Centennial Coal

Amendment Report

Angus Place Mine Extension Project

6 December 2019

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6 December 2019

Amendment Report

Angus Place Mine Extension Project

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EXECUTIVE SUMMARY

Introduction and Overview

Angus Place Colliery is an existing underground coal mine producing high quality thermal coal for domestic markets, predominantly supplying the Mount Piper Power Station. It is located 15 kilometres to the northwest of the regional city of Lithgow and 120 kilometres west northwest of Sydney in New South Wales.

The Project Application Area contains natural landscape features formed by the combination of geology, topography and vegetation. The area is characterised by environmental features such as pagodas, cliff lines, swamps, creeks, and deep valleys. Angus Place Colliery is bordered by Newnes State Forest to the east, Springvale Mine to the south, Lidsdale to the west and Gardens of Stone National Park to the north. The Gardens of Stone National Park is one of eight reserves that make up the Greater Blue Mountains World Heritage Area (refer to Figure 6.3).

The mine's current project approval (Project Application 06_0021) was granted in September 2006 under Part 3A of the *Environmental Planning and Assessment Act 1979*. The current project approval has since been declared a State Significant Development (SSD) under clause 6 of Schedule 2 to the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*, for the purposes of the EP&A Act. Accordingly, Angus Place Colliery now operates under a SSD approval. The Angus Place Colliery project approval and its subsequent modifications remain current and authorise the extraction of up to 4 million tonnes of run of mine (ROM) coal per annum. The current project approval will expire in August 2024 and a new development consent is required to enable Angus Place Colliery to operate beyond this date.

A new SSD application (SSD 5602) and supporting Environmental Impact Statement (EIS) was submitted to NSW Department of Planning, Industry and Environment (DPIE) in April 2014 (2014 EIS) for the Angus Place Mine Extension Project (APMEP). In 2015 a decision was made by Centennial Angus Place Pty Limited (Centennial Angus) to place the Angus Place Colliery into care and maintenance following the completion of secondary extraction within longwall panel 900W. Secondary extraction of longwall panel 900W was completed on 15 February 2015 and the mine was placed in care and maintenance on 28 March 2015. At that stage, the assessment of the APMEP was placed on hold.

A review of the APMEP has now been completed to take into consideration up to date information obtained from the adjacent Springvale Mine as well as recent changes in operational requirements. This review has resulted in proposed changes to the APMEP as presented in the 2014 EIS. On 23 October 2019 DPIE issued a letter to Centennial Angus Place confirming that the changes to the Project could be considered in an Amendment Report to Development Application (SSD 5602).

In order to facilitate the amendment to Development Application SSD 5602, this Amendment Report has been prepared in accordance the correspondence from DPIE dated 23 October 2019 and the draft *DPIE Guideline for Preparing an Amendment Report*, dated June 2019. Specifically, this report provides details of the revisions to the APMEP and includes updated assessments that take into consideration contemporary standards and guidelines and the latest information available to inform the assessment process.

Summary of Amended Project

The APMEP, as amended will, in general, include all currently approved operations, facilities and infrastructure of the Angus Place Colliery, except as otherwise indicated below:

- Extend the life of the mine to 31 December 2053;
- Increase in Project Application Area from 10,460ha to 10,551ha;
- Increase in full time equivalent (FTE) personnel from 300 to 450;

- Increase the extraction rate up to 4.5 million tonnes per annum of ROM coal from the Lithgow Seam underlying the Project Application Area;
- Continue the development of new roadways to enable access to the proposed 1000 panel longwall mining area;
- Extraction of existing approved longwall 910;
- Development and extraction of 15 longwalls (LW1001-1015) with void widths of 360m;
- Development of underground roadway connections between the Angus Place Colliery underground mine workings and the Springvale Mine underground mine workings;
- Transfer up to 4 Mtpa of run-of-mine (ROM) coal to the Angus Place pit top for processing and handling before being transported off site in accordance with the Western Coal Services Project development consent (SSD 5579)
- Transfer up to 4.5 Mtpa of ROM coal by underground conveyor to the Springvale Mine pit top via proposed new underground connection roadways for handling and processing in accordance with the Springvale Mine Extension Project development consent (SSD 5594);
- Enlargement of the ROM coal stockpile at the Angus Place Colliery pit top from 90,000 t to 110,000 t capacity
- Construction of the approved but not yet constructed 4.5 m shaft at the Angus Place Ventilation Facility (APC-VS2) on the Newnes Plateau.
- Installation and operation of the ventilation fan at the Angus Place Ventilation Facility (APC-VS2) on the Newnes Plateau.
- Construction and operation of one additional downcast shaft and mine services boreholes within the proposed Angus Place Ventilation Facility (APC-VS3) on the Newnes Plateau to support mining in the 1000 panel area;
- Construction and operation of additional dewatering facilities and associated infrastructure on the Newnes Plateau to support mining in the 1000 panel area to facilitate the transfer of mine water into the Springvale Delta Water Transfer Scheme (SDWTS);
- Transfer of mine inflows from the existing and proposed workings at Angus Place Colliery to the Springvale Water Treatment Project (SSD 7972) for treatment and beneficial reuse at the Mount Piper Power Station
- Operation of the Angus Place Colliery 930 Bore and associated infrastructure for raw mine water transfer from the SDWTS to the underground mining area; and
- Connection to the Lithgow City Council main sewer line prior to the commencement of longwall extraction (subject to a separate development application through Lithgow City Council).

Consideration of Social and Economic Impacts

Springvale Coal Mine (owned by Centennial Coal) currently employs 450 full-time mine workers and is scheduled for closure in 2024. Accordingly, Centennial Angus Place has strategically sought approvals for the APMEP in light of Springvale's impending closure. The APMEP, once developed, will provide continued employment opportunities for up to 450 full time employees. This will ensure that the current social and economic climate on the Lithgow region would remain relatively stable, as it exists with the operation of Springvale.

The social and economic impacts of Springvale's closure is an important aspect to consider as part of the proposed APMEP. As the economic stability of this region relies on the amended APMEP being approved. This has been substantiated within Section 8.8 and Appendix F and Appendix O.

Consideration of MNES and EPBC Referral 2013/6889

In June 2013, Centennial Angus Place lodged a referral under the EPBC Act to expand underground mining operations at the Angus Place Mine (EPBC 2013/6889). On 7 July 2013, the Commonwealth Department of the Environment and Energy (DoEE) determined that the Project was a Controlled Action.

On 7 November 2019, DoEE accepted the proposed variation to EPBC 2013/6889 and the proposed action will continue to be assessed on behalf of the Commonwealth by the NSW Government under an accredited assessment process. Where applicable, any impacts to threatened species or ecological communities will be offset in accordance with the New South Wales Biodiversity Conservation Act 2016, Biodiversity Assessment Method (BAM) and the EPBC Act Environmental Offsets Policy.

New Understanding and consideration of Swamp Impacts

In contrast to the 2014 EIS, and based on the extensive monitoring data and analysis since 2014 it has been found that mining directly beneath lineaments or significant geological faults has triggered changes to hydrology in swamps overlying the Springvale Mine. In the case of the APMEP it is not possible to avoid the associated lineaments as a very significant area of longwall extraction would be sterilised and remaining extraction areas would be rendered unviable.

Subsidence-related impacts are expected at Tri-Star Swamp, Twin Gully Swamp, Trail Six Swamp and the hanging swamps within their catchments. Impacts to THPSS-associated threatened species are also likely in these locations. In accordance with the BC Act and EPBC Act, any environmental consequences assessed to be greater than negligible to THPSS and their associated threatened species will be required to be offset in accordance with the NSW Biodiversity Offset Scheme and the Commonwealth EPBC Act Environmental Offsets Policy. This Amendment Report and supporting technical assessment have taken a conservative stance by assuming total loss of THPSS within the Amended Project Application Area, thereby presenting the maximum potential ecosystem and species credit liability.

Revised Assessment of Other Key Environmental Issues

The Amendment Report has been informed by updated technical assessments including the results of new and update modelling of potential impacts. The following are the key summary points of the updated technical Reports:

- The predicted vertical subsidence based on the APMEP longwall layout is greater than that predicted above LW1003 to LW1008 in the 2014 EIS, due to the changes in longwall void widths and proposed mining heights. The predicted profiles of vertical subsidence above LW1009 to LW1014 are similar since both layouts adopt a 360 m void width and have similar proposed mining heights;
- Monitoring data and analysis to date has found mining directly beneath lineaments or significant geological faults has triggered changes to hydrology in swamps. In the case of the APMEP it is not possible to avoid the associated lineaments as a very significant area of longwall extraction is sterilised and remaining extraction areas are rendered unviable. A swamp offset Strategy is proposed to mitigate against this potential impacts;
- Aquifers that provide habitat for stygofauna are expected to be impacted by reductions in groundwater levels following mining induced groundwater depressurisation. However, in the wider catchment wide context, these impacts would be relatively minor;
- Localised impacts to aquatic habitat and macroinvertebrates will occur following predicted mine subsidence and associated fracturing in streams and ephemeral drainage lines adjacent to and overlaying the proposed longwalls. However, As reported by Cardno (2019), these impacts would be relatively minor in the context of the wider catchment area;

- No more than minor and localised impacts on riparian habitat are expected. There may be some die-back of fringing aquatic vegetation following flow diversions and drainage of pools and subsidence induced rockfalls could damage some vegetation. However, riparian vegetation is abundant throughout the Study Area and wider catchments and the loss of a small amount is expected to have negligible impacts on aquatic ecology;
- One Aboriginal heritage site was identified as having the potential to be impacted by the Amended Project, being the rock shelter site (#45-1-0084). This site has not been ground-truthed, but will require additional attempts to locate the site prior to the commencement of mining in the vicinity of the rock shelter;
- Air Quality Impacts will mostly occur during construction phase, where particular matter emissions will be generated from bore pumps and downcast ventilation shaft works. These works are temporary and mitigation measures have been appropriately proposed to reduce any potential emissions to the limited residential dwellings within the area; and
- Noise Impacts will mostly occur from operational phase, with some impacts during construction which is of a temporary nature. Mitigation measures have been appropriately proposed to reduce any potential emissions to the limited residential dwellings within the area.

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Definitions

Term	Definition
Aeromagnetic data	Aeromagnetic data is geographical survey, which is formed by using a magnetometer aboard or towed behind an aircraft.
Amended Project	Amendment to the existing development application (SSD_5602)
Angle of draw	The angle measured from the vertical, connecting the edge of the mining void to the surface expression of the lateral limit of subsidence (defined as less than 20 mm/m). At Angus Place Colliery, this angle of draw is 26.5 degrees.
Baseflow	Is the portion of streamflow or shallow subsurface flow that is delayed before being fed into surface water bodies, stream, rivers etc.
Closure	Is the reduction in the horizontal distance between the valley sides. The magnitude of closure is typically expressed in the units of millimetres (mm).
Compressive Strain	The changing tension or compression in rocks and soil. Normal strain is calculated as the change in horizontal distance between two points on the ground, divided by the original horizontal distance between them. Strain is typically expressed in units of millimetres per metre (mm/m). Tensile strains occur where the distances between two points increase and compressive strains occur when the distance between two points decrease. The predicted strains have been determined by analysing the strains measured at Angus Place and Springvale Collieries and elsewhere in the NSW coalfields where the mining geometries and overburden lithologies are similar.
Curvature	The change in tilt between two adjacent sections of the tilt profile divided by the horizontal length of these sections. Usually expressed as the inverse of the radius of curvature. Curvature can be convex (hogging) or concave (sagging). Hogging causes compression of surface materials while sagging causes tension. The larger the radius or curvature (or the smaller the inverse), the smaller the potential for damage to rigid natural or built structures.
Depth of cover	The vertical thickness of rock and soil above the mining area (overburden). As the depth of cover increases, the surface expression of subsidence effects is less likely. Observed subsidence is a function of the interaction between void depth to width ratio, such that a narrower, deeper longwall panel will cause less subsidence than a wider, shallower panel.
Ephemeral	Refers to something that is short-lived.
Extensometers	An extensometer is a device that is used to measure changes in the length of an object. It is useful for stress-strain measurements and tensile test.
Far-field movements	Is a traditional method of predicting surface subsidence movements above areas of total extraction near horizontal coal seams.
Fault	Faults are fractures in Earth's crust where rocks on either side of the crack have slid past each other.
Geological	Refers to the study or Earth’s physical structure and substances.
Geotechnical	Refers engineering of the behaviour of Earth’s materials, such as soils, rocks etc.
Groundwater depressurisation	Natural water pressure is high within aquifers, due to the weight of the soil layers above. When mining occurs the weight of soil layer above decreases causing depressurisation of groundwater to occur. This may lead to subsidence or strains to occur.

Term	Definition
Hydrogeological	Is the scientific study of the movement, distribution and management of groundwater in soil and rocks.
Hydrology	Is the scientific study of the movement, distribution and management of water.
Impact Envelope	An indicative area where surface infrastructure will be constructed as part of the Amended Project. Targeted surveys will focus on avoiding and minimising impacts on threatened species and their habitats by avoiding areas of high biodiversity value, confining construction to pre-disturbed areas and established access tracks where possible.
Lineament	A lineament is a distinctive linear feature in a landscape that is an expression of an underlying geological structure such as a fault, fracture, or joint. The predicted vertical subsidence has been increased by 25% in these locations.
Longwall	A longwall is a form of underground coal mining, where a long wall of coal is mined in a single slice or a shaving action by an electric cutter machine.
Meteorological environment	Refer to the atmosphere environment, specially the weather.
Micrometres	Is a unit of measurement being one millionth of a metre.
Pagodas	Is a rock formation in a tower shape.
Project Application Area	The Project Application Area comprises an area of 10,551 ha and is defined by the Mining Lease (ML 1434) and Exploration Licence boundaries (EL6856 and EL6293), as shown on Figure 3.1.
Strata	Strata refers to the layers of sedimentary rock, igneous rock or soil that were formed on the Earth's surface.
Study Area	The surface area that could be affected by the extraction of the proposed LW1001 to LW1015. Two (2) areas have been considered for the APMEP: ■ the 26.5° angle of draw represents the minimum extent for the assessments for the conventional ground movements (i.e. vertical subsidence and its associated effects). ■ the 600 m boundary represents the minimum extent of the assessments for the valley related effects. This distance is based on the recommendations from the Southern Coalfield Inquiry (DPIE, 2008) for the risk management zones. The Study Area referred to in this assessment is the area within 600 m of the proposed longwalls (refer to Figure 3.1) unless otherwise stated.
Subsidence	Subsidence is the vertical and horizontal displacement of the land as strata immediately above the extracted coal seam collapses into the mined-out void. Mining-induced subsidence can affect land surfaces and sub-surfaces and associated natural and built structures in a variety of ways and to varying extents

Term	Definition
	with the extent of subsidence impact tending to be greater in areas with shallow depth of cover to the coal seam and less in areas with greater depth of cover. Subsidence is usually expressed in millimetres (mm). The predicted vertical subsidence as a result of the APMEP has been predicted using the Incremental Profile Method (IPM) which has been calibrated for the local conditions.
Tilt	Tilt is the change in the slope of the ground as a result of differential subsidence. Tilt is usually expressed in millimetres per metre (mm/m). The predicted tilt and curvature as a result of the APMEP has been predicted using the IPM, which has been calibrated for the local conditions.
Upsidence	Is the relative uplift within a valley, which results from the dilation or buckling of near surface strata at or near the base of the valley.
Valley related movements	The streams within the amended application area will be affected by valley related movements, which are commonly observed along streams in the NSW coalfields. Valley related movements are normally described by the following parameters: ■ Upsidence is the relative uplift within a valley which results from the dilation or buckling of near surface strata at or near the base of the valley. The magnitude of upsidence is typically expressed in millimetres (mm). ■ Closure is the reduction in the horizontal distance between the valley sides. The magnitude of closure is typically expressed in millimetres (mm). ■ Compressive strains occur within the bases of valleys as a result of valley closure and upsidence movements. Tensile strains also occur in the sides and near the tops of the valleys as a result of valley closure movements.

Acronyms and Abbreviations

Name	Description
ABS	Australian Bureau of Statistics
ACARP	Australian Coal Industry's Research Program
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AIP	The NSW Aquifer Interference Policy (AIP) (NSW Office of Water, 2012)
APMEP	Angus Place Mine Extension Project
AQIA	Air Quality Impact Assessment
AQMP	Air Quality Management Plan
AQMS	air quality monitoring station
ASG	average standing water levels
AWBM	Australian Water Balance Model
AWS	automatic weather station
BAM	Biodiversity Assessment Methodology
BC Act	Biodiversity Conservation Act 2016
BIA	Biodiversity Impact Analysis
BMCS	Blue Mountains Conservation Society
BoM	Bureau of Meteorology
CBA	Cost- Benefit Analysis
CEMP	Construction and Environmental Management Plan
CFMMEU	Construction Forestry Maritime Mining And Energy Union
CHMP	Cultural Heritage Management Plan
CHP	coal handling plant
CPP	Coal Processing Plant
CRD	cumulative rainfall departure
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTMP	Construction Traffic Management Plan
DGR	Director General's Environmental Assessment Requirements
DoEE	Commonwealth Department of the Environment and Energy
DPE	NSW Department of Planning and Environment
DPIE	NSW Department of Planning, Infrastructure and Environment
DPII	Department of Planning, Industry and Investment
ECD	Environment and Community Database
EIA	Economic Impact Assessment
EIS	Environmental Impact Statement
EL	Exploration Licence
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
EPL	Environment Protection Licence
EPL	Environment Protection Licence

Name	Description
ESA	Environmental Study Area
FM Act	Fisheries Management Act 1994
FTE	Full Time Equivalent
GDE	Groundwater Dependant Ecosystems
GHG	Greenhouse Gas
ha	Hectare
HV	Heavy vehicles
HVAS	high-volume air samplers
IPM	Incremental Profile Method
Km	Kilometre
LCC	Lithgow City Council
LDP	Licenced Discharge Point
LEG	Lithgow Environment Group
LEP	Local Environmental Plans
LV	Light vehicles
m	Metres
ML	Mining Lease
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
MOP	Mining Operations Plan
MPPS	Mount Piper Power Station
MSEC	Mine Subsidence Engineering Consultants
Mtpa	Million tonnes per annum
MYC	Mount York Claystone
NARCliM	The NSW and ACT Regional Climate Modelling
NGAF	National Greenhouse Accounts Factors
NGER Act	National Greenhouse and Energy Reporting Act 2007
NMP	Noise Management Plan
NPHS	Newnes Plateau Hanging Swamp
NPSS	Newnes Plateau Shrub Swamp
NSW	New South Wales
NSW EPA	NSW Environment Protection Authority
PA	Project Application
PCT	Plant Community Type
PEP	Protection of the Environment Policies
POEO Act	Protection of the Environment Operations Act 1997
RAP	Registered Aboriginal Parties
ROM	Run of Mine
RTS	Response to Submissions
SDWTS	Springvale Delta Water Transfer Scheme

Name	Description
SEIA	combined Social Impact Assessment (SIA) and Economic Impact Assessment (EIA)
SEP	Stakeholder Engagement Plan
SEPP	State Environmental Planning Policy
SIA	Social Impact Assessment
SSD	State Significant Development
TAPM	The Air Pollution Model
THPSS	Temperate Highland Peat Swamp on Sandstone
TIA	Traffic Impact Assessment
TMP	Traffic Management Plan
TSP	total suspended particulates
WSPs	Water Sharing Plans

1. INTRODUCTION

Angus Place Colliery is an existing underground coal mine capable of producing high quality thermal coal for domestic markets, including the nearby Mount Piper Power Station. The Angus Place Colliery is currently under care and maintenance. It is located 15 kilometres (km) to the northwest of the regional city of Lithgow and 120 km west northwest of Sydney in New South Wales.

The Angus Place Colliery's current project approval (Project Application 06_0021) was granted in September 2006 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The current project approval has since been declared a State Significant Development (SSD) under Clause 6 of Schedule 2 to the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*, for the purposes of the EP&A Act. Accordingly, Angus Place Colliery now operates as a SSD approval. The Angus Place Colliery project approval and its subsequent modifications remain current and authorises the extraction of up to 4 million tonnes of run of mine (ROM) coal per annum. The current project approval will expire in August 2024 and a new development consent is required to ensure Angus Place Colliery is operational beyond this date.

1.1 Project Background

Centennial Angus Place Pty Limited (Centennial Angus Place) submitted a new SSD application (SSD 5602) and supporting Environmental Impact Statement (EIS) to the NSW Department of Planning, Industry and Environment (DPIE) in April 2014 (2014 EIS) for the Angus Place Mine Extension Project (APMEP). The APMEP sought to extend the life of the Angus Place Colliery and continue the ability to extract up to 4 million tonnes per annum (Mtpa) of ROM coal using longwall mining techniques. The APMEP also sought to continue the utilisation of existing infrastructure, as well as construct and operate additional infrastructure to support the underground mining operations.

The exhibition period for the EIS commenced on 12 April 2014 and ended on 26 May 2014. A Response to Submissions (RTS) report was lodged with the DPIE on 1 October 2014 to respond to submissions received during the public exhibition period. A supplementary RTS was lodged with the DPIE in December 2014.

In response to a prolonged downturn in international coal markets, a decision was made by Centennial Angus Place to place the Angus Place Colliery into care and maintenance following the completion of secondary extraction within longwall panel 900W. Secondary extraction of longwall panel 900W was completed on 15 February 2015 and the mine was placed in care and maintenance on 28 March 2015. At that stage, the assessment of the APMEP was placed on hold.

1.2 Project Update

Since the submission of the 2014 EIS, and subsequent RTS documents, a review of the APEMP has been completed to take into consideration up to date information obtained from the adjacent Springvale Mine as well as recent changes in operational requirements. This review has resulted in proposed changes to the APMEP compared to what was presented in the 2014 EIS.

To enable Centennial to progress the APMEP, Centennial sought written agreement from DPIE to modify the SSD 5602 development application.

On 23 October 2019 DPIE issued a letter to Centennial Angus Place confirming that the changes to the APMEP could be considered in an Amendment Report to Development Application SSD 5602. Refer to Appendix A.

1.3 Director General's Requirements

Director General's Environmental Assessment Requirements (EARs) for the APMEP were issued by the DPIE on 6 November 2012. Supplementary Director General's Requirements were issued on 30 August 2013 to address Commonwealth matters of national environmental significance following the determination of the APMEP being a controlled action. The EARs issued for the APMEP remain valid.

The assessments prepared to support the Amendment Report have been prepared in accordance with the Director General's EARs issued on 6 November 2012 and the Supplementary Director General's Requirements issued on 30 August 2013. Where relevant, contemporary standards, policies or guidelines released since the issuing of the EARs have been referenced and assessed.

In regard to the assessment of biodiversity impacts for the APMEP, it is noted that although the *Biodiversity Conservation Act 2016* (BC Act) has subsequently come into effect, the transitional arrangements apply to the APMEP pursuant to Clause 28(1) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*. As such, the Biodiversity Assessment has been developed in accordance with the relevant biodiversity assessment guidelines in force at the time the Director General's EARs were issued.

1.4 Purpose of Amendment Report

Specifically, this report provides details of the revisions to the APMEP and includes updated assessments that take into consideration contemporary standards/guidelines and the latest information available to inform the assessment process.

In order to facilitate the amendment to Development Application SSD 5602, this Amendment Report has been prepared in accordance with correspondence from DPIE dated 23 October 2019 and the DPIE *Guideline for Preparing an Amendment Report*, dated June 2019 (refer to Table 1-1).

1.5 Proponent Details

Angus Place Colliery is owned by Centennial Springvale Pty Limited (as to 50%) and Springvale SK Kores Pty Limited (as to 50%) as participants in the Springvale unincorporated joint venture. The Angus Place Colliery is operated by Centennial Angus Place for and on behalf of the Springvale joint venture participants. Centennial Angus Place is the applicant for the APMEP.

The relevant postal address is:

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Table 1-1 Consideration of the DPIE Guideline for Preparing an Amended Project Report

Recommended Amended Report Structure	Document Location
Executive Summary	Executive Summary
Introduction	Chapter 1 - Introduction
Description of Amendments	Chapter 2 – Description of Amendments
Strategic Context	Chapter 3 - Strategic Context
Statutory Context	Chapter 4 - Statutory Context
Engagement	Chapter 5 - Additional Consultation and Engagement
Assessment of Impacts	Chapter 8 - Revised Assessment of Key Environmental Issues
Evaluation of Merits	Chapter 9 - Evaluation of Merits
References	Chapter 10 – References
Updated Project Description	Appendix B
Updated Mitigation Measures	Appendix C
Supporting Information	The following technical assessments are included as attachments to this Amendment Report: Appendix E: Surface Water Impact Assessment Appendix F: Revised Social Impact Assessment Appendix G: Revised Subsidence Assessment Appendix H: Groundwater Impact Assessment Appendix I: Revised Biodiversity Impact Assessment Appendix J: Revised Aquatic Ecology Impact Assessment Appendix K: Revised Air Quality Impact Assessment Appendix L: Revised Noise Impact Assessment Appendix M: Revised Cultural Heritage Impact Assessment Appendix N: Revised Traffic Impact Assessment Appendix O: Revised Economic Impact Assessment

2. DESCRIPTION OF AMENDMENTS

Since the submission of the 2014 EIS, and subsequent RTS documents, a review of the APMEP has been completed to take into consideration up to date information obtained from the adjacent Springvale Mine as well as recent changes in operational requirements. This review has resulted in proposed changes to the APMEP compared to what was presented in the original 2014 EIS.

Details of the key changes to the APMEP to what was proposed in the 2014 EIS is provided below and summarised in Table 2-1. A full updated project description for the APMEP as amended is provided in Appendix B.

Table 2-1 Summary of Project Changes

Activity	Proposed in 2014 EIS	Proposed Project Case
Mine Life	■ Existing project approval (PA 06_0021) expires 18 August 2024. ■ 2014 EIS sought approval for continued operations for 25 years from date of consent. ■ Rehabilitation activities to be completed following this period.	■ Mine life to 31 December 2053 ■ Rehabilitation activities to be completed following this period.
Hours of Operation	■ Operate 24 hours per day, 7 days per week.	■ No change
Employment	■ 300 FTE personnel	■ 450 FTE personnel
Site Access	■ Pit top access via Wolgan Road ■ Access to existing and proposed infrastructure in the Newnes State Forest via a designated access route at the intersection of Chifley Road and Old Bells Line of Road (for heavy or light vehicles) or via the State Mine Gully Road (light vehicles only).	■ No change
Coal Production	■ Annual extraction limit of 4 Mtpa of ROM coal.	■ Annual extraction limit of 4.5 Mtpa of ROM coal.
Mining Method and Mine Design	■ Continuous miner and longwall extraction ■ Continued development of new roadways to enable access to the proposed 1000 panel longwall mining area ■ Extraction of existing approved longwall 910 ■ Development and extraction of 19 new longwalls (LW1001-1019) with void widths between 260 m and 360 m.	■ Continuous miner and longwall extraction ■ Continued development of new roadways to enable access to the proposed 1000 panel longwall mining area ■ Extraction of existing approved longwall 910 ■ Development and extraction of 15 longwalls (LW1001-1015) with void widths of 360 m. ■ Development of underground roadway connections between the Angus Place Colliery underground mine workings and the Springvale Mine underground mine workings.

