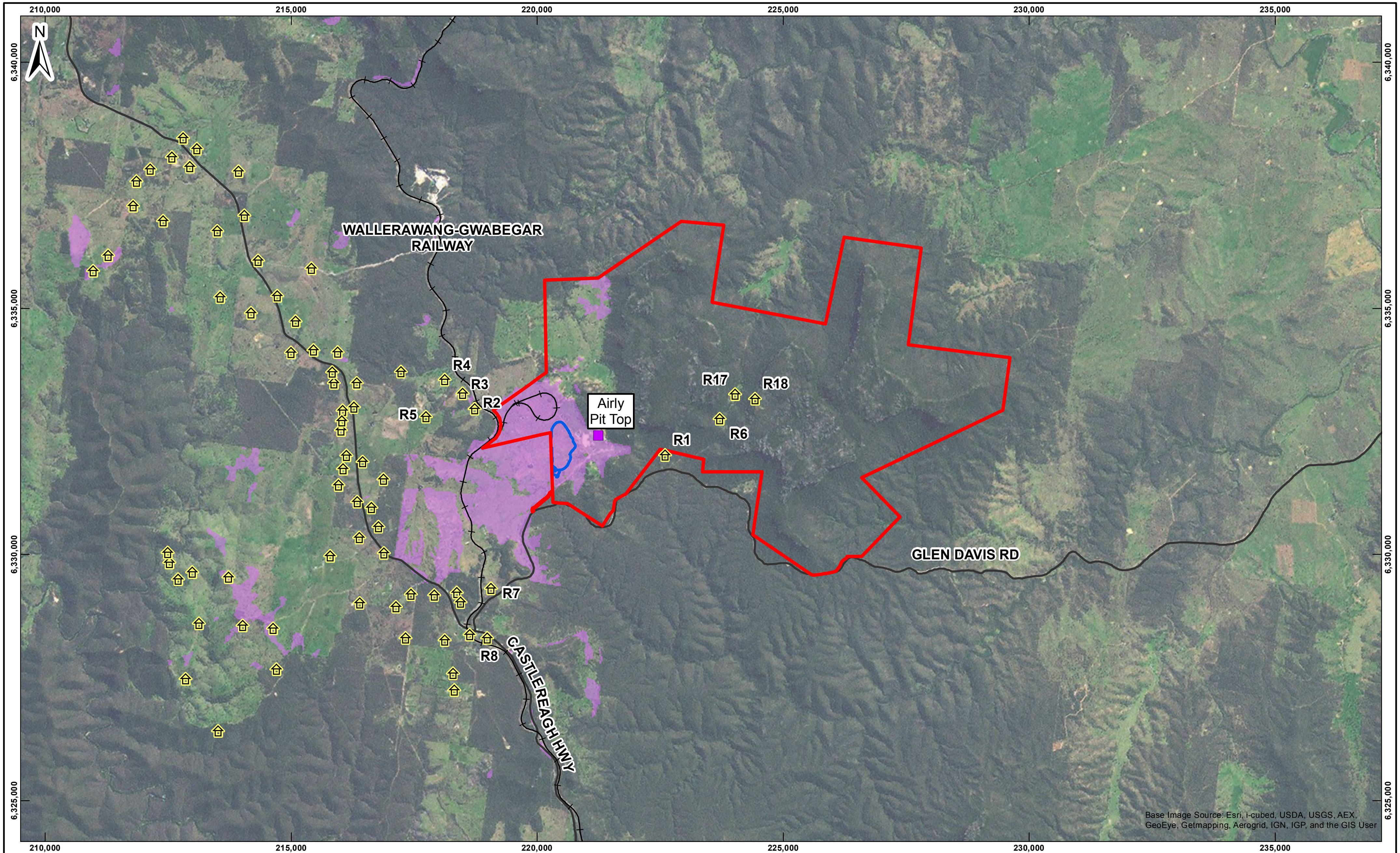
Figure 10.45: Zone of Visual Influence Diagram - Proposed REA

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.45

A4



LEGEND

- Project Application Area
- Rail
- Main Road
- Private Residential Dwelling
- Proposed REA
- Visibility

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:100,000

Figure 10.46: Zone of Visual Influence Diagram - Proposed REA Including Tree Cover

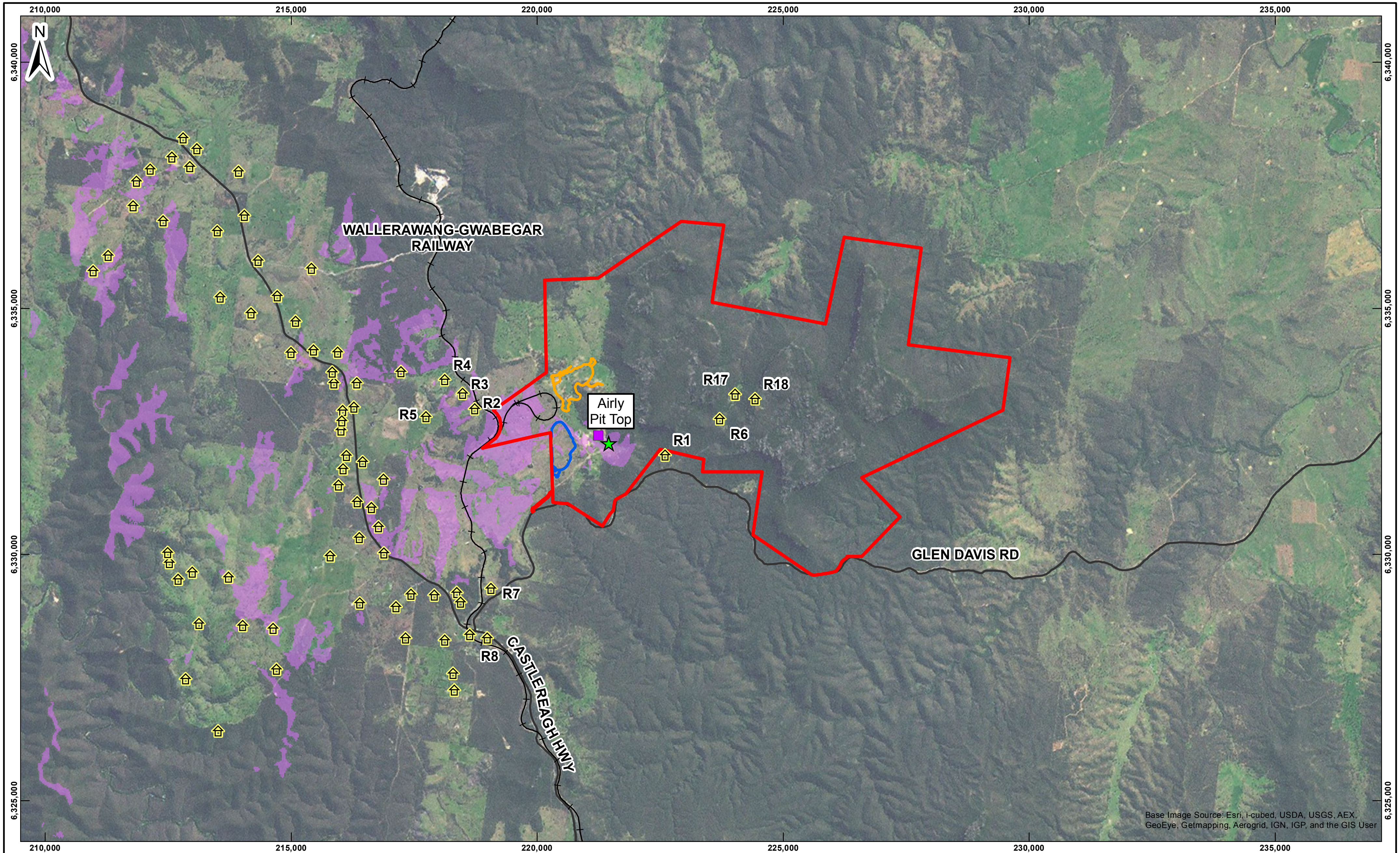
0 1,000 2,000 3,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.46

A4



LEGEND
- Project Application Area
- Airly Mine Administration Building
- Private Residential Dwelling
- Rail
- Main Road
- Alternative REA
- Proposed REA
- Visibility

Coordinate System: GDA 1994 MGA Zone 56

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:100,000

Figure 10.47: Zone of Visual Influence Diagram - Administration building

0 1,000 2,000 3,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.47

A4

10.10.4.3 Mining Impacts

A series of mining zones which include the 'Cliff Line Zone and Zone of First Working' were identified in the *Subsidence and predications and Impact Assessment for Airly Mine* (Golder Associates 2014). Figure 8.2 illustrates the visible extent of the Cliff Line Zone and Zone of First Working.

Subsidence was estimated between 10 to 30 mm in both Cliff Line Zone and Zone of First workings illustrated in Figure 8.2. Potential visual impact of subsidence has been assessed to be between low and insignificant.

The Project Application Area contains extensive and high cliffs, damage to which from subsidence would have a potential significant visual impact. Accordingly, mine design criterion defines that cliff failures which should not be induced by mining and cliff failure rates would remain at background levels. Airly Mine design ensures that cliff failures do not occur as a result of mining and so no visual impacts are predicted to cliffs.

The Project Application Area also contains many pagodas, which have also been taken into consideration by the mine design and there is no cracking or toppling of pagodas predicted. Accordingly no visual impacts are predicted to pagodas.

Surface cracking, which can be visible at close distances, is not predicted over most of the mining area due to limited upward migration of the underground fracture zone. In the New Hartley Shale Mine Potential Interaction Zone, there is cracking visible above the old workings, albeit most likely only noticeable to trained people. The Project has the potential to cause the reopening of these cracks, and possibly the formation of new cracks, some of which would be visible at close distances. Expected receptors in this zone will be off-track bushwalkers. Given the thickly vegetated nature of the zone and the limited visibility of predicted cracking, the visual impact of such cracking (should it occur) is expected to be low.

