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.

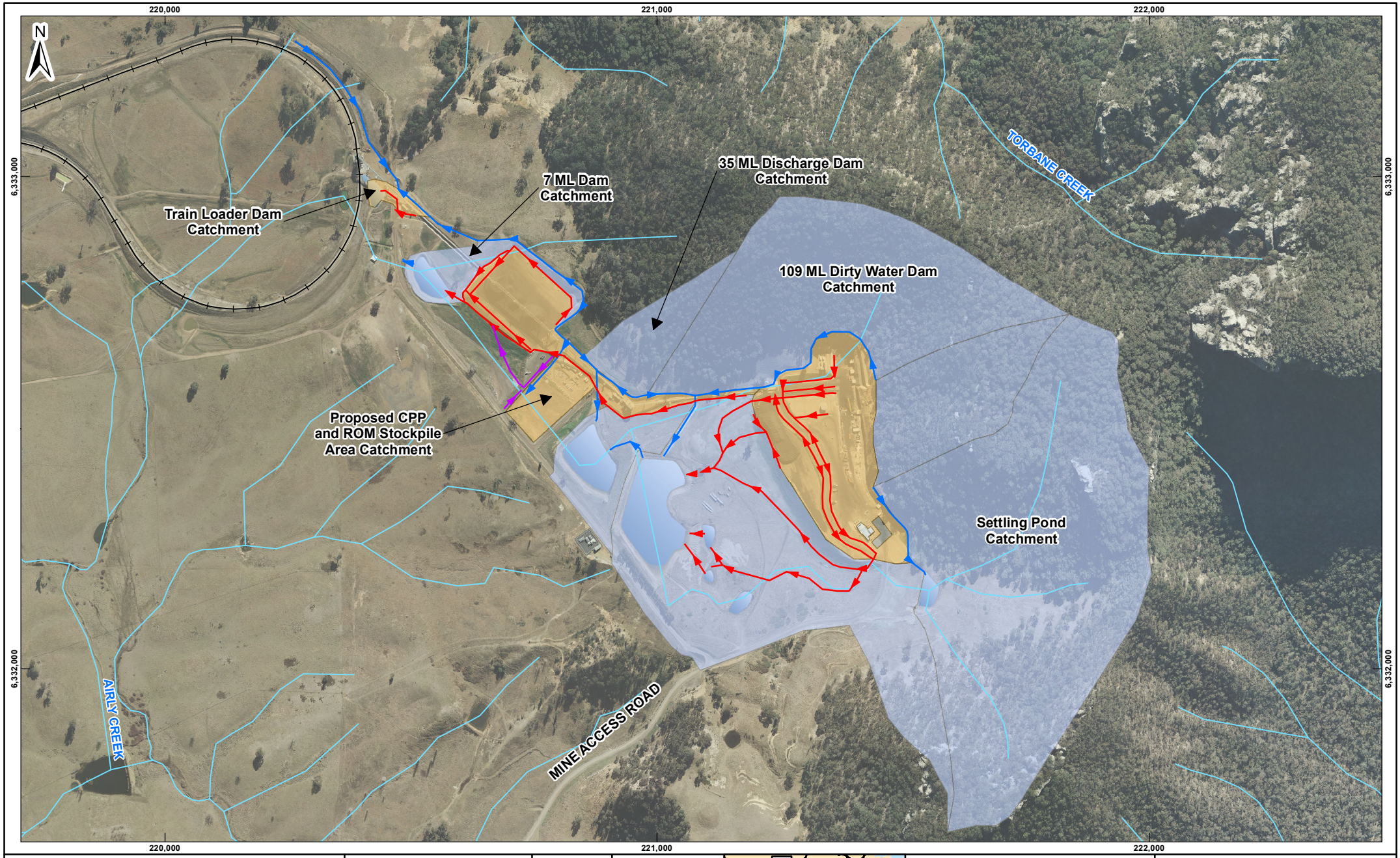
Regional groundwater sources occur within strata well below the target coal measures and extend laterally beyond the Project Application Area. According to the Western Coalfield (Southern Part) Regional Geology 1:100,000 map, the deeper Shoalhaven Group was deposited in a marine environment and therefore 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.

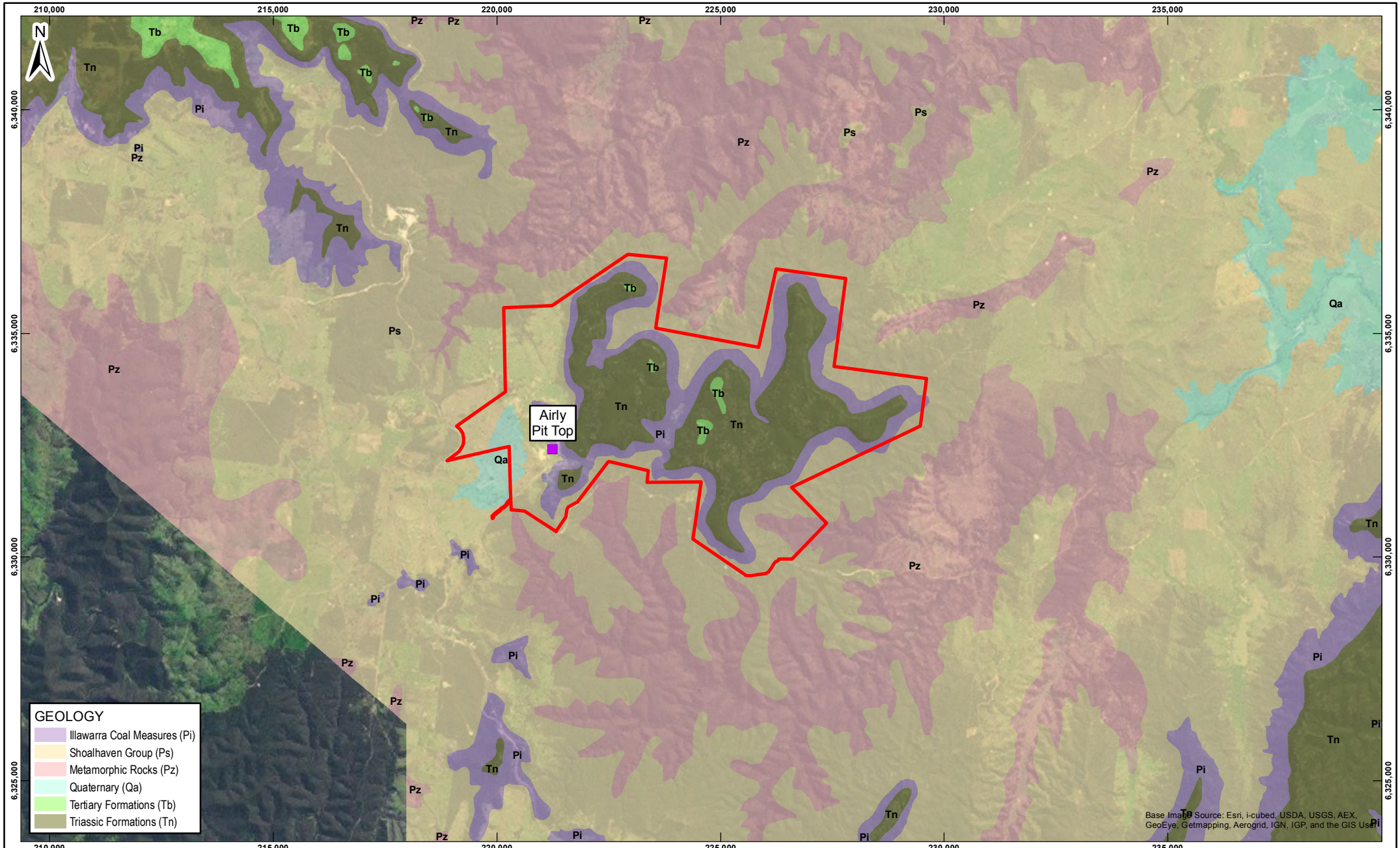
Depressurisation of the Permian strata under proposed operations is predicted to be up to 7.5 m within the fracture zones overlying the Lithgow Seam and up to 6 m within the underlying Marrangaroo Formation. Under currently approved operations, depressurisation would have been up to 12 m within the fracture 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

DATE	15/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:110,000

Figure 10.2: Geological Map

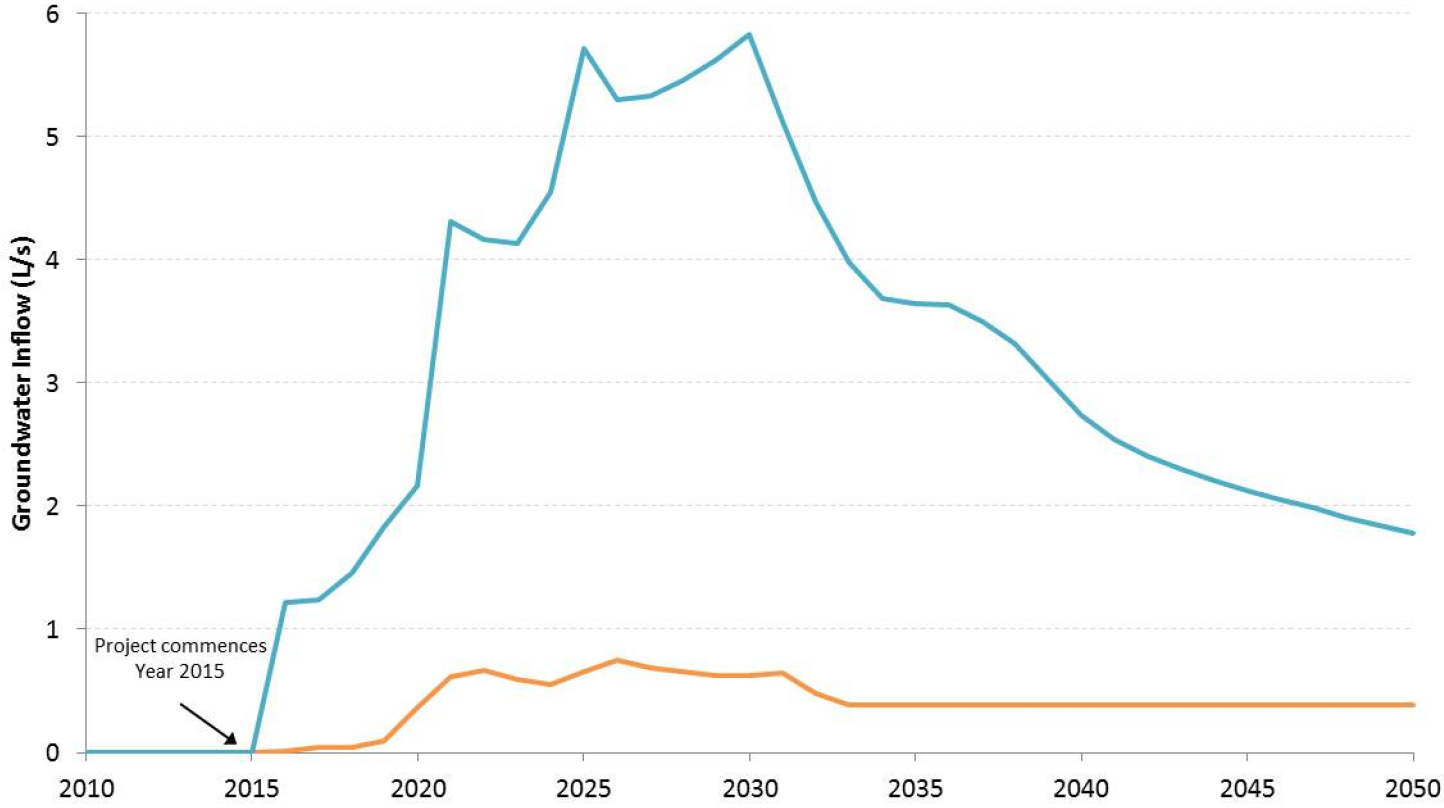
0 1,000 2,000 3,000 4,000 Metres

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

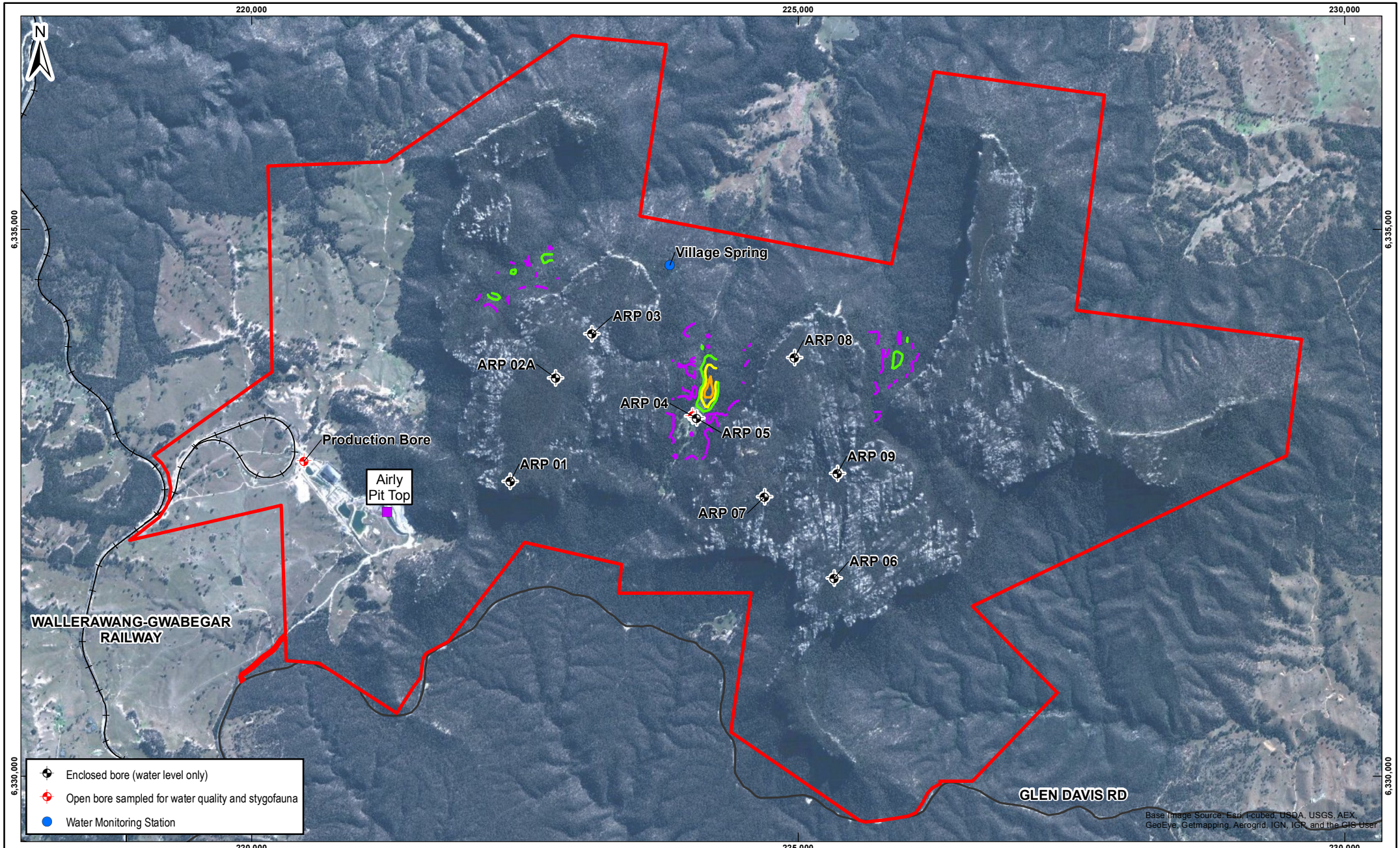
Figure 10.3: Modelled Groundwater Inflows for Proposed Conditions

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

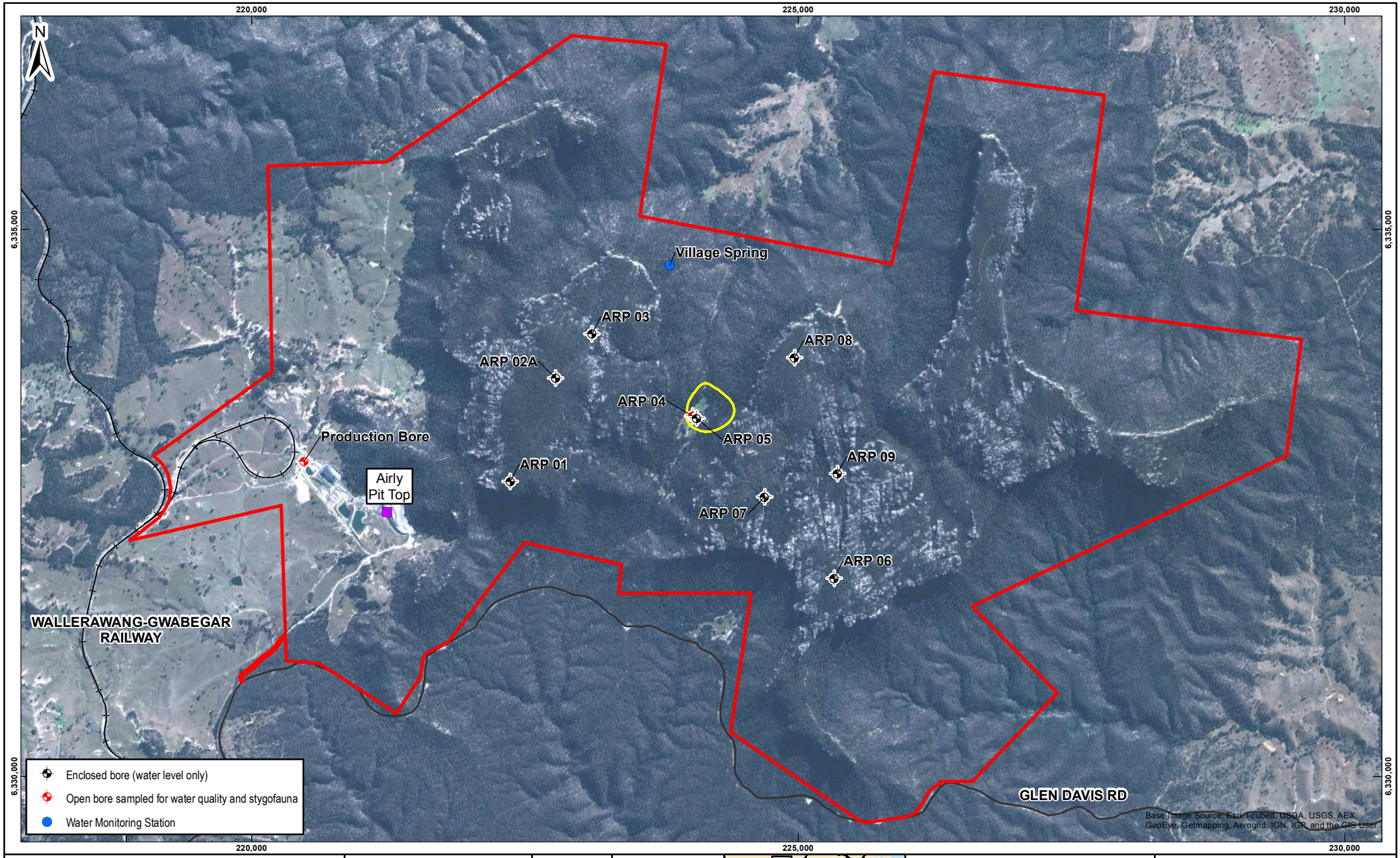
0 500 1,000 1,500 2,000 Metres

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

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	Trap Nights	500	531	200	200	2,600	2,617	600	646	3,900	3,994
Large mammals	Cage	Trap Nights	120	114	48	48	624	630	144	156	936	948
Arboreal mammals	Arboreal B	Trap Nights	120	122	48	48	624	626	144	156	936	952
Various sized mammals	Hair Tube Terrestrial	Trap Nights	180	250	80	150	1020	946	225	230	1,425	1,576
	Hair Tube Arboreal	Trap Nights	180	250	80	150	1020	950	225	230	1,425	1,580
	Motion detection Camera	Trap Nights	N/A	15	N/A	8	N/A	64	N/A	48	N/A	135
Bats	Harp trap	Trap Nights	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	Hours	8	2.2	4	4.8	52	62	12	28	76	97
	Spotlighting in car	Hours	0.8	1.2	0.1	1.1	2.5	11.5	1.2	3.7	4.6	17.5
	Call Playback (mammals)	Hours	4	8	2	5	25	23	5	5	36	41
	Call Playback (birds)	Hours	31 locations at 1km apart across the site.					41 play back sessions undertaken at various sites spread throughout the site				
Diurnal birds	Area Search	Hours	N/A	6	N/A	10	N/A	52	N/A	16.7	N/A	84.7
Reptiles	Habitat Search	Hours	4	22	1	3	25	26	5	3	35	54
	Spotlighting	Hours	4	2.2	1	4.8	25	62	5	28	35	97
Amphibians	Habitat Search	Hours	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.