Activity	Proposed in 2014 EIS	Proposed Project Case
Mining Sequence	■ North from LW1001 to 1017 ■ South from LW1018-1019 ■ Longwall 910 last to be extracted	■ South from LW1001 to 1002 ■ North from LW1003 to LW1015 ■ Longwall 910 last to be extracted
Coal Handling	■ All ROM coal transferred from the underground mining area to the surface of the Angus Place Colliery pit top via the drift conveyor ■ Stockpiled at the ROM coal stockpile ■ Conveyed from ROM coal stockpile to CPP for crushing and sizing ■ Conveyed from CPP to Product Coal Bin for loading into trucks via the Product Coal Conveyor	■ Initial development ROM coal and up to 4 Mtpa of ROM coal in emergency situations transferred from the underground mining area to the surface of the Angus Place Colliery pit top via the drift conveyor ■ Stockpiled at the ROM coal Stockpile ■ Conveyed from ROM coal stockpile to CPP for crushing and sizing ■ Conveyed from CPP to Product Coal Bin for loading into trucks via the Product Coal Conveyor ■ Up to 4.5 Mtpa transferred by conveyor to the Springvale Mine pit top via proposed new underground connection roadways for handling and processing in accordance with the Springvale Mine Extension Project development consent (SSD 5594)
Coal Transport	■ Coal transported offsite from the Angus Place Colliery pit top by truck in accordance with the Western Coal Services Project development consent (SSD 5579)	■ Coal transported offsite from the Angus Place Colliery pit top by truck in accordance with the Western Coal Services Project development consent (SSD 5579) ■ Coal transferred to the Springvale Mine pit top transported offsite by truck in accordance with the Springvale Mine Extension Project development consent (SSD 5594) or by overland conveyor in accordance with the Western Coal Services Project development consent (SSD 5579)
Mine Support Infrastructure	■ Existing infrastructure at the Angus Place Colliery pit top ■ Existing infrastructure on the Newnes Plateau ■ Additional infrastructure on the Newnes Plateau for mine water management and ventilation	■ Existing infrastructure at the Angus Place Colliery pit top ■ Enlargement of the ROM coal stockpile from 90,000 t to 110,000 t capacity ■ Existing infrastructure on the Newnes Plateau ■ Additional infrastructure on the Newnes Plateau for mine water management and ventilation

Activity	Proposed in 2014 EIS	Proposed Project Case
Mine ventilation	■ Three drifts located at the Angus Place Colliery pit top are both downcast and fresh air intake shafts. ■ One upcast shaft with electric fan and diesel back up fan located at the Angus Place Colliery pit top. ■ Two ventilation shafts (3.5 m and 4.5 m) approved for construction at the Angus Place Ventilation Facility (APC-VS2) on the Newnes Plateau. Ventilation fans to be installed on the upcast shaft. The 3.5 m shaft constructed. ■ Construction and operation of one additional downcast shaft to the north mains headings in the 1000 Panel Area	■ Continue to operate all existing mine ventilation drifts, shafts and fans. ■ Construction of the approved but not yet constructed 4.5 m shaft at the Angus Place Ventilation Facility (APC-VS2) on the Newnes Plateau. ■ Installation and operation of the ventilation fan at the Angus Place Ventilation Facility (APC-VS2) on the Newnes Plateau. ■ Construction and operation of one additional downcast shaft to the north mains headings in the 1000 Panel Area
Underground Water Management	■ Continued transfer of mine water to the SDWTS via existing dewatering facilities ■ Construction and operation of additional dewatering facilities and associated infrastructure within the 1000 panel area to facilitate the transfer of mine water into the SDWTS ■ Transfer of mine water to the Angus Place Colliery pit top for discharge via LDP001 (2014 EIS proposed) ■ Transfer of mine water to the Angus Place pit top for subsequent transfer to the Springvale Water Treatment Project (SSD 7592) via the Angus Place Pipeline (current approved) ■ Operation of the Angus Place Colliery 930 Bore and associated infrastructure for raw mine water transfer from the SDWTS to the underground mining area	■ Continued transfer of mine water to the SDWTS via existing dewatering facilities ■ Construction and operation of additional dewatering facilities and associated infrastructure within the 1000 panel area to facilitate the transfer of mine water into the SDWTS ■ Transfer of mine water to the Angus Place pit top for subsequent transfer to the Springvale Water Treatment Project (SSD 7592) via the Angus Place Pipeline (current approved) ■ Operation of the Angus Place Colliery 930 Bore and associated infrastructure for raw mine water transfer from the SDWTS to the underground mining area
Surface Water Management – Angus Place Colliery Pit Top	■ Operation of various water storages and pollution control infrastructure. ■ Operation of a temporary Water Treatment Facility (Up to 31 December 2019) ■ Operation of LDP001, LDP002 and LDP005	■ No change
Surface Water Management – Newnes Plateau	■ Operation of clean water diversion drains at infrastructure sites on the Newnes Plateau ■ Operation and management of sediment dams and sumps at the Angus Place ventilation facility (APC-VS2)	■ No change

Activity	Proposed in 2014 EIS	Proposed Project Case
	■ Transfer of water from the Angus Place ventilation facility (APC-VS2) to the Springvale Mine underground workings	
Wastewater	■ Onsite wastewater treatment system and irrigation area via LDP005	■ Connection to the Lithgow City Council (LCC) main sewer line prior to the commencement of longwall extraction (subject to a separate development application through LCC)
Utilities and Services	■ Reliance on various non-mine owned infrastructure	■ No change
Exploration Activities	■ Ongoing throughout the Project Application Area	■ No change
Rehabilitation and Final Landform	■ Progressive rehabilitation on the Newnes Plateau. ■ Life of mine rehabilitation to be undertaken of all disturbed areas associated with the Angus Place Colliery pit top and Newnes Plateau.	■ No change
Surface Disturbance for Infrastructure	■ Up to 23.25 ha of vegetation clearing ■ Impacts within assessed Environmental Study Areas	■ Up to 49.93 ha of vegetation clearing ■ Impacts within an assessed Impact Envelope
Waste Management	■ No coal reject material is generated. ■ General waste disposed of to landfill by licensed waste contractors. ■ Materials recycled wherever possible ■ Waste oil and oily water are disposed of by licensed waste transporters to a licensed waste treatment plant.	■ No change
Project Application Area	■ 10,460 ha	■ 10,551 ha
Environmental Management	■ Existing environmental management system including management plans and monitoring programs ■ Review and update of environmental management system as required	■ No change

2.1 Project Application Area

The amended APMEP proposes a modified Project Application area to take into consideration revisions to the mine plan and to encompass the proposed new underground roadway connections between the Angus Place Colliery and the Springvale Mine. The amended Project Application Area encompasses 10,551 ha, an increase of 91 ha. Figure 2.1 shows the 2014 EIS Project Application Area and the proposed amended Project Application Area.

2.2 Mine Life

The amended APMEP now proposes to undertake mining operations up to 31 December 2053 with rehabilitation activities to continue beyond this date. This aligns mining operations at the Angus Place Colliery to the current projected life of the Mount Piper Power Station.

2.3 Coal Production

The amended APMEP seeks an increase in the current and previously proposed annual extraction limit from 4 Mtpa of ROM coal to 4.5 Mtpa of ROM coal.

2.4 Mining Method and Mine Design

Mining will continue to be carried out using a combination of continuous miners and longwall mining equipment. Although the Amended Project proposes to continue the required underground roadway development to enable access the proposed 1000 panel longwall mining area, the mine plan for the 1000 panel longwall mining area has been modified. These modifications include:

- Shortening longwalls to provide a minimum setback from the Gardens of Stone National Park of 1000 m to reduce the risks of subsidence related impacts on the National Park; and
- Shortening longwalls to avoid directly undermining the Trail 6 Newnes Plateau Shrub Swamp.

To ensure the mine remains economically viable, an increase in the void widths to some longwalls has been proposed to provide a consistent 360 m wide longwall void width across the entire 1000 panel longwall mining area.

These mine plan changes have resulted in the number of longwalls being reduced from 19 to 15 with an overall reduction in the mine plan footprint when compared to what was presented in the 2014 EIS.

The amended APMEP still proposes to extract the previously approved but not yet extracted LW910 as was previously proposed in the 2014 EIS.

In addition to the above, the amended APMEP proposes to establish additional underground roadway connections between the underground roadway connections between the Angus Place Colliery underground mine workings and the Springvale Mine underground mine workings to facilitate the transfer of coal from the Angus Place Colliery to the Springvale Mine pit top for processing and transportation offsite. Further details on this proposed coal transfer system is provided below.

The 2014 EIS mine plan and proposed amended APMEP mine plan is shown in Figure 3.2

2.5 Mining Sequence

On approval, longwall mining at Angus Place Colliery would commence in LW1001 and move southward towards LW1002 before progressing generally northwards from LW1003 to LW1015.

2.6 Employment

The amended APMEP is proposing to seek approval for up to 450 FTE personnel. Although the amended APMEP will seek approval for all 450 FTE personnel to operate from the Angus Place Colliery pit top, it is likely a portion of the 450 FTE personnel will access the APMEP area from, and utilise the infrastructure at, the Springvale Mine pit top.

The utilisation of the Springvale Mine pit top will be in accordance with the Springvale Mine Extension Project (SSD 5594). SSD 5594 authorises up to 450 FTE personnel to operate from the Springvale Mine pit top. Any employees operating from the Springvale Mine under the APMEP will remain within the assessed and approved 450 FTE personnel as already approved by the Springvale Mine Extension Project. As such, there will be no cumulative impact on the local road network servicing the Springvale Mine.

2.7 Coal Handling

The 2014 EIS proposed that up to 4 Mtpa of ROM coal be transported to the Angus Place Colliery pit top for handling and processing. The Amended Project proposes to continue to transport coal to the Angus Place Colliery Pit top at a rate of up to 4 Mtpa with an alternative option to transfer up to 4.5 Mtpa of ROM coal to the Springvale Mine pit top via a series of underground roadway connections.

Coal transported to the Angus Place Colliery pit top will continue to be handled and processed in accordance with the description provided in Appendix B.

For coal transferred to the Springvale Mine pit top, the coal would be handled and processed in accordance with the already approved Springvale Mine Extension Project development consent (SSD 5594).

Once the underground roadway connections between the Angus Place Colliery and the Springvale Mine are completed, the transfer of coal to the Springvale Mine pit top would take precedence over coal being transferred to the Angus Place Colliery pit top with coal transfers to the Angus Place pit top only occurring during emergency situations. This will result in reduced noise impacts resulting from the transport of coal along the private haul roads between the Angus Place Colliery and the Mount Piper Power Station. The underground roadway connections to enable coal transfers to the Springvale Mine pit top will be established prior to the commencement of longwall extraction in the 1000 panel longwall mining area.

The location of the proposed underground roadways to connect the Angus Place mine to the Springvale Mine is presented in Figure 3.1.

The volume of coal transferred to the Springvale Mine pit top will remain within the previously assessed and approved coal handling limit of 5.5 Mtpa considered as part of the Springvale Mine Extension Project.

2.8 Coal Transport

Coal transferred to the Angus Place Colliery pit top will continue to be transported offsite by truck in accordance with the Western Coal Services Project (SSD 5579).

Coal transferred to the Springvale Mine pit top will be handled and transported offsite in accordance with either the Springvale Mine Extension Project (SSD 5594) or the Western Coal Services Project (SSD 5579).

2.9 Underground Water Management

Mine inflows, encountered during mining operations, will continue to be either:

- Transferred to the 1 ML fire tank at the Angus Place Colliery pit top for reuse or transfer to the Springvale Water Treatment Project (SSD 7592) via the Angus Place Haul Road Pipeline; or
- Transferred to the Springvale Delta Water Transfer Scheme (SDWTS) via existing and proposed additional dewatering bore facilities and associated infrastructure.

2.10 Angus Place Colliery Pit Top Surface Water Management

Licenced Discharge Point LDP001 will be decommissioned following cessation of discharges in December 2019 and LDP002 will continue to operate as a rainfall based discharge point.

2.11 Wastewater

Should the project be approved, a pipeline to transfer wastewater will be constructed to transfer wastewater to the Lithgow City Council main sewerage line. Once the transfer of wastewater from the Angus Place Colliery pit top to the Lithgow City Council main sewerage line is completed, LDP005 will no longer operate. The construction of the wastewater transfer line will be the subject of a separate development application through Lithgow City Council. The sewerage treatment line will be constructed and operational prior to the commencement of longwall extraction at the Angus Place Colliery.

2.12 Surface Disturbance for Infrastructure and Access

As the location of surface infrastructure required to support the project is dependent on the approved mine plan, and due to the potential changes to the mine plan throughout the life of the project, flexibility as to where surface infrastructure is approved to be located is required. The infrastructure required to support the project is detailed in Appendix B and includes:

- dewatering bore facilities;
- access track upgrades;
- establishment of new access tracks;
- easement corridors for power;
- water connection pipelines;
- booster stations;
- downcast ventilation shaft facility (APC-VS3); and
- service boreholes.

To provide flexibility for the location of infrastructure throughout the life of the project, the amended APMEP will seek approval to undertake all surface disturbance activities required to establish infrastructure for the APMEP within an Impact Envelope.

WOLGAN STATE FOREST

GARDENS OF STONE NATIONAL PARK

BEN BULLEN STATE FOREST

CULLEN BULLEN

NEWNES PLATEAU

Angus Place Colliery

NEWNES STATE FOREST

LIDSDALE

FALNASH STATE FOREST

WALLERAWANG

SPRINGVALE

BLUE MOUNTAINS NATIONAL PARK

MARRANGAROO NATIONAL PARK

CLARENCE

LITHGOW

Legend
- Amended Project Application Area
- Major Road
- Railway
- Watercourses
- Consolidated Coal Lease
- Exploration Licence
- Mining Lease
- State Forest
- National Park

Data Source:
DPI DCBD and DTDB 2018
ESRI World Imagery 16th Nov 2014
ESRI World Street Map

Site Context

F2.1

Drawing No:	0511056s_EIS_G013_R2.mxd		Angus Place Mine Extension Project
Date:	28/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 1,000 2,000m

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ERM

WOLGAN STATE FOREST

WOLLEMI NATIONAL PARK

GARDENS OF STONE NATIONAL PARK

CULLEN BULLEN

BEN BULLEN STATE FOREST

NEWNES STATE FOREST

LIDSDALE

Legend
- Amended Project Application Area
- Centennial Coal
- The State Of New South Wales
- Freehold Landowner
- Major Road
- Railway
- State Forest
- National Park

Data Source:
DPI DCBD and DTDB 2018
ESRI World Imagery 16th Nov 2014

Amended Project Application Area Land Status

F2.2

Drawing No:	0511056s_EIS_G015_R0.mxd		Angus Place Mine Extension Project
Date:	28/11/2019	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 500 1,000m

N

ERM

3. STRATEGIC CONTEXT

The APMEP approval is sought to expand an existing coal mine on the basis that the mining industry is an important component of the regional economy. The AMPEP will provide ongoing revenue streams to Federal (e.g. corporate income taxes), State (e.g. royalties, payroll tax) and Local (e.g. land rates) governments over the period of the operation of the mine which is directly associated with the Lithgow region. The APEMP will continue to supply thermal coal to domestic power stations (and to the export market).

There are a number of strategic documents that have been prepared by both the State and Local governments in relation to coal mining and the economic and social direction of the Lithgow region. Table 3-1 provides a summary of the relevant strategic documents and how the APEMP sits within their strategic directions and goals.

Table 3-1 Relevant Strategic Documents

Relevant Strategic Documents	Summary
Lithgow Land Use Strategy 2010 – 2030 (LLUS)	The LLUS sets the direction and the policy of the Lithgow regions settlement and land use until 2030. A key theme of this document is in relation to the balance between coal mining and retail, being the two largest employers within this region. This effects demographic issues such as population decline and the increased aging population in the region. Coal mining within the region, including the Angus Place Colliery plays an important role in the regions strategic planning and is pivotal for ongoing landuse planning. The APMEP will ensure that economic prosperity is continued within this region, until such a time that a transition from coal occurs.
Lithgow City Council Economic Development Strategy 2018-2022 (LCC EDS)	Coal mining has been identified as the largest contributor to the Lithgow regions 'gross domestic product' and is the largest goods importer in this region. It is also the second largest employer within the area. The LCC EDS was developed to ensure the region aligns with the broader state and region's economic development planning strategies and priorities. The LCC EDS centres around the importance of coal mining for the region's economic planning, but provides for strategies for when the region will need to transition away to a post-mining economy. Centennial Angus Place is aware of their operations role in the economic stability and energy stability in this region. The APMEP will ensure that economic prosperity is continued within this region, until such a time that a transition from coal occurs.
Strategic Statement on NSW Coal, 2019	The Strategic Statement outlines the NSW Government's objective to deliver strong economic growth by maintaining a balance between resource development and the protection of State assets. Specifically, the NSW Governments objective is to realise the economic value of mining coal, as well as protecting the health of our environment. The key objectives of the Strategic Statement are: ■ Co-existing - Land use conflict; ■ Transparency and process; ■ Sustainability; ■ Safety

Relevant Strategic Documents	Summary
	■ Best practice and leading technologies; ■ Economic value and return for taxpayer; and ■ Regional economic development. Centennial Angus Place are supporting the Strategic Statement in a number of key ways: ■ Reusing an existing mine site, thereby limiting the impact area on other land uses; ■ Providing ongoing employment; ■ Maintaining the recreational pathways within the Newnes Plateau; ■ Seeking approval to operate and consulting the community about the APMEP; and ■ Installing best practice mining technologies which are safe.

The APEMP seeks to support a balance between resource development and environmental values and recognises that the Newnes Plateau is a location of environmental sensitivity. Section 8 and Section 9 of this Report provide the environmental assessment outcomes and evaluates the merits of the APMEP.

The APMEP is also supporting local and regional employment while the region transitions to from its traditional mining and power generation base towards other industries. This is an important consideration with the proposed Springvale Mine closure occurring by 2024.

Overall, the APMEP supports the majority of the strategic objectives of both the State and Local government in relation to land use and social-economic outcomes. Centennial Angus Place recognise that there are conflicts between the abovementioned State objectives in relation to impacts to environmental assets. This specifically relates to the Newnes Plateau and impacts to swamps as outlined in Section 7 and Section 8.2. However, it is considered that an 'optimal' balance between resource development and the protection of environmental values is being achieved through the redesign of the project based on the latest science, combined with the management, mitigation and offset strategies.

3.1 Site context

A detailed description of the site was provided in the 2014 EIS, with the description summarised for the purpose of this Amendment Report in Table 3-2 below.

Table 3-2 Site Description

Aspect	Description
Site Location	Angus Place Colliery is located in the Western Coalfield of New South Wales, 15 km northwest of the city of Lithgow and 120 km west northwest of Sydney. Angus Place pit top is accessed via the Castlereagh Highway and is located 5 km north of the village of Lidsdale, and 7.4 km northeast of Wallerawang.
Surrounding Land Uses	As shown on Figure 3.2, land uses in the vicinity of the Project Application Area consists of State Forest and National Park as well as residential uses, agriculture, open cut and underground coal mining, coal handling infrastructure, transport infrastructure, commercial forestry and power generation. Wallerawang is the closest retail and commercial centre, located 7 km south west of the pit top. Appendix D provides the details of all properties within the Project Application Area. The Lidsdale Siding Coal Loading Facility at Wallerawang has been used as a coal storage and rail loading facility since 1974 to distribute coal by rail from Centennial Coal's western region mines to ports on the NSW coast. Lidsdale village is located to the west of the Project Application Area and provides a rural fire service, park amenities and a church. The nearest large urban centre is Lithgow with a population of 21,000 (ABS, 2018). Lithgow is recognized as a tourist destination and meets the higher order retail, commercial and professional service needs of the area. Lithgow was established on coal mining; however, steel manufacturing and other industrial enterprises have also been carried out in the region. The area around Angus Place Colliery has been subject to extensive mining operations in the past, with a number of active or completed mines in the vicinity, including Centennial's existing operations.
Zoning	The Project Application Area includes areas of RU3 Forestry, RU2 Rural, RU1 Primary Production and SP2 Infrastructure zones under the Lithgow Local Environmental Plan 2014, as shown on Figure 3.3. Land uses within the Project Application Area predominantly consists of historical and existing mining operations and commercial forestry in the Newnes State Forest. Newnes State Forest comprises approximately 25,000 ha of pine plantation and native forest that is selectively logged under the Forestry Corporation of NSW tenure and management. In addition to the timber industry, the Newnes State Forest also supports a number of recreational land uses. Public access is permitted in the Newnes State Forest with common recreational activities consisting of motorcycle riding, four wheel driving, bushwalking, camping, mountain bike riding, canyoning, photography, bird watching and other such recreational and adventure activities. A small portion of land along the western boundary of the Project Application Area is cleared and is used for agriculture.
Ownership	Land ownership within and surrounding the Project Application Area consists of Crown Land, privately owned land and land owned and managed by the Forestry Corporation of NSW. Parcels of freehold land are located within the western boundaries of the Project Application Area and generally in the vicinity of Angus Place pit top.
Landscape Features	The Project Application Area contains significant natural landscape features formed by the combination of geology, topography and vegetation. The area is characterised by environmental features such as pagodas, cliff lines, swamps, creeks, and deep valleys. Angus Place Colliery is bordered by Newnes State Forest to the east, Springvale Mine to the south, Lidsdale to the west and the Gardens of Stone National Park to the north. Significant landscape features within the local area are shown on

Aspect	Description
	Figure 3.1.
Topography	The Project Application Area is located in an area of significant topographical variation. Most of the land surface within the Project Application Area and its environs lies within the Newnes Plateau at elevations from 900 m to greater than 1175 m Australian Height Datum (AHD). Topography within the Newnes Plateau comprises narrow gorges with high undulating ridgelines and sandstone cliffs, which range between 10 m and 40 m in height. The floors of creeks and gullies lie at elevations of between 960 m and 980 m AHD. The pit top is at a lower elevation of approximately 930 m AHD. Relatively open and flat valleys of the upper Coxs River and tributaries characterise the Angus Place pit top area.
Soils and Geology	The 2014 EIS identified thirteen (13) principal landscape units which overlie the Project Application Area. The major soil orders present are Tenosols covering 9,060 ha (86.8%) of the Project Application Area and which represent the Hassans Walls, Warragamba, Wollangambe, Medlow Bath, Newnes Plateau and Long Swamp Soil Landscape units. Other minor soil orders include Kandosols covering 588 ha (5.3%), Kurosols covering 335 ha (3.2%) and Rudosols covering 412 ha (3.9%). The major soil types within the proposed surface infrastructure areas are Tenosols. Other minor soil types include Kandosols and Rudosols. Soils across the Project Application Area have low inherent fertility and low agricultural potential.
Hydrology	The Project Application Area traverses both the Wolgan River/Carne Creek and Coxs River catchments. The Coxs River Catchment and the Wolgan River Catchment are both under the jurisdiction of the Hawkesbury-Nepean Catchment Management Authority, although the Coxs River is listed within the boundary of the Sydney Drinking Water Catchment under the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*. Both the Wolgan River and the Coxs Rivers have contributions from watercourse and creeks within the Project Application Area.
Climate	The climate in the region is typical of a cool temperate mountain climate, characterised by cold winters and warm summers. The highest temperatures occur throughout December, January and February, with the coolest temperatures occurring in July. Snow and/or sleet are common in winter months. Climate data has been sourced from the Bureau of Meteorology (BoM) website (http://www.bom.gov.au/climate/data/). A number of weather stations have been identified near the Project Application Area and are listed below in order of preference, taking into consideration locality, altitude and quality of data: ■ Lidsdale (Maddox Lane) – Station No. 63132. Located just 5 km from the pit top. This is the most representative and up to date dataset for Angus Place Colliery. Data recorded from 01/08/1959 to present; ■ Lithgow (Birdwood Street) – Station No. 63224. Located 15 km to the south of the pit top. Data recorded from 01/04/1889 to 30/06/2006. Table 3-3 below provides a snap-shot of the climate at the Angus Place Colliery.

Aspect	Description

Table 3-3 Weather and Climate Data (BOM, 2019)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Lidsdale (Maddox Lane) – Station No. 63132														
Rainfall														
Mean	85.8	75.9	66.6	42.4	47.9	49.8	50.0	63.2	53.0	68.0	72.4	73.9	758.3	2009 2019
Lowest	8.0	5.6	3.8	1.0	2.6	2.6	2.7	1.8	3.4	2.4	7.6	0.0	329.8	
Highest	213.6	270.4	270.4	202.6	131.2	228.3	214.0	363.8	123.0	228.4	164.7	217.0	1260.3	
Temperature														
Mean	26.7	24.6	22.4	18.7	15.0	11.3	10.9	12.5	16.3	19.7	22.6	24.4	18.6	2006-2019
Lowest	22.7	20.9	20.0	15.6	13.4	9.6	9.6	10.3	14.5	17.0	19.9	19.2	17.6	
Highest	30.0	28.7	24.6	22.1	16.5	12.4	12.5	14.2	19.3	22.0	26.0	26.4	19.5	
Lithgow (Birdwood Street) – Station No. 63224														
9 am conditions														
Mean 9am temperature (°C)	18.7	17.8	15.8	12.4	8.5	5.6	4.7	6.4	10.0	13.5	15.7	18.1	12.3	1913 2006
Mean 9am relative humidity (%)	64	70	73	76	81	82	79	73	64	60	60	61	70	1912 2006
Mean 9am wind speed (km/h)	6.7	6.1	6.5	7.5	7.2	8.3	8.4	10.2	10.9	9.8	8.9	7.9	8.2	1965 2006
3 pm conditions														
Mean 3pm temperature (°C)	23.9	22.9	20.8	17.4	13.3	10.0	9.3	10.8	13.7	17.0	19.7	22.7	16.8	1965 2006
Mean 3pm relative humidity (%)	54	58	60	59	66	67	66	56	54	51	53	50	58	1987 2006
Mean 3pm wind speed (km/h)	10.3	9.0	8.8	9.2	9.6	10.6	11.4	13.3	12.7	11.8	11.3	11.3	10.8	1965 2006

WOLGAN STATE FOREST

GARDENS OF STONE NATIONAL PARK

WOLLEMI NATIONAL PARK

CARNE CREEK

WOLGAN RIVER

BEN BULLEN STATE FOREST

NEWNES PLATEAU

Lambs Creek

Kangaroo Creek

COXS RIVER

NEWNES STATE FOREST

Carne Creek

LIDSDALE

Sawyers Swamp Creek Ash Dam

Legend

- Amended Project Application Area
- 2014 EIS Project Application Boundary
- Existing Workings
- Proposed Mine Plan Workings
- 2014 EIS Mine Plan Workings
- Major Road
- Railway
- Watercourses
- State Forest
- National Park
- 50 Newnes Plateau Shrub Swamp
- 51 Newnes Plateau Hanging Swamp
- 53 Mountain Hollow Grassy Fen

Data Source:
Study Areas - Client Provided
Infrastructure - Golder 2014
DFSI, DCDB/DTDB 2018, VIS - DECCW
ESRI World Imagery 16th Nov 2014

2014 EIS Project Application Area and Amended Project Application Area

F3.1

Drawing No:	0511056s_EIS_G008_R4.mxd		Angus Place Mine Extension Project
Date:	28/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 500 1,000m

N

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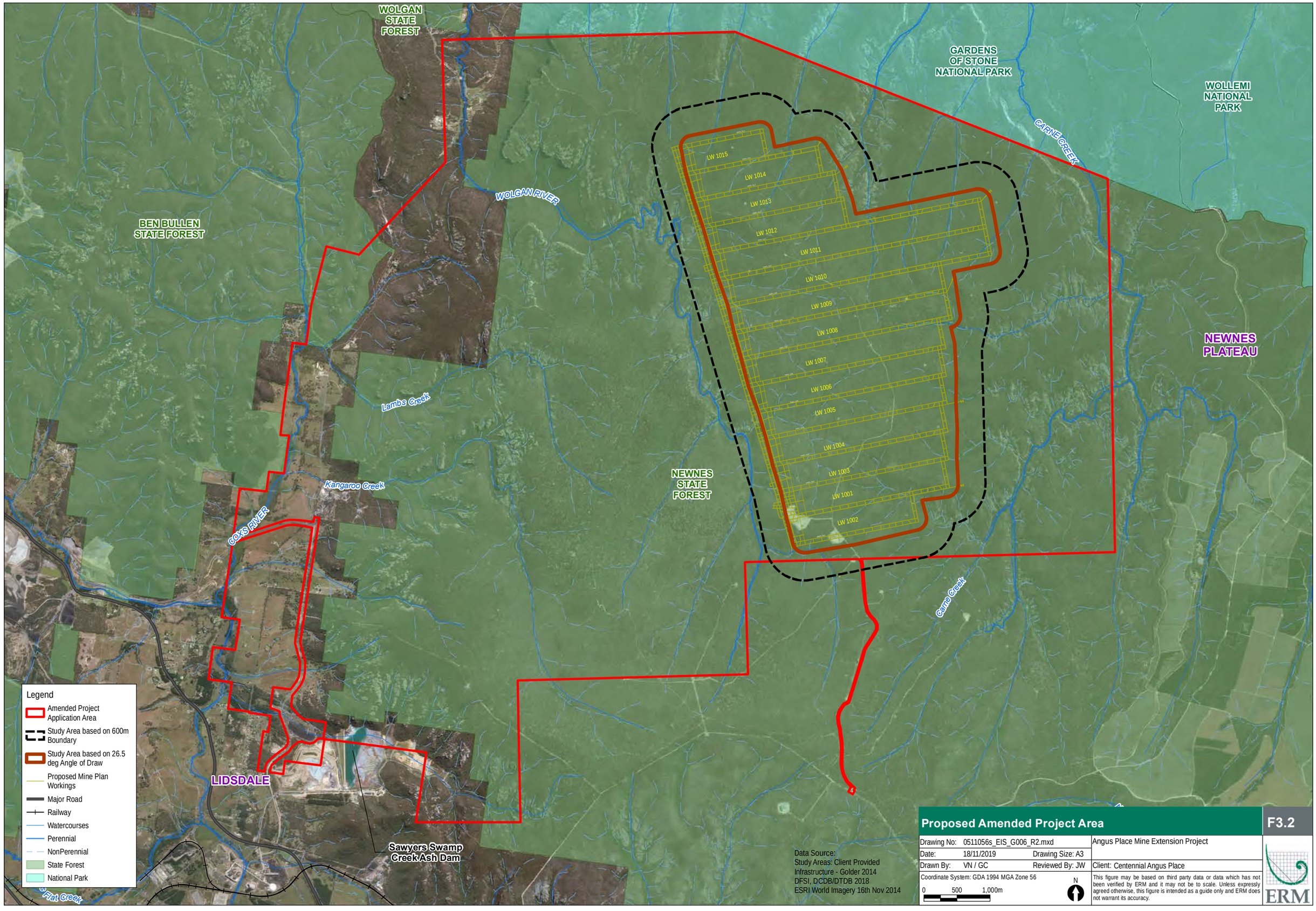