10.10.5 Consequences of Potential Visual Impacts

The key visual components of the pit top will be the proposed CPP, the coal and soils stockpiles, the proposed REA and the existing coal handling infrastructure and buildings. Whilst construction is likely to be more visible than the operational stage of the Project, these activities would be temporary and transient in nature. Views toward construction sites would be restricted by existing landform and tree cover.

Minimal visual impacts will be experienced at the sensitive receptors during the construction and operation of the Project. Mitigation measures will be implemented during the construction and operation phases of the Project to reduce the potential visual impacts. Current and future Project facilities will require low level intensity lighting. Lighting would include individual and direction flood lighting and will avoid broad area lighting where possible. The majority of the infrastructure area associated with the Project will be unlikely to require additional lighting, or lighting that will be directly visible from surrounding view locations.

The proposed REA will cause visual impacts to some receptors in the way of long distance views, short duration or screened views, with remaining receptors being predominantly blocked by landform and tree cover.

As the Project will involve upgrades of current surface infrastructure and construction of the CPP and development of a REA, the views from the receptors will not be significantly visually impacted by the Project. There is no significant difference of the REA with regard to overall visibility of potential for visual impact. The location of the REA will be directly visible from private residential dwellings within or surrounding the Project Application Area.

The mine design minimises subsidence and consequent visual impacts are negligible in most of the Project Application Area. Surface cracking is predicted in the New Hartley Shale Mine Potential Interaction Zone but these cracks will have limited visibility and so will generate low visual consequences.

10.10.6 Mitigation and Management Measures

During the construction and operation of the Project, a number of mitigation measures will reduce the visual impacts, these include the following.

- Reducing the extent of visual contrast between visual portions of the Project structures and the surrounding area. This can be achieved through the use of dark toned non-reflective materials and selecting colours similar to existing infrastructure.
- Minimising light spill outside of areas required to be lit.
- Where possible, establishment of tree, shrub and ground cover consistent with native woodland and grasslands. Tree planting at the basal area of the REA will be undertaken.
- Progressive and ongoing restoration and rehabilitation of the REA will minimise visual contrast between the emplaced reject materials and surrounding landcover.

10.10.7 Conclusion

The visual character and amenity of the regional and local area of the Project Application Area will not be significantly altered by the Project. The key proposed Project elements would have a negligible to low visual impact on people living in or travelling through this area. The sloping and ridgeline landforms with moderate to dense tree cover result in an overall low level of visibility and a negligible to low magnitude of visual significance. Significant views from the Muggi Murum-ban SCA (including views from Mount Airly and Genowlan Point) toward the Gardens of Stone National Park and Capertee Valley would not be impacted by the Project (GBD, 2013). Construction effects will be temporary and transient resulting in negligible or low significance.

Surface cracking, is not predicted over most of the mining area due to the Project. Surface cracking is predicted in the New Hartley Shale Mine Potential Interaction Zone but these cracks will have limited visibility and only occasional visitors are expected in this zone and ground visibility is limited. The visual impact of such cracking is expected to be low.

Existing infrastructure will continue to have direct line of sight with some receptors. However the minor upgrades to existing infrastructure, the construction of the CPP and development of the proposed REA within the established pit top area will result in no change in magnitude and consequently no change to the significance of visual effects. Establishment of landscape treatments including the establishment of tree, shrub and groundcover would ensure a suitable screen that is consistent with the surrounding visual character and zoning development.

10.11 Waste Management

This section specifically responds to the DGRs, which provide the following in regard to waste aspects:

The Director-General's requirements

Waste:

- accurate estimates of the quantity and nature of the potential waste streams of the development, including tailings and coarse reject;
- a tailings and coarse reject disposal strategy, including an adequate justification of the chosen strategy over other alternative disposal options, including underground storage; and
- a description of measures that would be implemented to minimise production of other waste, and ensure that that waste is appropriately managed.

10.11.1 Existing Waste Management

Waste generated at Airly Mine is classified and managed in accordance with the *Waste Classification Guidelines* (DECCW 2009) and relevant regulatory requirements of the *Waste Avoidance and Resource Recovery Act 2001 (*WARR Act) and the *Protection of the Environment Operations Act 1997* (POEO Act).

In accordance with the WARR Act, Airly Mine adopts the principles of the waste management hierarchy as follows:

- waste avoidance
- waste re-use
- waste recycling/re-processing/treatment
- waste removal and disposal.

The waste management procedure at Airly Mine is operated in accordance with the Waste Minimisation and Management Plan (Airly MP 1081). This has provisions for the management of waste through recovery and recycling, segregation of general waste from cardboard and timber, and recycling of metals and oil. All potentially hazardous material is stored and/or bunded appropriately in accordance with relevant standards. The waste management procedure at Airly Mine aims to minimise the amount of waste sent to landfill and ensure that waste is managed in line with relevant legislative requirements.

EPL 12374 requires that licensed activities be carried out in a competent manner and this includes the treatment, storage, processing, reprocessing, transport and disposal of waste. The types and quantities of waste currently generated at Airly Mine, together with the management strategy for this waste are summarised in Table 10.67. Quantities have been obtained from the 2012 Airly Waste Management Report. In 2012, total annual waste was recorded at approximately 223 t and recycled waste at 152 t.

Table 10.67: Existing Waste Sources and Quantities

Waste Stream	Example Waste	Management/Disposal Method	Annual Quantity (2012)
General Solid Waste			
Mixed Solid Waste	Putrescible wastes and non- putrescible waste such as glass, plastic, rubber, plasterboard, ceramics, bricks, concrete, wood and paper. This also includes waste that meet the classification of *General Solid Waste under DECCW's Waste Classification Guidelines (2009)*	General consumable waste materials are stored in 5 x 3.5 m^3 and 2 x 10 m^3 waste skips and collected regularly by licensed providers for off site disposal to landfill.	24 t (mixed solid waste); 199 t (bulk solid waste)
General Solid Waste (Recyclables)			
Paper and Cardboard	Paper and cardboard	Colour coded recycling containers are placed in identified areas for collection of cardboard and paper products. These, and smaller receptacles in the administration and office areas, are collected regularly by licensed providers.	6.4 t
Scrap Steel/Metals	Scrap Steel/Metals	All scrap steel/metal is placed into a dedicated skip, which are sold to scrap steel merchants for recycling.	25.8 t

Waste Stream	Example Waste	Management/Disposal Method	Annual Quantity (2012)
Liquid Waste			
Used oil filters and drums	Waste oils/Grease	Used oil filters are stored in designated bins and are taken to a recycling facility by a registered waste disposal company. At the recycling facility, these are crushed to recover all oil and subsequently, both the oil and metal is recycled. Materials still containing liquid are not disposed of to landfill. These materials are removed by licensed contractors for recycling or disposal and a licensed waste management facility. 20L drums are drained into waste oil collection (drum drainer) and placed into scrap metal recycling bins. Grease cartridges are placed in sealed drums within the bulk oil store, prior to collection by licensed contractors.	2 t (oil water) 5.8 t (used oil) 108 t (drill mud) 0.76 t (oil filters) 0.52 t (oily rags/absorbents)
Hydrocarbons/ Hazardous Materials	Oils and diesel fuels	Hazardous materials including oils and fuels are stored in accordance with Australian Standards. A spill response procedure is in place which addresses clean-up procedures in an event of a spill. Hazardous materials that need to be disposed of are stored within an allocated area prior to being removed by a licensed hazardous waste contractor.	2.1 t (coolant)
Waste effluent	Sewage	Sewage and grey water from the bathhouse and offices at the pit top area is treated on site by a sewage treatment facility. The mine's effluent system upgrade was completed during June 2012 and the life of mine Ecomax effluent treatment system caters for the expected future workforce. Underground sewage is contained by Alfab activated biological toilets. Septic tanks have been installed at the Train Loader facility to manage sewage from the toilet located at the Train Loader. The sewage is transported by a licenced contractor to the Ecomax Effluent Treatment System for disposal.	

The Airly Mine Waste Minimisation and Management Plan (MP-1081) identifies waste streams and the appropriate contractor/licensed facility that accepts each type of waste. The MP-1081 identifies regulatory requirements and appropriate methods for disposal. Table 10.67 identifies typical wastes that are generated and their disposal at Airly Mine.

Centennial Coal has a company-wide waste collection and recycling service provider including recyclables, workshop materials and general office wastes. Oil drums and filters are disposed of with waste metals through metal recyclers. Aluminium cans are a separate stream sold to metal recyclers. Waste oil (and oily water) is disposed of by licensed waste transporters and recyclers, or at treatment plants. Oil rags, filters and general workshop wastes are separated for collection by a licensed waste contractor. Remaining waste is removed from site by a licensed waste contractor.

10.11.2 Proposed Waste Management

The waste management systems currently employed at Airly Mine will continue for the Project. The Project will not generate any additional waste materials or additional waste volumes on an annual basis during operations. Wastes, such as general waste, waste fluids and waste containers, will be managed as part of the Airly Mine current procedures. This will include inert volumes of coal waste from underground road maintenance activities. Recyclable materials will be segregated and collected by licensed providers. Management of all waste is identified in Table 10.68**.**

Waste will be generated on a life of mine basis given the extended operational mine life. There will be a limited volume of waste generated underground and waste will continue to be managed in accordance with current waste management strategies.