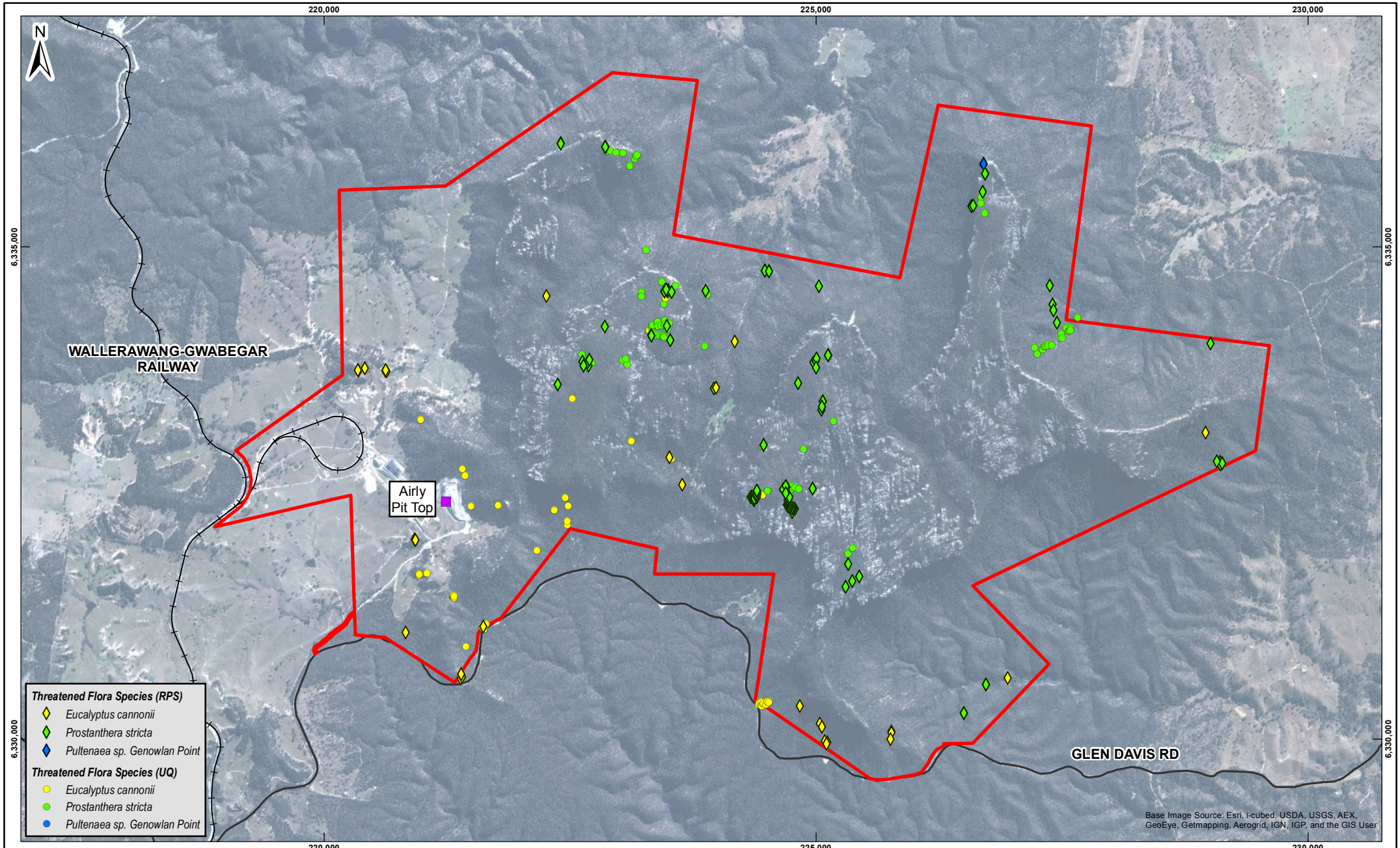
Eucalyptus cannonii (Capertee Stringybark)

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)

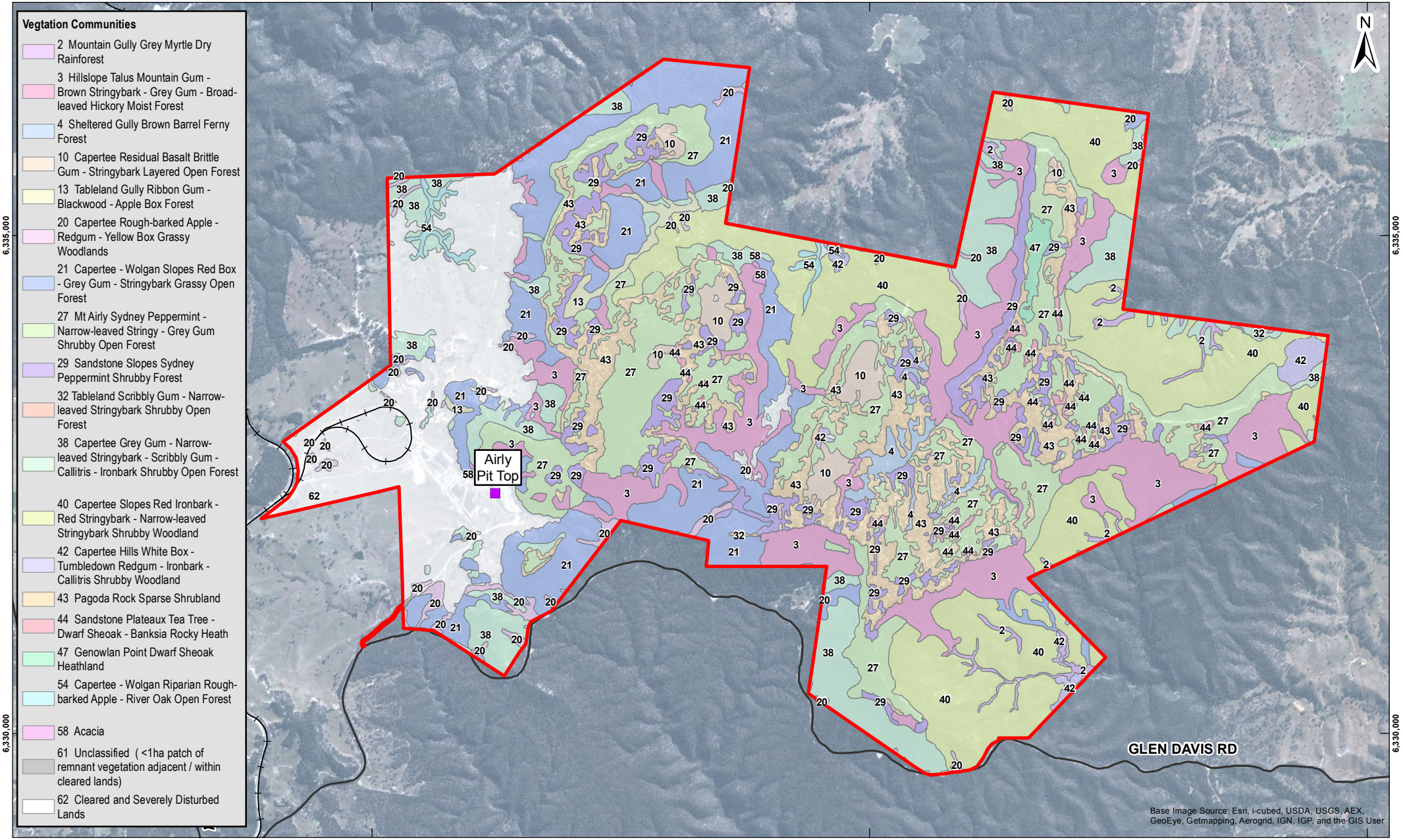
The species occurs as a single population at Genowlan Point. The population of approximately 50 individuals is restricted to a very small area of only 250 square metres. The species occurs on well-drained stony soil near a cliff edge.

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

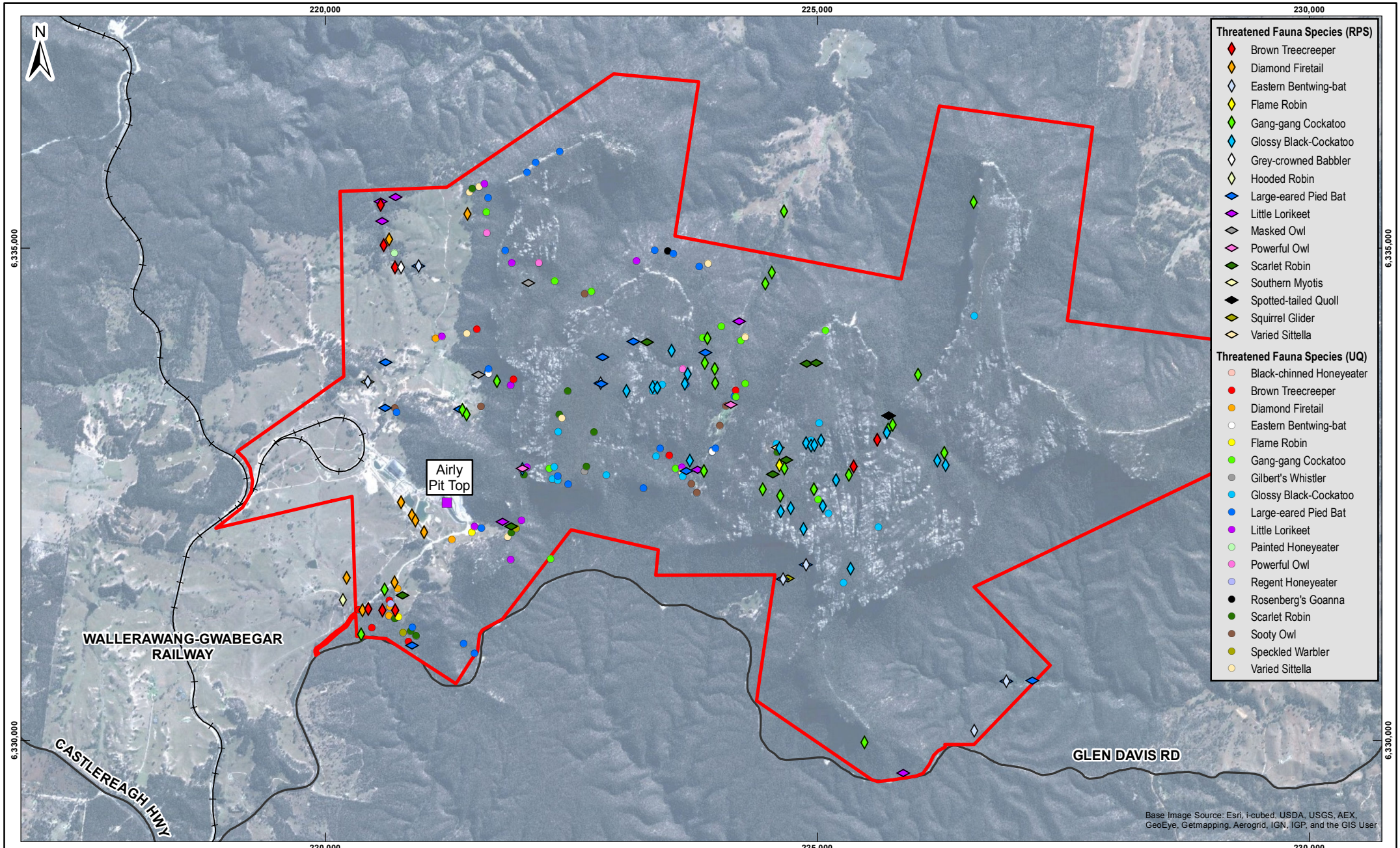
The Project Application Area is located on the western margin of a large system of protected areas (including the Greater Blue Mountains World Heritage Area) that surrounds the western rim of the Sydney Basin, preserving the sandstone-based links between the Sydney, Hunter and Central West regions of 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

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

Figure 10.8: Location of Threatened Fauna Species

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

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.

Subsidence

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.

Water Quality and Sedimentation

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:

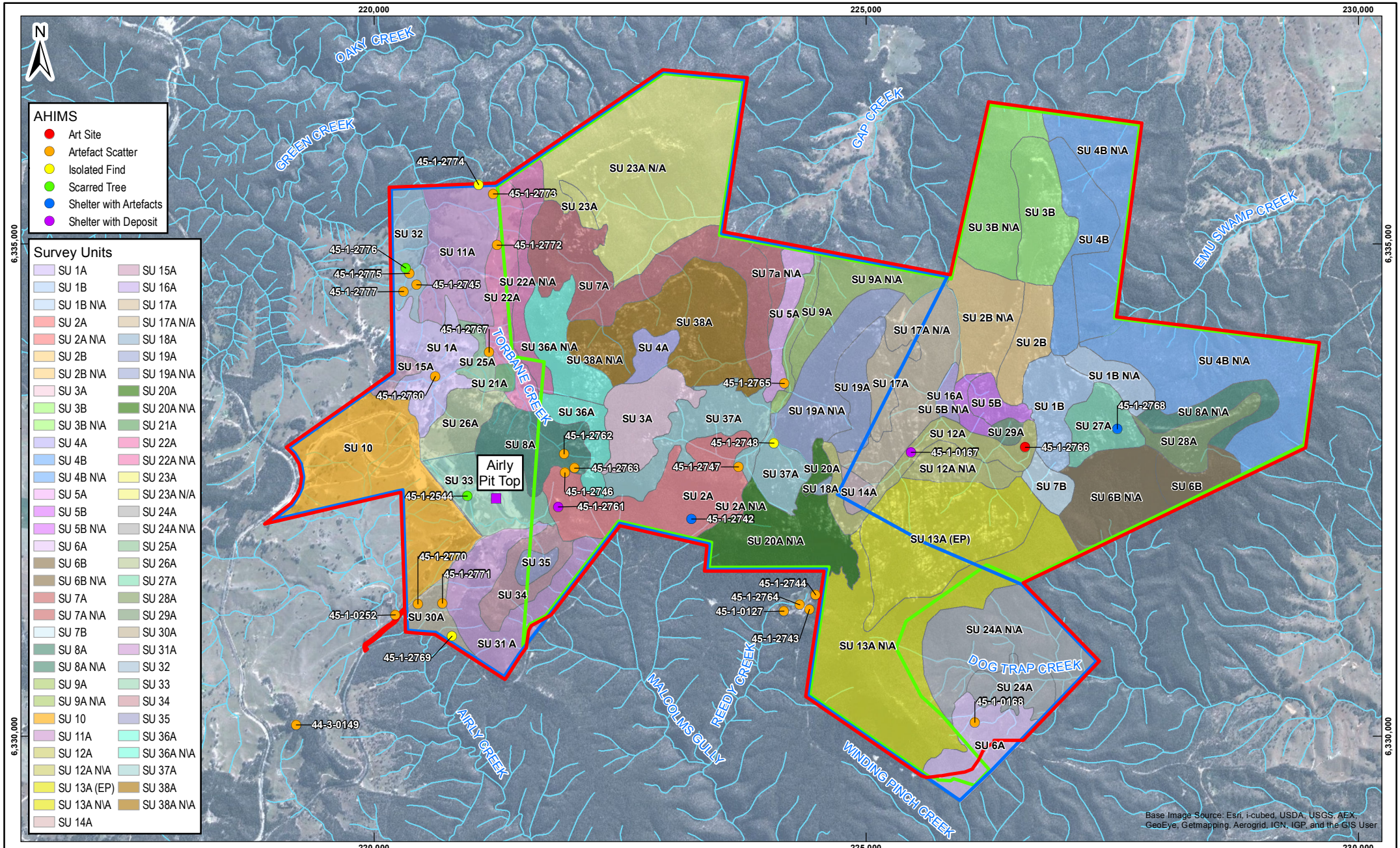
- Brayshaw, 1990, Airly Mine (Authorisation Area A232) archaeological assessment for Environmental Impact Statement
- Brayshaw, 1991, Airly Mine (Authorisation Area A232) follow up archaeological assessment to assess potential impacts, for Environmental Impact Statement
- Mills, 1998 Airly Mine, archaeological 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

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

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.

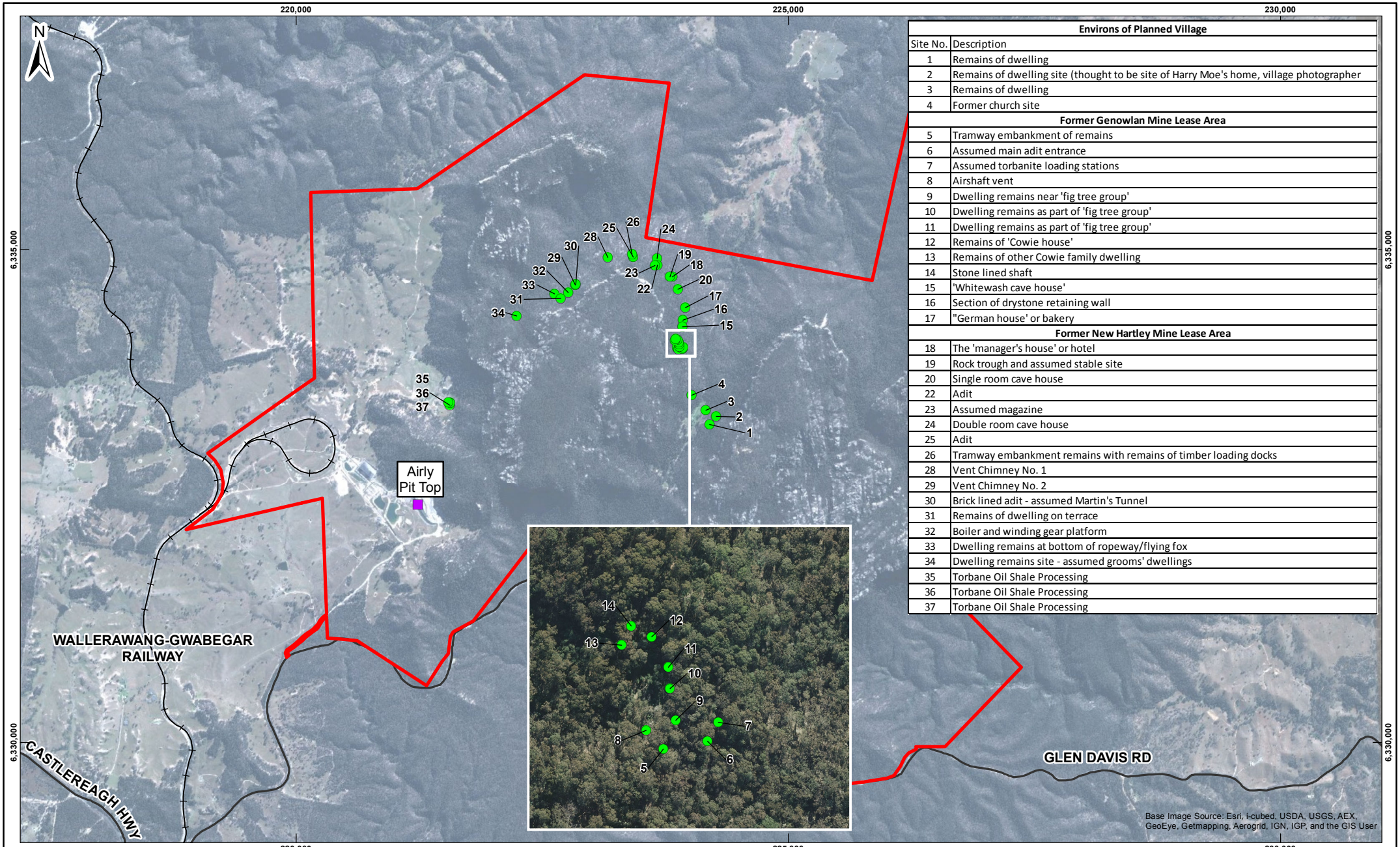
Four adits have been identified previously, however, there are understood to be many more associated with early shale and coal mining activities throughout the mountain.

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.



Environs of Planned Village	
Site No.	Description
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

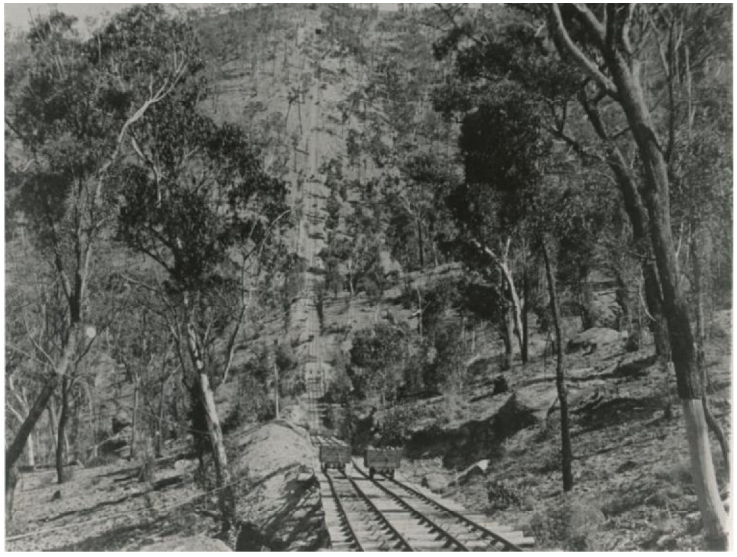


Plate 93 Tramway at Airly (ref LDHS0669, from the LDHS held at the Lithgow Library Learning Centre (Date unknown)

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

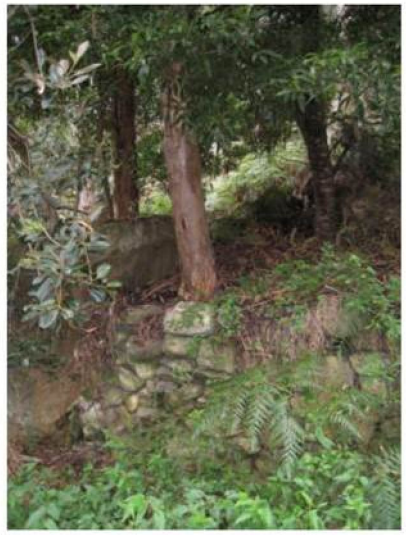


Plate 119 Site 13

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

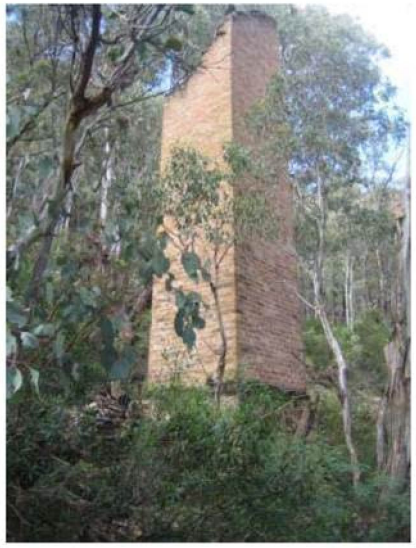


Plate 132 Site 29

Vent Chimneys 1 & 2

Plate 133 Site 30

Brick Lined Adit (assumed 'Martins's tunnel) sits alongside Ventilation Chimney No. 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 (95^{th} percentile)	80 dBA

Note: 95^{th} 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

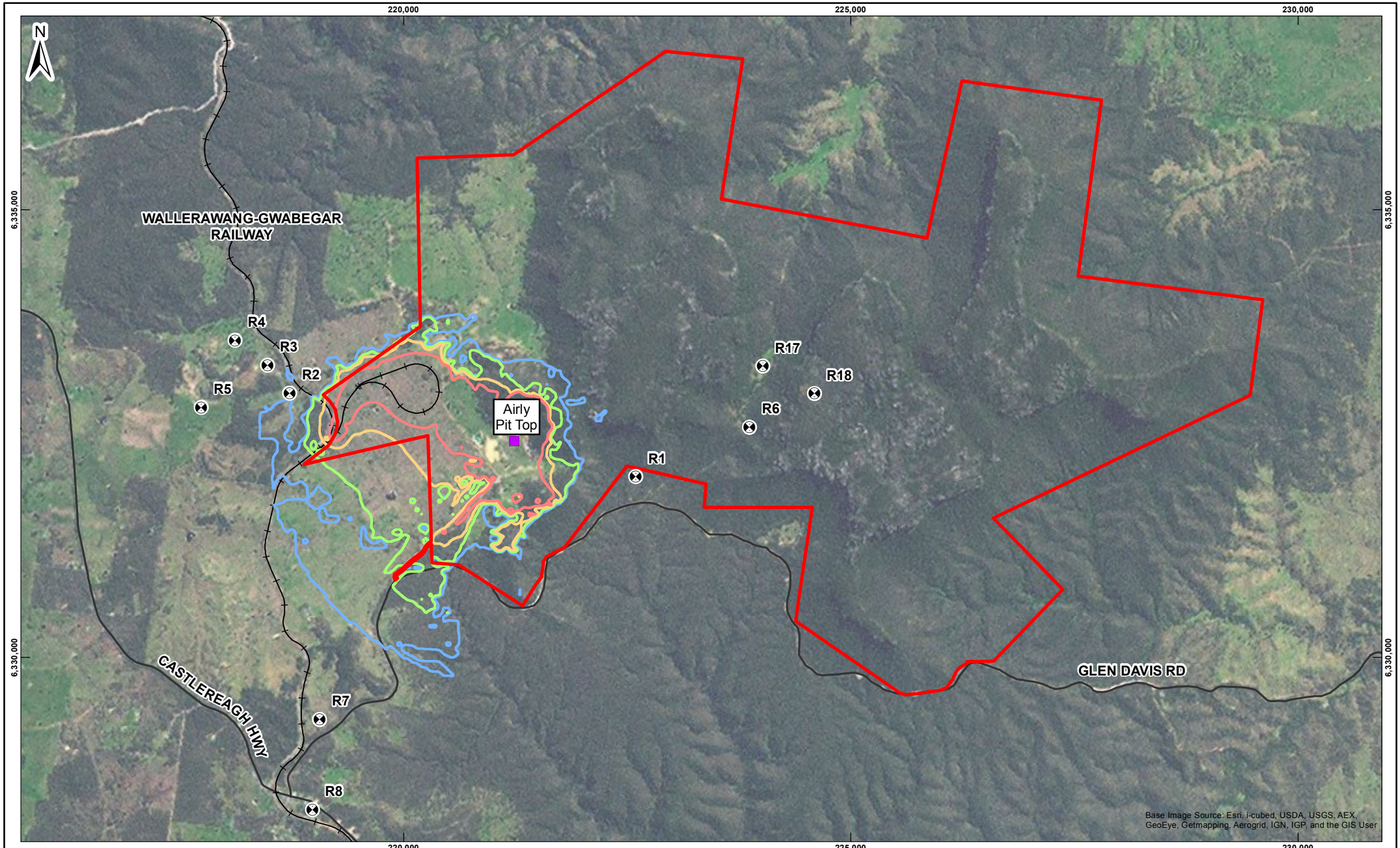
Noise predictions for operations at sensitive receivers are presented in Table 10.35**,** with reference to the relevant Project specific noise criteria during calm weather and for temperature inversions.