Proposed Amended Project Area

F3.2

Drawing No:	0511056s_EIS_G006_R2.mxd		Angus Place Mine Extension Project
Date:	18/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 500 1,000m

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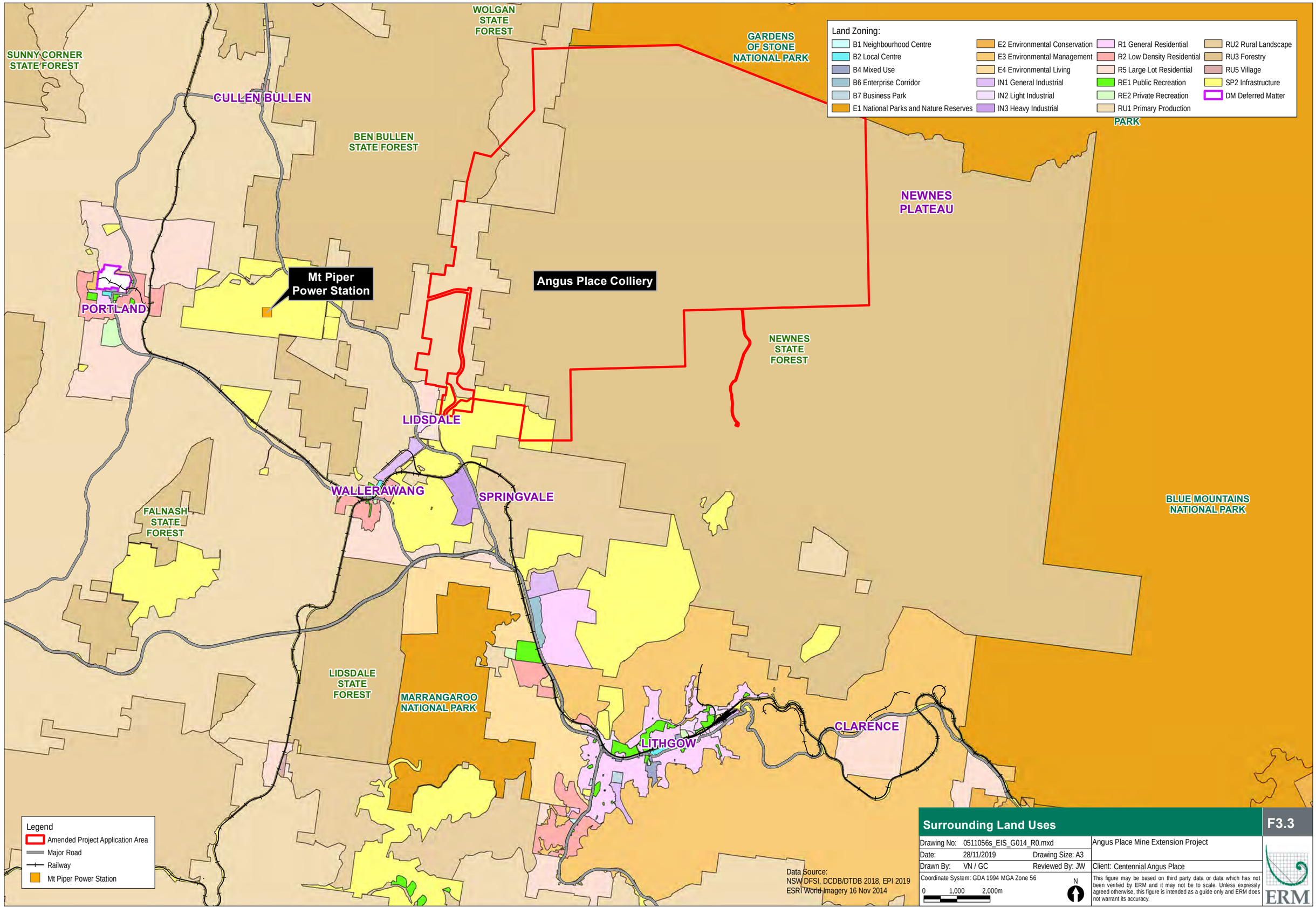

Surrounding Land Uses

F3.3

Drawing No:	0511056s_EIS_G014_R0.mxd		Angus Place Mine Extension Project
Date:	28/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 1,000 2,000m

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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

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4. STATUTORY CONTEXT

The amended APMEP has been assessed with full consideration of the applicable legislative requirements of the Commonwealth and State, along with the local planning and environmental frameworks of the Lithgow Local Government Area (LGA), where applicable. This Chapter provides a review of the relevant regulatory framework and the application to the amended APMEP design.

4.1 Approvals Pathway and Permissibility

The development assessment and approval system in NSW is set out in Parts 4 and 5 of the EP&A Act. Division 4.7 in Part 4 provides for the assessment and determination of State Significant Development (SSD). Pursuant to Section 4.36 of the EP&A Act, projects are classified as SSD if they are declared to be such by the State Environmental Planning Policy *SEPP (State and Regional Development) 2011* (SRD SEPP).

Clause 55 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) outlines the process for amending a development application –

Clause 55 What is the procedure for amending a development application?

1. *A development application may be amended or varied by the applicant (but only with the agreement of the consent authority) at any time before the application is determined.*
2. *If an amendment or variation results in a change to the proposed development, the application to amend or vary the development application must have annexed to it written particulars sufficient to indicate the nature of the changed development.*
3. *If the development application is for—*
   a. *development for which concurrence is required, as referred to in Section 4.13 of the Act, or*
   b. *integrated development, the consent authority must immediately forward a copy of the amended or varied application to the concurrence authority or approval body.*

On 23 October 2019 (refer to Appendix A) correspondence was received from the DPIE concurring that the proposed amendments to the APMEP could be considered in an Amendment Report. This Amendment Report has been prepared in accordance with the advice provided in the DPIE correspondence dated 23 October 2019 and the *Guidelines for Preparing an Amendment Report* (DPIE, 2019).

4.2 Regulatory Summary

The relevant regulatory framework and the application to the amended APMEP is provided in Table 4-1.

Table 4-1 Regulatory Summary

Legislation	Project Applicability
Commonwealth Legislation	
Environmental Protection and Biodiversity Conservation Act 1999	The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires approval of the Commonwealth Minister for Environment for actions that may have a significant impact on Matters of National Environmental Significance (MNES). The EPBC Act is administered by the Commonwealth Department of the Environment and Energy (DoEE) and lists threatened species, ecological communities and other MNES. Any proposed action that is expected to have an impact on MNES must be referred to the Minister for assessment under the EPBC Act, or assessed under the accredited process between the Commonwealth and the State of NSW.

Legislation	Project Applicability
	In June 2013, Centennial Angus Place Pty Limited (Centennial) lodged a referral under the EPBC Act to expand underground mining operations at the Angus Place Mine (EPBC 2013/6889). On 7 July 2013, the Commonwealth Department of the Environment and Energy (DoEE) determined that the APMEP was a Controlled Action. On 7 November 2019, DoEE accepted the proposed variation to EPBC 2013/6889 and the proposed action will continue to be assessed on behalf of the Commonwealth by the NSW Government under an accredited assessment process (refer to Appendix A).
Native Title Act 1993	The *Native Title Act 1993* recognises that Aboriginal people may have rights and interests to certain land and waters which derive from their traditional laws and customs. Native title may be recognised in places where Indigenous people continue to follow their traditional laws and customs and have maintained a link with their traditional country. Most of the lands within the Project Application Areas are subject to an Ancillary Deed which was entered into on the 31 January 2003 by the Gundungurra Native Title Claim Group, the Gundungurra Tribal Council Aboriginal Corporation and Centennial Springvale Pty Ltd, Springvale SK Kores Pty Ltd, Coalex Pty Ltd, Centennial Coal Company Ltd, Centennial Angus Place Pty Ltd and Ivanhoe Coal Pty Ltd. As such, these Centennial Companies are bound by the terms of this Deed. The Deed is subject to a confidentiality clause and as such detailed commentary regarding the Deed is not provided in this document.
National Greenhouse and Energy Reporting Act 2007	The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) provides a single national framework for the reporting and dissemination of information about the greenhouse gas emissions, greenhouse gas projects, and energy use and production of corporations. It makes registration and reporting mandatory for corporations whose energy production, energy use or greenhouse gas emissions meet specified thresholds. Centennial reports emissions from the corporation on an annual basis, including those from the Angus Place Colliery, in accordance with the NGER Act.
NSW State Legislation	
Environmental Planning and Assessment Act 1979	The Environmental Planning and Assessment Act 1979 (EP&A Act) and its associated regulations and instruments set the framework for development assessment in NSW. Developments requiring consent under a planning instrument (such as State Environmental Planning Policies and Local Environmental Plans) are assessed under Part 4. The APMEP is to be assessed under Part 4 of the EP&A Act.
Protection of the Environment Operations Act 1997	The Protection of the Environment Operations Act 1997 (POEO Act) is administered by the NSW Environment Protection Authority (NSW EPA). The objectives of the POEO Act are to protect, restore and enhance the quality of the environment. The POEO Act regulates and requires licensing for environmental protection, including for waste generation and disposal and for water, air, land and noise pollution. Relevant features of the POEO Act include: ■ protection of the environment policies (PEPs); ■ integrated environment protection licensing; and ■ regulation of scheduled and non-scheduled activities.

Legislation	Project Applicability
	Under the POEO Act, an Environment Protection Licence (EPL) is required for premises at which a 'scheduled activity' is conducted. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purpose of the act. Centennial holds an EPL for mining for coal and associated works at the Angus Place Colliery (EPL467), which covers the mining operation, surface facilities and overland conveyors at Angus Place Colliery. The provisions of EPL467 prescribe water quality and volumetric discharge limits of various surface water pollutants to designated Licenced Discharge Points (LDP). The location of LDPs under EPL467 (latest revision, 9 April 2019), and details of limits to quality and volumetric discharge are summarised in Appendix E – Surface Water Impact Assessment.
Mining Act 1992	No new mining lease under the *Mining Act 1992* is required over the Project Application Area although part ML1303 and ML1326 will need to be sub-leased from Springvale for the underground roadways. It is expected that the conditions of the SSD consent will require a new Mining Operations Plan (MOP) and Extraction Plan to be prepared and approved for the APMEP.
Water Management Act 2000	The *Water Management Act 2000* governs the issue of water access licences and approvals for those water sources (rivers, lakes, estuaries and groundwater) in New South Wales where Water Sharing Plans (WSPs) have been established. Part 2 of the Water Management Act 2000 establishes access licences for the take of water within a particular water management area. The Water Management (General) Regulation 2011 is the primary regulation instrument under the Water Management Act 2000. In general, the Water Management Act 2000 requires a: ■ water access licence to take water (refer to Figure 8.1); ■ water supply works approval to construct a work; and ■ water use approval to use the water.
Work Health and Safety (Mines and Petroleum Sites) Act 2013.	Centennial Angus Place currently holds all necessary approvals under the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* which aims to assist in securing and promoting the health and safety of people at work at mines, petroleum site or related places. Gas drainage and management at Centennial Angus Place will continue to be regulated under the provisions of the Act.
Mine Subsidence Compensation Act 1961	The Project Application Area is not located within a Mine Subsidence District. No surface improvements will require approval by the Subsidence Advisory NSW prior to construction.
Dams Safety Act 1978	The APMEP does not propose any underground mining or surface disturbance on or in the vicinity of any dams prescribed under the *Dam Safety Act 1978*
Crown Lands Act 1989	There is Crown land within the Project Application Area. The APMEP will not require a licence to use Crown Land under the provisions of the *Crown Lands Act 1989*.
Roads Act 1993	Section 138 of the *Roads Act 1993* requires consent be obtained prior to disturbing or undertaking work in, on or over a public road. No works are proposed by the APMEP in, on or over a public road.

Legislation	Project Applicability
Biodiversity Conservation Act 2016	The NSW *Biodiversity Conservation Act 2016* (BC Act) came into effect on 25 August 2017. The BC Act replaces the NSW *Threatened Species Conservation Act 1995*, the NSW *Nature Conservation Trust Act 2001* and parts of the NSW *National Parks and Wildlife Act 1974*. The BC Act transitional arrangements apply to the APMEP pursuant to Clause 28(1) of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*.
National Parks and Wildlife Act 1974	The National Parks and Wildlife Act 1974 (NPW Act) contains provisions for the protection and management of national parks, historic sites, nature reserves and Aboriginal heritage. By operation of Section 4.41 of the EP&A Act, the APMEP does not require any additional approvals under the NPW Act. An Aboriginal Heritage Assessment was completed as part of the 2014 EIS (RPS 2014) and updated by Niche (2019), both of which comply with the NPW Act requirements.
Aboriginal Land Rights Act 1983	The *Aboriginal Land Rights Act 1983* provides for the constitution of local, regional and State Aboriginal Land Councils and a mechanism for Land Councils to claim Crown land. There are no known granted claims over Crown land in the Project Application Area.
Heritage Act 1977	Historical archaeological relics, buildings, structures, archaeological deposits and features are protected under the *Heritage Act 1977*. There are no heritage items in the Project Application Area within the World Heritage List, NSW Heritage Register, Australian Heritage Database or the relevant Local Environmental Plans (Niche 2019). In any event, Approval is not required under Part 4 of the *Heritage Act 1977* due to the operation of Section 4.41 of the EP&A Act.
Contaminated Land Management Act 1997	The relevance of this legislation to the APMEP is outlined in *SEPP No. 55 Remediation of Land*
Forestry Act 2012	Existing access permits with Forestry Corporation of NSW will be required to be updated for the construction and operation of the new infrastructure in the Newnes State Forest.
State Environmental Planning Policies	
SEPP (State and Regional Development) 2011	*SEPP (State and Regional Development) 2011* (SRD SEPP) came into effect upon the repeal of Part 3A of the EP&A Act and identifies development to which the SSD assessment and determination process under Division 4.1 in Part 4 of the EP&A Act applies.
SEPP (Mining, Petroleum Production and Extractive Industries) 2007	*SEPP (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW.
SEPP (Infrastructure) 2007	*SEPP (Infrastructure) 2007* (Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across NSW by improving regulatory certainty and efficiency through a consistent planning regime and greater flexibility in the location of infrastructure and service facilities.
SEPP (Sydney Drinking Water Catchment) 2011	*SEPP (Sydney Drinking Water Catchment) 2011* applies to land within the Sydney drinking water catchment. The Project Application Area is in part located within the Sydney drinking water catchment.

Legislation	Project Applicability
SEPP No. 33 Hazardous and Offensive Development	*SEPP No. 33 - Hazardous and Offensive Development* (SEPP 33) regulates, amongst other things, the determination of development applications to carry out what is defined in SEPP 33 as development for the purposes of a "potentially hazardous industry" or "potentially offensive industry". With the continued implementation of best management practices for hydrocarbons and explosives used within the Project Application Area and the other measures outlined in this EIS to reduce or minimise the impact of the APMEP, as well as effective implementation of the approved EMS and occupation health and safety management systems, the APMEP would not pose any significant risk, in relation to its locality, to human health, life or property or to the biophysical environment.
SEPP No. 44 Koala Habitat Protection	*SEPP No. 44 – Koala Habitat Protection* provides for the protection of koala habitat by ensuring that areas subject to development proposals are considered for their value as habitat or potential habitat for koalas. The Greater Lithgow LGA is listed under Schedule 1 of SEPP No. 44 as an area to which the SEPP applies. SEPP 44 is currently being reviewed and they key changes in the proposed amended SEPP will relate to the: ■ definitions of koala habitat; ■ list of tree species; ■ list of councils; and ■ development assessment process.
SEPP No. 55 Remediation of Land	*SEPP No. 55 – Remediation of Land* (SEPP 55) provides for a state-wide planning approach to the remediation of contaminated land in order to reduce the risk to human health or any other aspect of the environment.
Other Considerations	
Lithgow Local Environmental Plan 2014	Local Environmental Plans (LEPs) are instruments that guide planning decisions for LGAs and allow Councils to manage the ways in which land is used through zoning and development consents. The Project Application Area includes areas of RU3 Forestry, RU2 Rural, RU1 Primary Production and SP2 Infrastructure zones under the *Lithgow Local Environmental Plan 2014* (LEP). Development for the purposes of "underground mining" is prohibited under the Lithgow LEP within RU1, RU2, RU3 and SP2. Sub-clause 7(1)(a) of the Mining SEPP also states that development for the purpose of underground mining may be carried out on any land with development consent. Clause 1.9(1) of the Lithgow LEP notes that the provisions of the SEPPs prevail over the LEP, in accordance with the EP&A Act. In relation to any inconsistency between the Mining SEPP and an LEP, sub-clause 5(3) provides that the Mining SEPP prevails to the extent of the inconsistency. On this basis, any provision in the Lithgow LEP that would otherwise operate to prohibit the APMEP has no effect, and accordingly, the APMEP is permissible with development consent on the land in which the APMEP will be carried out that is within the Lithgow LGA.

Legislation	Project Applicability
Lithgow Land Use Strategy 2010-2030	Lithgow City Council's *Lithgow Land Use Strategy 2010-2030* (LLUS) was adopted by Council on 31 October 2011 and endorsed by the NSW Department of Planning and Infrastructure on 24 May 2012. The LLUS is a combined Land Use Issues Paper and Strategy. It explores the issues that currently face the Lithgow LGA and recommends a new planning approach to address these issues. The Strategy will be implemented through the planning system, primarily through the Draft Lithgow LEP 2013 and Development Control Plan, as well as Council's other policy, regulatory and governance functions. This Strategy is significant to Council and the community because it will set directions and policy for the LGA's settlement and land use management for the next 20 years. The Strategy will be reviewed throughout this period every five years to ensure that its findings and recommendations remain relevant, are in keeping with sound planning principle and are continuing to meet the needs and expectations of the community.
Water Sharing Plans	Water Sharing Plans (WSPs) establish rules for sharing water between the environmental needs of the river or aquifer and water users, and between different types of water use such as town supply, rural domestic supply, stock watering, industry and irrigation. There are Water Sharing Plans for regulated and unregulated river catchments and groundwater sources in water management areas. For groundwater, the amended longwalls are located within the Sydney Basin Richmond Groundwater Source of the Greater Metropolitan Region Groundwater Sources 2011. The Angus Place Colliery pit top is within the Sydney Basin Coxs River Groundwater Source of the Greater Metropolitan Region Groundwater Sources 2011. The APMEP is also situated within the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources. There is no direct extraction of surface water within this Region, however a reduction in baseflow contributions to surface water systems requires licensing, as per the requirements of the NSW Aquifer Interference Policy. For surface water, the APMEP is on the boundary of the Upper Nepean and Upstream Warragamba Water Source (Wywandy Management Zone) and the Hawkesbury and Lower Nepean Rivers Water Source (Colo River Management Zone) of the Water Sharing Plan for Greater Metropolitan Region Unregulated River Water Sources 2011 (NSW). Surface water catchments within the Upper Nepean and Upstream Warragamba Water Source, which include Kangaroo Creek and Coxs River are also declared by the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 (NSW)* to be within the Sydney Drinking Water Catchment.

5. ADDITIONAL CONSULTATION AND ENGAGEMENT

Stakeholder engagement was originally undertaken in 2014 during the development of the 2014 EIS and when the application was placed on public exhibition. A number of potential social impacts and opportunities were raised during this consultation period which are included in the Social Impact Assessment (Appendix F). These relate to the following issues:

- Concern in relation to the potential loss of local and regional social and economic benefits currently derived from Springvale Mine due to any cessation of mining activity in the absence of approved operations at Angus Place;
- Continuation in the flow of direct and indirect employment and economic benefits derived from Centennial Mining activities to the nearby communities of Wallerawang-Lidsdale, Portland and the broader Lithgow LGA;
- Continuation of Centennial Coal and workforce voluntary contributions to the community through sponsorship and donations;
- The role of Angus Place in aiding the economic transition of Lithgow LGA from an economy based on coal fired power generation and coal mining to a more diverse and resilient economy;
- Concern that the APMEP may lead to subsidence and fracturing of the bedrock of Wolgan River, Carne Creek, minor cliffs and the draining of Tri-Star Swamp and Twin Gully Swamp resulting in the permanent loss of some valued environmental assets;
- Concern that subsidence may result in damage to the valued cliffs and pagodas on Newnes Plateau, reducing visual amenity for passive and active recreational user groups;
- Concern that APMEP related surface water discharge may impact the quality of water in waterways within and adjoining the Project Application Area;
- Increased vehicle traffic on State Mine Gully Road and connecting roads on the Newnes Plateau during construction;
- Impacts to recreational amenity in the Newnes Plateau due to construction traffic, noise, dust and temporary access restrictions for user groups of Newnes Plateau;
- Amenity benefits associated with the removal of coal haulage trucks from a decrease in truck movements; and
- Potential for impact on local Indigenous cultural heritage values and artefacts identified in the Project Application Area.

As the majority of community concerns have already been addressed within the original application process, the APMEP consultation focused on informing the key stakeholders on the amended APMEP design and the revitalisation of the application. The following Table 5-1 provides a summary of the ongoing consultation that has been provided to support this Amendment Report.

Table 5-1 Centennial Stakeholder Consultation

Stakeholder	Meeting Date	Description
Department of Planning, Industry and Environment (DPIE)	23 October 2018	Presentation to the DPIE on proposed changes to the APMEP.
	5 December 2018	Presentation to DPIE regarding mine plan options for the APMEP.
	5 February 2019	Presentation to the DPIE on outcomes of mine plan options investigations for the APMEP and preferred mine plan to progress.
	18 April 2019	Submission of request to DPIE to progress the APMEP through an Amendment Report.
	23 October 2010	Formal response from DPIE regarding acceptance of an Amendment Report approach.
Department of Environment and Energy	24 July 2019	Presentation on background to Springvale and Angus Place Colliery projects and proposed pathway forward with the APMEP.
	6 September 2019	Submission of a referral variation request to the Department of the Environment and Energy (DoEE) in accordance with the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).
	12 September 2019	Submission of a revised referral variation request following feedback from the DoEE.
	7 November 2019	Acceptance of the EPBC referral variation request.
Western Region Combined CCC	17 November 2017 10 April 2018 13 November 2018 9 April 2019 21 August 2019[1]	General updates on Centennial operations. Extraordinary meeting held 21 August to discuss the APMEP in detail.
Western Aboriginal Cultural Heritage Committee	7 November 2018 15 May 2019	General updates about the APMEP and survey methodology.
Lithgow Environment Group (LEG)	14 March 2018	Meeting to update on Centennial projects.
Colong Foundation	23 March 2018 2 May 2019	Specific meeting to discuss the APMEP.
LEG and Blue Mountains Conservation Society (BMCS)	5 June 2018 18 July 2018	Meeting to discuss Centennial projects including the APMEP.
Garden of Stone Alliance (GSA), Colong Foundation, BMCS, LEG	27 June 2019	Briefing to discuss the APMEP.
Lithgow City Council (LCC) and Colong Foundation Briefing	11 June 2019	Facilitated meeting for Colong Foundation to meet with LCC to discuss Destinations Pagoda and the APMEP.
Wallerawang Lidsdale Progress Association	6 August 2019	Discuss the APMEP and proposed Swamp Offset Strategy.
Western CCC Chairs	2 September 2019	Meeting with the Chairs of the Clarence Mine CCC and the Western Region Combined CCC to discuss the APMEP and proposed Swamp Offset Strategy.

Stakeholder	Meeting Date	Description
MPPS Community Representative	2 September 2019	Discuss the APMEP and proposed Swamp Offset Strategy.
Lithgow / Oberon Landcare	3 September	Discuss the APMEP and proposed Swamp Offset Strategy.
LCC	Multiple dates	
Construction Forestry Maritime Mining Energy Union (CFMMEU)and Lodge Officials	3 September	
Lithgow National Trust	18 September	
Community Information Sessions	17-19 October	General information about Centennial with focus on the APMEP.

6. REVISED SUBSIDENCE PREDICTIONS

This chapter describes the updated subsidence predictions as a result of the amended mine design. It is informed by the technical subsidence impact assessment prepared by MSEC (2019). This report is provided in full in Appendix G.

As outlined within the 2014 EIS, the primary objective of mine design is safety, underground and on the surface. By managing safety, the mines manage subsidence impacts on the surface and in turn manages environmental and social consequences. At Angus Place Colliery, the continued application of risk based planning has driven mine planning, mine design and subsidence management, based on geological and geotechnical constraints, the location of sensitive surface features and an increased understanding of swamp impacts (refer to Chapter 7).

6.1 Geological summary

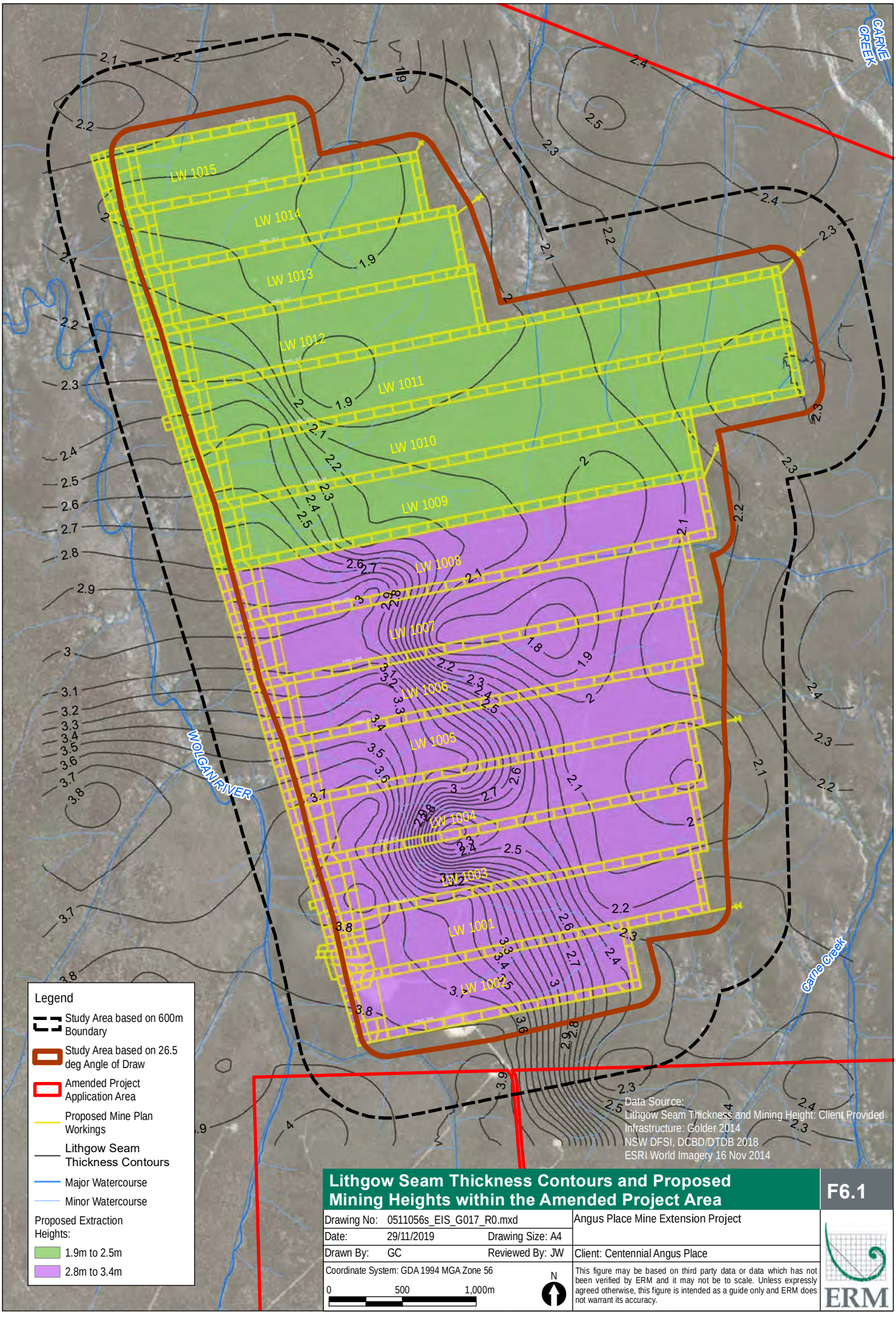
A full description of geological conditions and constraints was provided in the 2014 EIS. In summary, Angus Place lies in the south-western part of the Western Coalfield of the Sydney Basin. The western coalfield mainly consists of relatively flat-lying rocks of Permian and Triassic age. The Upper Permian Illawarra Coal Measures are overlain by the sandstones of the Triassic Narrabeen Group, with interbedded shale and siltstone layers.