Table 10.68: Proposed Waste Volumes and Management Measures

Example Waste	Management/Disposal Method
General Solid Waste (Construction)	
General construction waste	There will be skips on site for general waste and recyclable materials.
Liquid Waste (Construction)	
Excess process and dirty water during exploration drilling	Portable tanks will capture drilling fluid from borehole drilling. The drilling fluid will be reused and on completion of drilling activities and disposed of appropriately. Sediment and erosion controls will be implemented to manage dirty water runoff from the site.
Oils and chemicals associated with construction equipment and plant	All chemicals and oils will be on self bunded storage pallets. Disposal will follow the appropriate guidelines.
Sewage	Chemical toilets will be provided during construction, maintained and removed by licensed contractors. The existing Effluent Treatment Facility will be maintained. The existing septic tanks at the Train Loader will be maintained.
Liquid Waste (Operation)	
Same as existing Table 10.67	As per Table 10.67

Waste generation and management will continue to be monitored through monthly reporting, that details the amounts of each waste type that are disposed of or recycled, and identifies the appropriate contractor or waste facility that receives the waste or recyclables. Waste management will continue to comply with the requirements of the DECC (2009) “Waste Classification Guidelines” and relevant regulatory requirements of the WARR Act and the POEO Act. The existing waste management system and its associated procedures will be revised to ensure appropriate waste management and recycling processes and will address continual improvement as part of the systems requirements.

10.12 Hazards Management

This section specifically responds to the DGRs, which provide the following in regards to hazards:

> **The Director General’s requirements**
>
> **Hazards** –
>
> - paying particular attention to public safety, including bushfires

10.12.1 Hazardous Material Management

The electronic database “CHEMWATCH” is a material safety data sheet database available at the pit top. Hardcopies of material safety data sheets are also kept in a site Chemical Data Register. Prior to new chemicals being allowed on site, the Material Safety Data Sheet for the chemical is reviewed in terms of potential health, safety and environment issues.

Spill kits for the management of oil and diesel spills are available at strategic locations. An emergency eye wash is also provided on site.

All fuels and oils (engine, hydraulic, transmission) are stored in purpose built facilities with appropriate bunding and firefighting provisions. Diesel is stored in above ground bunded tanks from where it is transferred to diesel pods for underground use or direct to machinery.

A licensed contractor is engaged to remove and recycle and/or dispose of used oil and grease products at licensed facilities.

The only dangerous good used at Airly Mine includes diesel with quantities listed in Table 10.69.

Table 10.69: Dangerous Goods and Hazardous Materials

Material	Class/Packing Group	Storage Location	Distance to site boundary	Storage Quantity (litres)	Average Vehicle Movements per year	Approximate Load Size (litres)
Diesel	Class: 9 Packing Group: III	Workshop	>500 m	28,000	30	20,000
Diesel	Class: 9 Packing Group: III	Train Loader	>500 m	28,000	150	28,000

10.12.2 Spontaneous Combustion

The Lithgow coal seam has a low propensity for spontaneous combustion. There have been no spontaneous combustion issues in relation to in-situ or extracted Lithgow seam coal, and no incidences of spontaneous combustion to date at Airly Mine.

Typically, for the Lithgow seam coal, the highest risk of spontaneous combustion is during stockpiling for longer than one year. This is not an issue at Airly Mine, as coal is stockpiled for short periods.

10.12.3 Bushfire

10.12.3.1 Existing Environment

The majority of the land within the Project Application Area, including the Mugii Murum-ban SCA is heavily forested with native vegetation and has been identified as Bushfire Prone Land. Fire history data from the National Parks and Wildlife Service, who manage the SCA, indicate that the majority of bushfires in the area spread from the north and east of the SCA due to the direction of dominant winds throughout the bushfire season. A number of fire trails exist across the SCA including Mount Airly, Airly Gap, Genowlan Mountain, Point Hatteras and Genowlan Point. These act as containment lines mitigating a degree of bushfire risk to Airly Mine’s infrastructure.

Existing and proposed infrastructure at the pit top adjoins woodland and forest type vegetation to the north, east and southeast. The remainder of the pit top is bounded by open grazing land with minimal tree cover. The vegetation in the SCA is a mix of Woodlands (Grassy) and Short Heath (Open Scrub) (after Keith (2004) in RFS (2006a)). For the purposes of determining the bushfire risk within the Project Application Area, the vegetation is classified as dry sclerophyll forests (open forest).

The Fire Danger Index for Lithgow LGA is 80. The slopes around the pit top are up slope with a range 10 to 45 degrees. Infrastructure at the pit top is in excess of 40 m from the surrounding vegetation. This means that the pit top has a defined bushfire attack level of 12.5 (RFS, 2006b). This bushfire attack level requires actions to provide ember protection and prevent accumulations of debris.

The only activity proposed in the SCA is exploration and environmental monitoring. Slopes for typical exploration sites proposed will be predominately downslope with slopes in the range 10 to 35 degrees. Exploration activities are generally located less than 12 m from the vegetation and as such are considered to be in the Flame Zone of a bushfire (RFS 2006b). This is the highest possible rating for fire risk.

10.12.3.2 Potential Impacts

The existing and proposed mine infrastructure is likely to be exposed to strong to gale force winds from the northwest, west and southwest. The land in these directions is grazing land with low grass levels present, The forested land to the north, east and south east of the pit top infrastructure is down-wind of high fire danger winds and the set back distance to the vegetation is in excess of 40 m. Mine infrastructure has a 5 to10 m cleared (no vegetation) zone around each building providing an asset protection zone (APZ).

Whilst the severity of a fire coming from the more likely western aspect is low to moderate, the high level of human activity to the west comprising farming, Capertee Village and the Castlereagh Highway increases the likelihood of an ignition to possible.

Given the above combination of likelihood and consequence, the risk to the pit top from an external fire was considered significant in a risk assessment undertaken for the Project in conjunction with the National Parks and Wildlife Service (Section 9.3.4).

Proposed exploration and monitoring activities within the SCA are exposed to strong to gale force winds from the northwest, west and southwest. These winds, combined with the woodland and forest vegetation and steep topography could result in catastrophic bushfire events, if not managed properly.

Two possible hazard scenarios exist. Firstly, a fire could be ignited from Airly Mine activities within the SCA. This is less likely to cause harm to the Airly Mine personnel, but may spread to cause impacts in the SCA and possibly in surrounding lands. Secondly, Airly Mine activities within the SCA could be impacted by a fire. This scenario could result in personnel becoming trapped by fire and severely impacted.

Given the extreme bushfire attack category for the SCA there is a high risk of impact from fire to personnel during extreme fire danger periods. Local flora and fauna have adapted to fire, and as such adverse environmental impacts from bushfire are low. Notwithstanding, bushfire presents an operational risk to the exploration and other monitoring activities in the SCA and at the pit top.

10.12.3.3 Environmental Consequences

Given the APZs already exist around the existing buildings at the pit top and that the proposed infrastructure will be built on already disturbed land or on grazing land with minimal vegetation the impact from bushfire on the existing and proposed infrastructure at the pit top will be minimal. The exploration drill sites within the SCA will have a minimal 12 m distance from vegetation and therefore the potential impact of bushfire ignition from the drill rig will be minimal.

10.12.3.4 Mitigation Measures

Airly Mine has reduced the operational risk of bushfire through incorporation of mitigation and avoidance measures in the construction phases of the mine. During the design phase, the required APZ for the existing surface infrastructure as constructed were incorporated.

The proposed CPP will be constructed on land previously cleared land and as such no further clearing for asset protection is required for the CPP.

The proposed REA will be located on cleared grazing land and will be surrounded by a cut off drain system that will effectively act as a fire break around the structure. There will be no requirement to clear vegetation to provide an APZ outside the REA disturbance area.

The incoming 66 kV power supply at the pit top is located through open grazing land for the majority if its length. Those areas passing near bushland are maintained with 10 m clearing on each side of the conductors. All electrical power cable networks at the pit top area are trenched which avoids the potential for overhead lines to trigger bushfires or be destroyed by bushfires. All new electrical power cables required for the proposed CPP will also be trenched.

Airly Mine has established a Fire Management Plan (2011) and the further development of this management plan will be undertaken in consultation with the National Parks and Wildlife Service, and NSW Rural Fire Service if appropriate. The Fire Management Plan identifies both the risks posed by bushfire to Airly Mine assets, and control strategies to mitigate these risks. The Fire Management Plan will be structured to be compatible with the National Parks and Wildlife Service's Fire Management Strategy for the SCA.

Airly Mine undertakes a number of bushfire risk management procedures as follows.

- *Entry prohibited to Mugii Murum-Ban SCA during extreme fire weather*: Airly Mine will not permit personnel and contractors to access the SCA regardless of whether or not the SCA is open due to the risk posed by the limited availability of escape routes from the SCA in the event of a fire. National Parks and Wildlife Service can close entry to the SCA during periods of extreme fire weather. During this period Airly Mine personnel and contractors are prohibited to undertake work on the SCA.
- *Hot works*. Airly Mine has a hot work management system that forms part of the Mechanical Engineering Management Plan. This plan will be followed to prevent any fires due to hot works outside of designated areas. Personnel involved in hot work at Airly Mine are trained to carry out hot work. They are also trained in emergency response procedures and effective use of fire prevention methods and fire fighting equipment. Hot works are not permitted in the SCA during periods of severe or worse fire weather.
- *Fire response*. Fire hydrants and hoses have been installed at a number of locations around the pit top. The fire hydrants are identified by reflective signage and the equipment is regularly inspected and maintained. Fittings are compatible with NSW Fire Brigade and NSW Rural Fire Service requirements for ease of use by external fire fighters.
- *Water Supply.* Water can also be easily accessed from the existing water management structures at the pit top for fire fighting purposes. The largest dam alone has a capacity of 109 ML. All dams are clear of any overhead powerlines and vegetation. This makes them available for use by helicopters for airborne fire fighting activities.

Additionally, Airly's Fire Management Plan has been developed to comply with the provisions stated in Planning for Bushfire Protection (RFS, 2006b), which applies to development applications on land that is classified as Bushfire Prone Land. Given that the Project Application Area is located on Bushfire Prone Land, the objectives of this guideline have been consulted and applied to the Project in determining appropriate mitigation measures, such as the determination of the appropriate APZ. The objectives, and how they have been applied, are summarised below. Airly Mine will commit to these objectives.