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

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

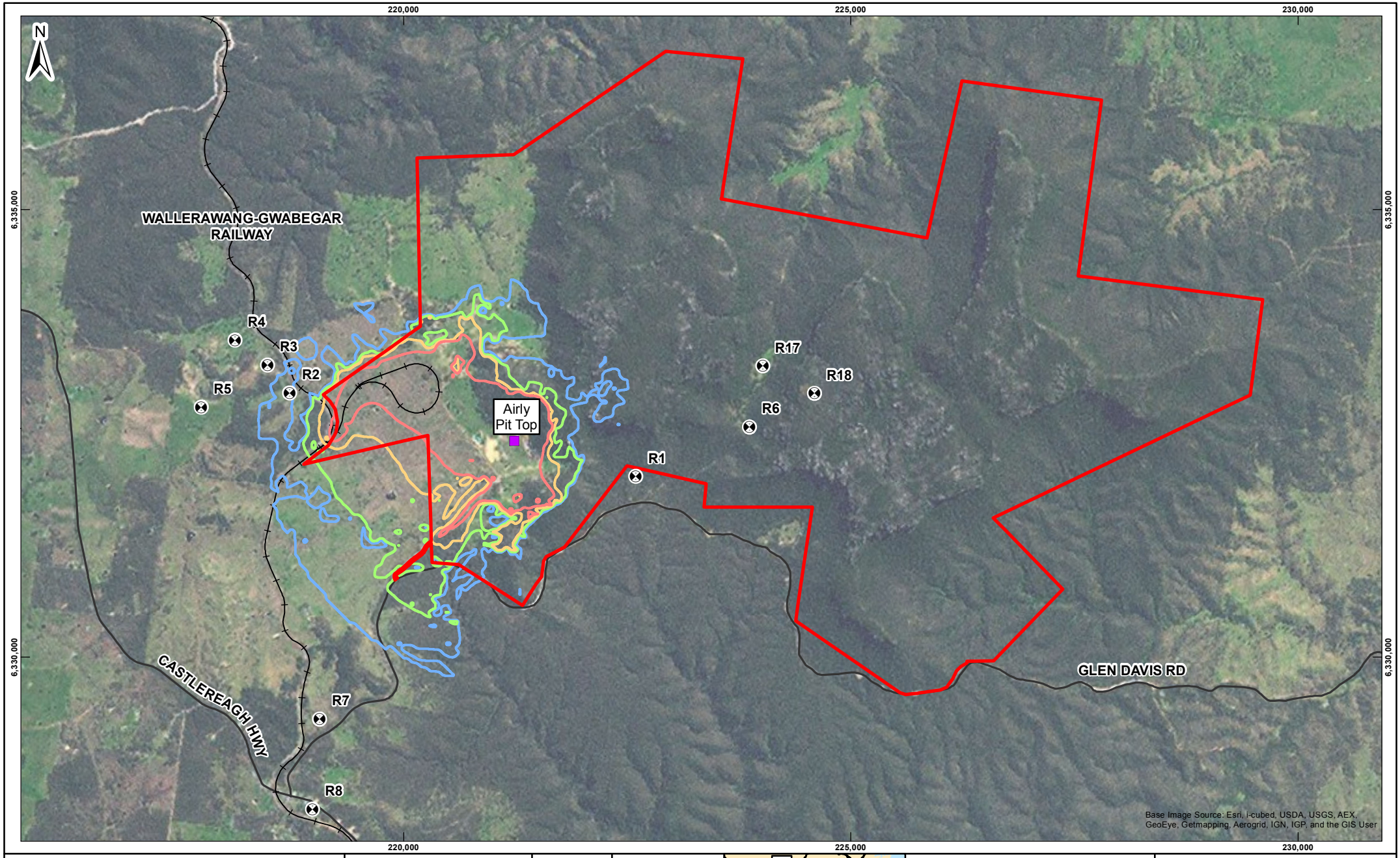
Figure 10.11: Predicted Existing Operational Noise LAeq (15min) - Night time Prevailing Winds

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

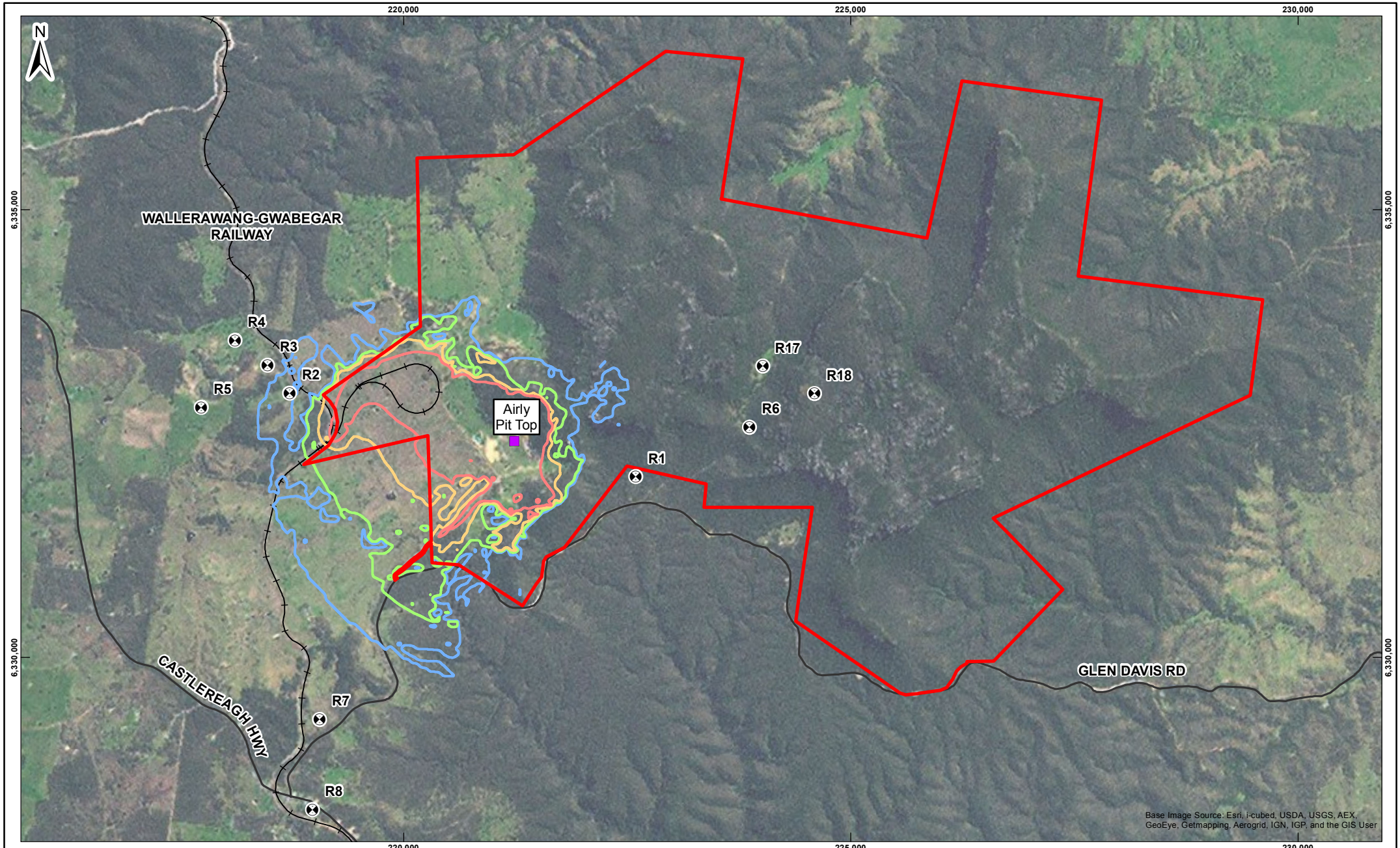
0 500 1,000 1,500 2,000 Metres

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

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 L_{Amax} 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) 1 hour when in use	
			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:

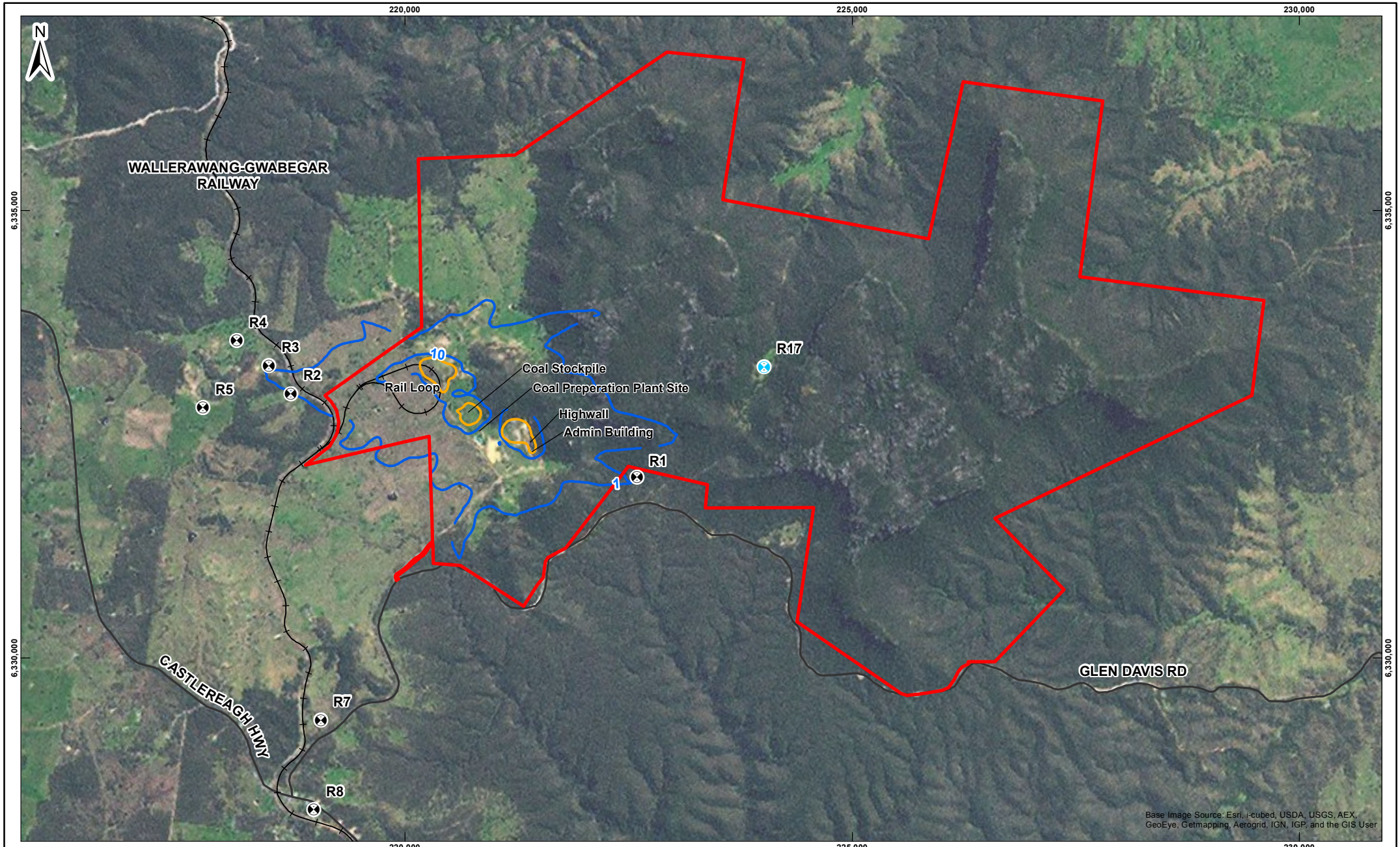
- handling, processing and transportation of ROM coal and product coal
- handling and transportation of coal rejects