The Lithgow/Lidsdale Seam lies within the Cullen Bullen Subgroup of the Illawarra Coal Measures with a combined thickness of about 7 m. It is proposed that only the Lithgow Seam will be extracted having a thickness ranging between 1.9 m and 3.9 m within the proposed mining area (refer to Figure 6.1).

The floor of the Lithgow Seam generally dips from the west to the east. The average seam dip across the proposed mining area is approximately 2% (1 in 50). The seam dip is relatively uniform over the length of the proposed longwalls. The seam is thickest in the south-western part of the proposed mining area and thinner in the eastern and northern parts of the mining area. The existing longwall equipment from Springvale Colliery will be utilised for LW1001 to LW1008 and it has an available mining height ranging between 2.8 m and 3.4 m. New longwall equipment will be utilised for LW1009 to LW1015 which will have an available mining height ranging between 1.5 m and 2.5 m. This will allow mining to a stable roof horizon to ensure the safety of mineworkers.

The depths of cover above the proposed longwalls vary between 270 m and 450 m. The lowest depths of cover occur along the drainage lines above the western ends of LW1005, LW1009, LW1010 and LW1012. The highest depths of cover occur along the ridgeline above LW1008. The average depth of cover across the proposed mining area is 370 m.

As described in the 2014 EIS, the deeper the coal that is being mined, the greater the pressure placed on coal pillars left to support the roof, and the greater the pressure on the roof. The depth of cover creates both horizontal and vertical stress on these pillars. The combination of a relatively high stress regime and weak, laminated roofing has led to numerous roof failures throughout the life of the mine to date. The specialised equipment and processes designed and implemented at the mine are considered industry best practice and ensure safe operating conditions for mine workers even in very poor roof conditions.



Lithgow Seam Thickness Contours and Proposed Mining Heights within the Amended Project Area

F6.1

Drawing No:	0511056s_EIS_G017_R0.mxd		Angus Place Mine Extension Project
Date:	29/11/2019	Drawing Size: A4	
Drawn By:	GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 500 1,000m

N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

6.2 Geological structures

As reported in the 2014 EIS and summarised by MSEC (2019), an investigation of the geological structures within the proposed mining area was originally undertaken by Palaris in 2013. These structures have been categorised into four (4) types:

- Type 1 – are major geological structural zones characterised by their size and length and can be projected for many kilometres. They have a strong surface expression that includes linear segments of deep valleys/gorges. They are recognised in underground workings as faulted or highly fractured ground. The Type 1 features are very confidently predicted within the Project Application Area.
- Type 2 - evidence of geological structure in the basement and mine workings except that the structural zone and the overlying topographic relief extend only a limited distance – perhaps one or two kilometres. In the immediate workings of Angus Place and Springvale these are uncommon.
- Type 3 – these geological structures are predicted from mapped underground structures (faults, joint zones or stress zones), and basement features. There is no associated surface topographic relief forming part of an alignment.
- Type 4 – identified basement structures that have no corresponding structures recognised in mine workings nor is it associated with surface relief. This type of structure prediction is the most common and are regarded as benign with respect to its impact on mining.

As shown in Figure 6.2, there are four (4) Type 1 structures that has been identified within the amended Study Area (based on the 600m boundary to the proposed longwalls). The NNE trending lineament[1] is associated with a tributary of Carne Creek above LW1010 to LW1013.

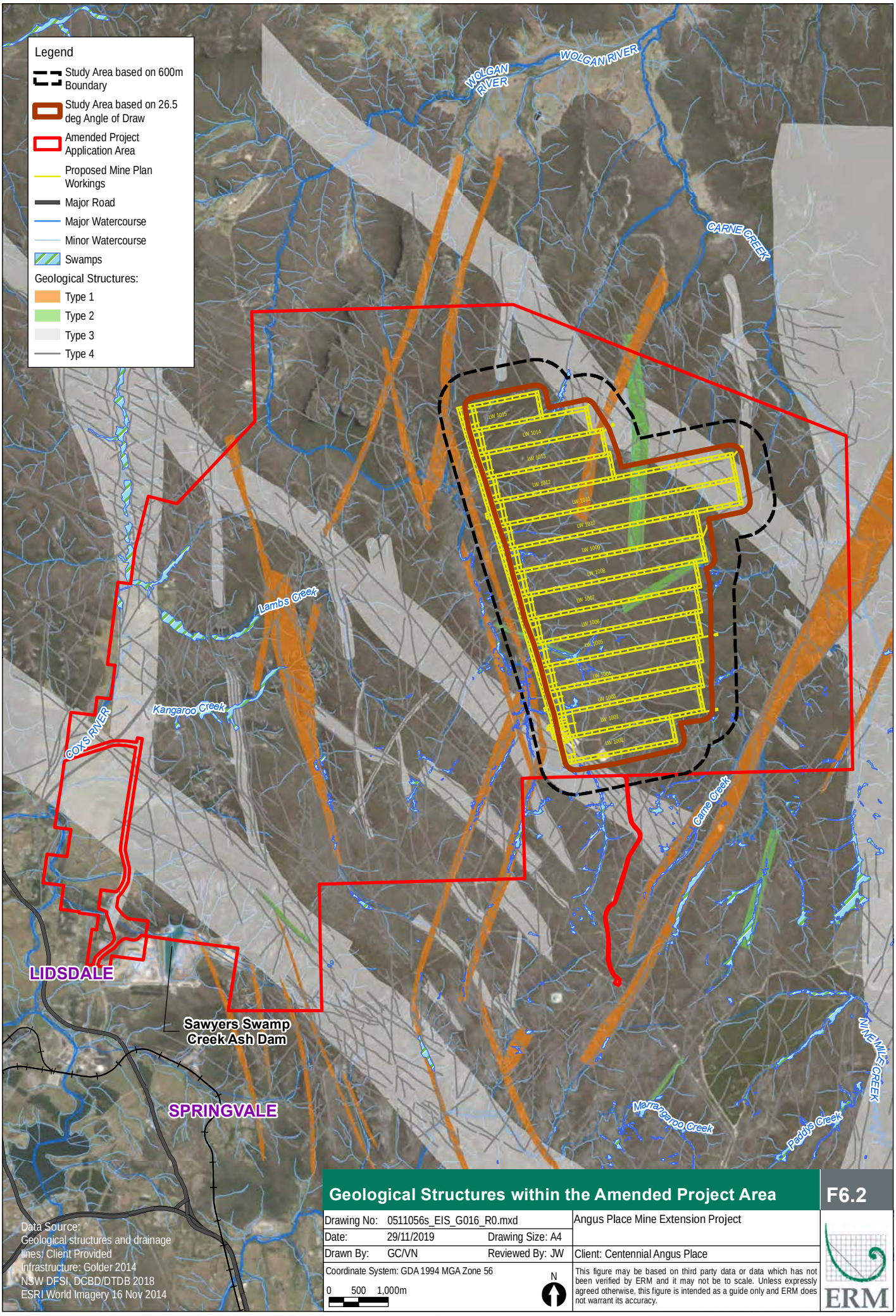
As shown in Figure 6.2, there are also three (3) Type 2 structures which have been identified within the amended Study Area comprising the:

- NW trending lineament associated with a tributary of the Wolgan River and Tri-Star Swamp above the western end of LW1005;
- ENE trending lineament associated with a tributary of Carne Creek above the eastern ends of LW1006 and LW1007; and
- NNE trending lineament associated with a tributary of Carne Creek above the mid-lengths of LW1010 and LW1011 and above the eastern ends of LW1012 and LW1013.

These Type 1 and Type 2 structural zones are interpreted to penetrate from the basement strata through to the surface and will affect the mine subsidence surface effects as a result of the proposed longwall mining. The calibration of the subsidence prediction model for the increased subsidence and strain at these lineaments is discussed in Appendix H and summarised in Section 6.4 below.

The Type 3 and Type 4 structures are unlikely to have a significant influence on the mine subsidence surface effects.

[1] A lineament is a distinctive linear feature in a landscape that is an expression of an underlying geological structure such as a fault, fracture, or joint.



Geological Structures within the Amended Project Area

F6.2

Drawing No:	0511056s_EIS_G016_R0.mxd		Angus Place Mine Extension Project
Date:	29/11/2019	Drawing Size: A4	
Drawn By:	GC/VN	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Data Source:
Geological structures and drainage lines: Client Provided
Infrastructure: Golder 2014
NSW DFSI, DCBD/DTDB 2018
ESRI World Imagery 16 Nov 2014

ERM

6.3 Identification of natural and built features within the Amended Mine Plan area

A summary of the natural and built features within the Study Area is provided in Table 6-1. The locations of these features are shown in Figure 3.1 and Figure 6.3.

Table 6-1 Identification of natural and built features within the Amended Application Area

Item	Identified within the 2014 EIS Mining area	Identified within the Amended Mining area	For detailed assessment refer to Section:
Natural Features			
Streams	Yes	Yes	Updated subsidence predictions for the drainage lines are presented in Section 6. Changes to hydrology due to subsidence impacts are presented in Table 8-7.
Aquifers or Known Groundwater Resources	Yes	Yes	Section 8.1.4
Springs or Groundwater Seeps	Yes	Yes	Section 8.1.4
Cliffs or Pagodas	Yes	Yes	Table 8-11
Steep Slopes	Yes	Yes	Table 8-11
Swamps or Wetlands	Yes	Yes	Table 8-6
Water Related Ecosystems	Yes	Yes	Section 8.3
Threatened or Protected Species	Yes	Yes	Section 8.2
National Parks and State Forests	Yes	Yes	Table 8-11
Natural Vegetation	Yes	Yes	Section 8.2
Any Other Natural Features Considered Significant	Yes	Yes	Section 8.2
Public Utilities			
Roads (All Types)	Yes	Yes	Table 6-5
Culverts	Yes	Yes	Table 6-5
Permanent survey control marks	Yes	Yes	Table 6-5
Farm Land And Facilities			
Fences	Yes	Yes	Table 6-5
Well or Bores	Yes	Yes	Table 6-5

Item	Identified within the 2014 EIS Mining area	Identified within the Amended Mining area	For detailed assessment refer to Section:
Industrial, Commercial And Business Establishments			
Mine Related Infrastructure Including Exploration Bores and Gas Wells	Yes	Yes	Table 6-5
Areas Of Archaeological Significance			
Aboriginal heritage sites	Yes	Yes	Section 8.6

6.4 Methodology used to predict the mine subsidence

For a full overview of conventional and non-conventional mine subsidence parameters and the methods that have been used to predict these movements please refer to Appendix G.

6.4.1 Definition of the amended study area

For the purposes of subsidence modelling, the Study Area is defined as the surface area that could be affected by the extraction of the proposed LW1001 to LW1015. Two (2) areas have been considered for the APMEP:

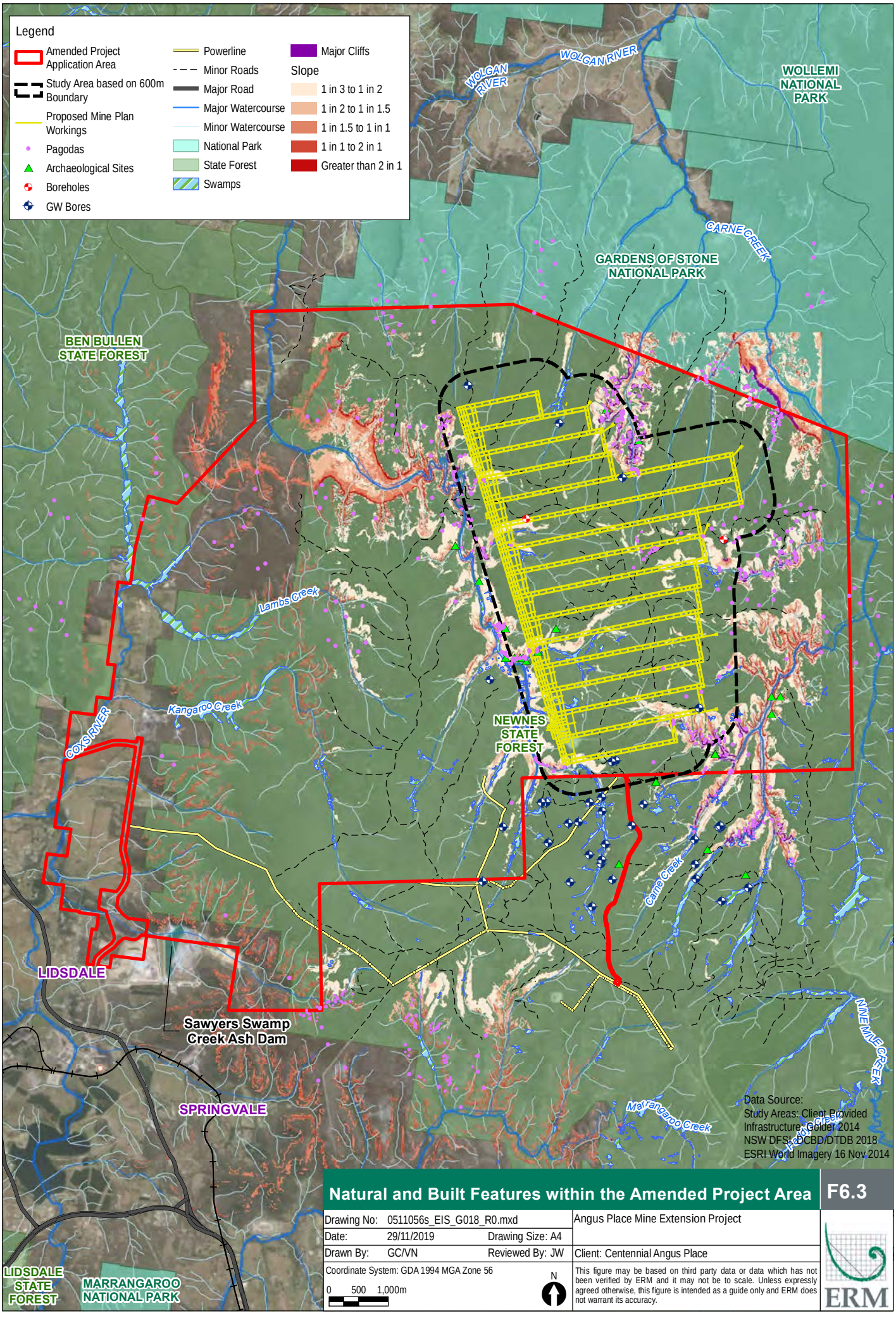
- the 26.5° angle of draw represents the extent for the assessments for the conventional ground movements (i.e. vertical subsidence and its associated effects). Low level conventional ground movements can extend beyond the 26.5° angle of draw. The natural and built features located outside the 26.5° angle of draw, which could experience these low level movements and could be sensitive to these movements have also been included in the assessments.
- the 600 m boundary represents the minimum extent of the assessments for the valley related effects. This distance is based on the recommendations from the Southern Coalfield Inquiry (DPIE, 2008) for the risk management zones. The natural and built features located outside the 600 m boundary, which could experience valley related effects and could be sensitive to these effects such as the Garden of Stones National Park, have also been included in the assessment.

The depths of cover within the amended mining area vary between 270 m and 450 m. The 26.5° angle of draw line, therefore, has been determined by drawing a line that is a horizontal distance varying between 135 m and 225 m around the limits of the secondary extraction areas. The predicted total 20 mm subsidence contour is located entirely within this 26.5° angle of draw (refer to Figure 6.5).

6.4.2 The Incremental Profile Method (IPM)

The predicted vertical subsidence effects for the proposed longwalls have been obtained using the Incremental Profile Method (IPM). The IPM has been developed by MSEC and refined over many years. It is an empirical model based on a large database of ground monitoring data from previous mining within the Southern, Newcastle, Hunter and Western Coalfields of NSW, including subsidence data from Springvale Mine and Angus Place Colliery.

As described by MSEC (2019), there is a high degree of accuracy between pre-mining modelled subsidence predictions and post-mining measured subsidence, which demonstrates that the subsidence modelling used for the APMEP is a proven technology, backed up with a rigorous dataset that takes into consideration historical mine design, subsidence monitoring, geological modelling, and topography.


Legend
Amended Project Application Area
Study Area based on 600m Boundary
Proposed Mine Plan Workings
Pagodas
Archaeological Sites
Boreholes
GW Bores
Powerline
Minor Roads
Major Road
Major Watercourse
Minor Watercourse
National Park
State Forest
Swamps
Major Cliffs
Slope
1 in 3 to 1 in 2
1 in 2 to 1 in 1.5
1 in 1.5 to 1 in 1
1 in 1 to 2 in 1
Greater than 2 in 1
WOLGAN RIVER
WOLGAN RIVER
WOLLEMI NATIONAL PARK
CARNE CREEK
GARDENS OF STONE NATIONAL PARK
BEN BULLEN STATE FOREST
Lambs Creek
Kangaroo Creek
COXS RIVER
NEWNES STATE FOREST
Carne Creek
LIDSDALE
Sawyers Swamp Creek Ash Dam
SPRINGVALE
NINEMILE CREEK
Marrangaroo Creek
LIDSDALE STATE FOREST
MARRANGAROO NATIONAL PARK
Data Source:
Study Areas: Client Provided
Infrastructure: Golder 2014
NSW DFSI: LPI/CBD/DTDB 2018
ESRI World Imagery 16 Nov 2014
Natural and Built Features within the Amended Project Area
F6.3
Drawing No: 0511056s_EIS_G018_R0.mxd
Angus Place Mine Extension Project
Date: 29/11/2019
Drawing Size: A4
Drawn By: GC/VN
Reviewed By: JW
Client: Centennial Angus Place
Coordinate System: GDA 1994 MGA Zone 56
0 500 1,000m
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

The IPM has been further calibrated to local conditions using the ground monitoring data from Angus Place and Springvale Collieries, and is described in Section 3.5 of MSEC (2019).

Detailed analysis provided by MSEC (2019) shows that the IPM method provides reasonable, if not, slightly conservative predictions where the mining geometry and overburden geology are within the range of the database. The method can also be further tailored to local conditions where ground monitoring data is available close to the mining area. It is therefore expected that the calibrated IPM will provide reasonable, if not, slightly conservative predictions of vertical subsidence for the proposed LW1001 to LW1015.

6.4.3 IPM and Lineaments

Increased subsidence effects have been observed where previously extracted longwalls at Angus Place and Springvale Collieries have mined beneath Type 1 and Type 2 geological structure zones (surface lineaments).

Locally increased vertical movement was observed along the surface lineaments at the eastern ends of LW940 and, to lesser extents, at the lineaments above the eastern ends of LW950 and LW960 at Angus Place. Locally increased vertical movements were also observed at the lineament between the longwalls at Angus Place and LW411 at Springvale Colliery.

As an example, it can be seen from Figure 6.4, the measured vertical movement above the eastern end of LW940 of 1900 mm exceeded the maximum predicted vertical subsidence obtained using the standard IPM of 1500 mm by around +27%. The measured maximum vertical movements above the eastern ends of LW950 and LW960 also exceeded the predicted maximum vertical subsidence by around 5% to 10%.

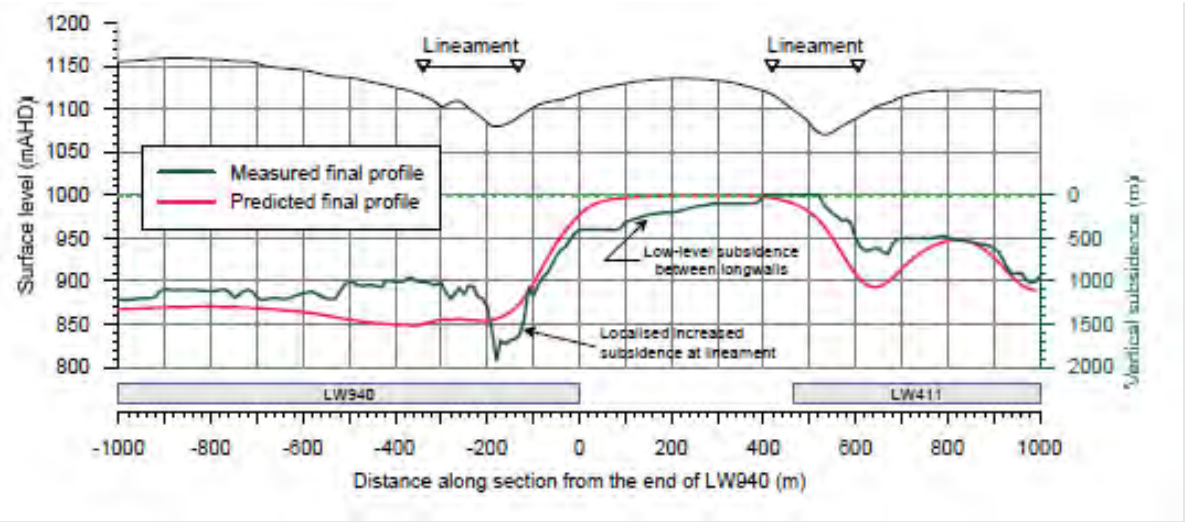
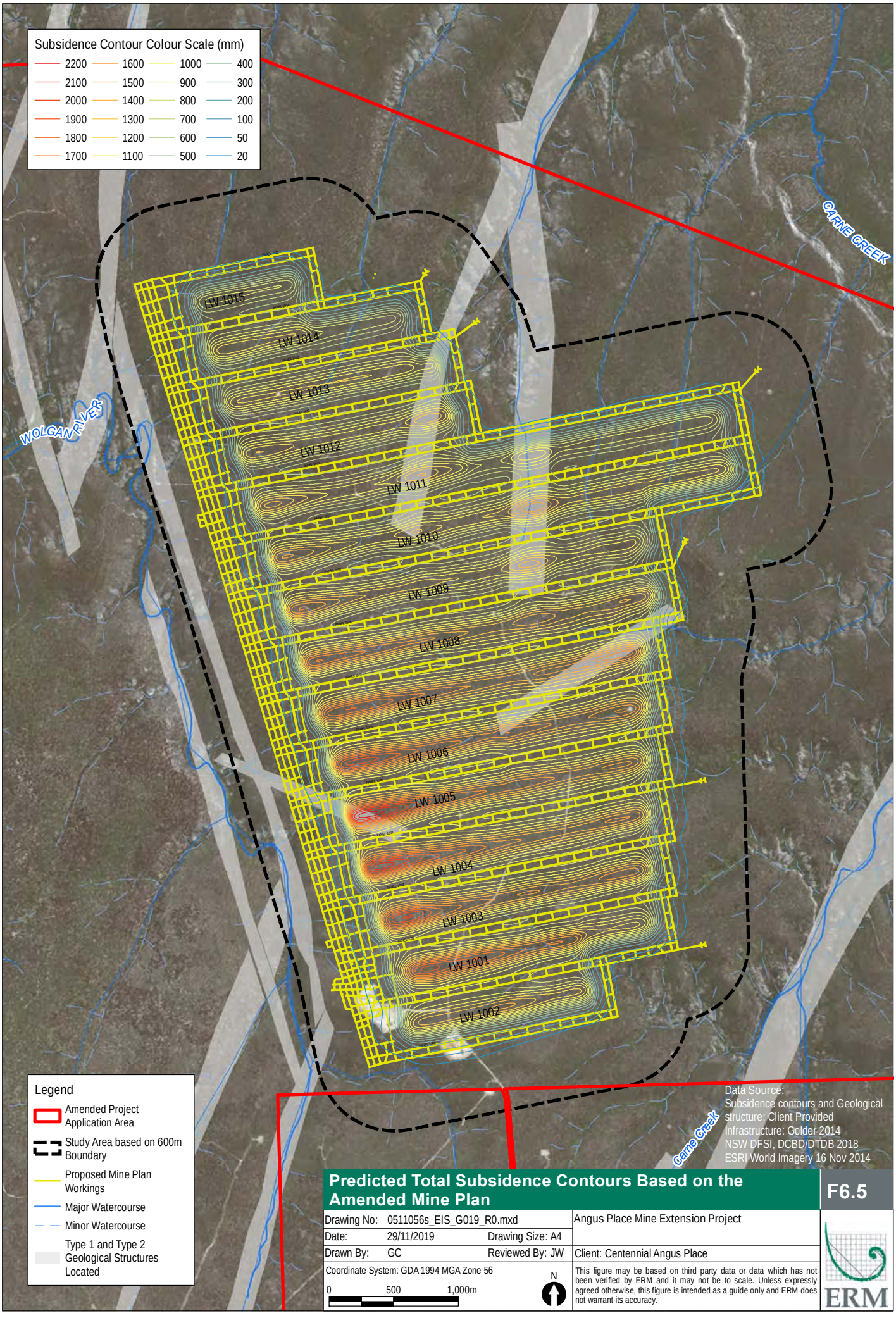


Figure 6.4 Measured changes in surface level and predicted subsidence along the surface lineament at the eastern ends of LW940


Subsidence Contour Colour Scale (mm)
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
50
20
LW 1015
LW 1014
LW 1013
LW 1012
LW 1011
LW 1010
LW 1009
LW 1008
LW 1007
LW 1006
LW 1005
LW 1004
LW 1003
LW 1001
LW 1002
WOLGAN RIVER
CARNE CREEK
Carne Creek
Legend
Amended Project Application Area
Study Area based on 600m Boundary
Proposed Mine Plan Workings
Major Watercourse
Minor Watercourse
Type 1 and Type 2 Geological Structures Located
Data Source:
Subsidence contours and Geological structure: Client Provided
Infrastructure: Golder 2014
NSW DFSI, DCBD/DTDB 2018
ESRI World Imagery 16 Nov 2014
Predicted Total Subsidence Contours Based on the Amended Mine Plan
F6.5
Drawing No: 0511056s_EIS_G019_R0.mxd
Angus Place Mine Extension Project
Date: 29/11/2019
Drawing Size: A4
Drawn By: GC
Reviewed By: JW
Client: Centennial Angus Place
Coordinate System: GDA 1994 MGA Zone 56
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Elevated strains can also occur in the locations of the surface lineaments. The subsidence predictions within this updated assessment have therefore been increased by 25% in the locations of the Type 1 and Type 2 geological structures and directly above the proposed longwalls.

6.4.3.1 Upsidence and closure movements

The streams and drainage lines within the APMEP will also be affected by valley related movements, which are commonly observed along streams in the NSW coalfields. As noted in MSEC (2019), valley related movements are normally described by the following parameters:

- Upsidence is the relative uplift within a valley which results from the dilation or buckling of near surface strata at or near the base of the valley. The magnitude of upsidence is typically expressed in the units of millimetres (mm).
- Closure is the reduction in the horizontal distance between the valley sides. The magnitude of closure is typically expressed in the units of millimetres (mm).
- Compressive strains occur within the bases of valleys as a result of valley closure and upsidence movements. Tensile strains also occur in the sides and near the tops of the valleys as a result of valley closure movements.

The predicted valley related effects due to the mining of the existing longwalls at Angus Place and Springvale Collieries and the proposed LW1001 to LW1015 have been made using the empirical method outlined in ACARP Research Project No. C9067 (Waddington and Kay, 2002).

As noted by MSEC (2019) the 2002 ACARP method of prediction for upsidence and closure is predominately based on monitoring data from the Southern Coalfield although the comparisons between measured and predicted movements at Angus Place and Springvale indicate that the method provides reasonable, if not, conservative predictions at these collieries.

6.5 Revised Subsidence Predictions for the Amended Mine Plan

6.5.1 Predicted vertical subsidence

The maximum predicted subsidence effects for the APMEP is: 2250 mm vertical subsidence, 25 mm/m tilt (2.5% or 1 in 40), 0.35 km^{-1} convex (hogging) curvature (2.9 km minimum radius) and 0.40 km^{-1} concave (sagging) curvature (2.5 km minimum radius). The predicted subsidence is generally greater in the south-western part of the mining area as the depths of cover are shallower and the mining heights are greater. The predicted subsidence is generally less in the central and north-eastern part of the mining area; however, locally increased subsidence occurs in the locations of the Type 1 and Type 2 geological structures.

The predicted strains presented in Appendix G have been based on a statistical analysis of the ground monitoring data from Angus Place and Springvale Collieries and other relevant collieries elsewhere in the NSW coalfields. The predicted strains in the eastern and northern parts of the amended mining area are 2.5 mm/m tensile and 4 mm/m compressive based on the 95 % confidence levels. The predicted strains in the south-western part of the mining area are 5 mm/m tensile and 6 mm/m compressive based on the 95 % confidence levels.