- *Afford occupants of any building adequate protection from exposure to a bushfire* –All existing buildings have been constructed out of fire resistant steel construction. Any future construction will continue to provide for fire protection in the design.
- *Provide for defendable space to be located around buildings* – An appropriate APZ has been established and maintained around all buildings in the pit top area.
- *Provide appropriate separation between a hazard and building which, in combination with other measures, prevent direct flame contact and material ignition*. The fuel load within the vicinity of the pit top area will be managed in accordance with the NPWS management plans for the SCA to provide appropriate separation between vegetation and the facility or area.
- *Ensure that safe operational access and egress for emergency service personnel and residents is available* –The pit top area is accessible via the Mine Access Road and the internal roads on the site. Access within the SCA is the responsibility of National Parks and Wildlife Service. Airly will remove personnel from the SCA during extreme fire weather to eliminate the issue of access.
- *Provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in the APZ* – The APZs associated with the infrastructure and assets will be maintained in accordance with the updated Airly Mine Fire Management Plan.

Ensure that utility services are adequate to meet the needs of fire fighters (and others assisting in bush firefighting) – All firefighting infrastructure at the pit top area is compatible with NSW Fire Brigade and NSW Rural Fire Service fittings. The dams at the Pit Top are available for firefighting use.

10.12.3.5 Public Safety

Public safety is a priority management aspect at Airly Mine. Centennial Airly recognises the proximity of the township of Capertee to Airly Mine and the mine's location within the Mugii Murum-ban SCA, and would accordingly implement procedures and controls to protect the safety of the public. Measures would be implemented at all times within the surface facilities area to ensure safety of visitors, contractors and the Airly Mine workforce. Unauthorised access to the underground operations is, and will continue to be, prohibited at all times.

Airly Mine has an existing Construction Environment Safety Management Plan that is used during exploration activities in the SCA. This plan includes the procedures to manage public safety in all areas where exploration work is conducted. This plan includes procedures for managing hot work and other ignition sources at the work sites.

A Construction Traffic Management Plan will be prepared.

A site security gate will be installed as part of the Project to ensure authorised access only to Airly Mine.

The Project will not generate any additional hazardous activities or materials to those currently used in the SCA and which would have the potential to impact on public safety. Existing hazards management plans are adequate for the Project and will be updated as required.

10.12.3.6 Conclusion

Airly Mine has a variety of management plans and systems which have been effective in managing and mitigating any potential associated bushfire and public safety risks associated with mining operations. However, a review of these plans will be undertaken in consultation with National Parks and Wildlife Service and NSW Rural Fire Service on a regular basis.

CHAPTER 11.0

Statement of Commitments

11.0 STATEMENT OF COMMITMENTS

This chapter details the draft Statement of Commitments which outlines all proposed environmental management and monitoring measures to reduce adverse impacts of the Project.

The Director-General's Requirements

- A statement of commitments, outlining all the proposed environmental management and monitoring measures

Centennial Airly is committed to the identification, mitigation and management of potential risks from the continued operations of Airly Mine. Key management plans are already well developed and in place to manage and monitor the performance of these operations including those listed in Table 11.1**.**

Table 11.1: **Existing Management Plans and Procedures**

Management Plan or System	Purpose	Update Required Following Development Consent
Mining Operations Plan	Covers activities at Airly Mine during operations. The document has been prepared in accordance with the *Guidelines to the Mining, Rehabilitation and Environmental Management Process prepared by the NSW Department of Mineral Resources, Updated April 2012.*	The Mining Operations Plan will be revised in accordance with the Department Guidelines.
Landscape and Rehabilitation Management Plan	To minimise and manage potential landscape and rehabilitation issues and to return the land to a pre-operation state or better, in line with the relevant consent conditions and in consultation with the key stakeholders.	The plan will be superseded by a new Rehabilitation Management Plan and will be prepared in accordance with the conditions of the new development consent.
Environmental Monitoring Plan	Provides details of monitoring and reporting of the various management plans.	The Plan will be updated in accordance with the conditions of the new development consent.
Stakeholder Engagement Plan	The objectives are to: ■ effectively communicate with relevant stakeholders ■ define responsible parties within Centennial in respect of the communication paths and forums ■ monitor and manage issues from relevant stakeholders ■ maintain a complaints protocol.	The Plan will be updated in accordance with the conditions of the new development consent.
Borehole Construction Environmental Management Plan	Project specific plan developed to ensure appropriate environmental management practices are followed during borehole construction.	No
Pollution Incident Response Management Plan	Covers the key actions to minimise the occurrence of a pollution incident and to manage a pollution incident if one occurs (during and after a pollution incident). The plan has been prepared for managing the impact to human health (employees and nearby neighbours) and the environment (onsite and offsite).	No
Air Quality Management Plan	Provides for the monitoring and management of air quality.	The Plan will be updated in accordance with the conditions of the new development consent.
Noise Management Plan	Sets out procedures for monitoring, assessing and responding to noise impacts.	The Plan will be updated in accordance with the conditions of the new development consent.

Management Plan or System	Purpose	Update Required Following Development Consent
Water Management Plan	Coordinates the management of water within the Airly Mine lease area in an efficient and sustainable manner.	The Plan will be updated in accordance with the conditions of the new development consent.
Waste Minimisation and Management Plan	To achieve waste minimisation through maximising re-use and recycling, to ensure environmentally responsible disposal of waste materials not suitable for re-use or recycling and to ensure environmental protection throughout all stages of waste handling, storage, collection and disposal.	The Plan will be superseded by a Waste Management Plan and will be prepared in accordance with the conditions of the new development consent.
Contractor Management Plan	This plan aims to ensure that all activities carried out on behalf of Airly by external contracted parties comply with legislative requirements, internal and external practices and guidelines.	No
Fire Management Plan	Sets out the procedures for reporting fire and for the inspection and maintenance of firebreaks and asset protection zones at the pit top.	The Plan will be updated in accordance with the conditions of the new development consent.
Strata Failure Management Plan	In accordance with Clause 28b (ii) of the *Coal Mine Health and Safety Regulation 2006* the objectives of this management system are to ensure as far as reasonably practicable the safety of all persons present at the coal operation with regard to underground strata.	This plan will be reviewed in consultation relevant geotechnical expertise to address any changes in mining methodology approved in the new consent. This review will include provisions for monitoring and management actions defined in Section 8.6.
Ventilation Arrangements	In accordance with Clause 21 of the *Coal Mine Health and Safety Regulation 2006,* Airly Mine has implemented Ventilation Arrangements to ensure as far as reasonably practicable the safety of all persons present at the coal operation with regard to mine ventilation.	No

The DGRs issued for the Project require that the EIS includes a summary of all proposed environmental management and monitoring measures, herein referred to as a Statement of Commitments. In addition to the above existing plans of management, Table 11.2 and Table 11.3 detail the Statement of Commitments for the Project that Airly is willing to adopt for implementation throughout the Project development phase and through to the end of the Project life, respectively, should approval be granted under Part 4 of the EP&A Act.

Table 11.2: Project Development Phase - Statement of Commitments

Desired Outcome	Action
Development Phase	
All construction is minimizes potential impacts to the environment.	Erosion and sediment control measures will be implemented in accordance with the guidelines 'Managing Urban Stormwater – Soils and Construction, Volume 2E: Mines and Quarries' (DECC2008). Prior to construction a Construction Environmental Management Plan will be prepared and will include a: ■ Noise Management Plan ■ Air Quality Management Plan ■ Site Water Management Plan It is also proposed to develop the following plans: ■ a management plan for the undermining of the tower complex in consultation with the owner of the infrastructure ■ Weed Management Plan ■ Construction Traffic Management Plan ■ \.

Table 11.3: Project Operation - Statement of Commitments

Desired Outcome	Action
General	
All operations are undertaken in a manner that will minimise the environmental impacts associated with the Project.	Operations will be undertaken in accordance with the description provided in this EIS.
Hours of Operation	
All operations are undertaken within the approved operating hours.	Operations will be undertaken 24 hours a day 7 days a week.
Subsidence	
All subsidence impacts to surface sensitive features are minimised.	Mining operations will be conducted in accordance with the design parameters and those parameters will be implemented in the areas defined in this EIS. A new Extraction Plan will be developed as required by the new consent and in accordance with any requirements of *Mining Act 1992*. This Plan will provide detail around the management of subsidence impacts on the natural and built environment. The Plan is supported by a Subsidence Monitoring and Reporting Programme and Community Consultation Process. The new Plan will incorporate requirements for mine design criteria, implementation, monitoring, management of mining systems and response plans to manage impacts to landscape, surface water, groundwater, and ecology impacts identified in as identified in Chapter 8.0 and in Sections 10.1, 10.2 and 10.3 of this EIS. The Plan will be developed in consultation with DITRIS (DRE) and OEH (land owner). The Plan will include subsidence management elements as follows. ■ Visual inspection of all mining areas prior, during and after mining activities will be undertaken.