- 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

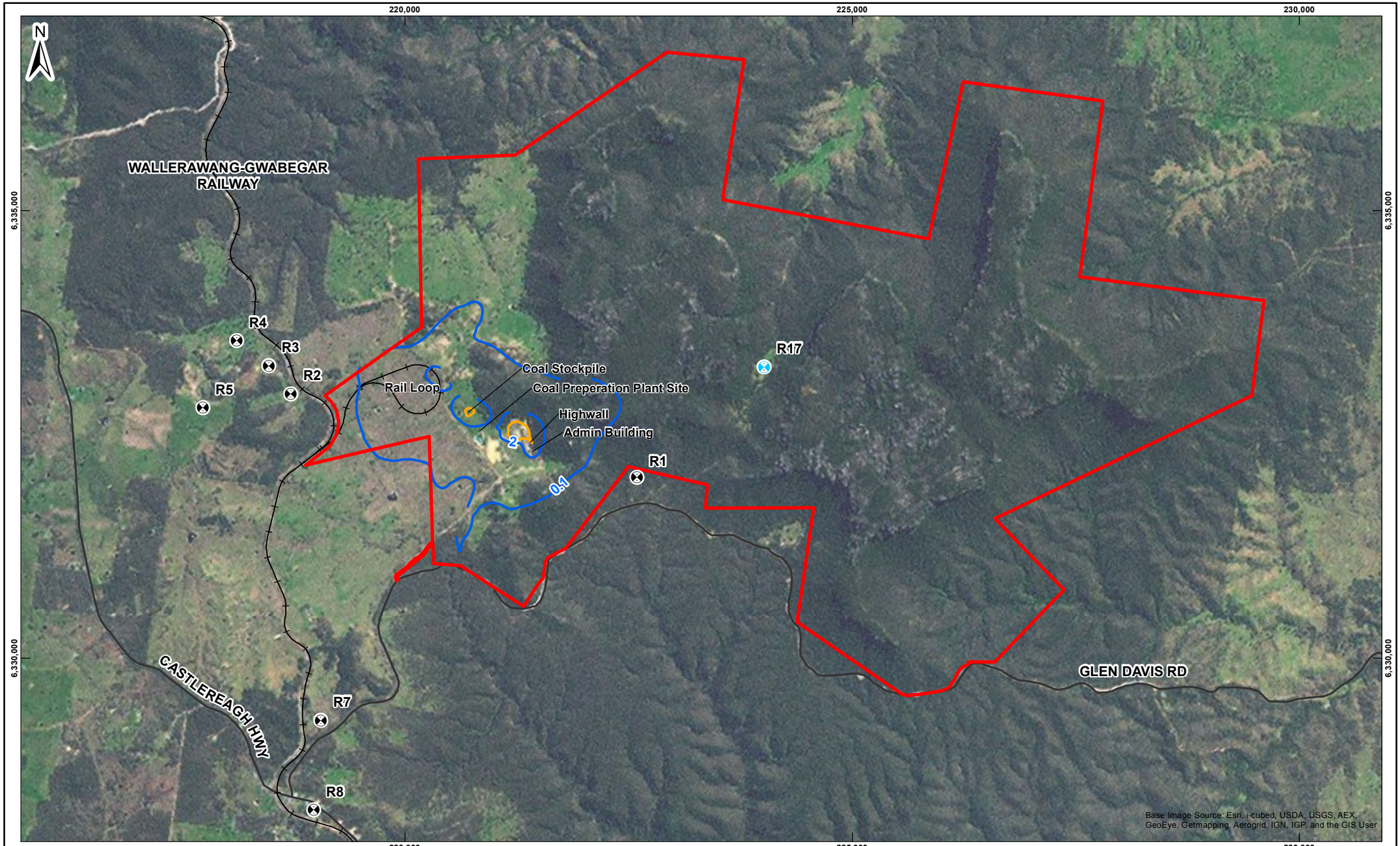
0 500 1,000 1,500 2,000 Metres

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

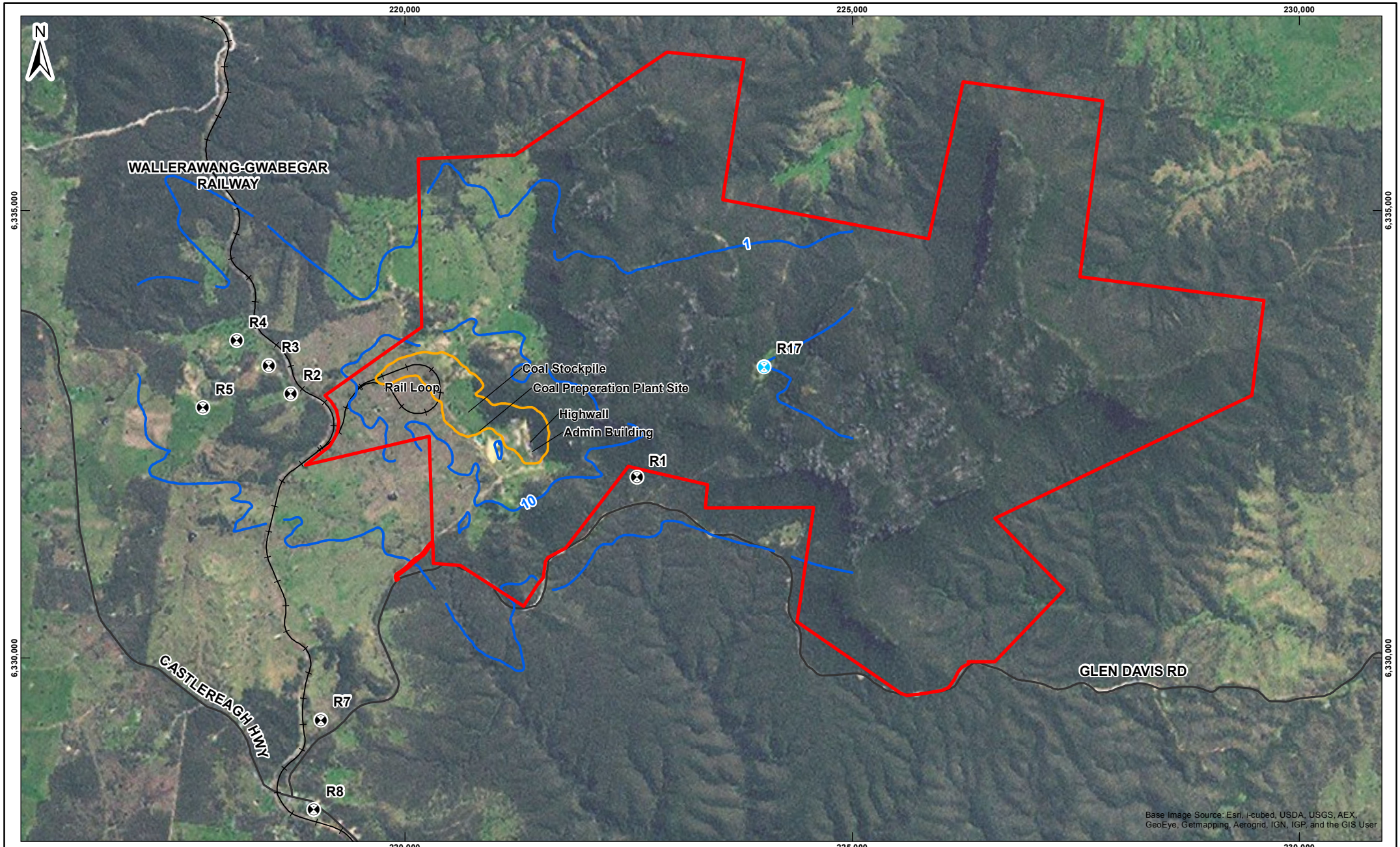
0 500 1,000 1,500 2,000 Metres

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

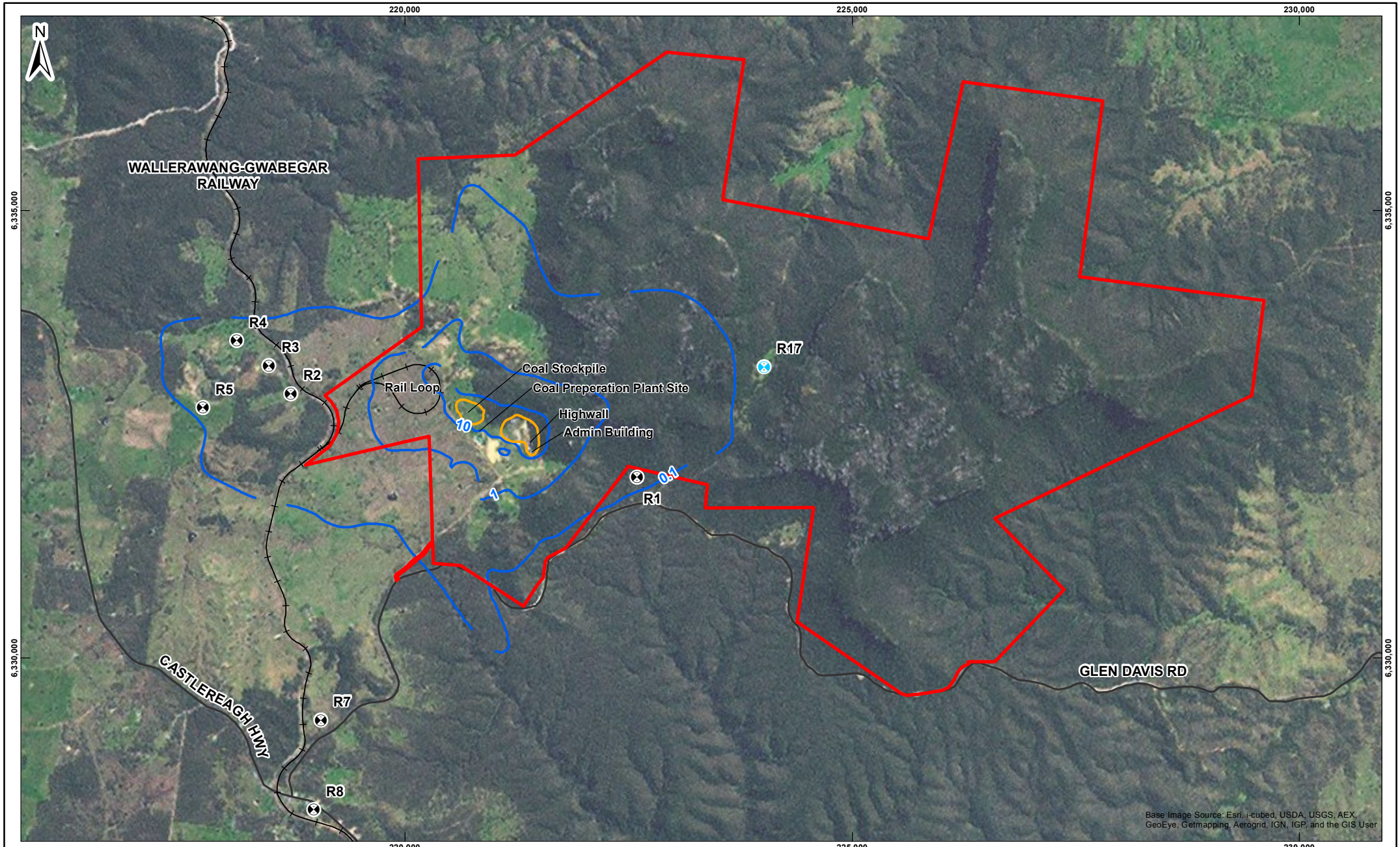
0 500 1,000 1,500 2,000 Metres

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

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:55,000

Figure 10.17: Existing PM10 - Annual Average Scenario 1a

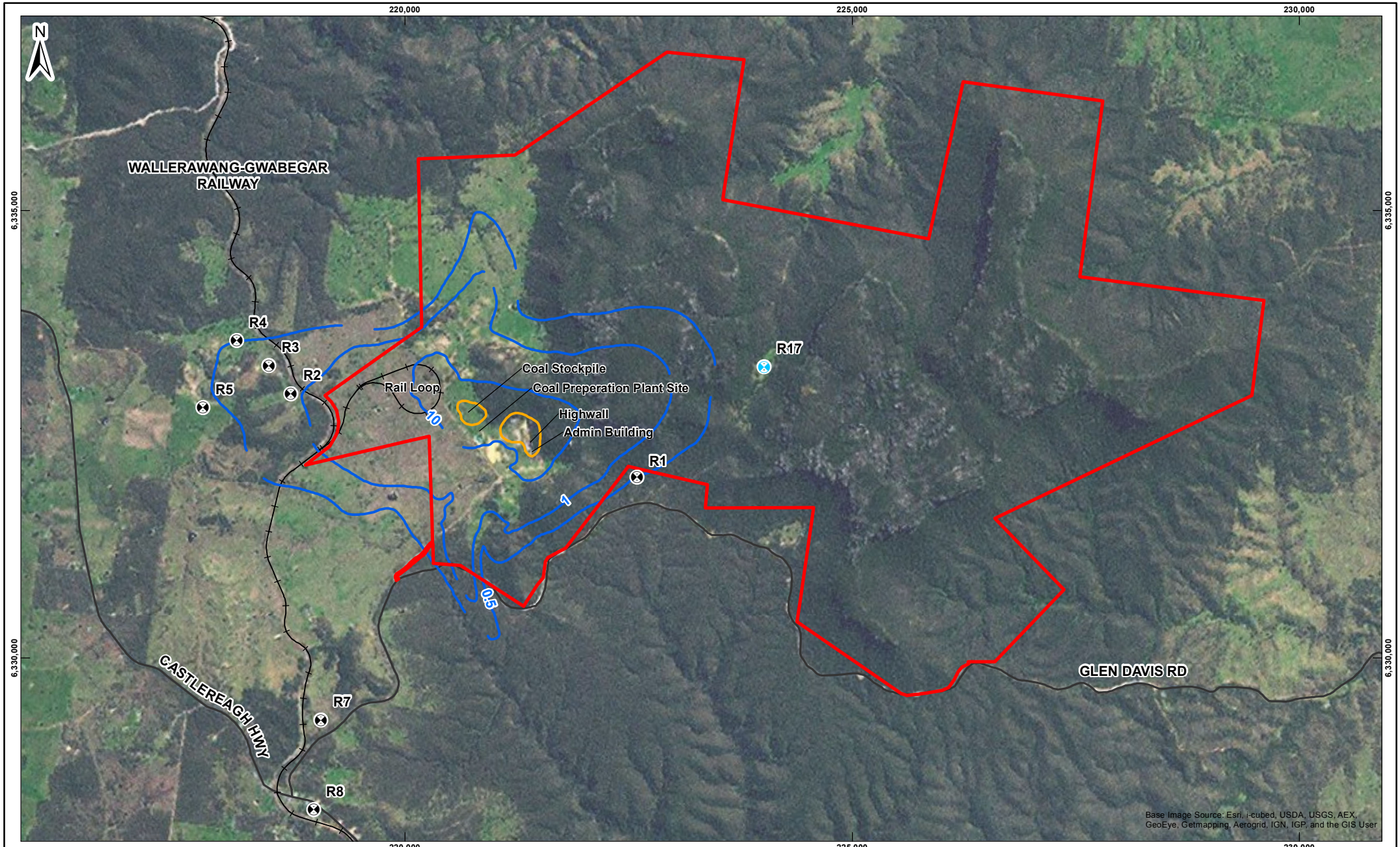
0 500 1,000 1,500 2,000 Metres

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

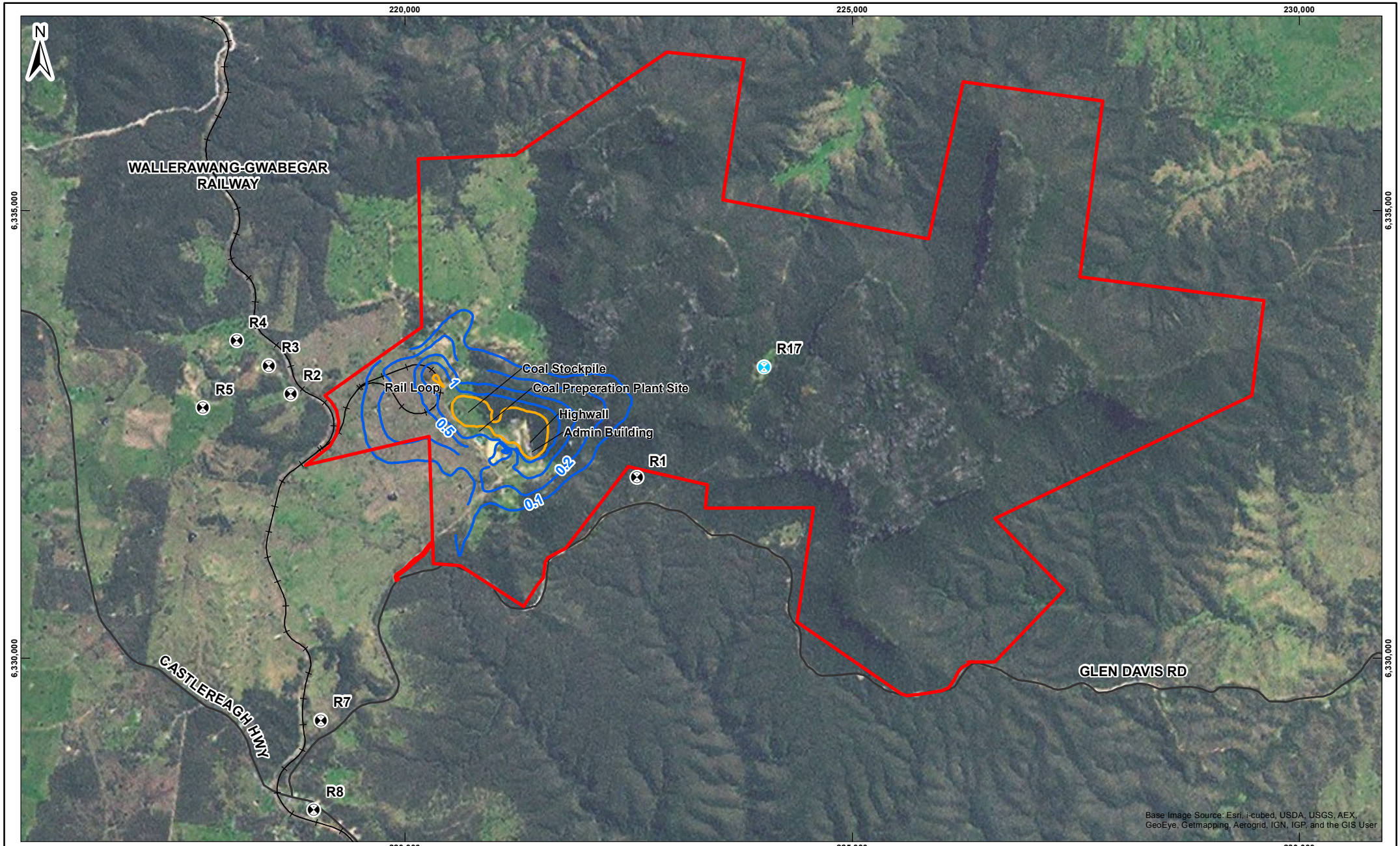
0 500 1,000 1,500 2,000 Metres

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

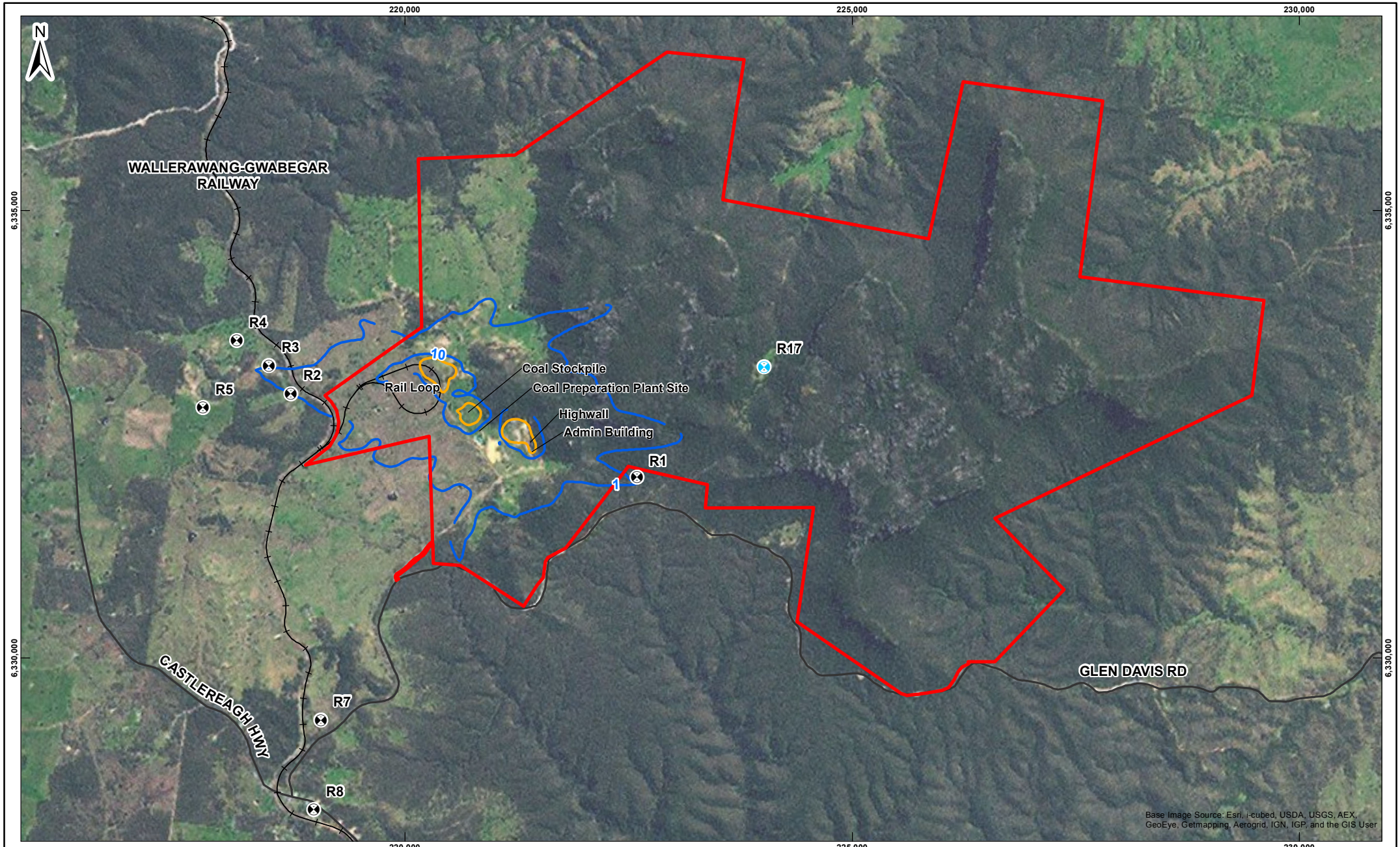
0 500 1,000 1,500 2,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG NO. 10-10.19