A summary of the maximum predicted values of incremental conventional vertical subsidence, tilt and curvature due to the extraction of each of LW1001 to LW1015 is provided in Table 6-2. The incremental values are the additional movements due to each proposed longwall being extracted.

Table 6-2 Maximum predicted incremental vertical subsidence, tilt and curvature resulting from the extraction of each of the proposed longwalls

Longwall	Maximum predicted incremental subsidence (mm)	Maximum predicted incremental tilt (mm/m)	Maximum predicted incremental convex curvature (km-1)	Maximum predicted incremental concave curvature (km-1)
LW1001	850	7	0.09	0.15
LW1002	1350	12	0.20	0.18
LW1003	1400	11	0.16	0.20
LW1004	1500	13	0.20	0.25
LW1005	1700	20	0.40	0.35
LW1006	1400	12	0.19	0.20
LW1007	1300	10	0.15	0.19
LW1008	1250	12	0.19	0.19
LW1009	1150	13	0.25	0.25
LW1010	1150	13	0.25	0.25
LW1011	1100	10	0.16	0.17
LW1012	1050	11	0.20	0.19
LW1013	850	10	0.18	0.17
LW1014	875	7	0.11	0.13
LW1015	900	8	0.14	0.14

A summary of the maximum predicted values of total vertical subsidence, tilt and curvature is provided in Table 6-3. The total parameters represent the accumulated movements within the APMEP due to the extraction of the existing and proposed longwalls.

Table 6-3 Maximum predicted total vertical subsidence, tilt and curvature after the extraction of each of the proposed longwalls

Longwall	Maximum predicted total subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total convex curvature (km-1)	Maximum predicted total concave curvature (km-1)
LW1001	850	7	0.09	0.15
LW1002	1450	12	0.20	0.20
LW1003	1950	12	0.20	0.20
LW1004	2000	14	0.20	0.25
LW1005	2150	20	0.40	0.35
LW1006-LW1015	2250	25	0.35	0.40

As shown in Figure 6.5, the maximum predicted total vertical subsidence of 2250 mm occurs at the western end of LW1005. This maximum subsidence occurs at a Type 2 geological structure where the depth of cover of 280 m is near the shallowest within the amended mining area and the proposed mining height is the greatest.

The comparison of the maximum predicted total conventional subsidence effects for the currently proposed longwalls versus the previous predictions provided for the 2014 EIS is provided in Table 6-4.

Table 6-4 Comparison of maximum predicted total subsidence effects

Report	Maximum predicted total vertical subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total convex curvature (km-1)	Maximum predicted Total concave curvature (km-1)
EIS (2014) mine design	1900	20	0.30	0.35
Amended mine design	2250	25	0.35	0.40

The predicted vertical subsidence based on the current longwall layout is greater than that predicted above LW1003 to LW1008 in the 2014 EIS, due to the changes in longwall void widths and proposed mining heights. The predicted profiles of vertical subsidence above LW1009 to LW1014 are similar since both layouts adopt a 360 m void width and have similar proposed mining heights.

6.5.2 Predicted tilts and strains

The maximum predicted conventional strains due to the extraction of the proposed LW1001 to LW1015, based on applying a factor of 10 to the maximum predicted curvatures are 3.5 mm/m tensile and 4 mm/m compressive strain.

The maximum predicted conventional tilt for the proposed LW1001 to LW1015 is 25 mm/m. The maximum predicted conventional horizontal movement is approximately 250 mm. Greater movements can develop in incised terrain, due to the increased horizontal movements that develops in the downslope direction.

6.5.3 Predicted far-field horizontal movements

In addition to the conventional subsidence movements that have been predicted, it is also likely that far-field horizontal movements will occur outside of the mining area. The predicted far-field horizontal movement at a distance of 1 km outside the mining area is 80 mm based on the 95 % confidence level.

As described by MSEC (2019) such movements tend to be bodily movements towards the mining area and are accompanied by very low levels of strain, generally in the order of survey tolerance (i.e. less than 0.3 mm/m). The potential impacts of far-field horizontal movements on the natural and built features within the vicinity of the APMEP are not expected to be significant.

6.5.4 Surface deformations

Longwall mining can result in cracking, heaving, buckling, humping and stepping at the surface. The extent and severity of these mining induced ground deformations are dependent on a number of factors, including the mine geometry, depth of cover, overburden geology, locations of natural jointing in the bedrock and the presence of near surface geological structures.

Surface deformations can also develop as the result of downslope movements where longwalls are extracted beneath steep slopes. In these cases, the downslope movements can result in the development of tension cracks at the tops and on the sides of the steep slopes and compression ridges at the bottoms of the steep slopes.

As described by MSEC (2019) the estimated fracture widths in the topmost bedrock, based on the maximum predicted conventional tensile strain of 3.5 mm/m and based on a typical joint spacing of 10 m, is in the order of 35 mm. In some cases, a series of smaller fractures, rather than one single fracture, would develop in the topmost bedrock.

Fracturing would only be visible at the surface where the bedrock is exposed, or where the thickness of the overlying soils is relatively shallow. Fracturing of bedrock is more likely to occur along the alignments of the streams, due to the compressive strains associated with valley related upsidence and closure effects. The fracture widths in the bedrock are expected to be typically in the order of 25 mm to 50 mm. Where reasonable depths of soils overlie the bedrock, the surface crack widths will be smaller and, in some case, may not visible at the surface.

Surface cracking is expected to be similar to that observed above the previously extracted longwalls at Angus Place and Springvale Collieries. As described by MSEC (2019) the surface cracking observed along Kangaroo Creek Road at Angus Place and Sunnyside Ridge Road at Springvale Colliery typically had widths ranging between 10 mm and 50 mm. Localised cracking also occurred with widths up to approximately 200 mm. Fracturing and buckling of the exposed bedrock occurred along Kangaroo Creek with widths typically ranging between 50 mm and 100 mm. Surface cracking on the valley sides of Kangaroo Creek had widths ranging between 10 mm and 110 mm.

6.6 Updated Subsidence Impact Assessment for Built Features

Table 6-5 provides the descriptions, predictions and impact assessments for built features which have been identified within or in the vicinity of the Study Area. These do not indicate any additional impacts to those presented in the 2014 EIS.

6.7 Updated Subsidence Impact Assessment for Natural Features

The natural features within the APMEP which have already experienced mine subsidence movements due to the previously extracted longwalls at Angus Place and Springvale Collieries have been assessed based on the predicted movements due to both the existing and proposed longwalls (i.e. cumulative movements). These features include:

- The Wolgan River,
- Carne Creek,
- Swamps within the Wolgan River valley, and
- Cliffs and pagoda complexes within the Wolgan River valley.

Angus Place also has approval to mine LW910N within the 900 Panel Area on the western side of the Wolgan River. LW910N will be mined on retreat following completion of the proposed longwalls in the 1000 Panel Area. The cumulative impact assessments for the natural features have also considered the predicted subsidence effects due to the mining of LW910N.

Chapter 8 of this Amendment Report provides the descriptions, predictions and impact assessments for all the natural features which have been identified within or in the vicinity of the Study Area.

Table 6-5 Updated Subsidence Impact Assessment for Built Features

Item	Description	Updated Subsidence Predictions	Updated Summary of Impacts
Public Utilities			
Roads (All Types)	There are unsealed roads and tracks located across the Study Area. The roads provide access to the area, including for fire-fighting and recreational activities. The Spanish Steps is a four-wheel drive access track (No. 5 fire trail) leading down to the Wolgan River. This feature is located approximately 500 m west of the finishing (i.e. western) end of LW1012.	The unsealed roads and tracks are located across the Study Area and are expected to experience the full range of predicted subsidence effects. Maximum predicted vertical subsidence: 2250mm Maximum predicted total tilt: 25mm/m Maximum predicted conventional tensile strain: 3.5 mm/m	The maximum predicted tilt for the unsealed roads and tracks is 25 mm/m (i.e. 2.5 %, or 1 in 40). The maximum predicted curvatures for these features are 0.35 km-1 hogging and 0.40 km-1 sagging, which represent minimum radii of curvature of 2.9 km and 2.5 km, respectively. The Spanish Steps is predicted to experience less than 20 mm vertical subsidence due to the mining of LW1001 to LW1015. Whilst this feature could experience very low levels of vertical subsidence, it is not expected to experience measurable tilts, curvatures or strains. Surface cracking and heaving of the unsealed road and track surfaces are expected to occur where they are directly mined beneath. The surface deformations are expected to be similar to those observed during previous longwall mining at Angus Place and Springvale Collieries. In the flatter sections of the unsealed roads and tracks (i.e. along the ridgelines), the crack widths are expected to be typically less than 25 mm; however, localised cracking with widths greater than 50 mm can also develop. Larger surface cracking could develop along the steeper sections of the unsealed roads and tracks and at the drainage line crossings. The crack widths in these areas are expected to be typically between 25 mm and 50 mm; however, localised impacts with widths greater than 100 mm can also develop. It is expected that the unsealed roads and tracks can be maintained in safe and serviceable conditions throughout the mining period using normal road maintenance techniques. The Spanish Steps is located approximately 500 m west of the proposed mining area and it is predicted to experience less than 20 mm vertical subsidence. At this distance, it is unlikely that fracturing or adverse surface impacts would occur at this feature due to the proposed mining.

Item	Description	Updated Subsidence Predictions	Updated Summary of Impacts
Culverts	There are small drainage culverts located within the Study Area that are associated with the unsealed roads and tracks.	The drainage culverts could experience the full range of predicted subsidence effects. Maximum predicted vertical subsidence: 2250mm Maximum predicted total tilt: 25mm/m Maximum predicted conventional tensile strain: 3.5 mm/m	These culverts comprise small concrete pipes which are located at the drainage line crossings. The mining-induced tilts could result in a reduction or, in some cases, a reversal of grade of the drainage culverts. In these cases, the culverts would need to be re-established to provide the minimum required grades. The predicted curvatures and ground strains could result in cracking of the concrete culverts. It may be necessary to repair, or in some cases, replace the affected culverts.
Permanent survey control marks	There are five survey control marks identified within the Study Area based on the 600 m boundary.	The survey control marks located directly above the proposed mining area could experience the full range of predicted subsidence effects.	The survey control marks located outside the proposed mining area could also experience vertical and horizontal effects. The marks located up to approximately 3 km outside the proposed mining area could experience small far-field horizontal movements. It is recommended that the survey control marks that are required for future use are re-established after the completion of the proposed longwalls and after the ground has stabilised. Consultation between Centennial and Spatial Services will be required to ensure that these survey control marks are reinstated at the appropriate time, as required.
Farm Land And Facilities			
Fences	There are fences located across the Study Area	The fences could experience the full range of predicted subsidence effects. Maximum predicted vertical subsidence: 2250mm Maximum predicted total tilt: 25mm/m Maximum predicted conventional tensile strain: 3.5 mm/m	The wire fences can be affected by tilting of the fence posts and by changes of tension in the fence wires due to strain as mining occurs directly beneath them. These types of fences are generally flexible in construction and can usually tolerate tilts of up to 10 mm/m and strains of up to 5 mm/m without significant impacts. It is possible that some of the wire fences within the Study Area could be impacted due to the proposed mining. Impacts on the fences could be remediated by re-tensioning the fencing wire, straightening the fence posts, and if necessary, replacing some sections of fencing.

Item	Description	Updated Subsidence Predictions	Updated Summary of Impacts
			It is expected that the potential impacts on the fences could be managed with the establishment of the appropriate management strategies.
Well or Bores	There are seven registered groundwater bores located within the Study Area based on the 600 m boundary. The locations and details of these bores were obtained from the Australian Groundwater Explorer, which is publicly available online (BOM, 2019).	The groundwater bores could experience the full range of predicted subsidence effects. Maximum predicted vertical subsidence: 2250mm Maximum predicted total tilt: 25mm/m Maximum predicted conventional tensile strain: 3.5 mm/m	The groundwater bores could experience adverse impacts due to LW1001 to LW1015, particularly where the bores are located directly above the proposed mining area. Impacts could include lowering of the piezometric surface, blockage of the bore due to differential horizontal displacements at different horizons within the strata and changes to groundwater quality.
Industrial, Commercial And Business Establishments			
Mine Related Infrastructure	An airshaft compound and substation are located above the western ends of the proposed LW1001 and LW1002. Other infrastructure and services will be constructed to support the mining activities, including drill holes, powerlines, water pipelines and groundwater bore compounds.	Maximum predicted vertical subsidence: 2250mm Maximum predicted total tilt: 25mm/m Maximum predicted conventional tensile strain: 3.5 mm/m	Management plans will be developed by Angus Place for these colliery-owned infrastructure and services, so that they can be maintained in safe and serviceable conditions throughout the mining period.

7. EVOLUTION AND UNDERSTANDING OF SWAMP IMPACTS

7.1 2014 Environmental Impact Statement

The 2014 EIS outlined the interactions between hydrological and hydrogeological dynamics and water levels within the endangered Newnes Plateau Shrub Swamps and Temperate Highland Swamps on Sandstone community as it was understood at that time. The 2014 EIS was supported by a detailed subsidence impact assessment (MSEC 2014) and a groundwater assessment (RPS 2014a).

As reported in the 2014 EIS, longwalls have been extracted directly or partially beneath 13 shrub swamps and 26 hanging swamps, across both Springvale and Angus Place Collieries. As a broad definition, the shrub swamps occur in valley floors while the hanging swamps occur on hillsides, and both are endemic to the Newnes Plateau. Surface impacts had been observed at five of these swamps including Kangaroo Creek Swamp, Narrow Swamp North, Narrow Swamp South, East Wolgan Swamp and Junction Swamp. These impacts had been investigated and were identified as largely the result of mine water discharge and not a direct result of the underground mining.

Subsidence impacts to swamp hydrology had been previously noted at two swamps (Kangaroo Creek Swamp and East Wolgan Swamp). In both of these cases investigations revealed that mine design was a primary causative factor. Other factors included:

- Presence of a Major Geological Fault Zone: Kangaroo Creek lineament, (“Type 1 lineament”);
- Steepness and depth of the valley containing the swamp (slope angles >18 degrees); and
- Location of swamp adjacent to the permanent barrier pillar (near western end of Angus Place Colliery’s LW940 and LW950).

Based on the reported impacts at Kangaroo Creek Swamp and East Wolgan Swamp, the ratio of longwall mining void width to depth of cover over mine workings was identified to be of critical significance in relation to impacts on swamps. Based on this finding, the mine design was modified for all future proposed mining areas in the vicinity of Newnes Plateau Shrub Swamps to ensure that the ratio of longwall mining void width to depth of cover over mine workings was <0.9. These sub-critical longwall panels (i.e. less than 0.9 ratio between void width and void depth) cause lower magnitudes of subsidence and maximum subsidence is unlikely to develop. No subsidence effects to swamp hydrology or flora communities have been identified in areas where this sub-critical mine design has been used in the past. This was applied to the 2014 EIS mine design with a void width reduction from 360m to 261m in the area of Tri-Star and Trail Six Swamps.

Projected changes to baseflow and maximum average standing water levels (ASG) in shrub swamps were predicted to occur at varying degrees, as detailed within Adhikary and Wilkins (2013), and summarised within the Groundwater Impact Assessment (RPS 2014a). These projections were considered to be conservative based on the modelled scenario design, and given that the hydrology within the majority of shrub swamps assessed was not predicted to be significantly impacted.

The most significant reductions to ASG levels were predicted at Twin Gully Swamp. This swamp had a projected drop in ASG levels from 12.4 cm to 10.6 cm above the soil surface. The post mining values predicted at Twin Gully Swamp suggested that soil saturation would persist, maintaining water availability for flora and fauna as well as soil anoxia, allowing for continued peat formation. All other monitored swamps had smaller projected decreases in ASG, and monitored swamps were projected to maintain ASG levels above the surface.

The APMEP was not expected to have a significant impact upon the hydrology of any hanging swamps. The reliance of these areas on perched aquifer systems was considered to effectively isolate them from any hydrological changes that may occur to the regional water table as a result of the proposed mining operations.

7.2 A New Understanding of Swamp Impacts at Springvale Mine

Continued monitoring of surface and groundwater levels, including implementation of the Extraction Plan Swamp Monitoring Programs approved under SSD5594 and EPBC2013/6881, has further developed the understanding of swamp interactions with mine subsidence since the preparation of the 2014 EIS.

From 2015, the interactions between geological, geotechnical and hydrological datasets at Springvale Mine have been analysed using ExtoChart Visual, a temporal and spatial data viewer developed by Keith O'Donnell and Associates and Centennial Coal. The development of ExtoChart Visual and its use for analysis of environmental monitoring datasets is described in detail by Centennial (2016) in the 'Evolution of understanding of the interactions of groundwater behaviour and mine subsidence at Springvale Mine'.

As reported by Centennial (2016), the following datasets can be analysed in the context of the physical features (topography, depth of cover, swamps, geological faults and lineaments) to better understand the interactions of groundwater behaviour, weather patterns and mine subsidence. The following data can be presented both spatially (in the context of the mine plan and geological model), and temporally:

- Underground extensometers
- Aquifer piezometers
- Mine pumping data
- Mining face positions
- Swamp piezometers
- Subsidence lines
- Rainfall data (CRD)

7.3 Identification of geological lineaments and significant faults

Studies have been conducted in the Western Coalfield since the 1970's to improve fault detection and prediction. These studies are based on the premise that the geological structural fabric of the overlying Permian strata in the Lithgow area is controlled by underlying features in the older basement strata. The studies have focused on faulting present in the overlying and underlying strata, with prediction of faults which may affect mining within the coal seam based on extrapolation to the seam of faults from above or below (Centennial, 2016).

Landsat photo imagery provides detail on the extent of surface lineaments, based on weathering patterns evident from surface topography (alignment of valleys and cliff lines) and distribution of vegetation. In addition, significant analysis has been conducted by SRK Consulting since 2000, using aeromagnetic data to map the basement structures, which has enabled accurate prediction of the location of structures in both the Permian strata and the surface.

Predictive models based on surface and basement lineament analysis are supplemented by mapping geological features and mining conditions in the underground workings. It is important to note that these fault identification methods continue to be effective at Springvale and Angus Place due to the sequence of igneous and sedimentary strata unit formation and the timing of development of faulting, and may not be applicable at other mines (Centennial, 2016).

Lineaments are classified into four groups in Palaris (2013). Type 1 and Type 2 structure zones are interpreted to be structures that penetrate from the basement strata, through the coal measure strata, to the surface (also referred to as surface lineaments). There is one Type 1 and three Type 2 structures that have been identified within the proposed mining area.

Type 3 structure zones are noted to occur only to Lithgow seam level and Type 4 structure zones occur within the basement.

There is a strong correlation between the roof dilation behaviour measured by the underground extensometers early in their lifecycle and the location of Type 1 and Type 2 lineaments identified by Palaris (2013). In addition to the lineaments identified by Palaris, there are also other significant faults which have been identified using this methodology. It is noted that extensometer data provides evidence of the influence of Type 4 structures in the overlying Lithgow Seam, even where these structures cannot be identified and mapped by geologists.

7.4 The influence of lineaments on mine subsidence and standing water levels within swamp

From the analysis conducted by Centennial (2016, 2017 and 2018) in the context of East Wolgan Swamp, Narrow Swamp, Sunnyside East Swamp, Carne West Swamp, Gang Gang South West Swamp, Gang Gang East Swamp there is increasing evidence that directly undermining significant fault zones in the strata overlying the Lithgow coal seam can cause changes to standing water levels in swamps overlying the significant fault zones.

The analysis includes measurement of the distance along the strike of significant fault zones from standing water level monitoring sites (which have not recovered) to direct undermining of the fault. The maximum distance recorded to date between the longwall face and measured changes to standing water levels in swamps is 1620m, in the case of Gang Gang South West Swamp. The minimum distance recorded to date between the longwall face and measured changes to standing water levels in swamps is 0m, in the case of Kangaroo Creek (Mid) Swamp, East Wolgan Swamp and Narrow Swamp. The reason for the differences between these distances appears to be related to the orientation of the mine workings relative to the lineaments and significant geological faults

Carne West Swamp Case Study

Longwall mining was conducted within a 26.5 degree angle and directly undermined Carne West Swamp using a modified longwall void width of 261m and a chain pillar width of 58m between March 2015 and October 2016. Subsidence of up to 605mm and strains of 0.7mm/m (tensile) to 2.4mm/m (compressive) were measured adjacent to Carne West Swamp (Centennial, 2016).

Based on the data presented by Centennial (2016), it can be seen that in September 2014 the minor standing water level change at CW1 piezometer occurs during the period of very low rainfall in 2013-14, thus the hypothesis of rainfall pattern could be valid at this point in time. However, soon after this time, standing water levels drop below any recorded in the baseline data. At this point in time, Longwall 415 face is approaching the eastern Deanes Creek lineament fault, at a distance of approximately 1.8km from CW1 piezometer, which is a distance well in excess of any locally documented effects of longwall mining to groundwater systems. By May 2015, standing water levels at both CW1 and CW2 piezometers are below the recorded baseline data and the hypothesis of rainfall pattern is no longer valid. At this point in time, Longwall 417 face has mined beneath the eastern Deanes Creek lineament fault, at a distance of approximately 1.0km from CW1 piezometer. It is evident from the data that minor changes to standing water level as a result of mine subsidence interactions with the lineament fault were detected at a distance of 1.8km along the strike of the lineament. Longer term changes to standing water levels were detected at a distance of 1.6km along the strike of the lineament.

Sunnyside East Swamp Case Study

Similar cases studies have also been undertaken at Sunnyside East Swamp which shows that temporary changes (<3 months duration) as a result of mine subsidence interactions with the lineament fault were detected at a distance of 2.25km along the strike of the lineament. Longer term changes to standing water levels were detected at a distance of 1.5km along the strike of the lineament (Centennial, 2016).

Gang Gang South West Swamp Case Study

The influence of direct longwall undermining of major geological lineaments on swamp piezometer standing water levels was also tested as a possible cause of changes to standing water levels at GW1 and GW2 piezometers and presented to the Springvale Independent Monitoring Panel (IMP) on 16 January 2017. The results of the analysis are reported in Centennial (2017) and conclude that the results from Gang Gang South West Swamp piezometers are significant. During the mining of Longwall 416 changes to standing water levels at GW1 piezometer occurred at a distance of 1580m. During the subsequent mining of Longwall 417, changes to standing water levels at GW2 piezometer occurred at a distance of 1620m.

Further, there was a correlation in behaviour of CW2 (in Carne West Swamp) and GW1 (in Gang Gang South West Swamp) piezometers. It is interpreted that there is a linkage via a zone of Type 3 (faults mapped in the Lithgow Seam) and Type 4 (basement faults interpreted from aeromagnetic data) faults which join the identified Type 1 lineaments which underlie Carne West Swamp and Gang Gang South West Swamp. The linked fault zone was also identified by early roof dilation behaviour measured by the underground extensometers.

7.5 Conclusion

Based on extensive monitoring data and analysis it has been found that mining directly beneath lineaments or significant geological faults has triggered changes to hydrology in swamps overlying the Springvale Mine. It has also been shown that it is possible to identify significant fault zones which are likely to influence groundwater behaviour using ExtoChart Visual analysis techniques.

The distance along the strike of significant fault zones from standing water level monitoring sites to where direct undermining of the fault using longwall mining techniques has caused changes to standing water levels which have not yet recovered is limited to approximately 1600 metres.

A meeting with SRK Consulting was held to review interpreted faulting which may be associated with swamps present above the APMEP, and to identify options for avoidance of longwall mining intersecting identified faults. In the case of the APMEP it is not possible to avoid the associated lineaments as a very significant area of longwall extraction is sterilised and remaining extraction areas are rendered unviable.

8. REVISED ASSESSMENT OF KEY ENVIRONMENTAL ISSUES

8.1 Water Impact Assessment and Management

The existing water management system at Angus Place Colliery, as described in the 2014 EIS, focuses on the pit top area and the Newnes Plateau infrastructure areas. The primary objectives of water management are the separation of clean and dirty water, and the effective collection, treatment and discharge of water.

From 2020, all mine inflows from existing and proposed workings will be transferred to the Springvale Water Treatment Project, via either the Springvale Water Treatment Project Water Transfer Pipeline or the Angus Place Haul Road Pipeline. Changes to the existing water management infrastructure required to support the amended APMEP are described in Chapter 2 and Appendix B.

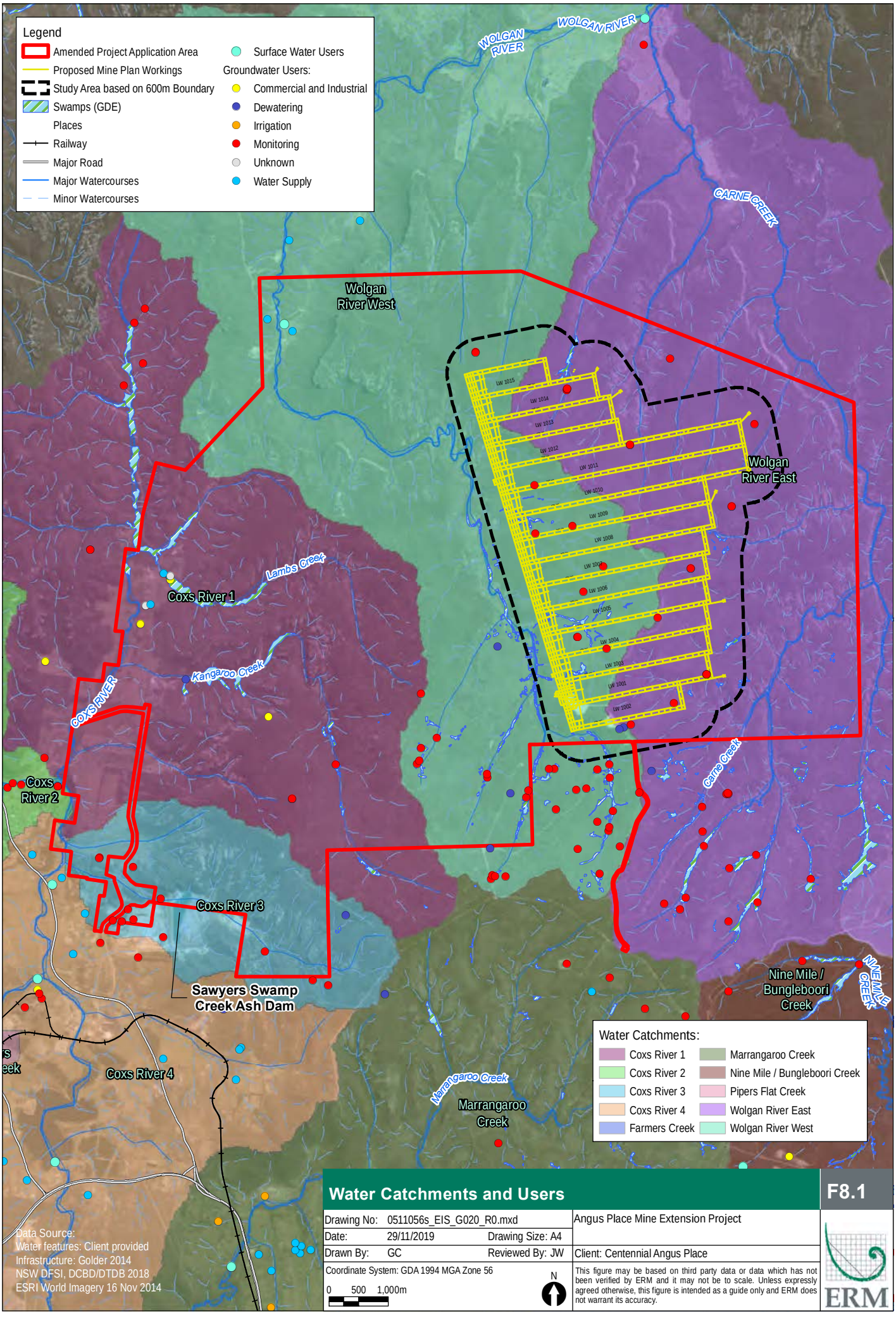
8.1.1 Existing Environment

A detailed description of the existing water catchment was presented in the 2014 EIS and is summarised in Table 8-1 below.