<table>
<tr><th>Desired Outcome</th><th>Action</th></tr>
<tr><td></td><td>Subsidence monitoring of initial panel and pillar mining on Mount Airly to confirm mining system performance and establish correlation between surface subsidence and underground geotechnical monitoring.
Ongoing underground geotechnical monitoring to demonstrate mining system performance will be undertaken.
Implement where practical remote subsidence monitoring techniques.</td></tr>
<tr><th colspan="2">Surface Water, Groundwater, Geomorphology and Aquatic</th></tr>
<tr><td>All surface water groundwater and aquatic impacts are minimised to the greatest extent possible.</td><td>The existing Water Management Plan for Airly Mine will be revised, including the preparation of a Groundwater Monitoring and Management Plan (GMMP). The GMMP will include the continuation of the existing groundwater monitoring program as outlined in Section 3.14.4, as well as the following:
Additional groundwater monitoring bores will be installed during the pre-mining phase within Gap Creek and Genowlan Creek alluvium in the areas of predicted groundwater drawdown and monitored for groundwater levels and quality (where accessible). An additional four monitoring bores (including loggers) are planned to be installed in late 2014.
Daily groundwater volumes transferred to the surface facilities area will be monitored.
The GMMP will establish critical threshold levels for groundwater levels and groundwater quality to trigger additional assessment and management, and will define the mechanism for identifying and reporting exceedances. Action will be taken if the Level 1 minimal impact considerations (or other critical threshold levels) are found to be exceeded.
Groundwater monitoring data will be audited on an annual basis and compared to hydrogeological modelling predictions. The GMMP will define the mechanism for identifying and reporting variations from predictions.
Should more than 278 ML/year of groundwater flow into the underground mine workings (i.e. more than the existing WALs) due to greater than predicted storage within the Permian strata (particularly within the old shale workings), it will be necessary for Centennial Airly to purchase an additional groundwater WAL to cover the excess groundwater volume.
Monitor current surface and groundwater monitoring points. The surface water monitoring will include the proposed REA Dam and the associated licensed discharge point. Additional groundwater monitoring points to be installed during the pre-mining phase within Gap Creek and Genowlan Creek alluvium in the areas of predicted groundwater drawdown The surface and groundwater monitoring points will monitor the following parameters:
Piezometric height
Groundwater quality
Groundwater flow
Surface water quality and flow.
Monitor groundwater bores on adjacent private properties to provide understanding of regional groundwater systems. Parameters to be monitored will be:
Piezometric height
Groundwater quality</td></tr>
</table>

Desired Outcome	Action
Aboriginal and Historical Heritage Management	
Ensure that identified and unidentified Aboriginal and Historic Sites are appropriately managed.	The sites identified in Chapter 8.0 and Section 10.3 will be subject to a monitoring programme within the Cultural Heritage Management Plan that will: ■ monitor for impacts caused by subsidence on identified archaeological sites prior to, during and post mining activities. The condition of the site will be compared with baseline. If the site is found to be damaged Centennial Airly will notify OEH and work in consultation to mitigate further impacts. Monitoring will cease once mining is complete under a particular site and inspection with NPWS demonstrate no further impact has occurred ■ Centennial Airly will follow the measures contained in the SCA Plan of Management in relation to the Airly shale mining complex ■ if unrecorded Aboriginal object/s or historical cultural heritage material are identified in the Project Area during works, then all works in the immediate area must cease and the area should be cordoned off. NPWS and OEH will be notified so that the site can be adequately assessed and a Plan of Management developed. ■ In the unlikely event that skeletal remains are found, work will cease immediately in the vicinity of the remains and the area will be cordoned off. The local police will be contacted to make an initial assessment to ascertain whether the remains are part of a crime scene or possible Aboriginal remains. If this is the case, the local police will contact OEH so that they can determine if the remains are Aboriginal.
Traffic and Transport	
Project-related impacts on the road network are limited.	Airly Mine will implement a construction traffic management plan during construction of the CPP. This will include: ■ consideration of shift start and finish times to avoid excessive usage of intersections by both Airly and contraction workers ■ consideration of delivery times for large items of plant during construction.
Noise and Vibration	
All noise impacts are minimised to the greatest extent possible.	The following noise mitigation and management measures will be implemented to reduce the noise impact of the Project: ■ preparation of a Noise Management Plan including noise monitoring program ■ noise levels are to be maintained at 35dBA or less at all identified receptors.
Air Quality	
All air quality impacts are minimised to the greatest extent possible.	Existing monitoring measures will continue for Airly Mine, consisting of the four static dust deposition gauges.

Desired Outcome	Action
Decommissioning and Rehabilitation Strategy	
Rehabilitation to be conducted in accordance with Industry Standards.	The Proposed REA will be rehabilitated in stages and limited progressive vegetation of batters will occur with each lift of the REA. Native species tree planting at the base of the REA will be undertaken prior to the commencement of the REA establishment to provide visual screening. On the completion of mining and associated activities, all disturbed areas will be rehabilitated, through the following stages: ■ Decommissioning: demolition of infrastructure ■ Landform Establishment: shaping, bulk earthworks and construction of drainage works ■ Growth Media Development: topsoiling and application of soil ameliorants; ■ Ecosystem Establishment: revegetation ■ Ecosystem Sustainability: monitoring and maintenance.
Waste	
All waste impacts are minimised to the greatest extent possible.	Dirty water management structures will be constructed in association with the work shop and refuelling facilities. This will include: ■ drainage to a collection point ■ collection of dirty water and separation of oil and grease from the waste water ■ disposal of waste oil and grease ■ direction of remaining dirty water to the dirty water management system
Hazards	
All hazard impacts are minimised to the greatest extent possible.	■ dangerous goods will be stored in accordance with normal dangerous goods storage procedures. ■ spill containment will be managed in accordance with relevant Australian Standards ■ safety hazards will be managed through occupational health and safety procedures ■ environmental hazards will be managed through the EMP ■ fire protection infrastructure and plant (including fire extinguishers, mains hydrants and hoses) will be provided and maintained in accordance with relevant Australian Standards ■ site emergency response plans including emergency contact numbers are provided within management system for the site ■ maintenance of asset protection zones around existing and proposed infrastructure.

CHAPTER 12.0

Justification and Conclusion

12.0 JUSTIFICATION AND CONCLUSION

A description of the need and justification for the Project is provided in this chapter having regard to environmental, economic and social considerations. This includes consideration of the principles of Ecologically Sustainable Development (ESD) and the consistency of the Project with the EP&A Act.

12.1 Need for the Project

Airly Mine's consent (DA 162/91) will expire on 12 October 2014 (Section 1.1). The Project seeks to provide for the continuation of mining to the east of the current workings for a further 20 years (excluding rehabilitation) within the existing mining lease boundary.

The Project is not seeking the same conditions of consent as previously approved where full extraction and anassociated maximum 1.8 m subsidence was approved in designated areas. This level of subsidence and the associated fracturing and impacts on groundwater and surface water systems would not be consistent with the current conservation values associated with the Mugii Murum-ban SCA and the community expectations more broadly. Instead the Project is seeking development consent for partial extraction techniques with minimal environmental impacts to extract coal resource from within ML1331 and A232 boundaries which would otherwise be sterilized, and the socio-economic values of the Project, discussed below, would not be realized.

Without development consent, Airly Mine will not be able to operate, resulting in the loss of 135 job opportunities (and up to 20 contractors) and the loss of access to 20 years of coal production at 1.8 million tonnes per annum.

On approval, the Project is projected to support 30 contractor positions during the construction phase. Subsequent mining will support up to 135 full time employeepositions and up to a further 20 contract positions. The salaries paid to these employees and contractors provide significant economic stimulus and activity in the local and regional economies.

The mining industry is an important component of the regional economy and will provide revenue streams to Federal (e.g. corporate income taxes), State (e.g. royalties, payroll tax) and Local (e.g. rates) governments over the period of the operation.

The net economic benefit of the Project for the State and regional communities is positive, at a net present value (NPV) of $259 million over the Project forecast period to 2034.

12.2 Environmental Impacts

As detailed in Chapter 9.0, the potential environmental impacts of the Project have been identified and assessed using a risk based approach, which commenced with the Broad Brush Risk Assessment and was followed by the Subsidence Constraints Risk Assessment following the completion of the subsidence impacts assessment (Golder Associates 2014) for the proposed mine design criteria. . The key environmental issues identified in that assessment were the subject of technical assessments summarised in Chapter 10.0 and provided in full in the appendices.

The potential environmental impacts of the Project have and will be minimised through the following measures:

- Obtaining a detailed understanding of the key environmental issues with the potential to be impacted by the Project. The multi-disciplinary assessment and consultation has been to a level of detail commensurate with the scale of the Project, industry standards and the legislative framework under which the Project is considered.
- Formulating a mine design with a successful and proven history, in previously mined areas and in other similar operations under similar surface topography and features, of elimination or minimisation of surface subsidence impacts, and one that is safe for the underground workforce and visitors to the surface. Conservative measures in mine design are:

  - consideration of sensitive surface features such as, cliffs, pagodas, groundwater systems, watercourses, ecology and sites of historical and Aboriginal significance that overlie the proposed mining areas
  - minimisation of subsidence impact through mine design by narrowing voids to highly sub-critical widths. Narrower void widths are tested and proven to minimise subsidence, eliminate surface fracturing and reduce sub-surface fracturing
  - application of a series of mining zones to provide specific mining methods for given areas that minimise subsidence impacts while providing for an economically feasible mine.
- Development of a robust numerical groundwater model (GHD 2014a) that predicts mine inflows and potential groundwater impacts with a high level of certainty.
- Continued implementation of the existing proactive strategies and up to date management plans employed at Airly Mine to avoid, minimise, mitigate, offset or manage potential impacts.
- Centennial Airly's commitment for the ongoing review and the further development of the existing environmental management plans where required, and the development of new plans as the need arises.
- Implementation of the Statement of Commitments.

Table 12.1 provides a summary of the key environmental assessment issues discussed in this EIS.

Centennial Airly's approach to the Project has been to apply a best practice system of environmental management: that is a hierarchy of avoid, minimise, mitigate and finally, offset residual impacts. On this basis, the mine planning and design process had already avoided and designed out many of the potential environmental consequences identified early in the risk management process. The technical assessments have determined the residual impacts following the implementation of mitigation measures where necessary.

The residual impacts of the Project are not significant and are acceptable to meet the objectives of the EP&A Act.