A4



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

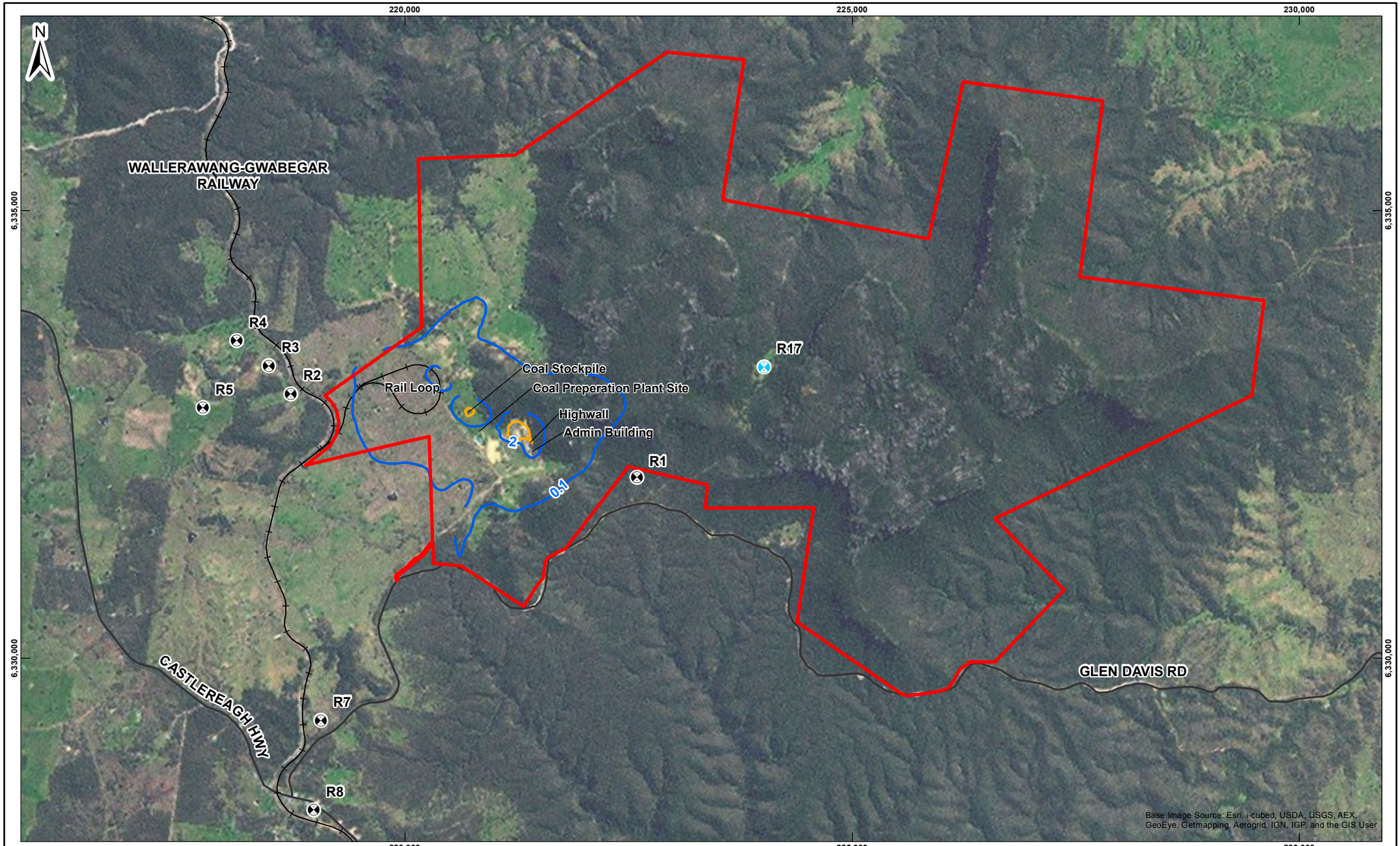
0 500 1,000 1,500 2,000 Metres

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

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

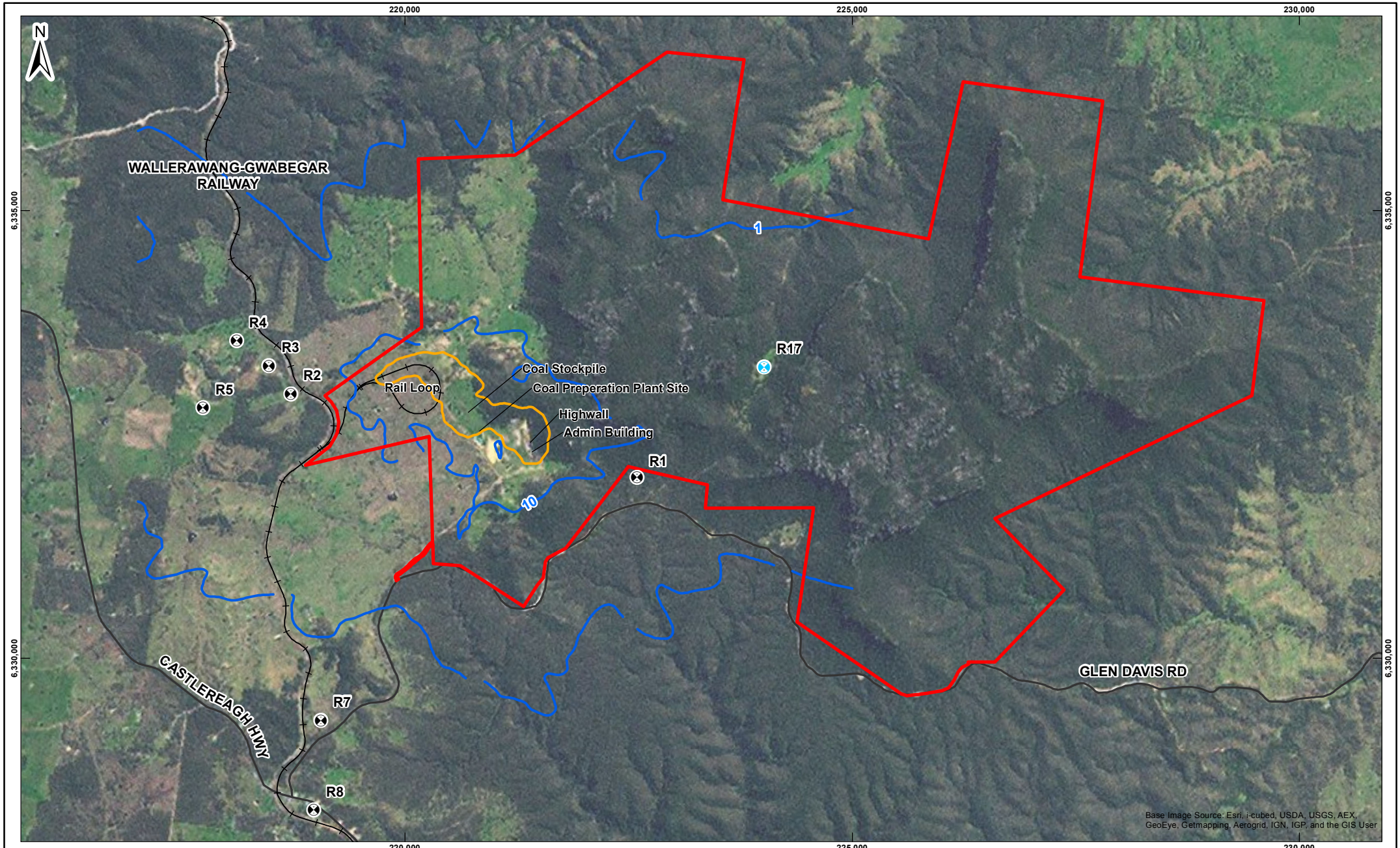
0 500 1,000 1,500 2,000 Metres

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

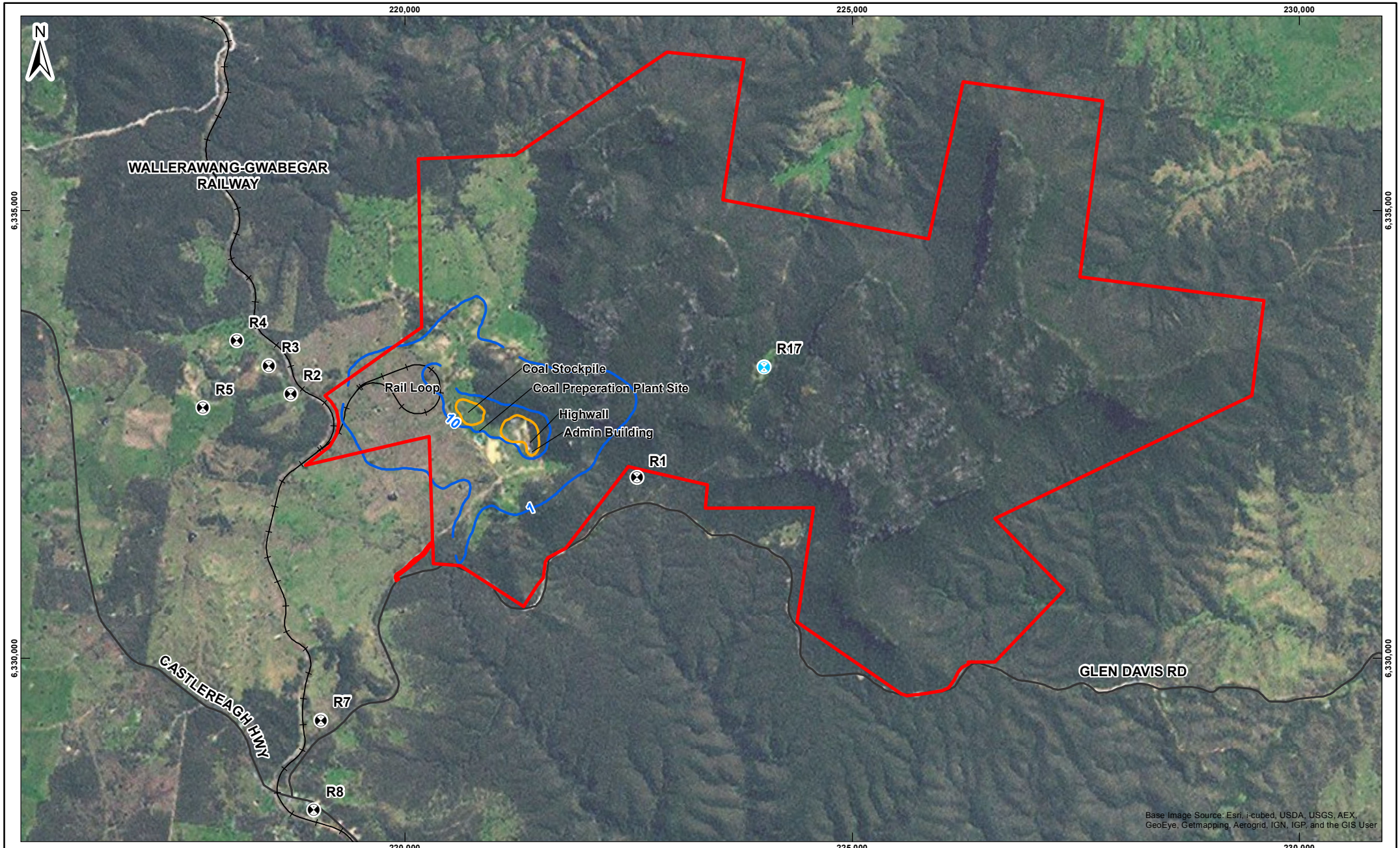
0 500 1,000 1,500 2,000 Metres

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

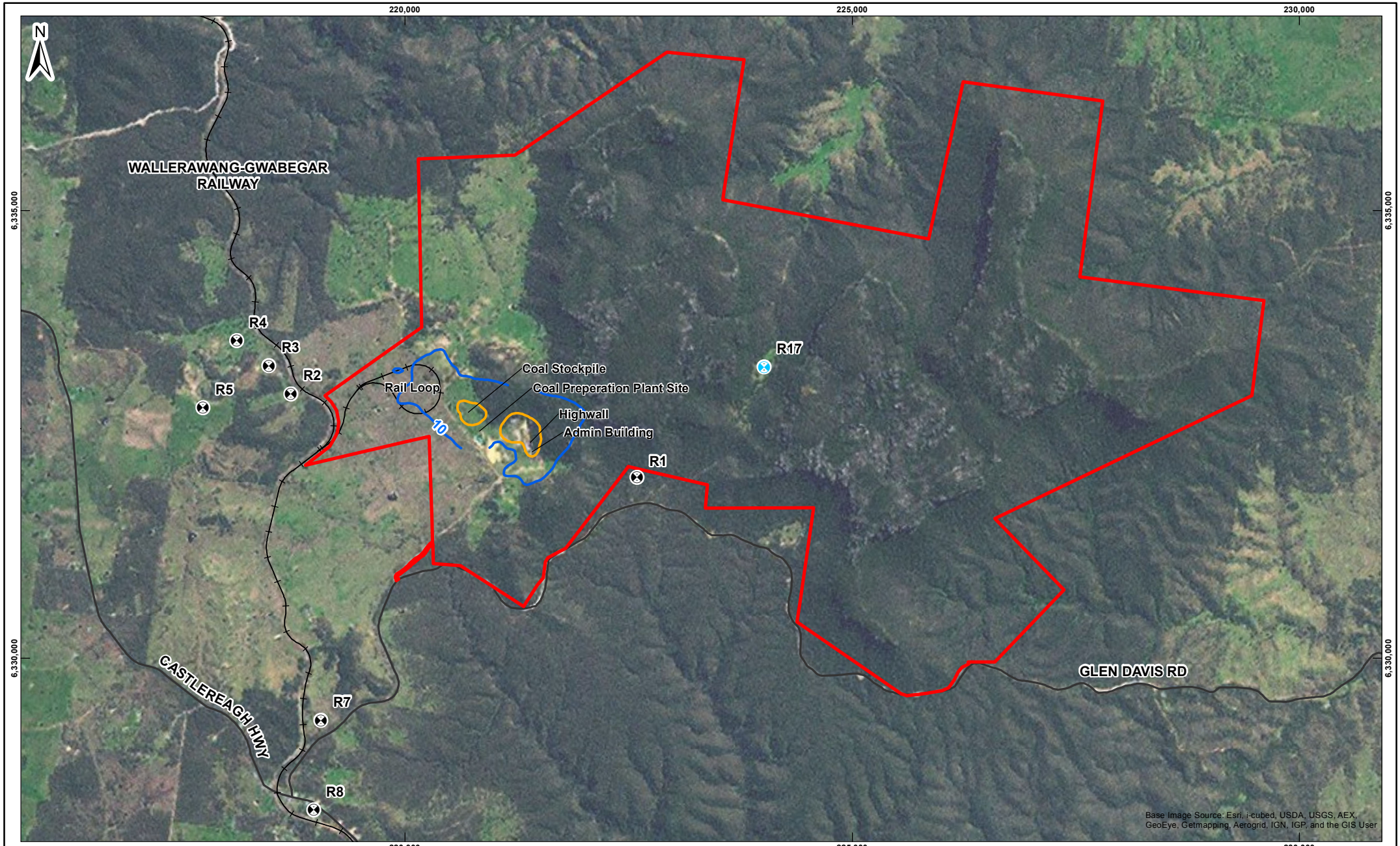
0 500 1,000 1,500 2,000 Metres

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

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

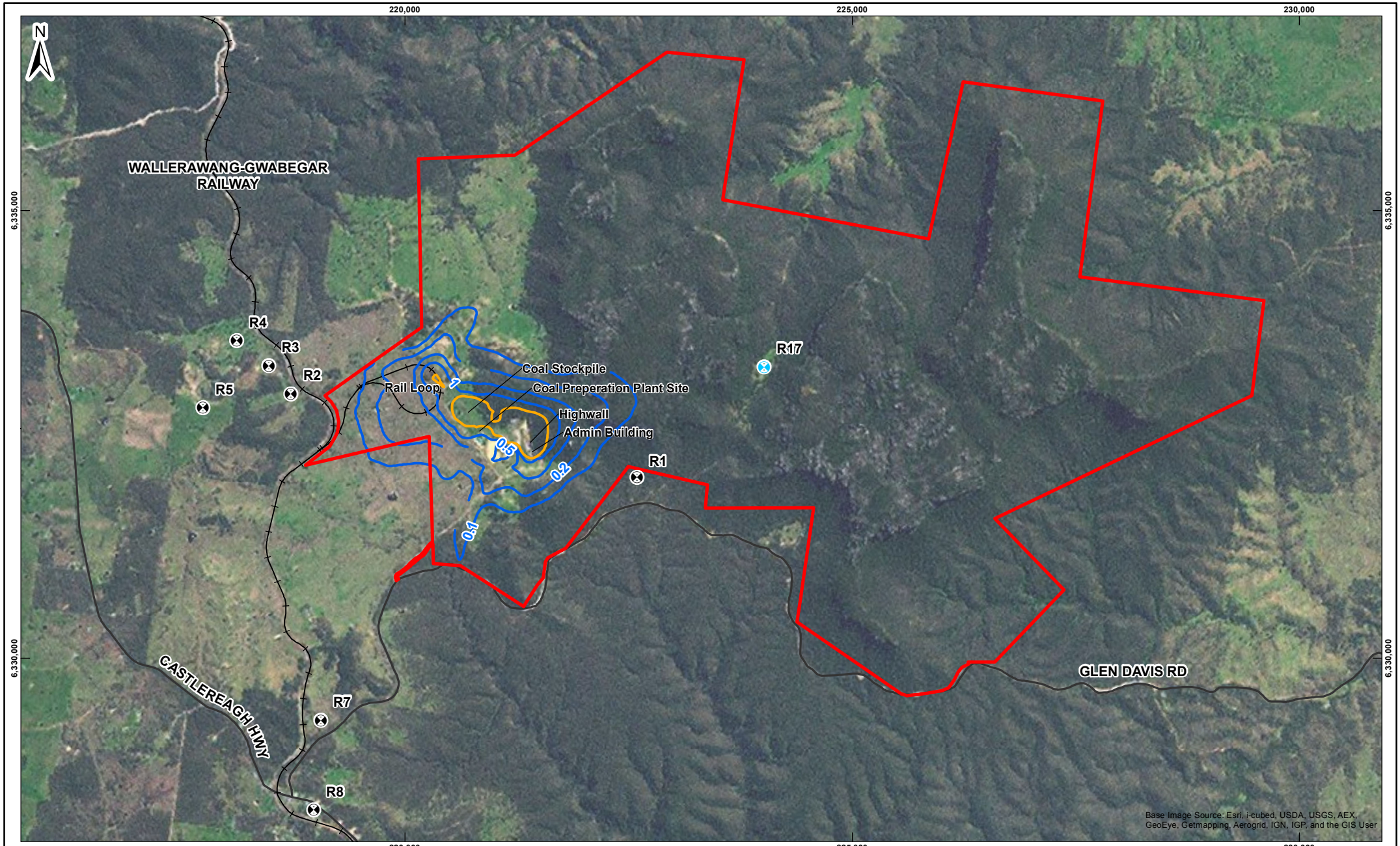
0 500 1,000 1,500 2,000 Metres

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

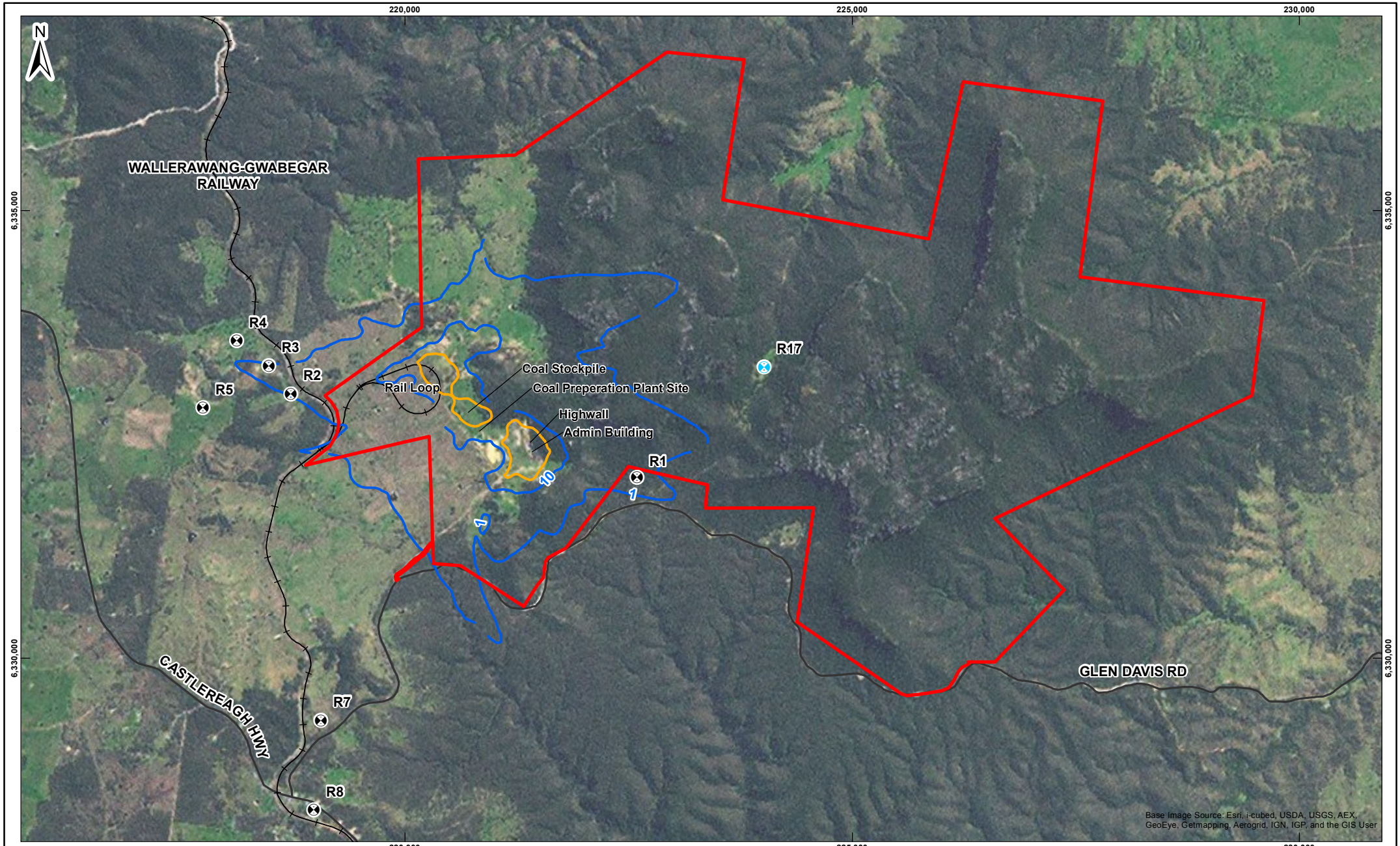
0 500 1,000 1,500 2,000 Metres

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

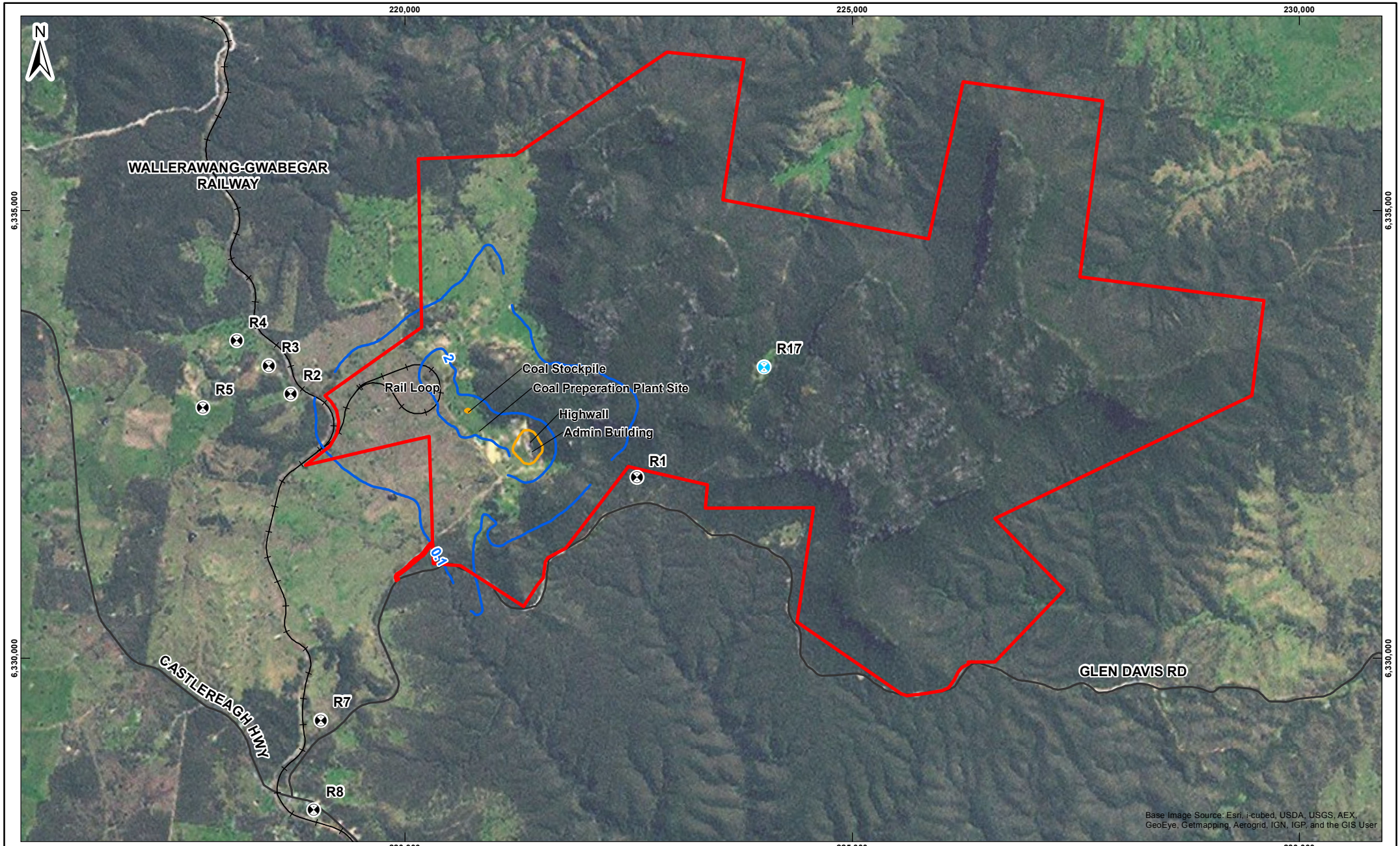
0 500 1,000 1,500 2,000 Metres

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

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

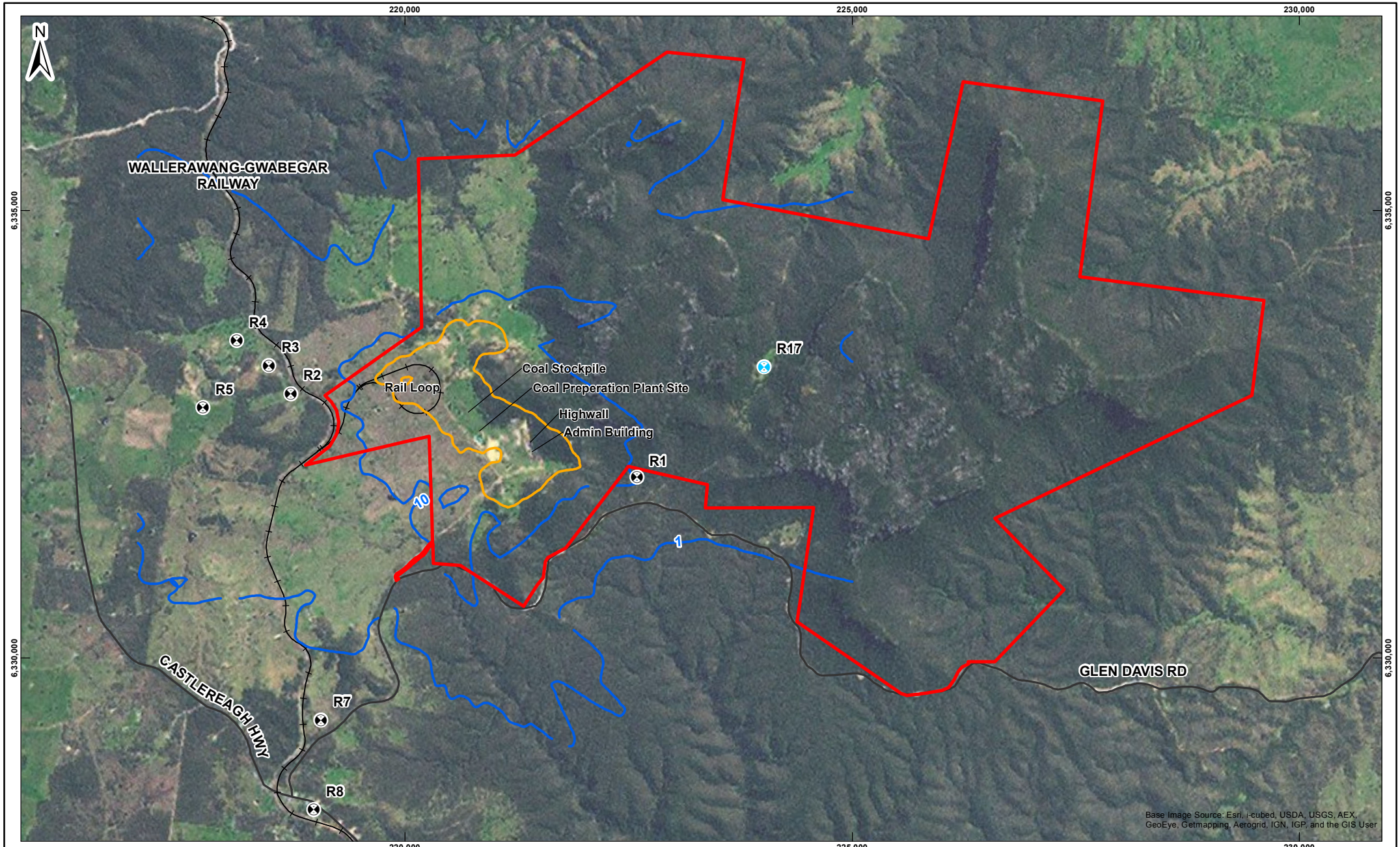
0 500 1,000 1,500 2,000 Metres

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

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

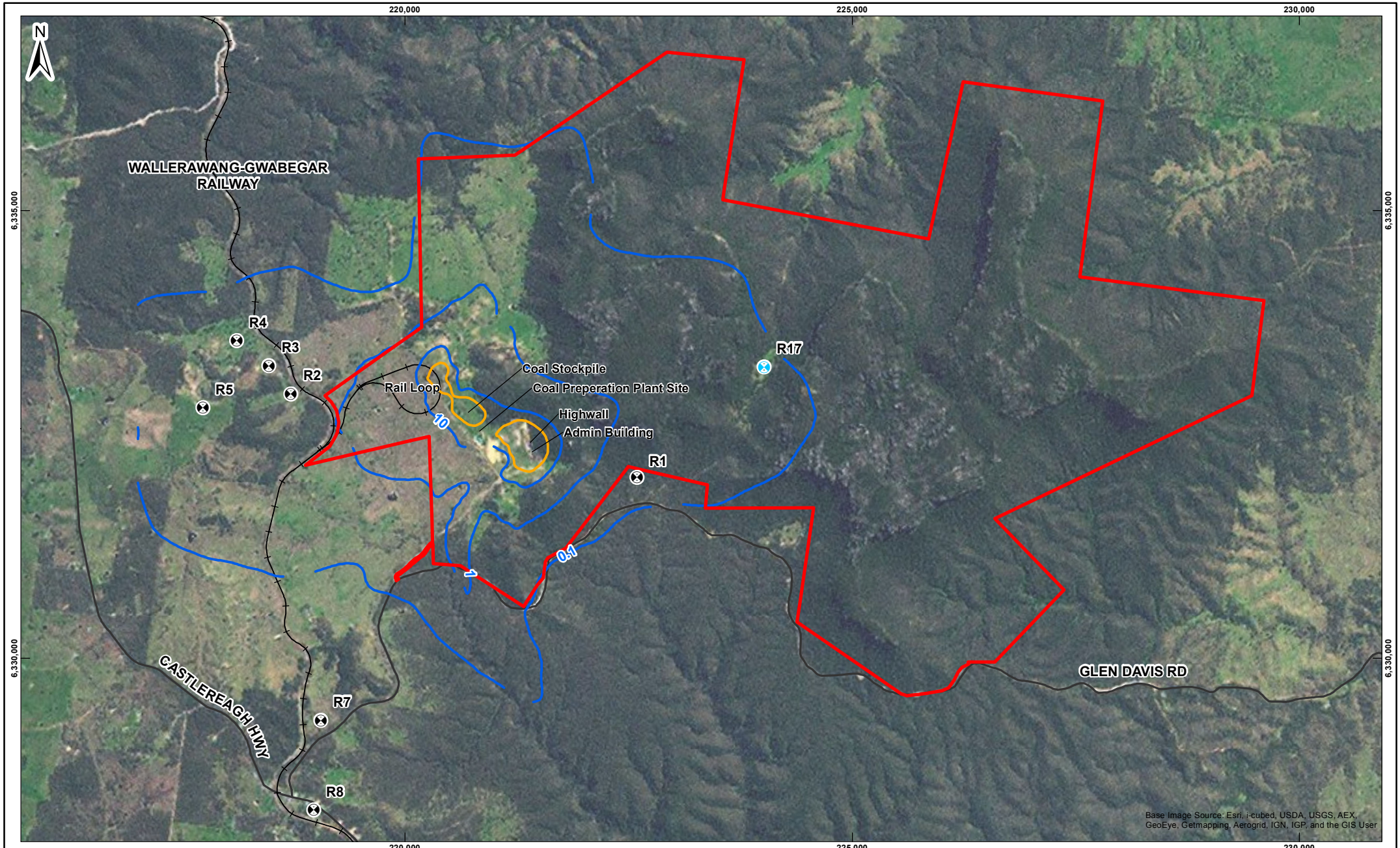
0 500 1,000 1,500 2,000 Metres