Table 8-1 Key Features of the Water Catchment Area

Feature	Description
Topography and elevation	Topography and elevation are presented in Chapter 2. Drainage lines off the plateau are often deeply incised in their lower reaches, incorporating numerous cliff lines and pagodas bordering the valley flanks. In the upper catchment areas, drainage lines are poorly defined to non-existent with overland sheet flow being the typical mode of discharge during high rainfall events.
Drainage lines	The primary watercourses within and adjacent to amended Project Application Area are the perennial Wolgan River and Carne Creek. A number of first, second and higher drainage lines are also located directly above the longwalls. Refer to Figure 8.1 and Figure 8.7].
Springs and Waterfalls	Other than the seepage faces that support the shrub and hanging swamps, there are no mapped springs within the amended Project Application Area or listed in the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011. There are no mapped waterfalls within the Study Area that are free flowing. There may be some ephemeral waterfalls during rain events within the amended Project Application Area.
Sensitive receptors	Sensitive surface water and groundwater receptors have been identified by Jacobs (2019a and 2019b) and include: ■ Temperate Highland Peat Swamps on Sandstone (THPSS) comprising both hanging swamps and shrub swamps. THPSS are listed as an endangered ecological community and falls under the 'Listed threatened species and ecological communities' Matters of National Environmental Significance (MNES) under the EPBC Act. It is also registered as high priority groundwater dependent ecosystems under the relevant water sharing plan. ■ Drainages and waterways; ■ Aquatic ecology associated with drainages and swamps (discussed in the Aquatic Ecology and Stygofauna Assessment, Cardno, 2019; refer to Section 8.3);

Feature	Description
	■ Groundwater Dependant Ecosystems (GDE); and ■ Surface water and groundwater users.
Groundwater Dependent Ecosystems	Within the amended Project Application Area, a number of GDEs and potential GDEs have been identified including terrestrial vegetation, river baseflow systems and stygofauna. Groundwater levels can be important in maintaining flows or pools that sustain ecosystems, particularly during times of drought. An updated review of the Bureau of Meteorology (BoM) GDE Atlas confirms that the Wolgan River (Western Branch) is identified as a potential aquatic GDE. The river is mapped as low to moderate potential on the Newnes Plateau, and moderate to high potential in the Wolgan Valley. The Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011, also lists THPSS as a high priority GDE. No other high priority GDEs are identified in the vicinity of the amended Project Application Area.
Groundwater users	A total of 437 groundwater users are registered in the vicinity of the amended Project Application Area as identified on Figure 8.1. Of these, 138 are registered for groundwater supply, 258 are registered as monitoring bores, 14 are registered as dewatering bores, five are registered as exploration bores, 18 have no recorded use and four have purpose recoded as “other”.
Surface water users	A total of 15 surface water users and associated water access licences are registered in the vicinity of the amended Project Application Area as identified on Figure 8.1. The major surface water user is WAL No. 27428 and encompasses the EnergyAustralia Coxs River Water Supply Scheme. That scheme connects Thompsons Creek Reservoir, Lake Wallace and Lake Lyell. Of the remaining surface water users, 11 are unregulated river licences, three for are domestic and stock use and one is for a major utility (power generation). The APMEP is also situated within the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources. There is no direct extraction of surface water within this Region, however a reduction in baseflow contributions to surface water systems requires licensing, as per the requirements of the NSW Aquifer Interference Policy. Details of licensing requirements are summarised in Section 8.1.2.


Legend
Amended Project Application Area
Proposed Mine Plan Workings
Study Area based on 600m Boundary
Swamps (GDE)
Places
Railway
Major Road
Major Watercourses
Minor Watercourses
Surface Water Users
Groundwater Users:
Commercial and Industrial
Dewatering
Irrigation
Monitoring
Unknown
Water Supply
WOLGAN RIVER
WOLGAN RIVER
CARNE CREEK
Wolgan River West
Wolgan River East
LW 1015
LW 1014
LW 1013
LW 1012
LW 1011
LW 1010
LW 1009
LW 1008
LW 1007
LW 1006
LW 1005
LW 1004
LW 1003
LW 1001
LW 1002
Lambs Creek
Coxs River 1
Kangaroo Creek
COXS RIVER
Coxs River 2
Coxs River 3
Sawyers Swamp Creek Ash Dam
Coxs River 4
Carne Creek
Nine Mile / Bungleboori Creek
NINE MILE CREEK
Marrangaroo Creek
Marrangaroo Creek
Water Catchments:
Coxs River 1
Coxs River 2
Coxs River 3
Coxs River 4
Farmers Creek
Marrangaroo Creek
Nine Mile / Bungleboori Creek
Pipers Flat Creek
Wolgan River East
Wolgan River West
Water Catchments and Users
F8.1
Drawing No: 0511056s_EIS_G020_R0.mxd
Date: 29/11/2019
Drawing Size: A4
Drawn By: GC
Reviewed By: JW
Coordinate System: GDA 1994 MGA Zone 56
0 500 1,000m
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Angus Place Mine Extension Project
Client: Centennial Angus Place
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
Data Source:
Water features: Client provided
Infrastructure: Golder 2014
NSW DFSI, DCBD/DTDB 2018
ESRI World Imagery 16 Nov 2014
ERM

8.1.2 Water Sharing Plans

Water Sharing Plans (WSPs) establish rules for sharing water between the environmental needs of the river or aquifer and water users, and between different types of water use such as town supply, rural domestic supply, stock watering, industry and irrigation. There are Water Sharing Plans for regulated and unregulated river catchments and groundwater sources in water management areas.

For groundwater, the amended longwalls are located within the Sydney Basin Richmond Groundwater Source of the Greater Metropolitan Region Groundwater Sources 2011. The Angus Place Colliery pit top is within the Sydney Basin Coxs River Groundwater Source of the Greater Metropolitan Region Groundwater Sources 2011.

For surface water, the APMEP is on the boundary of the Upper Nepean and Upstream Warragamba Water Source (Wywandy Management Zone) and the Hawkesbury and Lower Nepean Rivers Water Source (Colo River Management Zone) of the Water Sharing Plan for Greater Metropolitan Region Unregulated River Water Sources 2011 (NSW). Surface water catchments within the Upper Nepean and Upstream Warragamba Water Source, which include Kangaroo Creek and Coxs River are declared by the State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 (NSW) to be within the Sydney Drinking Water Catchment.

8.1.3 Local Hydrogeology and Surface Water/Groundwater Interactions

A review of local hydrogeology is provided by Jacobs (2019a and 2019b). The fundamental concepts such as recharge, and perched groundwater systems supporting swamps remain essentially the same as presented in the 2014 EIS, however, the understanding of depressurisation due to longwall subsidence and the potential interactions between subsidence and major geological structures has been advanced. Key elements of the conceptual hydrogeological model are presented on Figure 8.2.

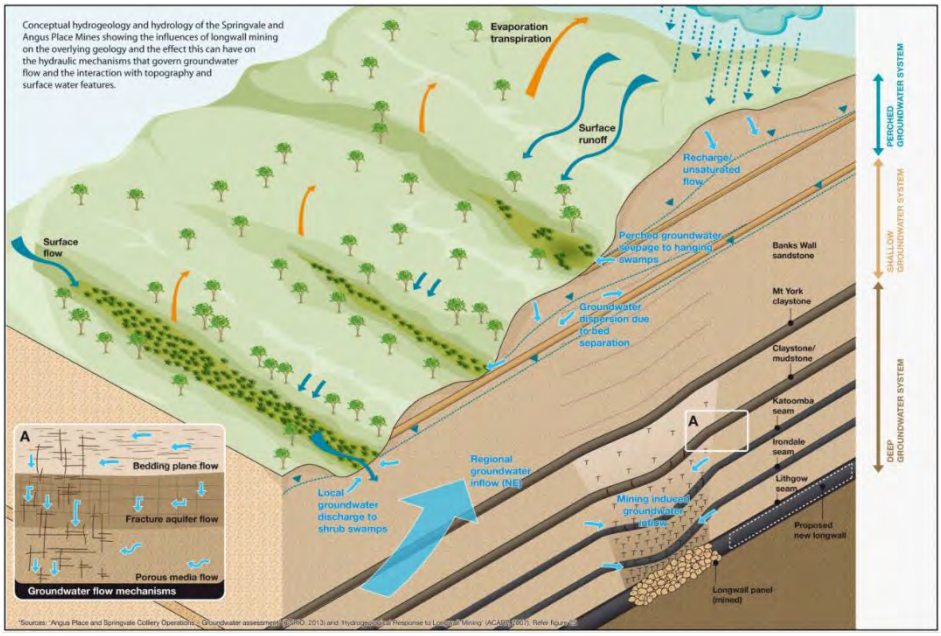


Figure 8.2 Conceptual Hydrogeological Model (Jacobs 2019a)

The permeability of the various formations is controlled by the porosity of the formation and the interconnection of the pore spaces, along with the degree of interconnective fracturing or cleating that is present. Within both the Narrabeen Group and Illawarra Coal Measures, significant porosity is likely to be limited and localised, with the majority of regional groundwater flow controlled by secondary fracture networks (Jacobs 2019b).

As described by Jacobs (2019a and 2019b) the dominant surface water/groundwater interactions on the Newnes Plateau involve infiltration and recharge processes to shallow groundwater; and groundwater discharge to surface water. Infiltration of rainfall and runoff is also likely to occur along the ridgelines and areas of exposed or shallow sub-cropping bedrock in the upper catchment areas.

Groundwater discharge to surface water occurs as seepages and drips from exposed faces on cliff lines or exposed bedrock in drainage lines and along valley floors. Groundwater seepage may contribute to stream baseflows and may support the development of hanging swamps or shrub swamps.

A summary of the surface water and groundwater interactions in the swamps is provided in the following sections.

Newnes Plateau Shrub Swamps

As described by Jacobs (2019b), the shrub swamps occur further down the catchment in the steeper terrain of incised valleys associated with second or third order streams. The steeper incision means the swamps are more likely to intersect water-bearing layers within the horizontally bedded sandstone. The water regime for these swamps therefore combines rainfall and surface water runoff, as well as groundwater inputs.

Groundwater quality is variable, depending on residence time within the aquifer. Discharge to the swamps is through either:

- groundwater movement along fractures, joints or bedding planes that intersect the peat swamp; or
- to a lesser extent, the lower permeability sandstone layers that intersect the peat swamp.

Newnes Plateau Hanging Swamps:

As described by Jacobs (2019b), the hanging swamps occur on steep valley sides or cliffs. Sediment and peat deposition is minimal and is limited to sediment caught within vegetation roots. Groundwater discharge to the swamps is caused by the presence of low-permeability layers within the aquifer forcing water sideways to seep out of the cliff face.

The flow system is local, and groundwater quality is expected to be fresh due to relatively short flow paths and residence times in the aquifer. Connection between aquifer and swamp is either permanent or ephemeral and occurs after rainfall.

8.1.4 Groundwater Impact Assessment

The Groundwater Impact Assessment has been prepared by Jacobs (2019a) and is provided in Appendix H. It takes into consideration the revised subsidence predictions (as outlined in Chapter 6) and the influence of lineaments on water levels within swamps (as described in Chapter 7).

Impacts to surface water are discussed separately in Section 8.1.6.

8.1.4.1 Revised groundwater modelling since 2014

Centennial maintains an extensive groundwater monitoring network on the Newnes Plateau that comprises monitoring of water levels and pore water pressure, water quality, and soil moisture data at a series of monitoring bores, using vibrating wire piezometers and soil moisture probe.

Since the time of the 2014 EIS an updated risk assessment and revised modelling have progressed including:

- Significant additional investigations have been undertaken within the swamps which are presented in the revised Groundwater Impact Assessment included as Appendix H. These include extensive baseline monitoring of swamp water levels, groundwater levels and quality including data from the neighbouring Springvale Mine;
- With respect to hydraulic data, the entire groundwater monitoring network at Springvale Mine, Angus Place Colliery and at Clarence Colliery is now included in the groundwater model;
- The numerical groundwater model has been built on the MODFLOW USG platform for the purpose of assessing mine dewatering requirements as well as mining impacts (drawdowns) on the local and regional aquifers and baseflow reduction impacts on watercourses;
- The updated groundwater model also considers the role of lineaments by the use of Pilot Points.

Details of the setup, and calibration of the hydrogeological model are provided in the Hydrogeological Model Report as appended to the Groundwater Impact Assessment (Appendix H). In accordance with the Australian Groundwater Modelling Guidelines (Barnett et. al., 2012), the intended model confidence level classification for the numerical groundwater model is Class 2.

8.1.4.2 Updated impact assessment

Groundwater Quality

Groundwater monitoring at Angus Place and Springvale Mine has not identified any water quality impacts to groundwater as a result of mining and accordingly, no future impacts to groundwater are anticipated as a result of the APMEP.

Following mine closure there is potential for groundwater seepage in the vicinity of the sealed portals. There is also potential for a component of acid generation within the mine voids and contributing overlying unsaturated formations. The potential for this will be assessed and managed at the mine closure planning stage.

Mine Inflows

Based on the modelling presented in Jacobs (2019a), mine inflows can be seen to increase significantly in 2025 with the re-commencement of extraction in the new 1000 Panel area, with predicted inflow peaking at over 25 ML/day. Following the initial peak, inflows are then predicted to be relatively stable and in the range 18 to 20 ML/day as mining progresses to the north. Following extraction of LW1015 in 2038, the formations surrounding and overlying the workings become increasingly depressurised and inflows begin to decline, falling to around 7 ML/d at the end of mining in 2053. Refer to Figure 8.3.

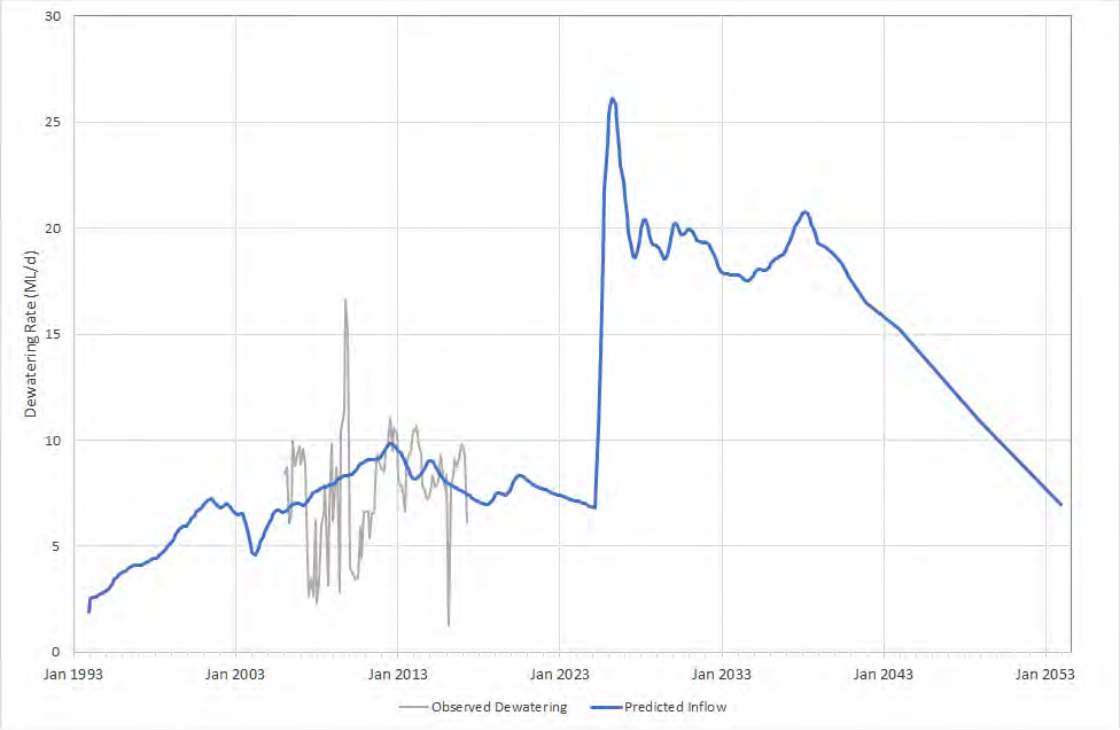


Figure 8.3 Predicted Inflows – Angus Place, Jacobs (2019a)

Water levels within the completed Springvale Mine will be maintained in a dewatered state such that access from the Springvale portal to the Angus Place longwalls is maintained and water does not top over into the Angus Place workings. At the end of mining at Springvale, the pumps will be turned off until mine void water levels recover to 810mAHD. At this level dewatering will resume again to maintain the water below 810mAHD.

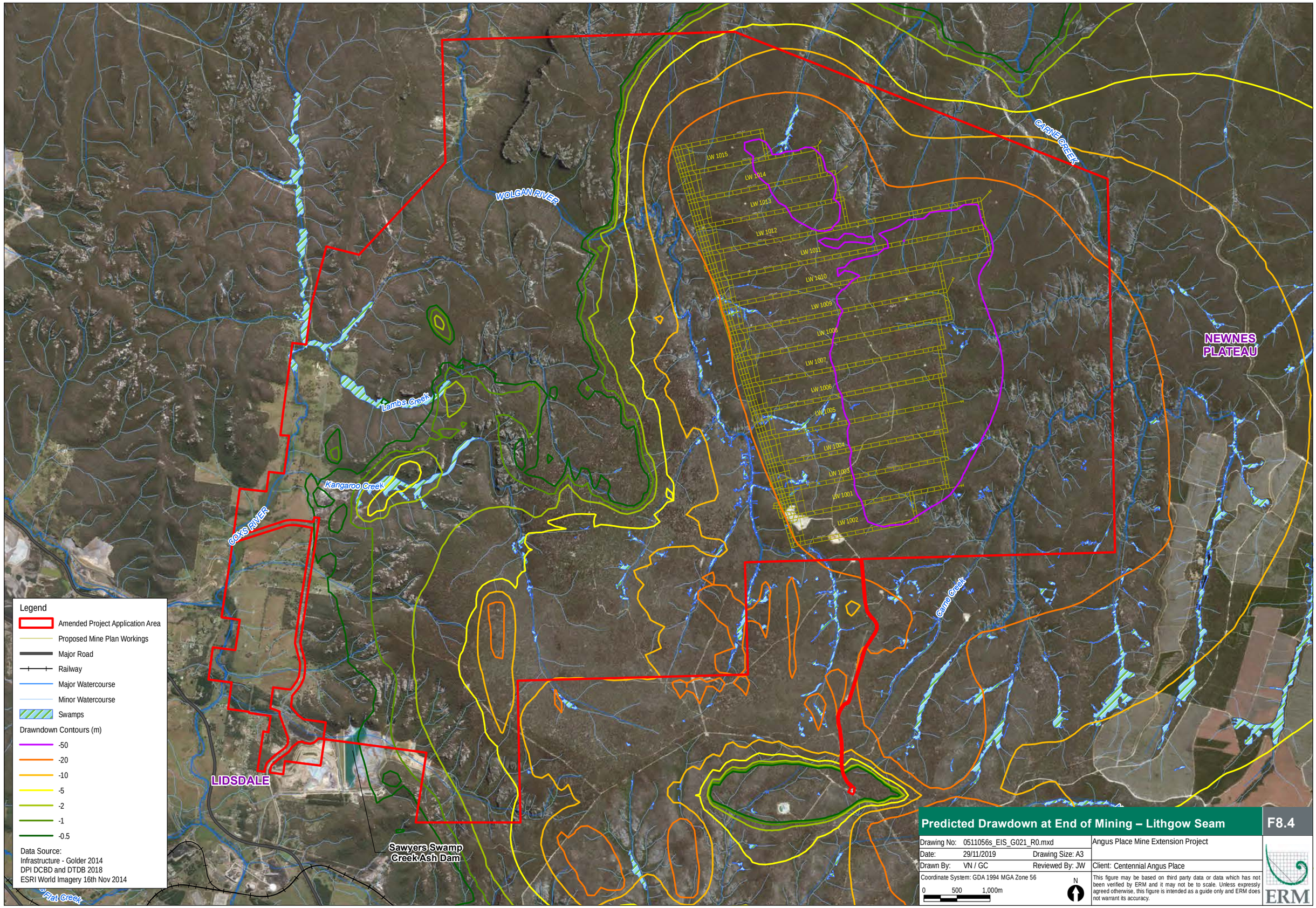
Groundwater Drawdown

Drawdowns presented in Appendix H are for the 10th percentile case, or greatest predicted water level decline. Predicted drawdowns and pressure declines (10th percentile) at end of mining in the Lithgow Seam, Bankswall Sandstone and at the uppermost water table are presented in Figure 8.4 to Figure 8.6.

The predicted decline in the uppermost water table is generally limited to the Newnes Plateau above the area of mining, although some areas of decline are also predicted where deeper formations subcrop in the valleys of the Wolgan River and Carne Creek adjacent to the mining area as outlined in Table 8-2 below.

Table 8-2 Summary of Predicted Drawdown – Uppermost Water Table, Jacobs 2019a

Tri Star and Twin Gully Swamps
The maximum predicted water table decline beneath both Tri-Star and Twin Gully Swamps is 10m for the 10th percentile drawdown, and 5m for the 90th percentile drawdown. Water table declines of this magnitude at Tri-Star Swamp are likely to result in a corresponding decline of swamp water levels leading to the drying or partial drying of the swamps.
Wolgan River Swamps and Trail Six Swamps
The maximum predicted water table decline beneath Trail Six Swamp is 10m for the 10th percentile drawdown, with only 0.5m for the 90th percentile decline. No significant drawdown is predicted at Wolgan River Swamp or Wolgan River Upper Swamp. Water level declines at Trail Six Swamp have potential to result in a corresponding decline of swamp water levels leading to the drying or partial drying of the swamps.
Birds Rock Swamp and Crocodile Swamp
The maximum predicted water table decline beneath both Birds Rock Swamp and Crocodile Swamp is up to 5m for the 10th percentile drawdown, with drawdown of the order of 2m predicted for most of the swamp area. For the 90th percentile decline, the predicted drawdown is generally less than 0.5m at Birds Rock and Crocodile Swamps with some areas of up to 1m drawdown predicted. Water level declines of this magnitude have potential to result in a corresponding decline of swamp water levels leading to the drying or partial drying of the swamps.
Wolgan River
No significant water table decline is predicted beneath the Wolgan River.
Long Swamp and Coxs River.
No drawdown is predicted in the vicinity of the pit top or Long Swamp and Coxs River.
Post Mining
At 38 years post mining, depressurisation within the Lithgow Seam is predicted to have propagated further than at end of mining. Drawdown will continue further to the northeast, east and southeast, with the 2m drawdown contour extending to the eastern model boundary. At 38 years post mining there is no significant increase in the extent of drawdown at the uppermost water table, there is also no significant recovery. More detailed groundwater and mine void recovery scenarios will be undertaken as part of detailed mine closure planning.


WOLGAN RIVER
CARNE CREEK
NEWNES PLATEAU
LW 1015
LW 1014
LW 1013
LW 1012
LW 1011
LW 1010
LW 1009
LW 1008
LW 1007
LW 1006
LW 1005
LW 1004
LW 1003
LW 1001
LW 1002
Lambs Creek
Kangaroo Creek
COXS RIVER
Carne Creek
LIDSDALE
Sawyers Swamp Creek Ash Dam
Pat Creek
Legend
Amended Project Application Area
Proposed Mine Plan Workings
Major Road
Railway
Major Watercourse
Minor Watercourse
Swamps
Drawndown Contours (m)
-50
-20
-10
-5
-2
-1
-0.5
Data Source:
Infrastructure - Golder 2014
DPI DCBD and DTDB 2018
ESRI World Imagery 16th Nov 2014
Predicted Drawdown at End of Mining – Lithgow Seam
F8.4
Drawing No: 0511056s_EIS_G021_R0.mxd
Date: 29/11/2019
Drawing Size: A3
Drawn By: VN / GC
Reviewed By: JW
Coordinate System: GDA 1994 MGA Zone 56
0 500 1,000m
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Angus Place Mine Extension Project
Client: Centennial Angus Place
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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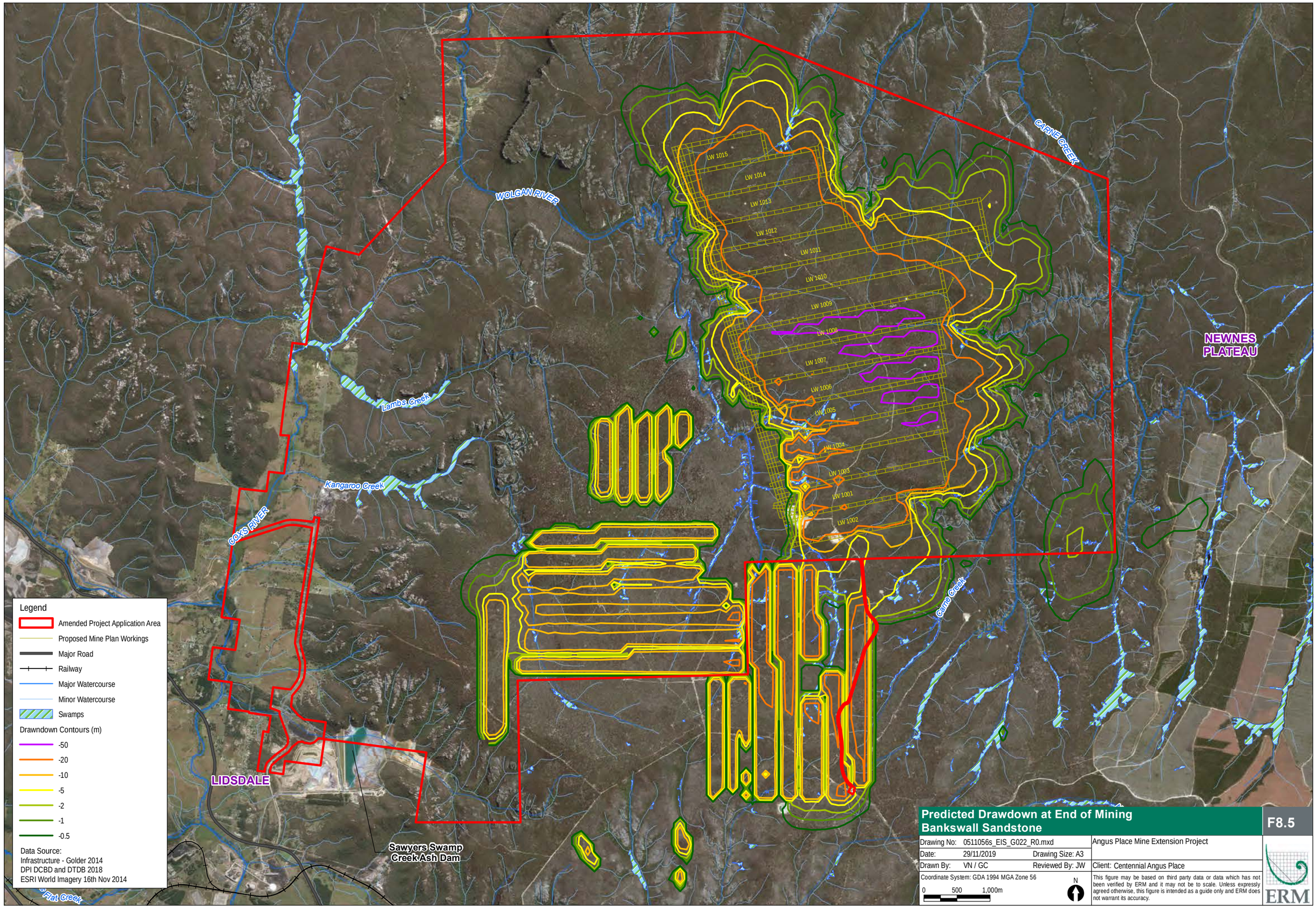

Predicted Drawdown at End of Mining Bankswall Sandstone

F8.5

Drawing No:	0511056s_EIS_G022_R0.mxd		Angus Place Mine Extension Project
Date:	29/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 500 1,000m

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WOLGAN RIVER

CARNE CREEK

NEWNES PLATEAU

Lambs Creek

Kangaroo Creek

COX'S RIVER

Carne Creek

LIDSDALE

Sawyers Swamp Creek Ash Dam

Flat Creek

Legend

- Amended Project Application Area
- Proposed Mine Plan Workings
- Major Road
- Railway
- Major Watercourse
- Minor Watercourse
- Swamps

Drawndown Contours (m)

- -20
- -10
- -5
- -2
- -1
- -0.5

Data Source:
Infrastructure - Golder 2014
DPI DCBD and DTDB 2018
ESRI World Imagery 16th Nov 2014

Predicted Drawdown at End of Mining Uppermost Watertable

F8.6

Drawing No:	0511056s_EIS_G023_R0.mxd		Angus Place Mine Extension Project
Date:	29/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 500 1,000m

N

ERM

Predicted Impacts to Groundwater Users

The predicted 10th percentile decline in water level in the Lithgow Seam has been used for the maximum potential water level decline during mining and at 38 years post mining. Groundwater users (for water supply purposes) within the 0.5m drawdown contour are identified in Table 8-3.

No impacts are predicted to groundwater users in the Wolgan Valley or Coxs River Valley.