Table 12.1: Summary of Environmental Impacts

Environmental Issue	Overview of Key Findings
Cliffs	▪ It is expected that between nil and 5% of the area of the majority of cliffs will experience mining related impacts. This is expected to manifest itself, at worst, as isolated, individual rockfalls, which in accordance with the ACARP (2002) cliff failure methodology is defined as insignificant. ▪ For the six specific cliffs, nil to 10% of cliff area will experience mining related impacts. Similarly, at worst it is expected to manifest as isolated, individual rockfalls. ▪ No surface cracking is expected to be generated.
Pagodas	▪ The very narrow void width combined with large stable chain pillars is designed to limit subsidence such that surface cracking of pagodas is not predicted.
Watercourses	▪ No fracturing, ponding or mining-induced scouring is predicted for watercourses.
Conservation Area	▪ The values of the Mugii Murum-ban State Conservation Area will remain unchanged. ▪ No measurable changes to water quantity or quality are predicted for streams in the World Heritage Area. ▪ No effects on ecological systems are predicted in the Greater Blue Mountains World Heritage Area.

Environmental Issue	Overview of Key Findings
Groundwater	▪ There will be a maximum 3.5 m drawdown of a 200 m length of the Gap Creek alluvial aquifer. All other sections of Gap Creek will remain unaffected. ▪ There will be a 1.1 m drawdown of a 100 m length of the Genowlan Creek alluvial aquifer. All other sections of Genowlan Creek will remain unaffected. ▪ There will be no drawdown in The Oasis or The Grotto areas. ▪ Flows from the Village Spring are likely to cease. ▪ There will be no effect on the regional groundwater system east of the Project Application Area that supplies the registered groundwater users in that area. ▪ Existing beneficial use categories will remain for all groundwater users. ▪ There are no cumulative impacts with other industries or operations in the region.
Surface Water	▪ Increased discharges through the existing LDP001 are expected during prolonged wet weather. ▪ Discharges from LDP001 are predicted to be within relevant water quality criteria. ▪ Subsidence has been minimised and therefore there will be insignificant impacts to waterway hydraulics or geomorphology. ▪ All surface water flow in the Project Application Area is classed as ephemeral. ▪ There will be a maximum 5% reduction in total stream flow at the confluence of Gap and Genowlan Creeks. Stream flow at this point is ephemeral under current natural conditions. ▪ Airly Creek is predicted to experience a maximum cumulative increase of 14.5% in flow. ▪ There will be no cumulative impacts with other industries or operations in the region.
Ecology	▪ No significant impacts are predicted on aquatic habitats, aquatic flora or aquatic fauna and or stygofauna. ▪ The Project is unlikely to have a significant effect on EECs, threatened species of their habitats.
Aboriginal Heritage	▪ Nine Aboriginal sites will be undermined, however the low levels of subsidence and tilt as a result of mining does not pose a risk of harm to these sites. ▪ Impacts due to mining are not expected to adversely affect Aboriginal Heritage sites.
Historical Heritage	▪ Mining has been limited in the area of the Airly Village component of the Airly shale mining complex to prevent impacts to historic heritage sites. The sites at the Torbane processing site will not be undermined. ▪ Mining under components of Airly Village are not predicted to cause any subsidence-induced damage.
Traffic	▪ No changes to road infrastructure are required as a result of the project ▪ Traffic management will be required during construction.
Socio-Economic	▪ The Project will enable mining to continue over a period of approximately 20 years. This will secure ongoing employment opportunities and socio-economic flow on benefits over this time for the local community and up to 135 full time employees and up to 20 contractor positions. ▪ the net economic benefit of the Project for the State and regional communities is positive, at a net present value of $259 million over the Project forecast period to 2041.
Noise	▪ Noise will be below the project specific criteria at all privately owned residences and the Airly Campground under all meteorological conditions, including temperature inversions. ▪ Operations will meet the relevant sleep disturbance criteria. ▪ Noise from construction will be within relevant criteria. ▪ Noise levels from trains will not change due to the Project.
Air Quality	▪ Dust levels from the Project are predicted to meet relevant air quality criteria for TSP, PM_{10}, $PM_{2.5}$ and dust deposition.
Greenhouse Gas Emissions	▪ There will be a negligible increase in the annual direct (Scope 1) emissions and the Project represents approximately 0.07% of NSW GHG emissions and 0.02% of Australia's total GHG emissions.

Environmental Issue	Overview of Key Findings
Soils and Land Capability / Agricultural Suitability / Recreational use	▪ There will be no land permanently removed from agriculture as a result of the Project, either due to mining or ancillary infrastructure. The Project will only have a minimal impact due to land that will be temporarily removed from agriculture. ▪ The predominant soils within the Project Application Area have extremely low agricultural capability and the Project will have negligible to minimal impacts on soil, land and agricultural resources. ▪ The Project will have negligible impact on surface and groundwater resources relied upon by agriculture. ▪ No impact on the recreational use of the area, including the Mugii Murrum-ban SCA, is predicted.
Visual	▪ Minimal impacts on the visual character and amenity of the Project Application Area are predicted. Post-mining, the pit top area will be rehabilitated to grazing land and so reduce existing visual impacts.
Waste Management	▪ No change to the annualised (non-coal) waste materials volumes will occur due to the Project.
Hazards Management	▪ No increased environmental or safety risk from hazardous materials, spontaneous combustion, bushfire or public safety will occur due to the Project.

12.3 Project Benefits

The socio-economic assessment identifies a number of benefits as an outcome of the Project at a local, regional and state level. The Project will involve continuation of current employment and coal production rate of 1.8 million tonnes per annum. Mining will be extended for approximately 20 years.

Key Project benefits are as follows:

- The Project proposed sustainable mining of coal whilst keeping adverse environmental impacts to a minimum. Mine design technologies and engineering methodologies (i.e. narrow void widths and variable mine design zones) will minimise subsidence effects, impacts and consequences.
- The Project will secure employment for up to 155 full time equivalents (135 employees of Centennial Airly and 20 contractors) with associated flow on effects for the life of the Project.
- Airly Mine will continue to invite community participation and provide support. This helps in strengthening the social fabric of the region.
- The Project will result in improved understanding of heritage significance of the area through field surveying.
- The Mine will continue to supply ROM coal for domestic use and product coal for export.
- The Project will result in an injection of approximately $259 million (NPV) into the local, regional, state and national economies over the life of the Project. This expenditure is likely to generate additional economic activity and flow on effects, providing further employment opportunities.

Based upon the predicted minimal environmental effects and the ability of Centennial Airly to manage these effects, the Project presents a minimal residual consequence on implementation of the Statement of Commitments.

12.4 Project Alternatives

Using the extensive knowledge, gained during years of previous mining, potential environmental constraints have been taken into account by Centennial Airly during the mine design process to ensure the Project is undertaken safely and in the most environmentally sensitive manner possible.

This has included consideration of alternatives in terms of mining method, mine design and in siting surface infrastructure required to support mining operations.

The Project has also considered two REA locations and three disposal options for the management of the reject materials from the proposed CPP. The preferred location of the REA (Section 4.8.3) results in lower potential environmental impacts, and offers operational practicality and safety, potential for expansion and overall feasibility compared to the alternative REA location discussed below.

Lastly, the EIS has considered the 'Do Nothing' option, which considers the consequences of DA 162/91 lapsing.

12.4.1 Mining Method

While the full extraction mining methods have historically been used at other Western Coalfields mines for reasons of safety and productivity, their use in the Project was predicted to generate subsidence impacts not in keeping with the inherent value of the SCA. Careful analysis of local geotechnical conditions shows that partial extraction methods can be used to provide an appropriate level of productivity and safety whilst minimising the level of subsidence.

12.4.2 Mine Plan and Design

The evolution of the mine design at Airly Mine has been outlined in Chapter 8.0. The mine planning and design process considered various alternatives, elimination measures, substitution measures, engineering and administrative controls, all to minimise and manage adverse environmental impacts from the Project.

Very early in the mine design process, Centennial Airly decided that the current consented mine design would generate subsidence and associated consequences beyond that which would have been acceptable to the public, the regulators and Centennial Airly itself. The current development consent allows for:

- maximum vertical subsidence up to 1800 mm
- strains up to 42.5 mm/m
- tilts of up to 85 mm/m.

The subsidence effects from this design were expected to generate significant impacts and consequences to the physical nature of the SCA. Potential impacts to surface and groundwater systems were also considered to be potentially significant.

In the consideration of mine designs that have a locally proven track record of subsidence impact minimisation, Centennial Airly investigated the application of the subsidence minimisation practices used at Clarence Colliery, which uses the following subsidence criteria for first workings::

- vertical subsidence 20 mm
- maximum tilt of 1.0 mm/m
- maximum strain of 1.0 mm/m.

For partial extraction zones, Clarence Colliery uses the following subsidence criteria:

- vertical subsidence 100 mm
- maximum tilt of 3.0 mm/m
- maximum strain of 2.0 mm/m.

Monitoring at Clarence Colliery shows that these criteria have resulted in underground mining causing no adverse subsidence induced effects in topographical and environmental conditions similar to Airly Mine. The mine design in the Project has been based to a large extent on the successful adoption of a minimal subsidence design at Clarence Colliery. As part of the mine design process, the following options were considered, primarily around varying voids widths as this is a key determinant in subsidence effects:

- partial pillar extraction layout with void widths ranging between 50.5 m and 70.5 m
- a form of Wongawilli type extraction with narrow panels and void widths ranging between 45.5 m and 65.5 m
- panel and pillar layout with void widths ranging between 51 m and 71 m
- shortwall (extraction by continuous miner) with void widths ranging between 51 m and 71 m.

These mining methods were evaluated to understand the level of subsidence associated with each and included assessments of pillar stability. The assessment selected the preferred mining method to be a panel and pillar system with an optimal void width of 61 m at a depth of cover >160 m.

Two main factors influenced this choice; the depth of cover (H) and the void width (W), noting that the W/H ratio is the critical determining factor for estimating subsidence. It was thus also concluded that the preferred panel and pillar mining method would not be appropriate to meet the subsidence design criteria over the entire Project Application Area because of the highly variable depth of cover.