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

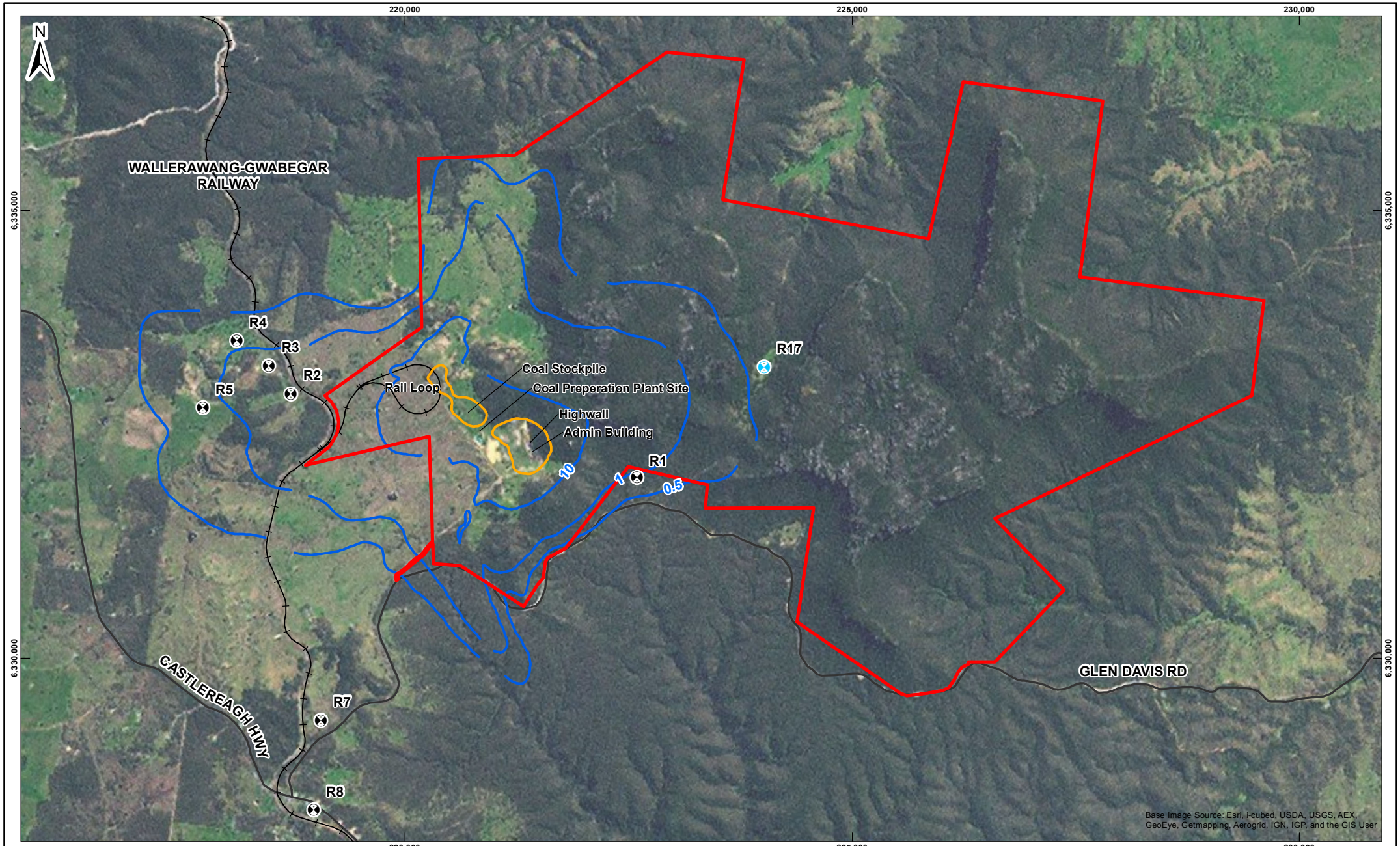
0 500 1,000 1,500 2,000 Metres

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

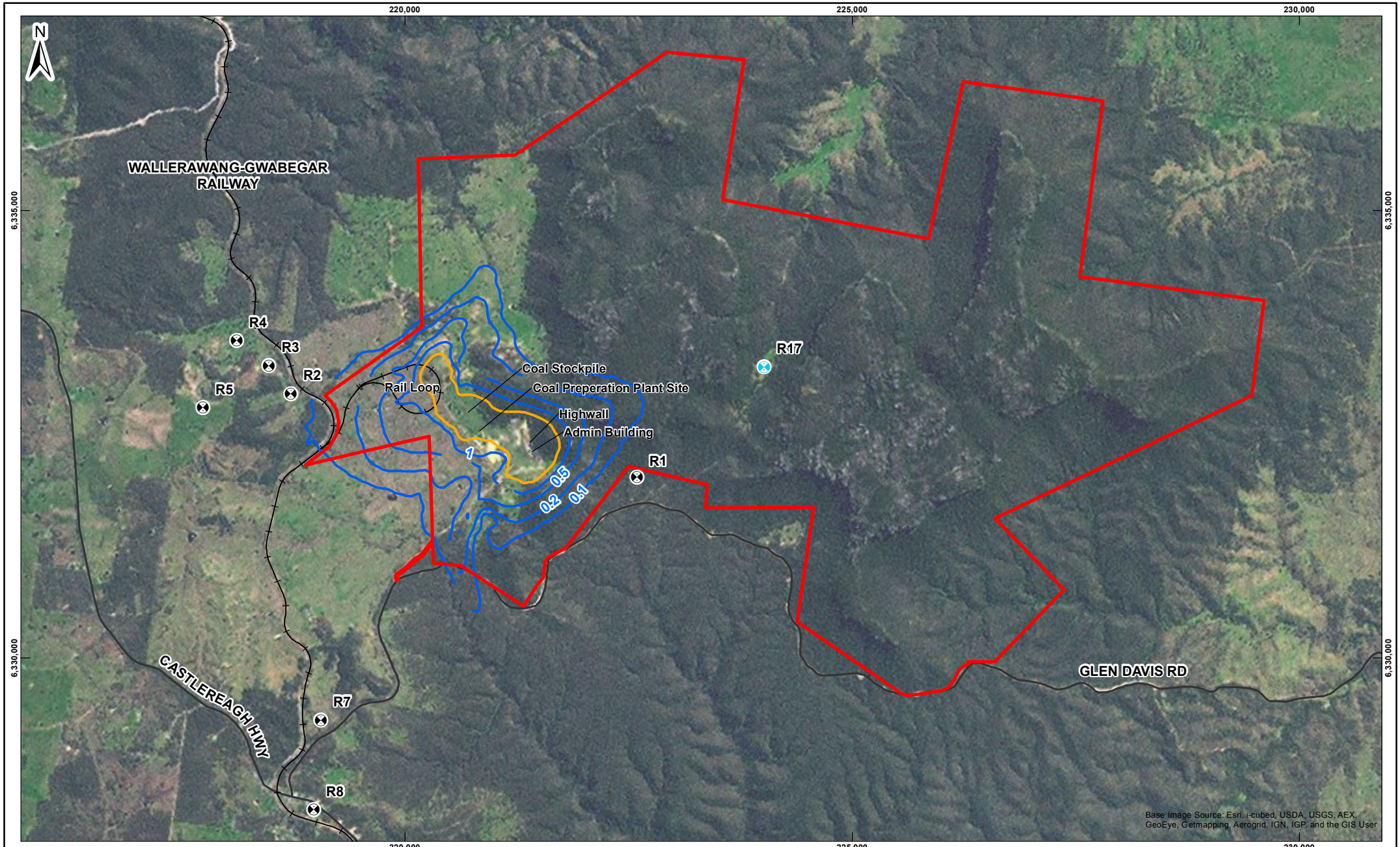
0 500 1,000 1,500 2,000 Metres

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

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

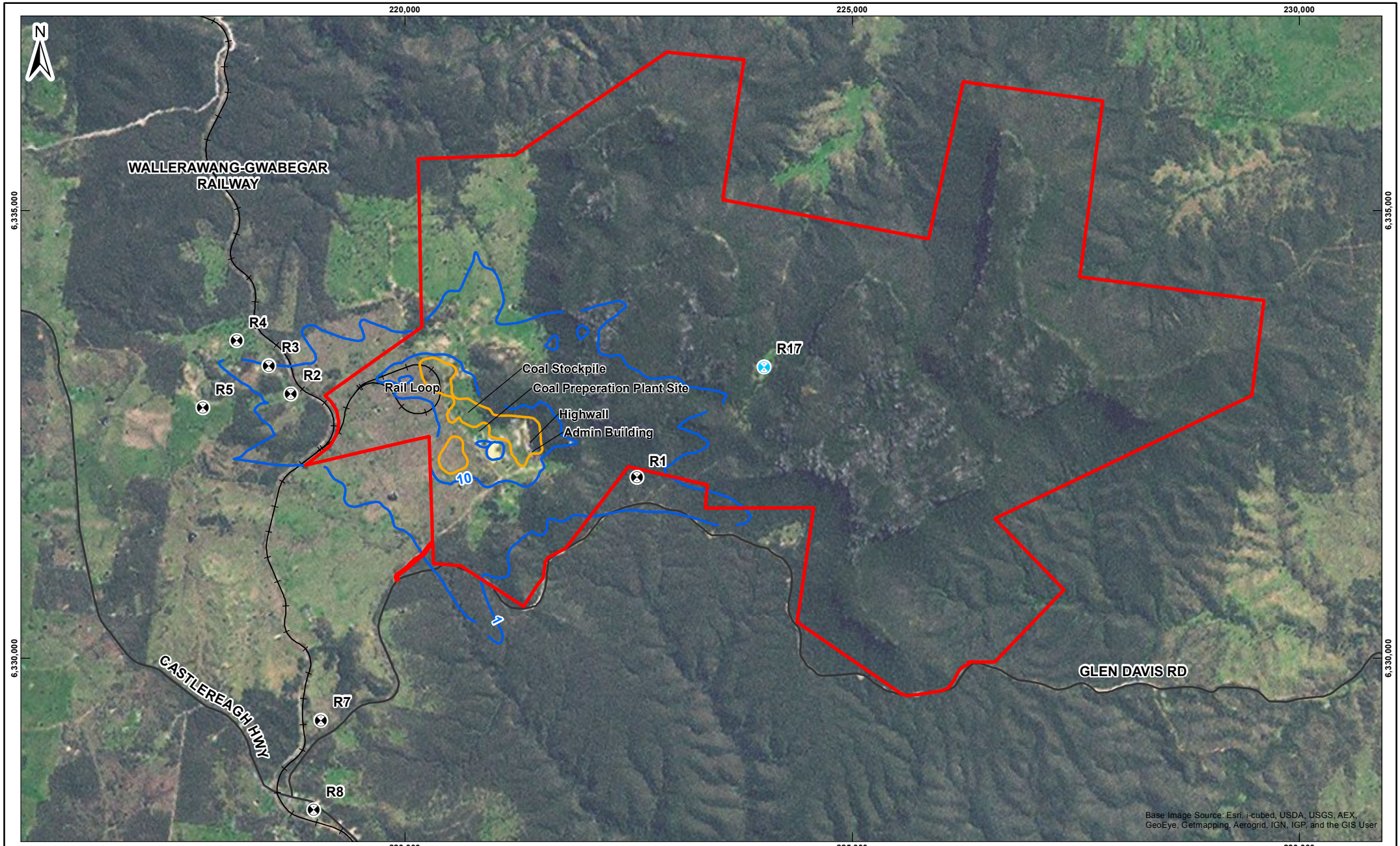
0 500 1,000 1,500 2,000 Metres

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

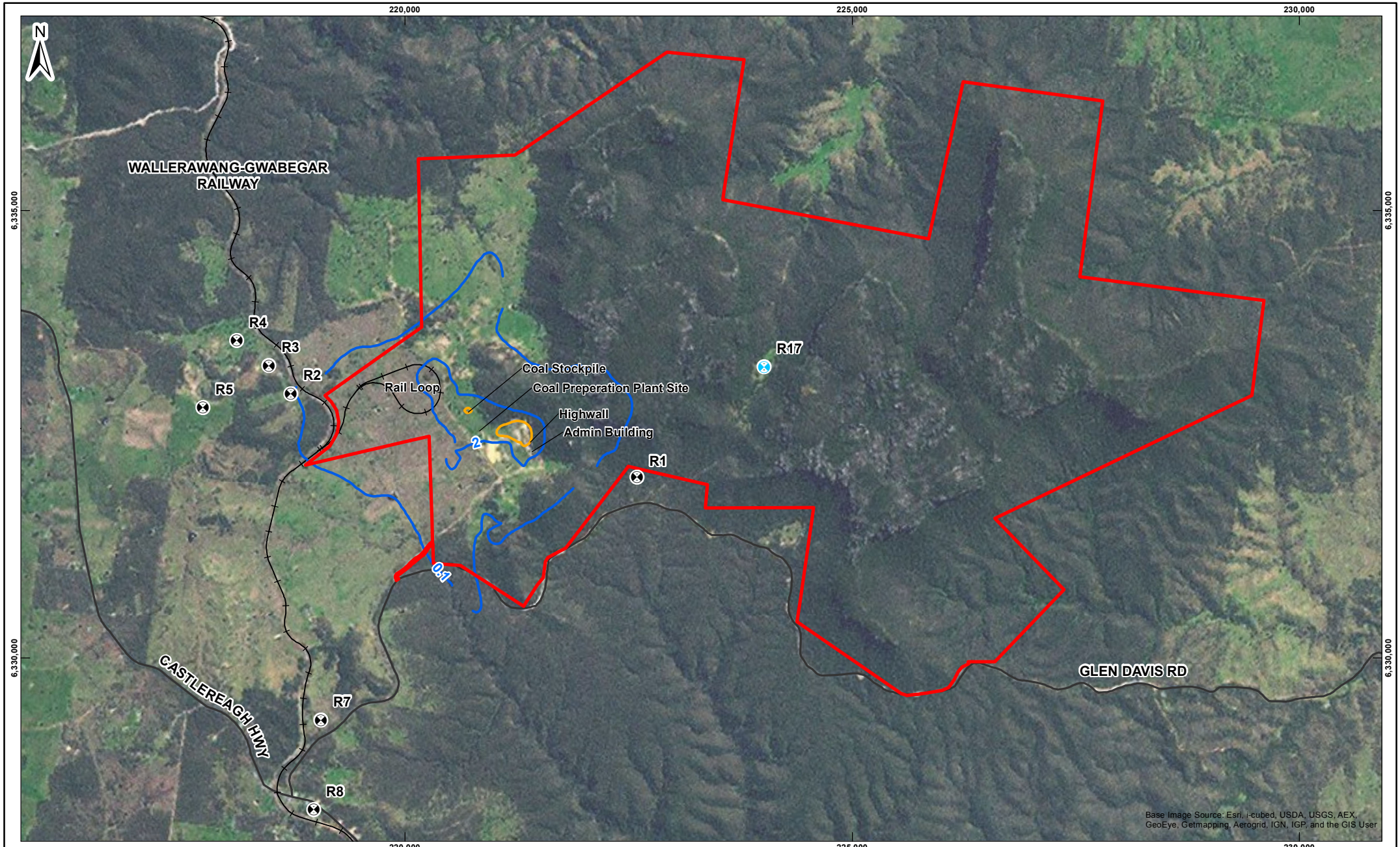
0 500 1,000 1,500 2,000 Metres

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

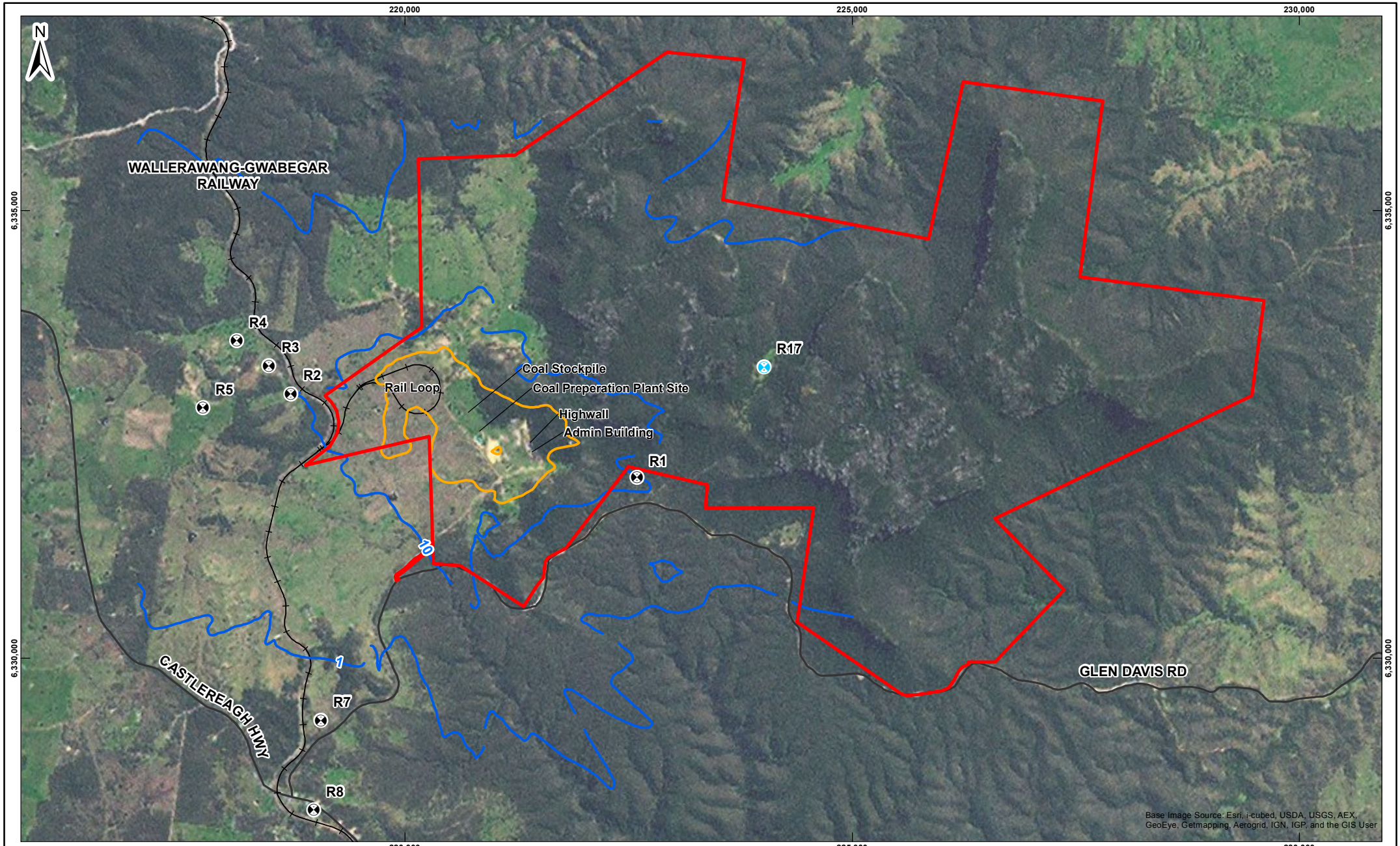
0 500 1,000 1,500 2,000 Metres

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

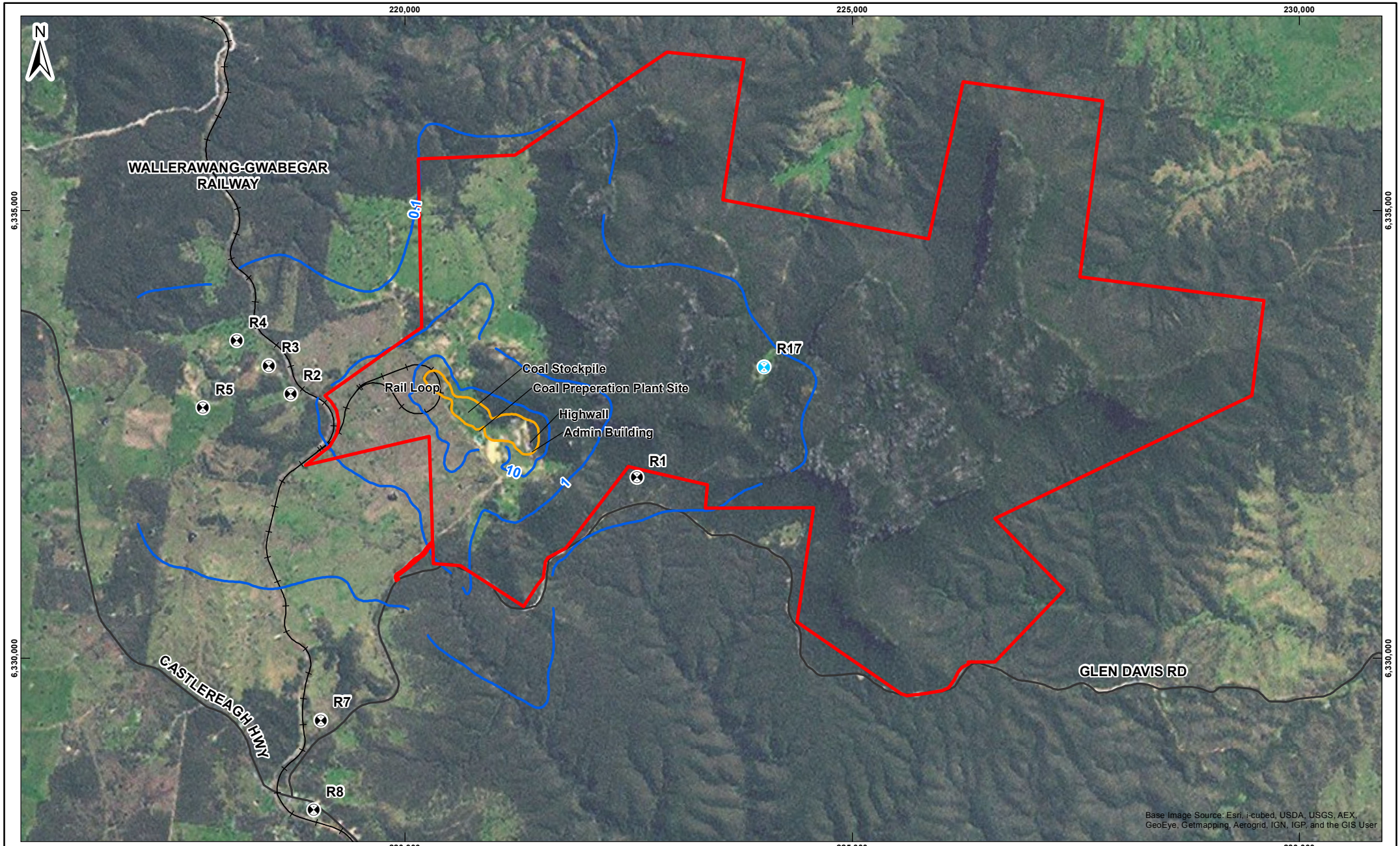
0 500 1,000 1,500 2,000 Metres

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

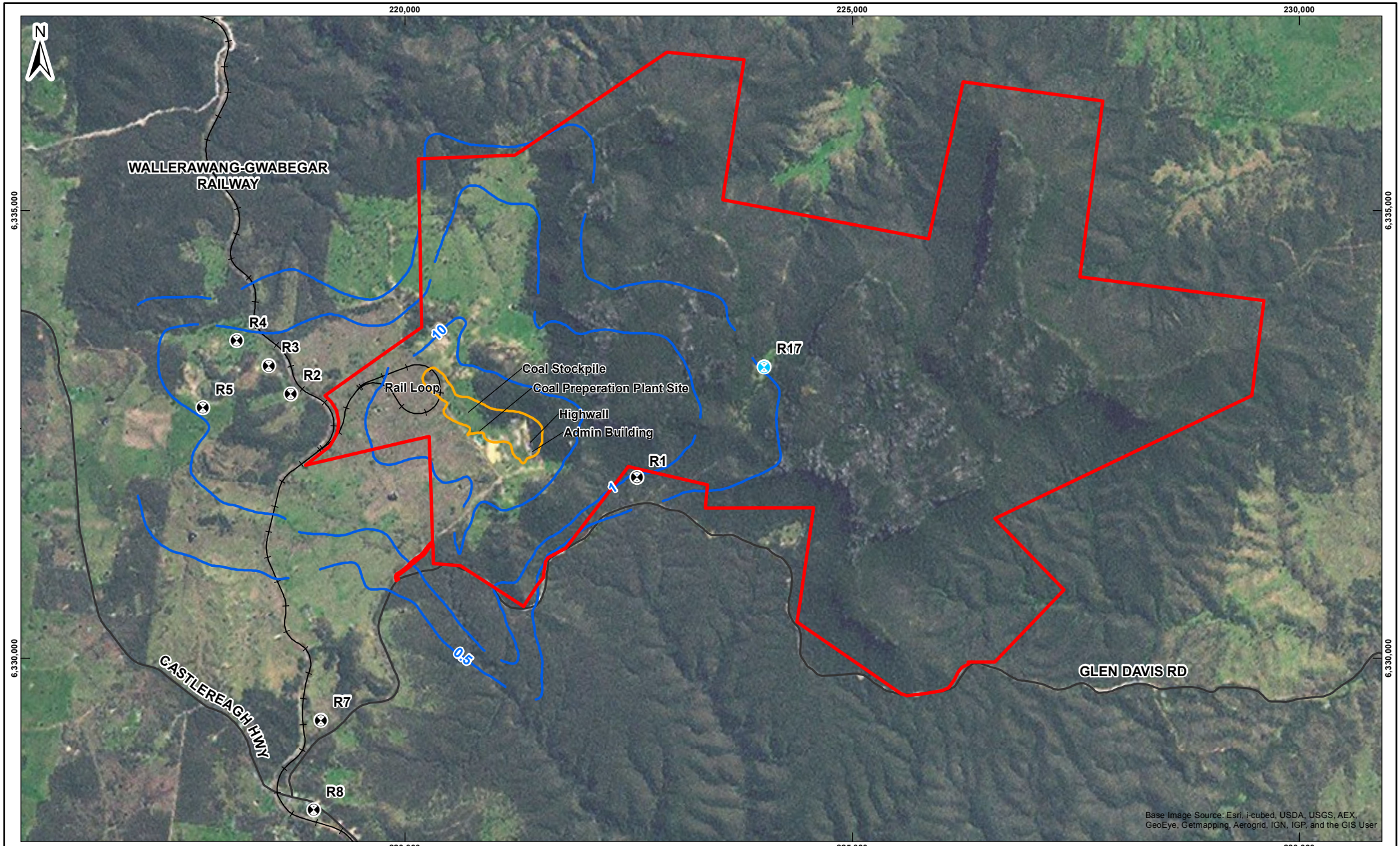
0 500 1,000 1,500 2,000 Metres

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

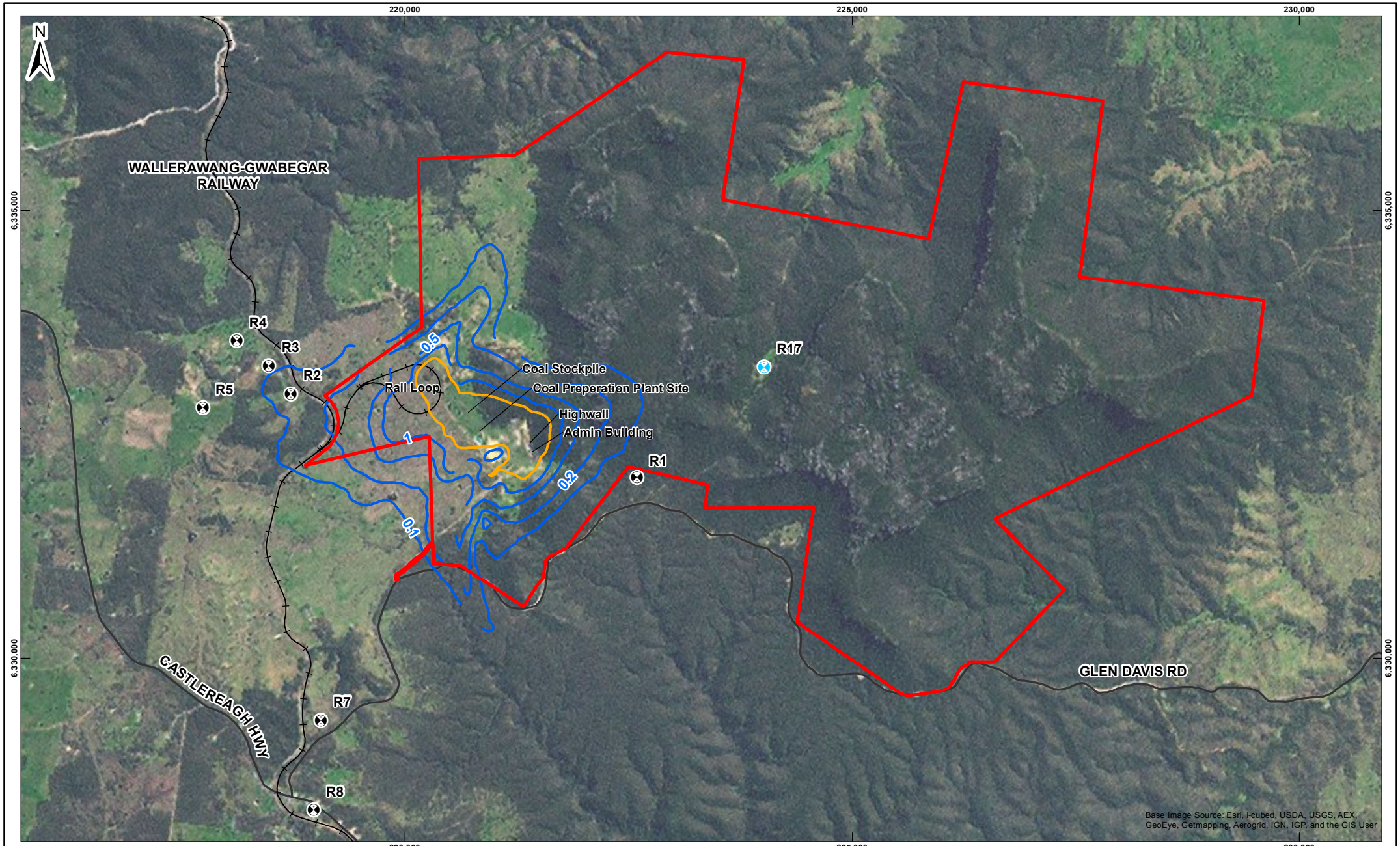
0 500 1,000 1,500 2,000 Metres

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/m$_2$/month (incremental), 4 g/m$_2$/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/m^3)				Maximum Incremental Impact (µg/m^3)			
	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/m^3)				Maximum Incremental Impact (µg/m^3)			