Table 8-3 Predicted Impacts to Groundwater Users

Bore ID	Purpose	Location	Comment
GW109337	Water Supply - test hole	Newnes Plateau Springvale Mine lease	5m drawdown at end of mining. Test bore – decommissioned.
GW042618	Commercial and Industrial - bore	Newnes Plateau south of Springvale – Abandoned Quarry	0.5 to 1 m drawdown in Lithgow Seam at end of mining increasing to 15m at 38 years post mining. Less than 0.5m drawdown above Mount York Claystone (MYC). Bore 29m deep – unlikely to be impacted.
GW101985	Water supply - bore	Newnes Plateau south of Springvale – Motocross Track	Less than 0.5m drawdown in Lithgow Seam at end of mining, increasing to 7-8m at 38 years post mining. Less than 0.5m drawdown above MYC. Bore 30m deep – unlikely to be impacted.
GW100718	Water supply - bore	Newnes Plateau south of Springvale Mine lease	0.5 to 1 m drawdown in Lithgow Seam at end of mining increasing to 3m at 38 years post mining. Less than 0.5m drawdown above MYC. Bore 15m deep – unlikely to be impacted.
GW109336	Water supply – test hole	Newnes Plateau south of Springvale Mine lease	0.5m drawdown in Lithgow Seam increasing to 3-4m post mining. Negligible drawdown above MYC. Bore 15m deep – unlikely to be impacted.
GW030862	Commercial and Industrial - bore	Angus Place Bord and Pillar in the Project Application Area	Predicted drawdown 2-4m. Dewatering service bore 146m deep.
GW106646	Commercial and Industrial - bore	Hanson Quarry near Clarence Colliery	Less than 0.5m drawdown in Lithgow Seam at end of mining, increasing to 3-4m at 38 years post mining. Negligible drawdown above MYC. Bore 30m deep – unlikely to be impacted.

Bore ID	Purpose	Location	Comment
GW105734	Water Supply - bore	Clarence Colliery	Less than 0.5m drawdown at end of mining. 3-4m drawdown in Lithgow Seam at 38 years post mining. 0.5 – 1m drawdown in Katoomba Seam. Bore 120m deep – unlikely to be impacted.
GW105433 GW105434 GW105435 GW103224 GW072919 GW072919	Water Supply and Commercial and Industrial - bores	At or near Lithgow Valley Springs	Less than 0.5m drawdown in Lithgow Seam at end of mining, increasing to 1-2m drawdown at 38 years post mining. Negligible drawdown above MYC. Bores 8 to 72m deep – unlikely to be impacted.

Predicted Impacts to GDEs

No significant water level decline is predicted at GDEs other than the THPSS. As described in Table 8-4, predicted water level declines are likely to result in drying, or partial drying of the swamps.

Declines in surface water flow are discussed in the Section 8.1.6.

Baseflow Impacts

Baseflow reductions are based on the 10th and 90th percentile water level change predictions, however the sense of magnitude is reversed. For baseflow the 10th percentile is the least change and the 90th percentile is the greatest change.

As noted in Jacobs (2019a) the predicted baseflow changes for individual swamps, include the entire contributing catchment. Predicted baseflow changes for Wolgan River and Carne Creek include all reaches and contributing catchments above that point. Baseflow changes reported for Wolgan River Swamps located midway between Wolgan River Swamp and Wolgan River Upper Swamp and incorporate all baseflow losses from contributing catchments above that point.

Climate Change Scenarios

Detailed discussion of climate change scenarios with respect to water level drawdown and reduction in surface flows (groundwater contribution to baseflow) are provided in the Hydrogeological Model Report as appended to the Groundwater Impact Assessment (Appendix H).

The climate change analysis, based on the NARCliM dataset, indicates that model results are consistent in both a High Rainfall and Low Rainfall environment with that simulated for median rainfall conditions. That is to say, the model results are relatively insensitive to climate change, as the bulk of the mine inflows are derived from storage, with only minor contribution from recharge (Jacobs 2019a and 2019b).

Table 8-4 Predicted baseflow impacts (90th percentile), Jacobs 2019a

Tri-Star Swamp and Twin Gully Swamp
Maximum predicted baseflow losses for Tri-Star Swamp during mining are 143.4 kL/day. Baseflow losses increase slightly post mining to 169 kL/day. Maximum predicted baseflow losses for Twin Gully Swamp during mining are 25.5 kL/day. Baseflow losses increase slightly post mining to 49.6 kL/day. The lower predicted impacts at Twin Gully compared to Tri-Star Swamp are attributed to the greater depth of cover at those locations.
Wolgan River Swamps and Trail Six Swamp
Maximum predicted baseflow losses at the location of the Wolgan River Swamps during mining are 565 kL/day. Predicted baseflow losses decrease substantially post mining to 185 kL/day. It is noted that this predicted baseflow reduction is cumulative of all upstream contributing catchments. Maximum predicted baseflow losses for Trail Six Swamp during mining are 28.8 kL/day. Predicted baseflow losses increase slightly post mining to 56.6 kL/day for the 90th percentile
Birds Rock Swamp and Crocodile Swamp
The maximum predicted baseflow losses for Birds Rock Swamp during mining are 49.5 kL/day. Baseflow losses remain relatively consistent post mining with maximum of 49.6 kL/day. The maximum predicted baseflow losses for Crocodile Swamp during mining are 10.6 kL/day. Baseflow losses reduce post mining with a long-term take of 2.8 kL/day.
Wolgan River and Carne Creek
Maximum predicted baseflow losses for the Wolgan River during mining are 670 kL/day. Baseflow losses decrease post mining to 296 kL/day. The maximum predicted reduction is in February 2030 and coincides with the completion of LW1006. Subsequent longwalls are further away from the Wolgan River. Maximum predicted baseflow losses for Carne Creek during mining are 366 kL/day. Baseflow losses increase post mining to 605 kL/day. The increase post mining, compared to the Wolgan River which shows reduced impacts post mining, is due to the mine being located up dip from Carne Creek. The depressurisation of the formations and the reduced through flow and seepage to Carne Creek will be a long-term impact.

Mine Closure

It is proposed that dewatering pumps will be kept running at Angus Place and Springvale Mine after the completion of mining to deliver water to the Springvale Water Treatment Project. The pumps will be switched off at the end of 2053.

CSIRO (2017) undertook an assessment of potential mine void recovery and seepage from sealed portals at Springvale (898.6mAHD), Angus Place (912.3mAHD), and the connected and abandoned Newcom Colliery (900.2mAHD). Key findings were as follows:

- Groundwater potential (as heads of water above the portal elevations) were assessed at 100m head from Springvale and 60m head for Angus Place. The assessment assumed no interconnection between the Springvale and Angus Place workings.

- Following the cessation of pumping, void water pressures would rapidly rise to 50m of head within 5 to 10 years at Springvale, and then slowly rise to a maximum of 100m over the following 100 years.
- At Angus Place a portal seal would experience positive pressure from groundwater 12 years after pumping has ceased. The pressure would rise to 40m after 40 years and then slowly rise to 60m over the following 200 years.
- The seepage at the sealed portals at the maximum potential heads was estimated at 0.3 ML/day for Angus Place and 0.5 ML/day for Springvale.

A detailed investigation and mine closure plan will be prepared within 5 years of the end of extraction at Angus Place as is required under standard conditions of consent.

8.1.5 NSW Aquifer Interference Policy (AIP) Minimal Impact Considerations

The NSW Aquifer Interference Policy (AIP) minimal impact considerations for highly productive porous rock aquifers are outlined in Appendix H. Table 8-5 presents a summary of the AIP Minimal Impact Considerations.

In general, with the exception of predicted water table declines at THPSS, the amended APMEP would meet with the Level 1 Minimal Impact Considerations for highly productive, porous rock aquifers.

Table 8-5 AIP Minimal Impact Considerations, Jacobs 2019a

Minimal Impact Consideration	Assessment
Water table - Level 1 Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 metres from any: high priority groundwater dependent ecosystem or high priority culturally significant site listed in the schedule of the relevant water sharing plan. OR A maximum of a 2m water table decline cumulatively at any water supply work.	Level 1 Water level decline greater than a 10% cumulative variation in the water table is predicted at THPSS, a high priority groundwater dependent ecosystem. No significant water table declines are anticipated at any water supply works.
Water table - Level 2 If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: (a) high priority GDE; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan then appropriate studies (including the hydrogeology, ecological condition and cultural function) will be required to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or culturally significant site. If more than 2m decline cumulatively at any water supply work, then make good provisions should apply.	The predicted water level decline is based on the current understanding of the groundwater systems supporting THPSS and the replication of subsidence impacts in the hydrogeological model. If the predicted water level declines eventuate and have a detrimental impact on swamp health and ecosystem functionality, Centennial Angus Place intend to offset those impacts through the use of the environmental offset facility of the BC Act and EPBC Act. An assessment of potential offsetting liabilities is provided under the Ecological Impact Assessment.

Minimal Impact Consideration	Assessment
Water pressure - Level 1 A cumulative pressure head decline of not more than a 2m decline, at any water supply work.	Level 1 – acceptable. No significant pressure declines are anticipated at any water supply works.
Water quality - Level 1 Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 metres from the activity.	Level 1 – acceptable. No detrimental change in water quality is anticipated.

8.1.6 Surface Water Impact Assessment

The Surface Water Impact Assessment has been prepared by Jacobs (2019b) and is provided in Appendix E. This updated assessment for the AMEP takes into consideration the revised subsidence predictions (as outlined in Chapter 6) for the new mine plan and takes into consideration that from 2020, there will be no discharge of mine water from the APMEP and all mine water not used on site will be transferred to the Springvale Water Treatment Project.

Impacts to the riparian habitats have been assessed by RPS (2019) and are discussed separately in Section 8.2. Impacts to aquatic ecology are discussed separately in Section 8.3.

8.1.6.1 Additional Surface Water Modelling Since 2014

Centennial maintains an extensive surface water monitoring network on the Newnes Plateau that comprises surface water quality and flow monitoring. In addition to the monitoring within the mine area, monitoring is also undertaken at several locations remote from the active mining area to serve as reference sites for assessment of potential future impacts from mining. These sites include Barrier Swamp, Best Swamp, and Firetail Swamp.

Since the 2014 EIS, additional investigations have been undertaken on the swamps at both Angus Place Colliery and Springvale Mine (refer to Chapter 7).

Additional monitoring infrastructure has also been installed including:

- Stream flow monitoring has been established within Twin Gully and Tri-Star Swamps and monitoring data has been collected since 2016. A flow depth sensor has also been installed in Tri-Star Swamp that has recorded daily flow depths since 2013; and
- Stream flow monitoring commenced at Barrier Swamp in late 2016, and at Firetail swamp and Best Swamp in late 2017.

A summary of the surface water monitoring sites used to inform this updated surface water impact assessment are provided in Appendix E.

Geomorphological characterisation of the streams overlying the longwall extraction area has been undertaken and the influence of the predicted subsidence on surface flows has been hydraulically modelled. The geomorphic river styles and key characteristics used in this revised impact assessment are:

- *Intact Valley Infill*: this is the geomorphic river style in which the majority of shrub swamps are located. Flow is typically subsurface with occasional surface expressions occurring at low points. Drainage channels are typically absent. Representative sites assessed include Trail Six / Japan Swamp, Twin Gully Swamp, Tri-Star Swamp, Gang Gang Swamp and Carne West swamp.
- *Channelised Infill*: is typically found on the inflow tributaries to the swamps. It is characterised by discontinuous channels located within a confined valley. Where present channels are typically small and trench-like.

- *Steep Headwater*: characterised by steep-graded, bedrock confined channels located in narrow confined valleys that typically lead into downstream gorges. Waterfalls and cascades are prevalent.
- *Gorge*: valley sides are steep to vertical (cliffs), sometimes deeply dissected by inflow tributaries leading to bedrock spurs which force the main channel to adopt a meandering path around them.

The Site Water and Salt Balance Assessment has been revised to reflect the updated water management of Angus Place Colliery. Model results have been updated to present the existing conditions (2019) and for the proposed condition being the period of peak dewatering (nominally 2027).

Hydraulic modelling has been undertaken in TUFLOW to simulate hydrodynamic behaviour under a range of rainfall conditions, for the both the pre-mining and post-mining landforms, to assess relative change in stream dynamics based on the revised subsidence predictions. The hydraulic modelling assessment report is provided as an Appendix to the Surface Water Impact Assessment (refer to Appendix E).

To assess the potential change to surface water flow in surface water catchments, including swamps, a combined GoldSIM/Australian Water Balance Model (AWBM) was developed. The model is referred to as the Springvale Angus Place Swamp Water Balance Model (SAPSWBM) and is presented in Appendix E.

8.1.6.2 Updated Impact Assessment

A summary of the revised subsidence predictions is provided in Chapter 6. A full assessment of potential impacts is provided in Appendix E.

Erosion and Sedimentation

During the establishment and operation of surface infrastructure, earthworks and excavations have potential to result in erosion of soils, and subsequent transport and deposition in waterways. No additional impacts to those presented in the 2014 EIS are likely to occur.

The existing erosion and sediment control facilities were assessed at the time of the 2014 EIS and found to be consistent with relevant guidelines (Jacobs 2019b).

Water Quality

The amended mine design will not result in any mine water discharges to the environment. No deterioration in surface water quality (pH, EC, TSS, Fe, or Mn concentrations) has been identified at Angus Place Colliery or Springvale Mine resulting from subsidence, and as such water quality impacts due to subsidence are not expected as a result of the amended mine design.

Following mine closure there is potential for groundwater seepage in the vicinity of the sealed portals. There is also potential for some acid generation within the mine voids and contributing overlying unsaturated formations. This potential will be assessed and managed at the mine closure planning stage.

Site Water and Salt Balance

As presented in Appendix E, key changes due to the amended APMEP are as follows:

- Direct rainfall, catchment runoff and evaporation of the Angus Place Colliery pit top are expected to remain unchanged from existing conditions. The difference between the proposed conditions and baseline conditions corresponds to the decommissioning of the Maturation Ponds following the connection of wastewater from Angus Place Colliery to the Lithgow City Council mains.
- Potable water use is expected to increase during operations as a result of the amended APMEP.
- Discharges via LDP001 are expected to cease by 2020.

- No change to discharges from LDP002 are expected as a result of the amended APMEP.
- Under existing conditions, the volume of water in the 800 Panel area and 900 Panel area are expected to decrease.

Overall the water and salt balance shows a net beneficial impact on the Coxs River catchment in terms of salt loads being released to the environment through discharge at LDP001.

No changes to water management of the Angus Place Colliery pit top are expected as a result of the amended APMEP, including no change to discharges via the rainfall-based discharge point of LDP002.

Watercourses and Newnes Plateau Shrub Swamps

Predicted mine subsidence is presented and discussed in the MSEC (2019) and summarised in Chapter 6.

Updated subsidence predictions for the Newnes Plateau Shrub Swamps are provided in Table 8-6 and based on the assessments provided by Jacobs 2019b and MSEC 2019.

Updated subsidence predictions for the Wolgan River, Carne Creek and drainage lines are presented in Section Appendix G. Changes to hydrology due to subsidence impacts are presented in Table 8-7.

Development of fractures within the sandstone bedrock underling watercourses across the Study Area caused by mining subsidence could significantly increase local hydraulic conductivity. This can significantly reduce, or in some cases effectively eliminate baseflow. This loss of flow can lead to the progressive drying of downstream swamps which can result in a range of impacts including loss of wetland plant species, drying and desiccation of the swamp peat, increased potential for incision, and erosion of the swamp surface during high flow events. During high flow events the increased surface flow will likely exceed the capacity of any subsurface fracture network surface and ensure continuation of surface flow.

Table 8-6 Updated subsidence impacts for the Newnes Plateau Shrub Swamps

Item	Updated Subsidence Impacts (Jacobs 2019b and MSEC 2019)
Tri-Star Swamp	The modelled change in flow is large and the impact is expected to be significant. Climate change scenarios are also presented in Appendix G, however, high and low rainfall scenarios result in essentially the same magnitude of change. The greatest predicted reduction in grade within Tri-Star Swamp is stepping out of the LW1005 subsidence trough of approximately 30mm/m. It is noted that there are no reversals in grade and as such no areas of ponding are predicted. The reduction in grade in Tri-Star Swamp, while not resulting in pooled water, may have potential for increased flow depth during peak flow due to backing up. The maximum predicted increase in grade is of the order of 10mm/m and is not considered to be significant from a stream flow perspective.
Wolgan River Swamp	The modelled change in flow is of moderate magnitude although not considered to be significant.
Wolgan River Upper Swamp	The modelled change in flow is of moderate magnitude although not considered to be significant.
Twin Gully Swamp	The predicted changes range between a minor to moderate increase and a minor to moderate decrease. It is considered that the impact of the change in flows in Twin Gully Swamp may be moderate, and is less than that predicted for Tri-Star Swamp.

Item	Updated Subsidence Impacts (Jacobs 2019b and MSEC 2019)
	This is expected to be influenced by the difference in extraction height and depth of cover between the two locations.
Trail Six /Japan Swamp	The magnitude of the changes in flow range from moderate to large and are expected to be significant. Small changes in numerical value lead to large changes by percentage and because the THPSS is a low flow environment, these changes to flow are likely to be significant.
Birds Rock Swamp	The modelled change in flow is a moderate to large decrease, and is considered to be significant.
Crocodile Swamp	Crocodile Swamp is located in a tributary of Carne Creek. The modelled magnitude of flow decrease is negligible and the expected impact of that change on Crocodile Swamp is insignificant.

Table 8-7 Updated surface water flow modelling for drainage lines

Item	Changes to hydrology due to subsidence impacts (Jacobs 2019b and MSEC 2019)
Wolgan River	Stream flow monitoring has been undertaken in the Wolgan River since 2008. Modelled changes to surface water flow are presented in Jacobs (2019b). The magnitude of change is relatively minor and the impact is not considered to be significant as the flow volume is much higher. Below confluence with Carne Creek the magnitude of change is considered to be minor to moderate and the impact is not considered to be significant. Above confluence with Carne Creek the magnitude of change is considered to be minor to moderate and the impact is not considered to be significant. The impact of the amended APMEP on surface water users within the Colo River Management Zone is considered insignificant.
Coxs River	The magnitude of change is negligible and hence the impact to surface water flow is considered insignificant. Given that the change to flow in the Coxs River is negligible, and there is no change to surface water quality due to the amended APMEP, the APMEP will satisfy the Neutral or Beneficial Effect on Water Quality test. Impact to the surface water users within the Wywandy Management Zone is insignificant.

NSW River Flow Objectives

An assessment of the amended APMEP against the NSW River Flow Objectives is provided in Table 8-8 with respect to third order drainages and higher. It is noted that potential impacts relating to THPSS will be addressed under the EPBC Act.

Table 8-8 NSW River Flow Objectives

River Flow Objective	Compliant	Assessment
Protect natural water levels in pools of creeks and rivers and wetlands during period of no flow	Yes	The amended APMEP is not predicted to have a significant impact on flows in the Wolgan River or Carne Creek.
Protect natural low flows "Protect natural low flows"	Yes	The amended APMEP is not predicted to have a significant impact on flows in the Wolgan River or Carne Creek.
Maintain wetland and floodplain inundation "Maintain or restore natural inundation patterns and distribution or floodwaters supporting natural wetland and floodplain ecosystems"	Yes	The amended APMEP is not predicted to have a significant impact on flows in the Wolgan River or Carne Creek.
Maintain natural flow variability "Maintain or mimic natural flow variability in all streams"	Yes	The amended APMEP is not predicted to have a significant impact on flows in the Wolgan River or Carne Creek.
Maintain groundwater ecosystems "Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems"	Yes	As outlined in the Groundwater Impact Assessment (Jacobs, 2019) no significant drawdown of the water table is expected beneath Wolgan River or Carne Creek.

Neutral or Beneficial Impact

During mining, the APMEP will meet the requirements of the State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 for neutral or beneficial effect on water quality for a continuing development. From 2020 all mine inflows from existing workings will be transferred to the Springvale Water Treatment Project for desalination and beneficial reuse at the Mount Piper Power Station.

Potential seepages following mine closure and mine void water level recovery will need to be assessed at the mine closure planning stage.

Subsidence Impacts to Surface Water

A detailed assessment of subsidence was undertaken in Section 6 and within Appendix G. The updated impacts of subsidence prediction on surface water is detailed within Table 8-9, for Wolgan River, Carne Creek and drainage lines.

8.1.7 Water Licence Requirements

8.1.7.1 Surface Water Access Licence Requirements

It is noted that Centennial has interests in surface water allocations in both the Wywandy Management Zone and Colo River Management Zone totalling 145 ML/yr and 1293 ML/yr respectively. These allocations are more than sufficient to cover the predicted surface water take. In the event that additional licence volumes would be required, then these would need to be purchased on the open market or through a controlled allocation order. It is understood that incidental water takes from a surface water source, such as reduced baseflow contribution due to groundwater drawdown, are not subject to cease to pump rules, as outlined in the relevant water sharing plan.

8.1.7.2 Groundwater Access Licence Requirements

Water sharing plans outline rules for managing water access licences and water supply works. Rules for the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 for groundwater are presented in Table 8-10.

8.1.7.3 Environmental Protection Licences

Centennial holds an EPL for mining for coal and associated works (EPL467). The EPL covers the mining operation, surface facilities and overland conveyors at Angus Place Colliery.

Under the proposed amended APMEP, discharge of treated stormwater at LDP002 remains unchanged, and discharge of mine water via LDP001 and treated effluent discharge via LDP005 (once longwall extraction commences) will no longer be required.

Table 8-9 Updated subsidence predictions for the Wolgan River, Carne Creek and drainage lines

Item	Updated Subsidence Impacts (Cardno 2019 and MSEC 2019)
Wolgan River	Maximum predicted vertical subsidence <20mm. Maximum predicted upsidence 290mm. Maximum predicted closure 370mm. The predicted mining-induced changes in grade are very small when compared with the natural gradient of the Wolgan River. It is unlikely that there would be adverse changes in the levels of ponding, flooding or scouring of the river banks due to the extraction of the proposed longwalls. Potential changes in stream alignment are expected to be very minor when compared with the changes in the surface water flow depths and widths that occur during natural flooding events. It is unlikely that there would be adverse changes in the stream alignment due to the extraction of the proposed longwalls. It is possible that fracturing could occur along the section of the river to the south of LW1002, where it is located closest to the proposed mining area. However, at these distances, the fracturing is expected to be minor and will not result in adverse impacts on the surface water flows or any reductions in the availability of aquatic habitat. Reductions in surface flow in Wolgan River associated with groundwater depressurisation are expected, but these reductions are relatively minor. The 9% reduction predicted for the Wolgan River just downstream of Twin Gully Swamp may result in some reduction in the availability of aquatic habitat, most likely during drier months, and may result in the reduction in population size of aquatic biota such as crayfish and other aquatic macroinvertebrates. Such impacts would likely have minor consequences for the wider populations of aquatic biota in the river and would largely be restricted to the section just downstream of Twin Gully Swamp. Downstream of the Study Area, reductions in baseflow are predicted to be 2%, which would be expected to result in negligible reductions in the availability of aquatic habitat and associated impacts to aquatic biota.
Carne Creek	Carne Creek is predicted to experience negligible conventional and valley related effects and it is unlikely that Carne Creek would experience adverse impacts due to the extraction of the proposed LW1001 to LW1015. Reductions in surface flow in the Carne Creek associated with groundwater depressurisation are expected, but these reductions are relatively minor. The 4 % reduction in surface flow predicted for Carne Creek would be unlikely to result in more than minor reductions in the availability of aquatic habitat and or more than minor associated impacts to aquatic biota.
Drainage lines (unnamed)	The drainage lines are located across the Study Area and could experience subsidence movements up to the maximum values. There are no predicted significant reductions or reversals of stream grade. Mining can potentially result in increased levels of ponding in locations where the mining-induced tilts oppose and are greater than the natural stream gradients that exist before mining. As the predicted changes in grade are small, typically less than 10 mm/m to 20 mm/m (1% to 2%), any localised changes in ponding are expected to be minor and not result in adverse impacts on the drainage lines. Mining can also potentially result in an increased likelihood of scouring of the stream beds.

Item	Updated Subsidence Impacts (Cardno 2019 and MSEC 2019)
	The maximum predicted tilt within the Study Area is 25 mm/m (2.5 %, or 1 in 40). The predicted mining-induced changes in grade are less than the average natural gradients along the drainage lines. It is unlikely that the mining-induced tilts would have an adverse impact on the surface water flows. Reductions in surface flow in these watercourses would also occur do to groundwater depressurisation, with a reduction in surface flow in swamp associated drainage lines of up to 28 %. Given this habitat follows a natural wetting and drying cycle, and that aquatic biota present here would be adapted to such conditions, an increase in the number of dry periods brought about by fracturing and/or flow diversions would likely have limited impact. It is likely that fracturing would occur along the drainage lines within the Study Area. Fracturing will predominately occur directly above the proposed mining area. However, fracturing can also occur outside the mining area, with minor and isolated fracturing occurring at distances up to approximately 400 m. The drainage of pools or rapid drop in stream flow due to fracturing induced flow diversions have potential to have localised, significant impact on aquatic biota, particularly on organisms that are left stranded. The estimated fracture widths in the topmost bedrock, based on the maximum predicted conventional tensile strain of 3.5 mm/m and based on a typical joint spacing of 10 m, is in the order of 35 mm. In some cases, a series of smaller fractures, rather than one single fracture, would develop in the topmost bedrock. The surface cracking is expected to be similar to that previously observed at Angus Place and Springvale Collieries. The crack widths are expected to be typically between 10 mm and 50 mm; however, localised cracking with widths greater than 50 mm can also develop. Outside the proposed mining area, the crack widths are expected to be typically less than 10 mm; however, localised cracking with widths greater than 25 mm can also develop. Surface water flow diversions could occur along the sections of drainage lines that are located directly above and adjacent to the proposed longwalls. In times of heavy rainfall, the majority of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds.

Table 8-10 Project Compliance with Water Access Licence and Water Supply Works Approvals Rules

Rule	Compliant	Comments
Part 8 - Rules for managing access licences		
Part 8 – Division 1 Water allocation account management rules	Yes	Water Access Licences are already held, with sufficient entitlement, to account for predicted groundwater take in any one water year.
Part 8 – Division 2 Daily access rules	N/A	Water supply works are more than 40m from the top of a high bank of a river. As per 36(1) daily access rules do not apply to an aquifer interference activity since that activity cannot 'Cease to Pump'
Part 9 - Rules for water supply work approvals		
Part 9 – 39 Distance restrictions to minimise interference between water supply works	Yes	Water supply works are: more than 400m from another work (other access licence) more than 100m from another work (basic landholder rights) more than 50m from the property boundary more than 1000m from another work (local water or major utility access licence) more than 200m from a Department monitoring piezometer
Part 9 – 40 Rules for water supply works located near contamination sources	N/A	There are no contamination sources in the vicinity of the APMEP.
Part 9 – 41 Rules for water supply works located near sensitive environmental areas	No	Due to predicted groundwater drawdown at THPSS, it is noted that the APMEP may not meet the requirement that water supply works are: at a distance specified by the Minister that is more than 200 metres from a high priority groundwater dependent ecosystem listed in clause 1 of Schedule 4, excluding a water supply work solely for basic landholder rights, if the Minister is satisfied that the water supply work is likely to cause drawdown at the perimeter of that groundwater dependent ecosystem. It is proposed that potential impacts to THPSS be managed via environmental offsets under the EPBC Act (refer to Section 8.2.4).

Rule	Compliant	Comments
Part 9 – 42 Rules for water supply works located near groundwater dependent culturally significant sites	N/A	There are no groundwater dependent culturally significant sites within the vicinity of the APMEP.
Part 9 – 44 Rules for water supply works located within distance restrictions	N/A	Not applicable since compliant with Part 9 – Clause 39.

8.1.8 Revised Water Management and Mitigation Measures

An updated list of management and mitigation measures based on the APMEP is provided below.