Due to the highly variable depth of cover, the mine design further considered varying partial extraction methods to achieve the subsidence design criteria and the necessary constraints upon surface damage. The following mining methods were considered:

- **Panel and Pillar Mining**: a twin entry chain pillar and a fully extracted maximum void width of 61m. Voids can be extracted by various mining methods. The resulting chain pillars would be designed to be long-term stable
- **Partial Pillar Extraction - Double-sided Lifting**: The pillars would be extracted on both sides of the roadway to a maximum depth of 10m, creating a span of 25.5 m. The intervening spine pillars would compartmentalise the span and would be designed to be long-term stable
- **Partial Pillar Extraction - Single-sided Lifting**: The pillars would be extracted on one side of the roadway to a maximum depth of 10m, creating a span of 15.5 m. The intervening spine pillars would compartmentalise the span and would be designed to be long-term stable
- **Pillar Splitting and Quartering**: This system involves splitting and quartering larger pillars on retreat with the remnants designed to be long-term stable
- **Bord and Pillar Mining:** This system involves first workings only with a continuous miner. The resulting spans would be restricted to the 5.5 m maximum width of the roadways and the intervening pillars would be designed to be long-term stable.

In addition to these mining method analyses, cliffs and pagodas were categorised and assessed in detail to provide a basis for mining designs in these zones. Appendix D provides detail on the relevant analysis, which aimed to define a mine design that:

- minimised caving heights
- reduced aquifer disturbance
- avoided inducing rocks falls or surface cracking.

12.4.3 Alternative Reject Emplacement Area Options

Three disposal options have been reviewed as viable reject emplacement options for Airly Mine through a feasibility options study (GHD 2014c) included in Appendix R. Two locations for the siting of the life of mine REA have been investigated through a wide range of technical assessments including ecology, cultural heritage, surface water and visual impacts.

Option 1: Conventional Disposal – Separate placement of coarse and fine reject materials. Coarse reject is stockpiled within the REA. The fine reject materials, in the form of a slurry, are contained within a dam that may be internal or external to the REA structure.

This option was investigated both for the proposed REA location (Section 4.8.3) and the alternate REA location shown in Figure 12.1.

Option 2: Surface Co-Disposal – Dewatering the fine reject, mixing the reject streams at the CPP, and co-disposing of the combined reject material as a "dry stack" at the REA location followed by compaction. This option was considered for both the proposed location (Section 4.8.3) and the alternate location (Figure 12.1).

Option 3: Underground Co-Disposal – Reject material is crushed to give an appropriate size distribution and mixed with water and a lubricant to allow extended pumping in pipes. The slurry is then pumped to an appropriate impoundment area within the existing underground workings.

Table 12.2 presents the details and results of the ranking system used in the evaluation of the options to recommend the preferred option of the reject emplacement location at Airly Mine. The options were evaluated in detail within the Airly Mine Reject Emplacement Options Feasibility Study (GHD, 2014c). The total score of each option is calculated using weighted average to include impact of each component/sub-component as shown in Table 12.2.

Table 12.2: Ranking of Reject Emplacement Options

Component	Weight	Option 1	Sub Option 2-1 (proposed REA location)	Sub-Option 2-2 (alternative REA location)	Option 3
Safety	**25%**	2	3.5	3.5	1
Environment	**25%**				
Visual	3%	2	3	1	4
Noise	3%	3	2	1	4
Heritage	3%	2	2	3	3
Ecology	5%	1	2	3	4
Groundwater	2%	1	3.5	3.5	2
Contamination due to seepage/runoff	9%	1	3.5	3.5	2
Operation	**16%**				
Reject Transport	7%	3	2	4	1
Constructability	4%	4	2.5	2.5	1
Required Infrastructure	4%	4	2.5	2.5	1
Maintenance	1%	3	3	3	1
Water Management	**9%**				
Pumping Head and Simplicity	2%	3	2	4	1
Water Sustainability	6%	2	3.5	3.5	1
Maintenance	1%	3.5	2	3.5	1
Cost	**25%**	4	2	3	1
Estimated Score		**2.6**	**2.7**	**3.1**	**1.5**
Rank		**3**	**2**	**1**	**4**

LEGEND

Rail

Alternative REA

Waterbody

Coordinate System: GDA 1994 MGA Zone 56

DATE	17/04/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:15,000

Figure 12.1: Alternative Reject Emplacement Area

0 100 200 300 400 500 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 12-12.1

A4

Option 1: Separate Disposal of Coarse and Fine Rejects

Of the four options analysed, this option was ranked third. It would likely be the most cost effective method when considering both capital and operational expenditure; however is the least favourable from an environmental perspective.

Safety concerns are also an issue with this option, particularly with regards to closure of the tailings storage section of the REA. The closure position would likely include capping of the tailings to prevent future oxidation and potential for acid drainage; however the low strength nature of the materials may prove unsafe for earth moving equipment.

Option 2: Co-Disposal of Reject Material

This is the preferred option at the proposed location discussed in Section 4.8.3 given that location is closer to the CPP, primarily from a cost perspective.

This option is favourable from an environmental perspective, provided any potential for acid drainage is appropriately mitigated.

Additional capital costs exist when compared to Option 1 due to the more comprehensive dewatering process of the tailings within the CPP. However, this will provide Centennial Airly with more water available for processing.

Option 3: Underground Pumped Co-Disposal

This option was found to be the least favourable of those analysed, primarily from a cost and safety perspective.

The most significant additional cost was found to be supply of pipelines capable of transporting slurry at 70% solids, with up to 5 km required given the extent of the proposed mine workings.

Due to the relatively flat dip in the coal seam (approximately 1:70), and the expected beaching profile of the slurry being between 1 in 5 and 1 in 10, deposition of the material will be labour intensive as the rejects may need to be mechanically moved within the underground workings. This will present safety issues due to the combination of confined spaces, poorer ventilation at the work site and changes to the geotechnical stability, as well as the introduction of water underground.

12.4.4 Do Nothing Option

A Do Nothing option to renew Airly Mine's development consent through the proposed Project would result in cessation of mining on 12 October 2014. The result of this would be the immediate loss of 58 staff currently employed at the Airly Mine. There would also be a loss of revenue to the State Government in the form of royalties and taxes as well as losses of revenue to the Federal Government in the form of taxes and other revenues.

Social impacts will also be experienced. At a community level, all the employees come from either the Lithgow LGA or the Mid-Western LGA. Both these LGAs rely significantly on incomes generated by mining to sustain local economic and social activity and both have been impacted by the recent difficult market conditions on the coal sector. The majority of the current employees at Airly Mine are from the Kandos and Rylstone areas that have been particularly impacted recently with the closure of the cement plant at Kandos and the completion of underground mining at Charbon Mine. The loss of these positions at Airly Mine will have a negative impact on the sustainability of these communities. This would be felt by local businesses that derive part of their income from spending by the mine and its employees.

The potential economic benefit of the Project is detailed in Chapter 6.0 and Appendix N. Closure of operations at Airly Mine will result in a potential loss of up to $344 million to the community as the mine would not be sustainable for any significant length of time on a care and maintenance basis. This should be compared to a social cost of the project of $85 million. Closure of the mine would incur a net loss to the community.

Airly Mine surface facilities and the Project more broadly have been designed to minimise impacts on other sectors in the local area. Tourism, recreation, agriculture and conservation activities are all continuing and even growing in parallel with the current operation. It is expected that due to the low impact of the Project, there will be no additional impact to these sectors. Closure of the mine would be unlikely to provide any measurable improvement in these other sectors of the local economy.

12.5 Ecologically Sustainable Development

The concept of sustainable development came to prominence at the World Commission on Environment and Development (1987), in the report titled "Our Common Future", which defined sustainable development as:

> *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

The overall objectives of Ecological Sustainable Development (ESD) are to use, conserve and enhance natural resources. This ensures that ecological processes are maintained facilitating improved quality of life, now and into the future.

In recognition of the importance of sustainable development, the Commonwealth Government developed a National Strategy for Ecologically Sustainable Development (Commonwealth of Australia, 1992) that defines ESD as:

> *Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.*

To this end, the National Strategy for Ecologically Sustainable Development was developed with the following core objectives:

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations
- to provide for equity within and between generations
- to protect biological diversity and maintain essential processes and life support systems
- to support development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

ESD is an objective of the EP&A Act under Section 5(a)(vii) and is a required assessment consideration under Schedule 2, Part 3, clause 7(4) of the *Environmental Planning and Assessment Amendment (Part 3A Repeal) Regulation 2011.*

ESD can be achieved through the implementation of the following principles and programmes:

- The ***precautionary principle***, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- ***Intergenerational equity***, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations
- ***Conservation of biological diversity and ecological integrity***, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration
- ***Improved valuation, pricing and incentive mechanisms***, namely, those environmental factors should be included in the valuation of assets and services.

In addition to the four ESD principles above, the EPBC Act identifies a fifth principle for consideration in environmental impact:

- Decision making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations.

These five principles are interrelated and need to be considered both individually and collectively as part of determining whether or not a project will be consistent with the principles of ESD.

12.5.1 Application of the Principles of ESD to the Project

Centennial Airly is committed to the principles of ESD and understands that social, economic and environmental objectives are interdependent. The principles of ESD have been applied in Project design, planning and assessment through:

- incorporation of risk assessment (Chapter 9.0) and analysis at various stages in the Project design and environmental assessment and within decision-making processes
- thorough consideration of mine design and mining technique in consideration of the geotechnical, hydrogeological and ecological interactions (Chapter 8.0)
- implementation of an adaptive management and avoidance approach to minimise the subsidence impacts (Chapter 8.0)
- numerous design iterations to minimise and where possible avoid impacts to the environment and community (Chapter 8.0)
- consultation with regulatory and community stakeholders (Chapter 7.0)
- assessment of potential greenhouse gas emissions associated with the Project (Section 10.8)
- optimisation of the economic benefits to the community arising from the development of the Project.