	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/m^3)				Maximum Incremental Impact (µg/m^3)			
	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/m^3)				Maximum Incremental Impact (µg/m^3)			
	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 ($\mu g/m^3$)								
	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 $\mu g/m^3$

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.

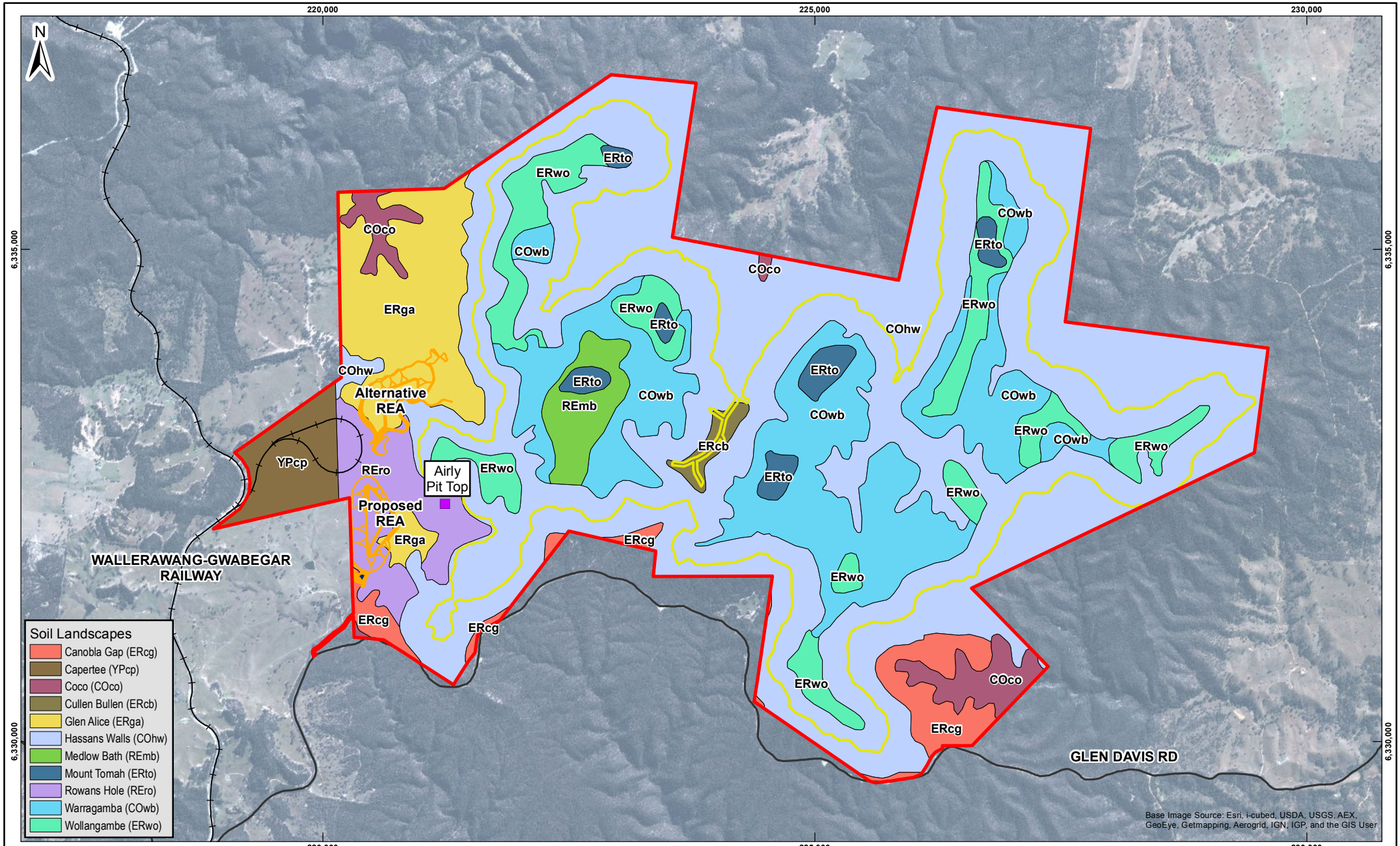
Limitations to this soil landscape include high water erosion hazard and localised flood hazard. It has moderate limitations to grazing and cultivation.

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

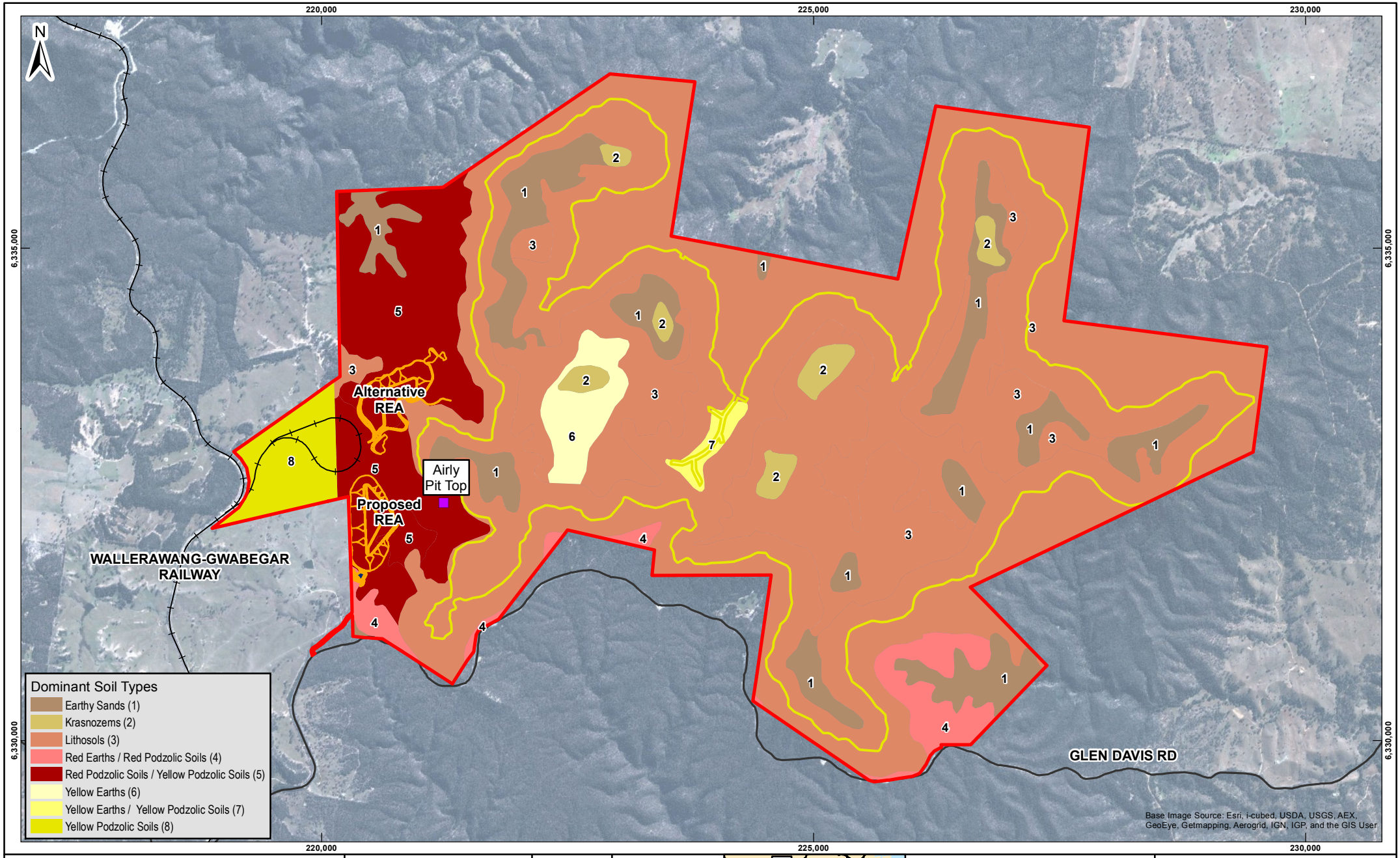
0 500 1,000 1,500 2,000 Metres

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

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.

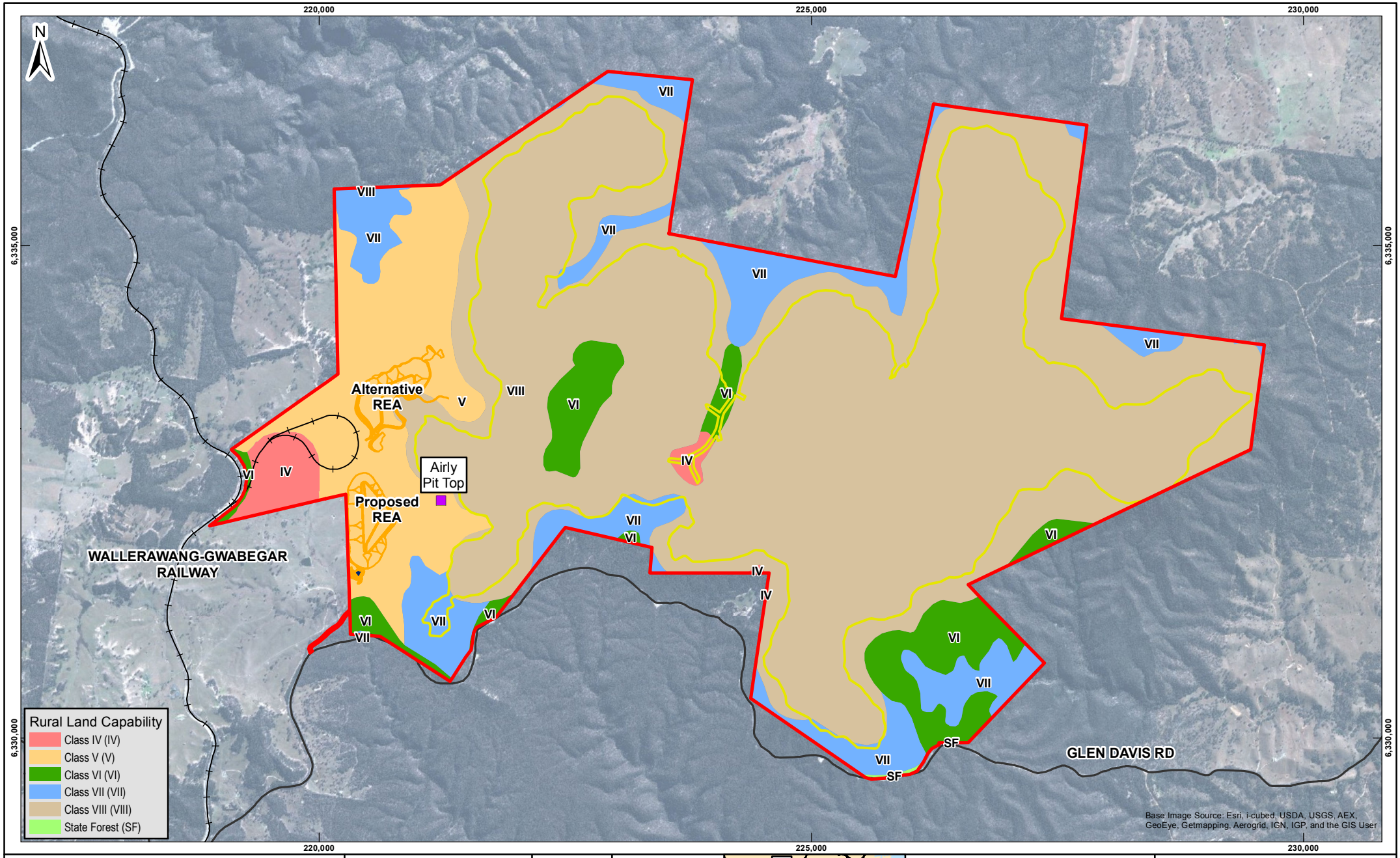
Table 10.59: Project Application Area and Proposed REA Rural Land Capability

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) Cliffs	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

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.

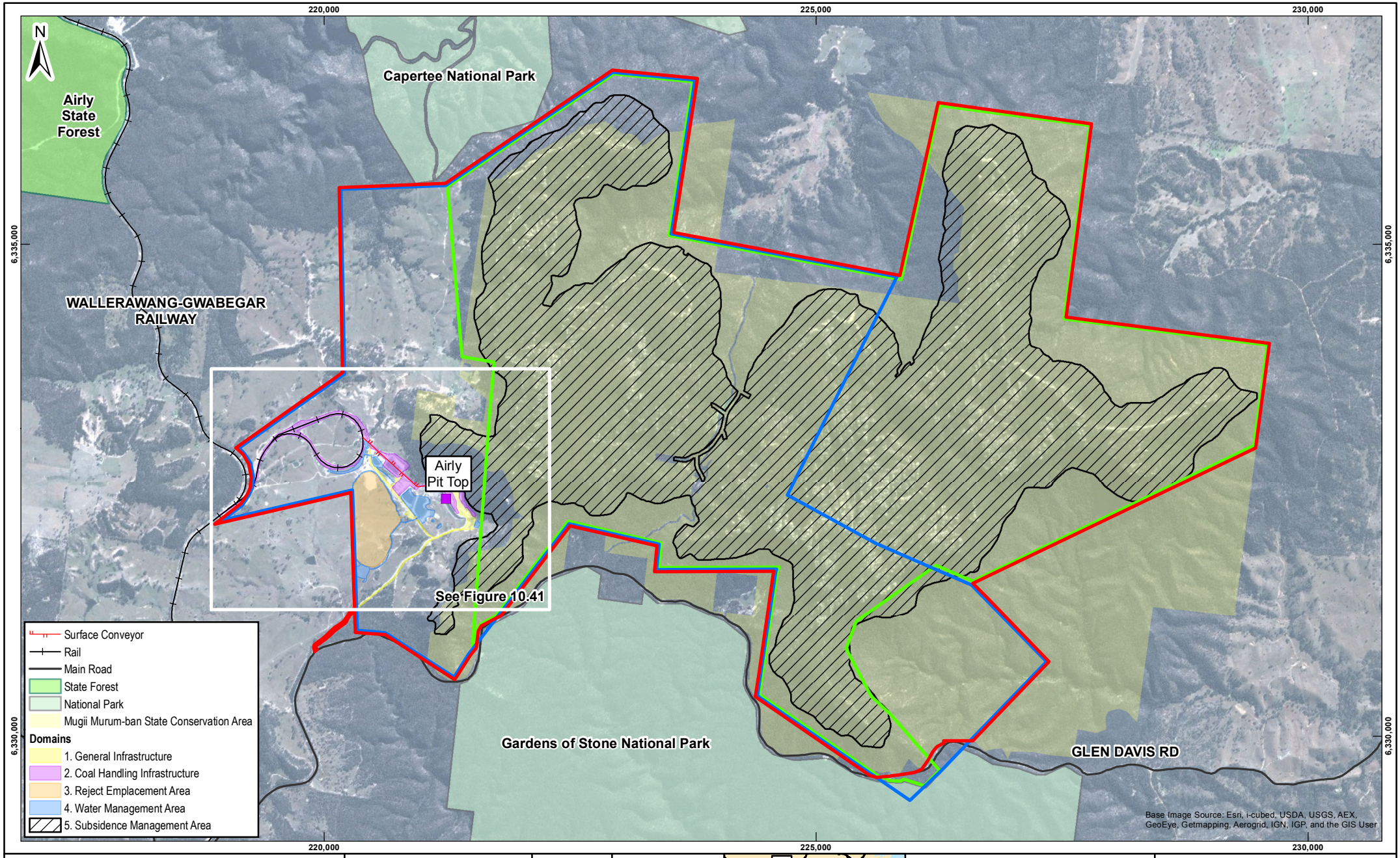
Primary domains are discrete land management units with similar operational function and/or similar geophysical features. There are five primary rehabilitation domains and these are summarised below.