12.5.2 The Precautionary Principle

The precautionary principle reinforces the need to take risk and uncertainty into account, particularly in relation to threats of irreversible environmental damage. In the application of the precautionary principle, at Airly Mine, decisions have been guided by careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and by an assessment of the risk-weighted consequences of various options

A rigorous and conservative approach to project planning and design has been employed for the Project as follows.

- As a precursor to initiating the environmental assessment process, a Broad Brush Risk Assessment was completed and issued with the Briefing Paper for the Project. This identified key issues relating to the Project which pose the greatest environmental risk and the likelihood and consequence of occurrence.
- A Subsidence Constraints Analysis was conducted in September 2013, to follow on from the Broad Brush Risk Assessment.
- Implementation of mine design criteria to avoid, through minimising subsidence effects on sensitive surface features.
- Water management measures have been devised to reduce erosion and sedimentation impacts.
- Asensitivity analysis of the key predictive models for subsidence.
- A range of mitigation measures will be adopted to minimise the potential for adverse environmental impact. These include physical controls such as subsidence management plans, the development of

environmental management and monitoring programmes, contingency measures, compensatory measures and ecological initiatives (Chapter 10.0).

12.5.3 Social Equity, Inter-Generational Equity

Social equity is defined by intergenerational equity, which is centred on the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

The primary objective of the Project is to allow continued operations of the existing Airly Mine and maintain continuity of coal production, optimising resource recovery for the life of mine in an environmentally and socially responsible manner.

This EIS has addressed the principles of social equity through:

- assessment of the socio-economic impacts of the Project, including the distribution of impacts between stakeholders, various consultation activities and consideration of the potential socio-economic costs of climate change (Chapters 6.0 and 7.0)
- engagement of suitably qualified and experienced technical specialists to ensure that the environmental assessment phases of the Project have been transparent
- management strategies, mitigation measures and monitoring programmes to minimise adverse impact upon the local environment and nearby communities. Emphasis has been placed on anticipation, avoidance and mitigation of potential impacts, as opposed to undertaking later remedial action
- implementation of compensatory measures and ecological initiatives during the life of the Project to compensate for potential localised impacts that have been identified for the development.

These actions and initiatives will assist in ensuring that current and future generations can enjoy equal and equitable access to social, environmental and economic resources through the maintenance of the health, diversity and production of the environment.

The Project will benefit current and future generations through the maintenance and expansion of employment and regional expenditure. The Project will continue to provide stimulus to local and regional economies and provide NSW export earnings and royalties, thus contributing to future generations through social welfare, amenity and infrastructure.

The greenhouse gas assessment has calculated Project emissions and compared with State and National totals. This indicates that the Centennial Airly Mine Extension Project Scope 1 emissions represent approximately 0.07% of NSW emissions and 0.02% of Australian GHG emissions.

Centennial Airly is committed to addressing the effects of operations and is undertaking research and development into reducing emissions generated by mine operations. Airly Mine 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 alignment with biodiversity offsets, and switching to biodiesel fuel if feasible. These measures are being investigated and all measures taken to offset GHG emissions associated with the Project will be in alignment with industry standards.

The most likely method of directly reducing Scope 2 GHG emissions from the site will be through the ongoing implementation of the site's Environmental Management Plan, which will continue to identify where potential savings in electricity could be made, together with the subsequent implementation of energy efficiency strategies where practical.

12.5.4 Conservation of Biological Diversity and Ecological Integrity

The principle of conservation of biological diversity and ecological integrity holds that it should be a fundamental consideration for development proposals.

For the purposes of this EIS, ecological integrity has been considered in terms of ecological health and ecological values. The potential environmental impacts of the Project, including upon ecological communities and habitat values, and measures to ameliorate these potential impacts have been assessed. The Project has sought to avoid, minimise and mitigate potential impacts on ecological values within the Project Application Area through a risk based approach that minimises surface impacts on the surrounding ecology. A great emphasis has been placed on avoidance to minimise adverse impacts in the first instance as opposed to remedial action at a later date. Specifically, the alternate REA option was not chosen, partly because it contains an endangered ecological community. The preferred option was initially designed with a water treatment dam that would have been partly within an endangered ecological community, and so was redesigned to avoid it.

A specialist ecological investigation was undertaken for the Project (including identification and assessment of any EECs (Section 10.2). A detailed baseline review and extensive surveys, along with avoidance of clearing known locations of threatened plants and formulating a mine design cognisant of ecological values, have all informed an analysis of the residual consequences of the Project.

In accordance with ESD principles, the Project addresses the conservation of biodiversity and ecological integrity by proposing an environmental management framework designed to conserve ecological values where practicable after consideration of potential Project impacts. Due to the very limited ecological impacts, no biodiversity offset strategy is proposed.

12.5.4.1 Greenhouse Gas Emissions

Natural ecosystems are vulnerable to climate change and projected changes in climate will have ecological implications. Habitat for some species may expand, contract and/or shift with the changing climate, resulting in habitat losses or gains, which could prove challenging, particularly for threatened species.

Valuation of potential impacts of greenhouse gas emissions has been incorporated in the Air Quality Assessment (Appendix L) for the Project.

12.5.4.2 Measures to Maintain or Improve the Biodiversity Values of the Surrounding Region

The Project has been designed to avoid impacts on biodiversity. This will be achieved through the minimisation of impacts to any EECs and other ecological communities through the implementation of the proposed mine design criteria and clearing of threatened species and EECs. The original Site Securiy Gate location was found to contain grassland areas that may be commensurate with the derived grassland component of Box-Gum Woodland. A redesign of the footprint of this facility has avoided those areas determined to have potential to meet the identification criteria of derived grasslands under the TSC Act and EPBC Act.

The alternative REA assessed and rejected (Section 12.4.3) contains 5.84 ha of woodland vegetation, including 0.79 ha of the Box-Gum Woodland listed community with a complete overstorey. This location is in close proximity to the threatened species *E. cannonii*. If this alternate REA location had been selected, the Project would have required the clearing of the Box-Gum Woodland, resulting in direct impacts on the Box-Gum Woodland, and indirect impacts on *E. cannonii*. This alternate REA location also contains 16 hollow-bearing trees while the proposed REA (Section 4.8.3) contains four hollow bearing trees. The proposed REA however is located within cleared land that supports a small proportion of area (3.27 ha) Box-Gum Woodland derived grasslands EEC. Overall, selecting the proposed REA location over the alternate REA assessed and rejected has resulted in significantly higher impacts for vegetation, flora and fauna being avoided.

The measures taken with respect to the avoiding the original location of the Site Security Gate and avoiding clearing of Box-Gum Woodland within the alternative REA option, in conjunction with the proposed rehabilitation strategy (Section 10.2.7.4) will allow the Project to maintain or improve the biodiversity values of the surrounding region in the medium to long-term.

Pit top facilities will be rehabilitated and revegetated to grazing land once these facilities are no longer required. There will be progressive rehabilitation of infrastructure sites on decommissioning. The progressive rehabilitation and life of mine rehabilitation will ensure minimal disturbance areas at any time.

12.5.5 Improved Valuation and Pricing of Environmental Resource

The principle of improved valuation, pricing and incentive mechanisms deems that environmental factors should be included in the valuation of assets and services, and that those who generate the pollution and waste should bear the cost of containment, avoidance or abatement. The cost associated with using or impacting upon an environmental resource, together with remediation costs is seen as a cost incurred to protect that resource.

While historically, environmental costs have been considered to be external to Project development costs, improved valuation and pricing methods attempt to internalise environmental costs and include them within Project costing. Economic analysis (Appendix N) estimates the value of social and environmental costs at approximately $85 million.

To this end, Centennial Airly acknowledges and accepts the financial costs associated with all the measures required for the mine to avoid, minimise, mitigate and manage potential environmental and social impacts for the Project.

The Socio-Economic Assessment analyses the Project and incorporates environmental values via direct valuation where practicable (e.g. greenhouse gas emissions of the Project and impacts of ROM coal transport by rail for export). Wherever possible, direct environmental effects of the Project are internalised through the adoption and funding of mitigation measures by Centennial Airly to mitigate potential environmental impacts.

The cost benefit analysis in Appendix N indicates a benefit-cost ratio of 4.0.

12.6 Conclusions

Airly Mine is a well-established underground coal mine, with well-defined surface and mining environments. Due to knowledge gained from historical operations at Airly Mine and Clarence Colliery, Airly Mine has an excellent understanding of mine design principles and requirements for the protection of surface features, and management of potential environmental impacts.

The Project requires approval under Part 4 Division 4.1 of the EP&A Act. As such, an assessment of the short, medium and long term impacts of the Project, taking into account the principles of ESD has been described in this chapter. The existing Airly Mine Environmental Management System, and the Statement of Commitments, provided in Chapter 11.0, forms the environmental mitigation, management and monitoring requirements for the Project. Airly Mine is committed to achieving sustainable development. The assessments and predictions made in this EIS will be subject to extensive environmental monitoring to ensure that they are verified and corrective actions implemented if and when necessary.

The technical studies have concluded that no significant alteration to the supporting physical or hydrological environments is likely to occur as a result of the Project. The Project will not prejudice future use of land in the area or affect the land use of adjacent areas.

A key Project benefit is the sustainable mining of coal with no significant environmental impact.

The socio-economic output of the Project will continue to provide direct and indirect employment and flow on benefits to the Lithgow Government Area and the surrounding region. There will be an injection of approximately $259 million (NPV) into the local, regional, state and national economies over the life of the Project. As such this is a state significant resource.

Based upon the predicted environmental impacts of the Project and the ability to manage these impacts to minimise harm to the environment, the Project will present an overall minimal residual consequence.

The Project meets environmental performance and socio-economic benefit requirements to be considered for approval.

The Project can be appropriately managed and result in residual consequences that do not have significant impacts on the receiving environment.

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Cover photos:
Airly Mine Panorama
Canyon on Genowlan Mountain

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