- **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

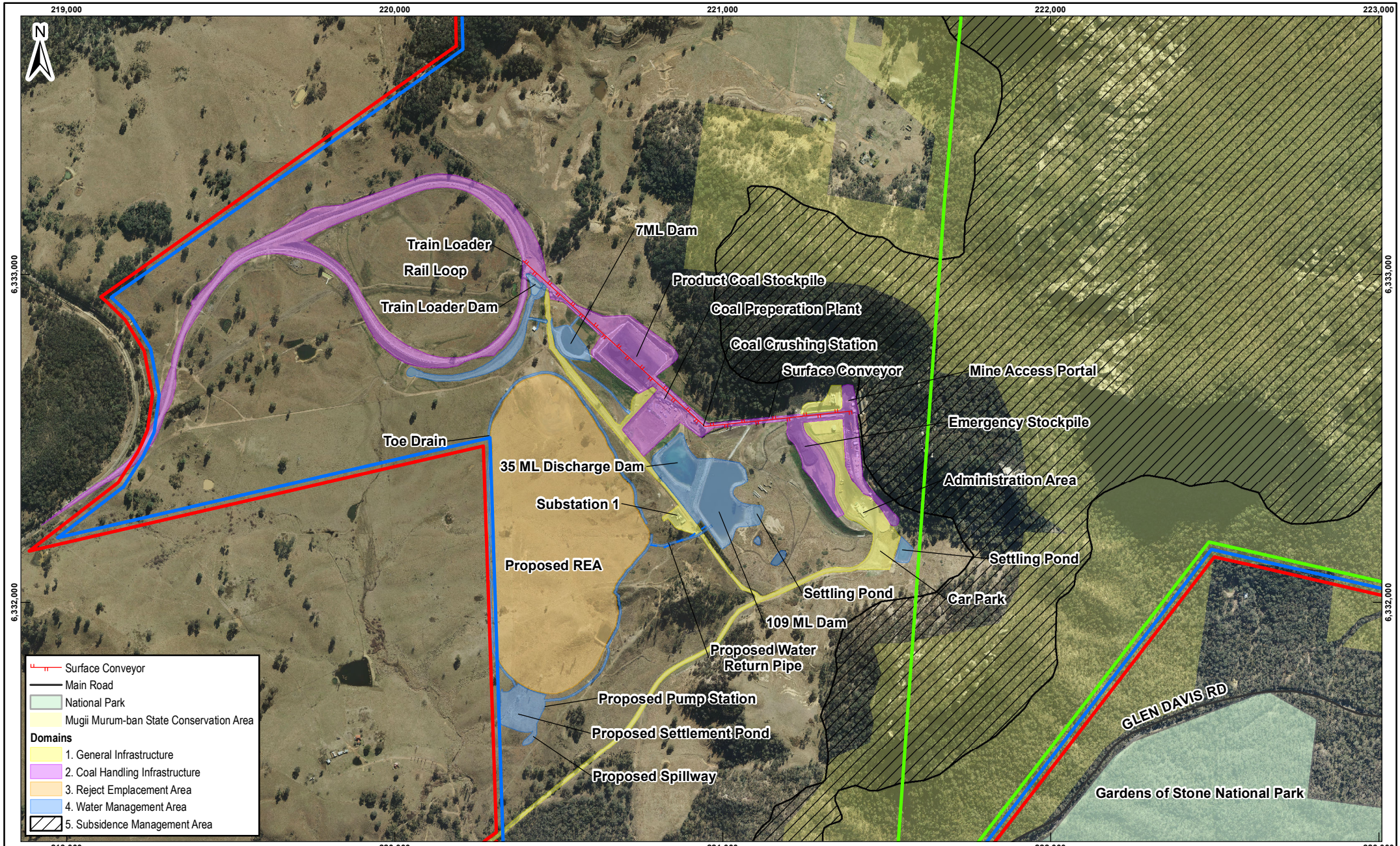
0 500 1,000 1,500 2,000 Metres

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

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:15,000

Figure 10.42: Airly Mine Primary Domains (Infrastructure Area)

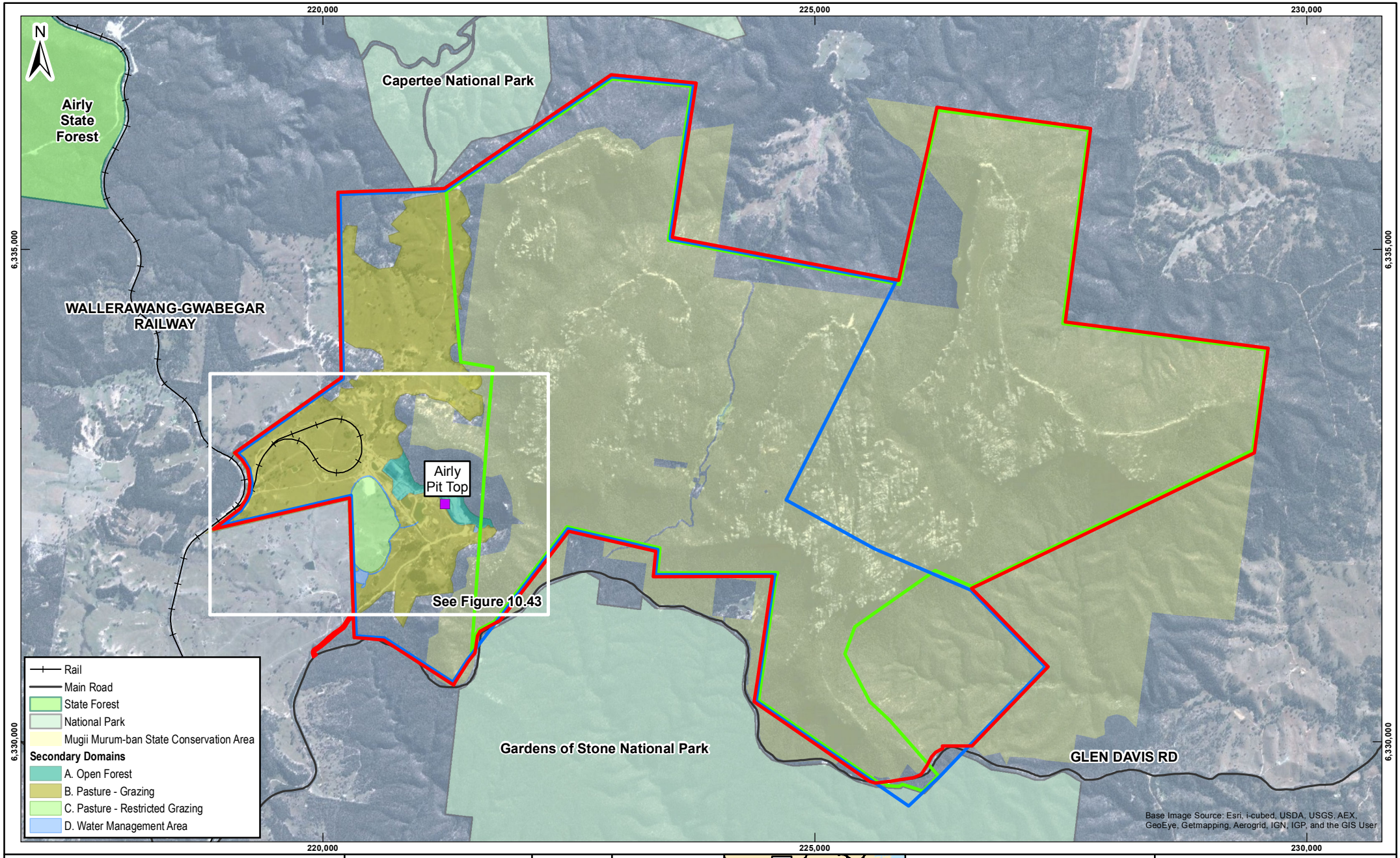
0 100 200 300 400 500 Metres

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

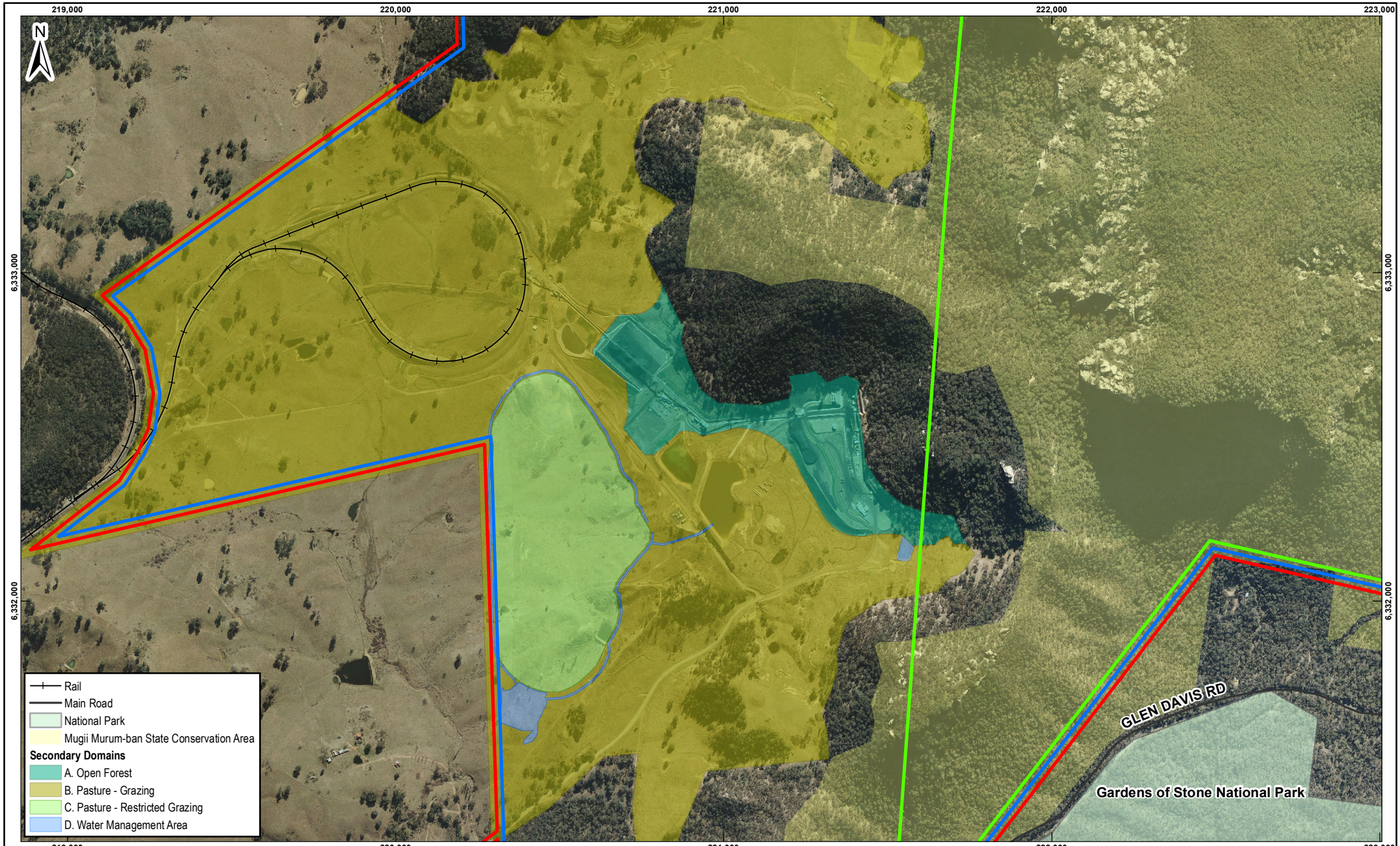
0 500 1,000 1,500 2,000 Metres

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

DATE	14/08/2014
SEAM	LITHGOW
REFERENCE	137623024-R Rev 0
SCALE	1:15,000

Figure 10.44: Airly Mine Secondary Domains (Infrastructure Area)

0 100 200 300 400 500 Metres

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

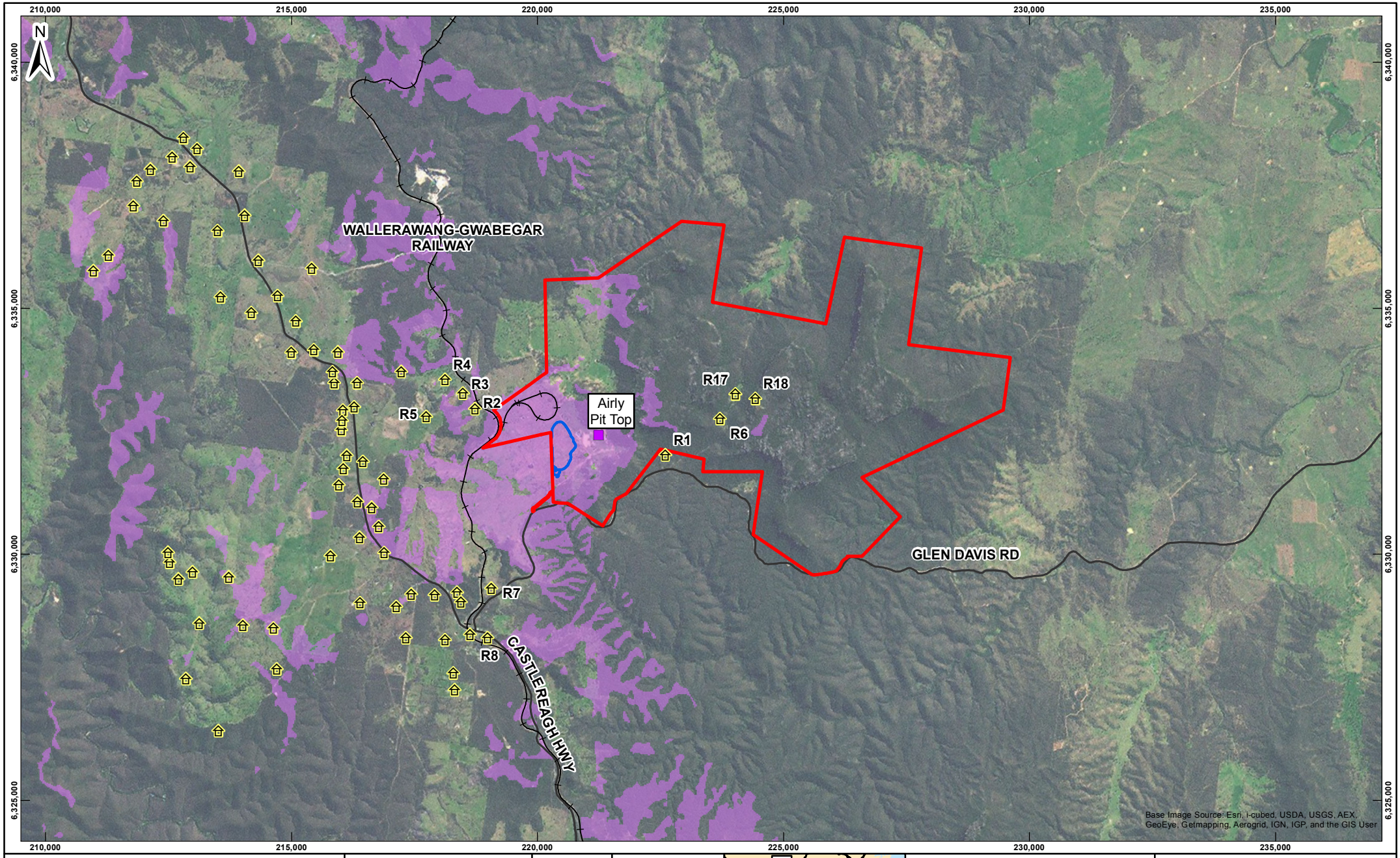
High Significance	A significant and dominant feature within the surrounding landscape and at complete variance with the landform, scale and pattern of the landscape, with the capacity to cause a significant deterioration in the existing view. The visual effects may not be minimised by mitigation measures 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
- Private Residential Dwelling
- Rail
- Proposed REA
- Main Road
- 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

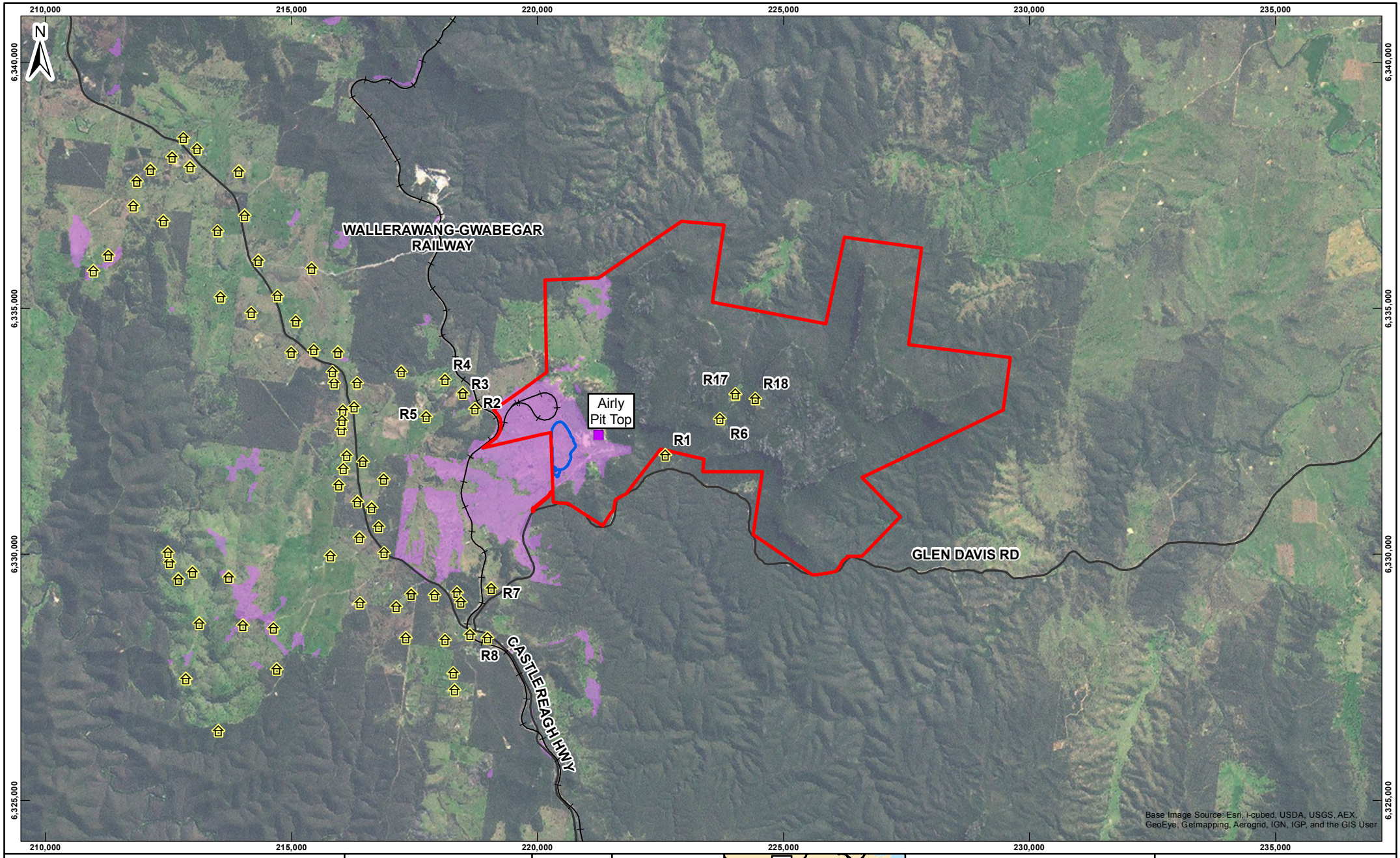
0 1,000 2,000 3,000 Metres

PLOTFILE No.

Centennial Coal
Airly

DRG No. 10-10.45

A4



LEGEND

- Project Application Area
- Private Residential Dwelling
- Rail
- Proposed REA
- Main Road
- 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

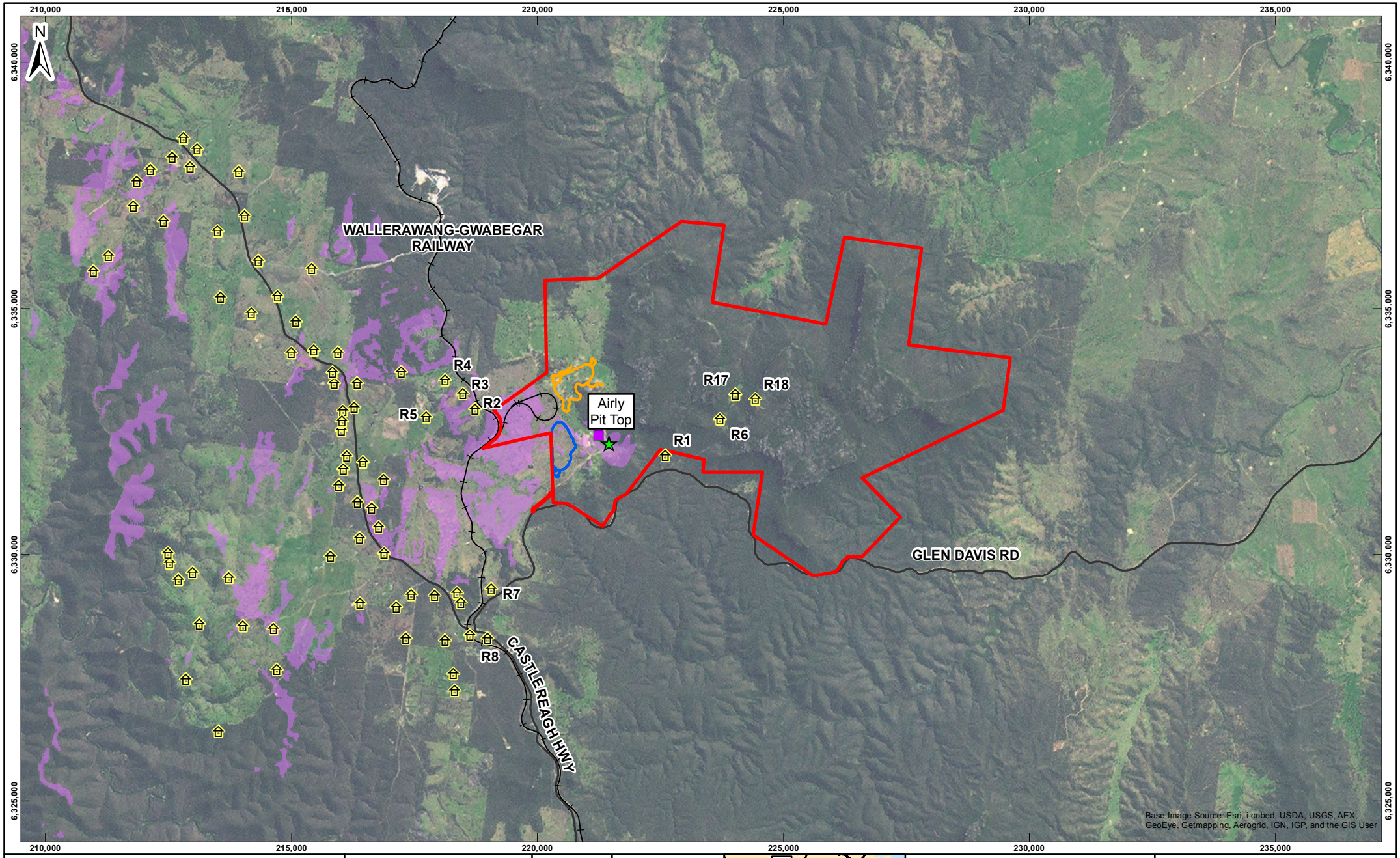
0 1,000 2,000 3,000 Metres

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.