- Groundwater monitoring will continue to utilise the existing groundwater and swamp monitoring network. The monitoring network and approach will be similar to that adopted for the current Springvale Mine, developed in consultation with the Springvale Mine Independent Monitoring Panel. Additional monitoring may be installed to collect data required for operational purposes.
- Mine inflows may be managed underground as required to address short term spikes in inflow, or for routine or emergency maintenance of dewatering infrastructure. The planned dewatering of the 700 and 800 panel areas is also considered a mine water management issue and will not have any material impact outside of daily mine water management. Water from various parts of the mine will be managed and blended such that the water quality meets the contractual requirements of the Springvale Water Treatment Project.
- A detailed mine closure plan will be developed and submitted for approval within five years prior to the completion of mining. Notionally, closure will include the placing of seals at all mine access ways, and internally within the mine workings, such that flow paths between Springvale Mine, Angus Place and the older Newcom workings are isolated.
- Drawdowns resulting from mine dewatering and subsidence are predicted to impact on the THPSS. Given the predicted impacts to a high priority GDE, the APMEP does not meet the Level 1 Minimal Impacts Considerations of the NSW Aquifer Interference Policy and will be offset in accordance with the proposed Swamp Offset Strategy (RPS 2019).
- All auxiliary infrastructure that may be required to be installed associated with additional dewatering bore facilities (including electrical easements, booster stations and pipeline connections) will be subject to a Construction and Environmental Management Plan (CEMP).
- Surface water monitoring for the APMEP will continue to utilise the existing surface water and swamp monitoring network that is already in place. The monitoring network and approach will be similar to that adopted for the current Springvale Mine and would require the establishment of a flow and water quality monitoring sites at the bottom end of Trail Six/Japan Swamp, Birds Rock Swamp and Crocodile Swamp.
- Annual stream condition monitoring will be implemented at key locations along water courses that overly or are within 600m of the proposed extraction area. Monitoring will comprise a combination of photographic monitoring and site observation to identify influences of sedimentation or scouring. Areas identified as potentially sensitive to subsidence and change in stream dynamics, such as the incised section of drainage in the upper reaches of Tri-Star Swamp southern tributary, may also be subject to monitoring of scarp heights and head cut height and progression.

8.2 Biodiversity Impact Assessment

The following sections summarise the key findings of the Biodiversity Impact Analysis (BIA), provided in Appendix I. The BIA assesses the difference in potential impacts arising from the amended APMEP compared to that assessed within the 2014 EIS which was informed by a Flora and Fauna Assessment (RPS 2014). Proposed amendments to the APMEP considered within this BIA and summarised here were broadly grouped into surface infrastructure and subsidence-related impacts.

Aquatic Ecology and Stygofauna is assessed separately and summarised in 8.3.

8.2.1 Existing Environment

Consistent with the 2014 EIS, the amended Project Application Area contains significant natural landscape features formed by the combination of geology, topography and vegetation. The area is characterised by environmental features such as pagodas, cliff lines, swamps, creeks, and deep valleys. Angus Place Colliery is bordered by Newnes State Forest to the east, Springvale Mine to the south, Lidsdale to the west and Gardens of Stone National Park to the north. The Gardens of Stone National Park is one of eight reserves that make up the Greater Blue Mountains World Heritage Area (refer to Figure 3.1).

8.2.1.1 Endangered Ecological Communities and Swamps

Vegetation communities have been mapped within and surrounding the amended Project Application Area using updated desktop analysis and vegetation surveys.

A total of 10 Plant Community Types (PCT) have been mapped by RPS (2019) within the Study Area and four within the surface infrastructure Impact Envelope (refer to Figure 8.7). Of these, only two are listed as an Endangered Ecological Community under the BC Act and/or EPBC Act:

- Newnes Plateau Shrub Swamp (NPSS; listed under the BC Act); and
- Temperate Highland Peat Swamp on Sandstone (THPSS; listed under the EPBC Act).

The mapped extent of the EPBC listed THPSS was delineated by RPS using high resolution (7 cm pixel size) colour imagery (RGB) which was captured in October 2018. THPSS is also characteristic of the Newnes Plateau Hanging Swamp (NPHS) which is not listed as an EEC under the BC ACt.

These swamp communities are also recognised as being a GDE as summarised in Section 8.1.

Threatened Flora

As reported by RPS (2014 and 2019) three threatened flora species have been recorded within the Study Area and would be subject to subsidence impacts:

- *Carex klaphakei* (Klaphake's Sedge);
- Persoonia hindii; and
- Veronica blakelyi.

The following threatened flora species are also reported as potentially occurring within the Study Area:

- *Acacia bynoeana* (Bynoe's Wattle);
- *Boronia deanei* (Deane's Boronia);
- Caesia parviflora var. minor (Small Pale Grass-lily);
- Eucalyptus aggregata (Black Gum);
- *Eucalyptus cannonii* (Capertee Stringybark);
- Eucalyptus pulverulenta (Silver-leaved Gum);

- Genoplesium superbum;
- *Lastreopsis hispida* (Bristly Shield Fern);
- *Persoonia acerosa* (Needle Geebung);
- *Prasophyllum fuscum* (Tawny Leek Orchid);
- Prostanthera cryptandroides subsp. cryptandroides (Wollemi Mintbush); and
- *Thesium australe* (Austral Toadflax).

Threatened Fauna

As reported by RPS (2014 and 2019) nine threatened fauna species have been recorded within the Study Area and would be subject to subsidence impacts:

- *Eulamprus leuraensis* (Blue Mountains Water Skink; BC Act = Endangered; EPBC Act = Endangered);
- *Pseudophryne australis* (Red Crowned Toadlet; BC Act = Vulnerable);
- *Cercartetus nanus* (Eastern Pygmy Possum);
- Petroica pheonicea (Flame Robin);
- Callocephalon fimbriatum (Gang-gang Cockatoo);
- *Chalinolobus dwyeri* (Large-eared Pied Bat);
- *Ninox strenua* (Powerful Owl);
- Chalinolobus Petroica boodang (Scarlet Robin); and
- Daphoenositta chrysoptera (Varied Sittella).

Threatened species known to be associated with THPSS and also included within the assessment of impact in Appendix I include:

- *Eulamprus leuraensis* (Blue Mountains Water Skink; BC Act = Endangered; EPBC Act = Endangered);
- *Petalura gigantea* (Giant Dragonfly; BC Act = Endangered; EPBC Act = Not Listed);
- *Boronia deanei* (Deane's Boronia; BC Act = Vulnerable; EPBC Act = Vulnerable);
- *Pseudophryne australis* (Red Crowned Toadlet; BC Act = Vulnerable);
- *Xerochrysum palustre* (Swamp Everlasting; EPBC Act = Vulnerable): and
- *Carex klaphakei* (Klaphake's Sedge; BC Act = Endangered).

A comparison between the Initial APMEP Likelihood of Occurrence (LoO) and the amended APMEP LoO has identified 40 additional threatened species that require survey within the Study Area. Of these, three are likely to occur within the Study Area in Swamps and 13 are likely to occur within the Impact Envelope (refer Section 8.2.3). Of the 115 species analysed in the amended APMEP LoO, 42 threatened flora and 50 fauna will require targeted surveys within the Impact Envelope, in line with the Biodiversity Assessment Method (BAM) because they are either likely to occur or are BAM Candidate Species. Of the species analysed in the amended APMEP LoO, 35 are listed as Serious and Irreversible Impact (SAII) species, nine are known to occur, three are highly likely to occur and five have a moderate likelihood of occurring. SAII species require extra consideration by the determining authorities with regards to whether there should be any additional and appropriate measures to minimise impacts.

8.2.2 Additional Surveys undertaken since 2014

A full detailed description of the additional floristics surveys undertaken since 2014 are provided in Appendix I and summarised below.

The current field methodologies for the amended APMEP have focused on areas at risk of subsidence related impacts, primarily impacts to swamps and associated threatened species through monitoring programs which are detailed in the Swamp Monitoring Program (refer to Appendix B of the BIA, RPS 2019) and the Biodiversity Management Plan (refer to Appendix C of the BIA, RPS 2019).

Data from 75 BAM plots was collected from the THPSS, of which 33 were utilised to quantify the maximum offset liability (refer to Section 8.2.4 and Appendix I). Sampling was performed between July 2018 and March 2019.

Surveys were also performed in March 2019 to determine the presence/absence of Blue Mountains Water Skink within the amended Study Area. Swamp vegetation comprising potential Blue Mountains Water Skink habitat was mapped using high resolution imagery (7 cm pixel resolution) and subsequently reviewed to identify high value habitat as described for this species in RPS (2019). Potential high value habitat was identified in Wolgan River, South Wolgan, Narrow, Sunnyside, Twin Gullies, Tri-Star, Birds Rock, Crocodile and Trail Six swamps. Sampling of these sites resulted in the identification of Blue Mountains Water Skinks at Sunnyside, Twin Gully, Tri-Star, Crocodile and Trail Six swamps.

8.2.3 Updated Impact Assessment

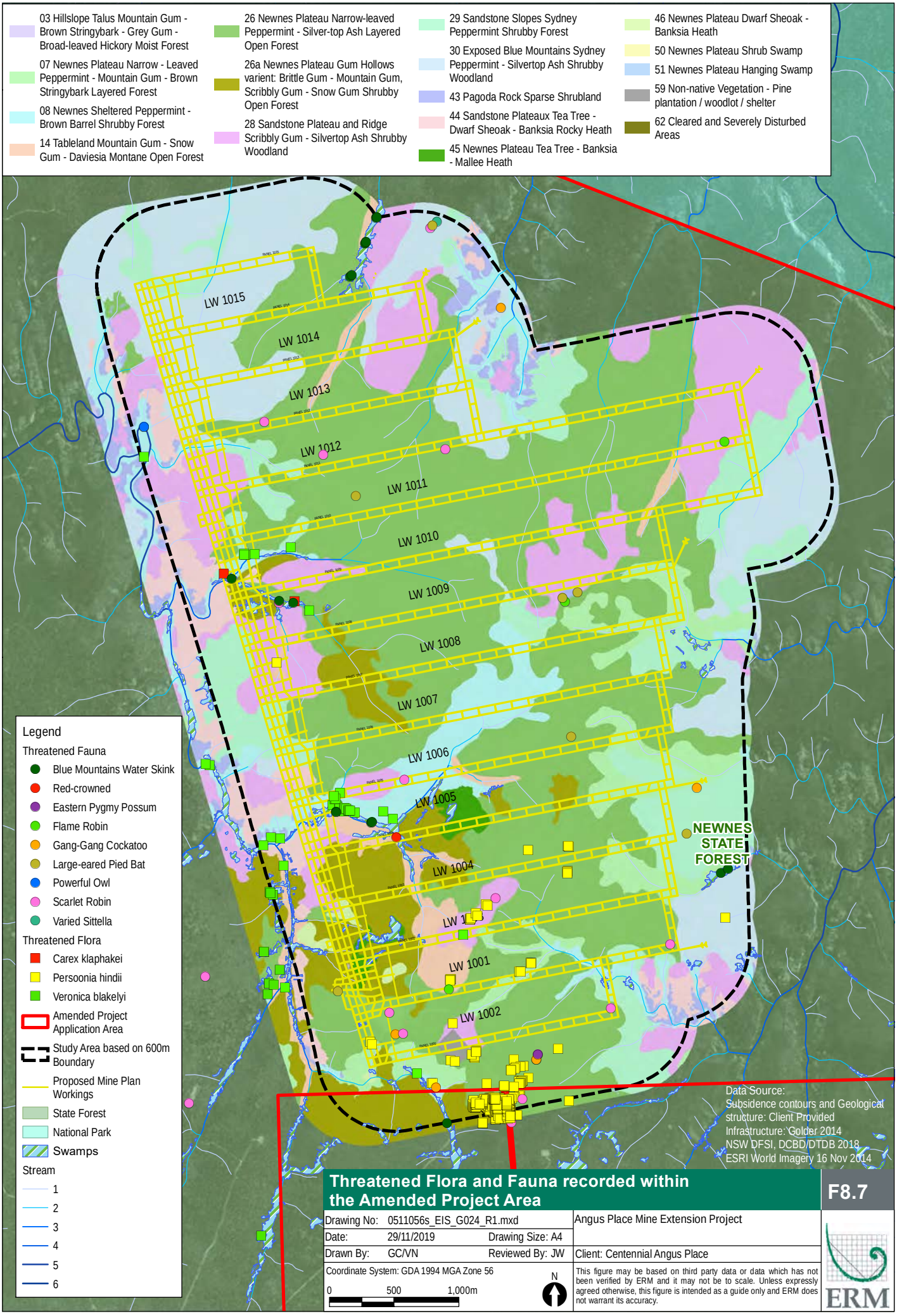
A full assessment is provided in Appendix I. The following summary considers two main causes of potential direct and indirect impacts:

- subsidence related impacts; and
- direct habitat removal within the Impact Envelope to accommodate surface facilities.

8.2.3.1 Subsidence-related Impacts

As described by RPS (2019) and MSEC (2019) subsidence has the potential to modify habitats through surface cracking, slope changes causing erosion and changes to hydrological regimes. Most of the Study Area is dry woodland, forest or heath. The risks of subsidence-related impacts on these drier habitats are low as even significant subsidence has minimal effect on dryland plant communities. Risks of subsidence-related impacts are higher in riparian habitats and GDE due to the potential for alterations to surface or groundwater hydrological regimes. Refer to Section 8.1.

Other habitat features that may be susceptible to high levels of subsidence include cliffs, pagodas and caves as subsidence may induce cracking or failure of these features to the extent that they become less suitable for habitation. Impacts to these key habitat features are summarised in Table 8-11 below.


03 Hillslope Talus Mountain Gum - Brown Stringybark - Grey Gum - Broad-leaved Hickory Moist Forest
07 Newnes Plateau Narrow - Leaved Peppermint - Mountain Gum - Brown Stringybark Layered Forest
08 Newnes Sheltered Peppermint - Brown Barrel Shrubby Forest
14 Tableland Mountain Gum - Snow Gum - Daviesia Montane Open Forest
26 Newnes Plateau Narrow-leaved Peppermint - Silver-top Ash Layered Open Forest
26a Newnes Plateau Gum Hollows varient: Brittle Gum - Mountain Gum, Scribbly Gum - Snow Gum Shrubby Open Forest
28 Sandstone Plateau and Ridge Scribbly Gum - Silvertop Ash Shrubby Woodland
29 Sandstone Slopes Sydney Peppermint Shrubby Forest
30 Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland
43 Pagoda Rock Sparse Shrubland
44 Sandstone Plateaux Tea Tree - Dwarf Sheoak - Banksia Rocky Heath
45 Newnes Plateau Tea Tree - Banksia - Mallee Heath
46 Newnes Plateau Dwarf Sheoak - Banksia Heath
50 Newnes Plateau Shrub Swamp
51 Newnes Plateau Hanging Swamp
59 Non-native Vegetation - Pine plantation / woodlot / shelter
62 Cleared and Severely Disturbed Areas
LW 1015
LW 1014
LW 1013
LW 1012
LW 1011
LW 1010
LW 1009
LW 1008
LW 1007
LW 1006
LW 1005
LW 1004
LW 1001
LW 1002
NEWNES STATE FOREST
Legend
Threatened Fauna
Blue Mountains Water Skink
Red-crowned
Eastern Pygmy Possum
Flame Robin
Gang-Gang Cockatoo
Large-eared Pied Bat
Powerful Owl
Scarlet Robin
Varied Sittella
Threatened Flora
Carex klaphakei
Persoonia hindii
Veronica blakelyi
Amended Project Application Area
Study Area based on 600m Boundary
Proposed Mine Plan Workings
State Forest
National Park
Swamps
Stream
1
2
3
4
5
6
Data Source:
Subsidence contours and Geological structure: Client Provided
Infrastructure: Golder 2014
NSW DFSI, DCBD/DTDB 2018
ESRI World Imagery 16 Nov 2014
Threatened Flora and Fauna recorded within the Amended Project Area
F8.7
Drawing No: 0511056s_EIS_G024_R1.mxd
Angus Place Mine Extension Project
Date: 29/11/2019
Drawing Size: A4
Drawn By: GC/VN
Reviewed By: JW
Client: Centennial Angus Place
Coordinate System: GDA 1994 MGA Zone 56
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Table 8-11 Updated subsidence predictions for key habitat features, RPS 2019

Habitat Feature	Summary of Potential Impacts
Wooded Habitats	As reported by RPS (2014 and 2019) tension cracks and soil destabilisation may cause localised disturbance of the root zone for some plants where this occurs. However, it is noted that a number of those threatened flora considered as having the potential to occur either respond positively to, or readily recover from disturbance, or naturally occur within areas where the soil surface is naturally unstable, such as mountain scree slopes. Any loss of threatened flora would be highly isolated and would not remove a significant proportion of soil seedbank such that an area would become unviable for threatened flora.
Riparian Habitats	It is expected that fracturing of the bedrock would occur beneath some sections of the drainage lines which are located directly above the proposed longwalls. Fractures in bedrock underlying watercourses across the Study Area could significantly increase local hydraulic conductivity, and in some cases eliminate base flow. Loss of flow can lead to the progressive drying of downstream swamps. [refer to Section 8.1.6].
Cliffs, Minor Cliffs and Pagodas	The mining layout has been designed such that the majority of the cliffs and pagoda complexes are located outside the 26.5° angle of draw from the extents for the proposed longwalls (MSEC 2019). There are three cliffs that are situated within the Study Area based on the 26.5° angle of draw and no pagoda complexes, only isolated pagodas, in the Study Area (MSEC 2019). Cliffs are predicted to experience less than 20 mm vertical subsidence and far-field horizontal movements towards the proposed mining area (MSEC 2019). It is unlikely that the cliffs would experience adverse impacts due to their distances outside of the proposed mining areas, however isolated rock falls could occur (MSEC 2019). Minor Cliff AP-MC1 is located above LW1013 and could experience fracturing, potentially resulting in localised spalling of exposed rockface (MSEC 2019). Minor cliffs outside the Study Area are unlikely to experience adverse impacts. Pagodas along the upper reaches of Drainage Lines 1 and 5 and the upper reaches of the Wolgan River are predicted to experience up to 150 mm vertical subsidence. Predicted strains for these pagodas is 1.4 mm/m tensile and 0.6 mm/m compressive based on the 95 % confidence intervals (MSEC 2019). Fracturing is a possibility of these pagodas due to tensile strains, which could result in rockfalls (MSEC 2019). It is unlikely that fracturing would occur in pagoda complexes that are located on or outside the 26.5° angled of draw (MSEC 2019).
Steep Slopes	The steep slopes and rock outcrops are expected to experience the full range of predicted subsidence effects. The maximum predicted tilt for the steep slopes and rock outcrops within the Study Area is 25 mm/m (2.5 %, or 1 in 40). The predicted changes in grade are very small when compared to the natural surface grades, which are greater than 1 in 3. It is unlikely that the mining-induced tilts would result in adverse impacts on the stabilities of the steep slopes and rock outcrops. Surface cracking previously observed at Angus Place and Springvale Collieries was typically within the range of less than 5 mm to 25 mm, but with isolated surface cracking in some locations greater than 50 mm. Remediation may be required for the larger surface cracking, including infilling with soil or other suitable materials, or by locally regrading and re-compacting the surface. Similarly, where cracking restricts the passage of vehicles along the tracks and fire trails that are required to be open for access, it is recommended that these cracks are treated in the same way.

Habitat Feature	Summary of Potential Impacts
National Parks or Wilderness Areas	<u>Gardens of Stone National Park</u> Gardens of Stone National Park is located 1040 m north of the proposed LW1011, at its closest point to the proposed mining area. It is located at a minimum distance of 840 m outside the 26.5° angle of draw from the proposed mining area. Vertical subsidence and its related effects (i.e. conventional tilt, curvature and strain) are not expected to be measurable. The National Park will experience far-field horizontal movements towards the proposed mining area. The predicted far-field horizontal movements at the National Park boundary (i.e. at a distance of 1000 m from the proposed longwall mining) is 80 mm based on the 95 % confidence level. Far-field horizontal effects tend to be bodily movements towards the mining area that are accompanied by very low levels of strain. The absolute horizontal movements do not result in adverse impacts, except where they are experienced by large built structures which are sensitive to differential horizontal movements, such as freeway bridges or large industrial buildings. The far-field and valley closure effects can be monitored, as longwalls are progressively mined towards the National Park, allowing an ongoing review of the observed versus predicted movements. The potential for adverse impacts in the National Park could then be avoided. <u>The Birds Rock Flora Reserve</u> The Birds Rock Flora Reserve is partially located within the Study Area. The reserve is located above the eastern ends of the proposed LW1006 to LW1009. Maximum predicted vertical subsidence: 2250mm Maximum predicted total tilt: 25mm/m Maximum predicted conventional tensile strain: 3.5 mm/m. The potential impacts on this site include changes in surface water drainage, surface cracking, and fracturing and spalling of the exposed rock formations.
State Forest	The Study Area is located within the Newnes State Forest which is managed by the Forestry Corporation of NSW. Maximum predicted vertical subsidence: 2250mm Maximum predicted total tilt: 25mm/m Maximum predicted conventional tensile strain: 3.5 mm/m The potential impacts include changes in surface water, changes to ground water and surface cracking.

As with the 2014 EIS, THPSS is the only EPBC Act listed Threatened Ecological Community (TEC) that has been recorded within the Study Area. In contrast to the 2014 EIS, and based on the extensive monitoring data and analysis since the 2014 EIS it has been found that mining directly beneath lineaments or significant geological faults has triggered changes to hydrology in swamps overlying the Springvale Mine (refer to Chapter 7). In the case of the amended APMEP it is not possible to avoid the associated lineaments as a very significant area of longwall extraction would be sterilised and remaining extraction areas would be rendered unviable.

Subsidence-related impacts are expected at Tri-Star Swamp, Twin Gully Swamp, Trail Six Swamp, Birds Rock Swamp, Crocodile Swamp and the hanging swamps within their catchments (refer to Section 8.1.6). These impacts may include vegetation dieback, major incision and erosion (in some instances down to bedrock), associated with loss of peat layer, significant loss of ecosystem function and ecological resilience, and ecological and geomorphic threshold exceedance. As such, impacts to THPSS-associated threatened species are also likely in these locations; these species are the Blue Mountains Water Skink (*Eulamprus leuraensis*), Giant Dragonfly (*Petalura gigantea*), Deane's Boronia (*Boronia deanei*), Red Crowned Toadlet (*Pseudophryne australis*), Swamp Everlasting (*Xerochrysum palustre*) and Klaphake's Sedge (*Carex klaphakei*).

In accordance with the BC Act and EPBC Act, any environmental consequences assessed to be greater than negligible to THPSS and their associated threatened species will be required to be offset in accordance with the NSW Biodiversity Offset Scheme and the Commonwealth EPBC Act Environmental Offsets Policy. RPS (2019) presents the maximum potential ecosystem and species credit liability given total loss of THPSS within the Study Area (refer to Section 8.2.4).

Based on this new understanding of swamp impacts, Centennial has prepared a detailed Swamp Offset Strategy (refer to Appendix I). The Swamp Offset Strategy demonstrates compliance with the Commonwealth Biodiversity Offset Policy for both Springvale Mine Extension Project (EPBC 2013/6881) and the amended APMEP.

8.2.3.2 Surface Infrastructure Impacts

To provide flexibility for the location of infrastructure throughout the life of the APMEP, the amended APMEP proposes to undertake surface disturbance activities within an Impact Envelope of 49.93 ha. This is an increase of 26.69 ha of potential surface disturbance since the initial EIS.

The actual footprint will likely be far less as infrastructure will be designed to avoid and minimise impacts on bushland and threatened species by avoiding areas of high biodiversity value and confining construction to pre-disturbed areas and established access tracks where possible. Where impacts cannot be avoided, the actual offset liabilities will be offset in accordance with the BC Act. The actual offset requirements will be informed by extensive field surveys and use of high-resolution (7 cm pixel resolution) aerial photography before and after construction.

The indicative offsets presented in Appendix I and summarised in Section 8.2.4 utilise a worst case approach and assume total loss of all vegetation and habitat within the 49.93 ha envelope consisting of four PCTs.

8.2.3.3 Mine-water Discharge Impacts

The 2014 EIS assessed up to 30 ML/day of mine water discharges from the Angus Place Colliery LDP001. Although the 2014 EIS concluded that this volume of discharge and expected water quality will unlikely have a significant impact on threatened entities or other MNES, the amended APMEP will avoid the potential to impact downstream sensitive receivers since any excess groundwater not used for onsite operational requirements will be transferred to the Springvale Water Treatment Project (SSD_7592).

8.2.4 Revised Offset Liabilities

8.2.4.1 Biodiversity Offset Requirements

In accordance with the BC Act and EPBC Act, any impacts from the proposed mine extension will be required to be offset in accordance with the NSW Biodiversity Offset Scheme and the Commonwealth Environmental Offsets Policy.

Although the actual offset liability will be determined following approval and additional survey, a maximum offset liability has been calculated for the Impact Envelope. The indicative Ecosystem credit liability, considering total impact is provided in Table 8-12.

Table 8-12 Indicative Ecosystem Credit Liability, Impact Envelope

Species/PCT	PCT	Area (ha)	Indicative Credit Liability
Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion	1100	0.61	31
Sydney Peppermint - Silvertop Ash heathy open forest on sandstone ridges of the upper Blue Mountains, Sydney Basin Bioregion	1248	47.18	1769
Narrow-leaved Peppermint - Silvertop Ash - Mountain Grey Gum shrubby open forest of the upper Blue Mountains, Sydney Basin Bioregion	967	2.51	94
Narrow-leaved Stringybark - Fringe Myrtle - Scaly Phebalium heathy woodland on exposed sandstone ranges of the Sydney Basin	1666	0.18	7

8.2.4.2 Swamp Offset Strategy

Based on a conservative assumption that all THPSS within the Study Area experience a greater than negligible impact, the total number of swamp ecosystem credits that Centennial may be liable for is 880 for PCT 657. This is considered to be a conservative assumption as not all THPSS within the Study Area are predicted to experience groundwater drawdown that would result in greater than negligible impacts.

The maximum offset liability for species credits for THPSS-associated threatened species are presented in Table 8-13. For the purposes of this maximum offset liability calculation, the entire area encompassed by the THPSS swamp boundary was considered suitable habitat.

Table 8-13 Species Credit Liabilities

Credit Type	Credits Required*
Blue Mountains Water Skink (*E. leuraensis*)	844
Giant Dragonfly (*P. gigantea*)	1276
B. deanei	844
Red-crowned Toadlet	639

** Although the calculations in the Swamp Offset Strategy do not currently include Xerochrysum palustre and Carex klaphakei, the final offset calculations will be revised following development approval and all impacted species will be included.*

The Swamp Offset Strategy (appended to the BIA in Appendix I) has been designed to satisfy the various State and Commonwealth offset policy requirements and takes into consideration the specific conditions of consent issued for the Springvale Mine Extension Project. The Swamp Offset Strategy includes:

- Payment into the Biodiversity Conservation Trust (BCT) Fund for impacts to THPSS and their associated threatened species associated with the APMEP (if approved).
- Support for a transfer of land (currently owned and managed by Forestry Corporation of NSW) into a State Conservation Area on a staged basis to satisfy the EPBC Act Environmental Offsets Policy requirements for both the Springvale Mine Extension Project and APMEP as well as contribute to the offset liability obligations under the Springvale Mine Extension Project development consent (SSD 5594).

- A monetary contribution from Springvale Coal to the management of the land as an additional supplementary measure to meet the offset obligations under the Springvale Mine Extension Project development consent (SSD 5594).
- A commitment to ongoing monitoring of THPSS and their associated threatened species within the Springvale Mine and Angus Place Colliery mine extension areas.
- A commitment to ongoing research on the Blue Mountains Water Skink (*Eulamprus leuraensis*).

The Commonwealth EPBC Act 1999 Offsets Policy states that 90 per cent of offset liabilities must be met with direct offsets. As identified in Appendix I by combining the entire area of the Newnes State Forest swamps with the impacted swamps within Angus Place and Springvale Extension Areas, this 90% requirement can be achieved.

8.2.5 Revised Management and Mitigation Measures

The revised statement of commitments (Response to Submission Report, Centennial 2014) committed to the preparation of a Research Strategy and a Biodiversity Management Plan.

A draft framework for the Swamp Monitoring Program and Biodiversity Management Plan has since been prepared for the APMEP to demonstrate an in depth understanding of the potential impacts of longwall mining on biodiversity and THPSS, and the best practice monitoring methods that will be implemented. A copy of these management plans are provided in full in Appendix I.

An updated list of management and mitigation measures based on the amended APMEP is provided below.

- A comprehensive monitoring program within the swamps will be implemented in accordance with a Swamp Monitoring Program. This will include a combination of intensive field survey and remote sensing methodologies.
- A comprehensive monitoring program within terrestrial environments will be implemented in accordance with a Biodiversity Management Plan.
- Research and monitoring programs for Blue Mountains Water Skink, Giant Dragonfly and *Boronia deanei* have been conducted for Springvale Mine and will be extended to include the amended APMEP Study Area to detect any potential mining related impacts to these species.
- Impacts to swamps will be offset in accordance with the Swamp Offset Strategy. The strategy has been designed to satisfy the various State and Commonwealth offset policy requirements.
- Where impacts cannot be avoided within the Impact Envelope, they will be offset in accordance with the BC Act within 12 months of impacts being realised. To accurately determine the impact of the amended APMEP, a liability report will be prepared, which details and calculates the actual Ecosystem and Species Credits required to offset any impacts. The offset requirements will be informed by extensive field surveys before construction (in accordance with the BAM) and will include use of high-resolution (7 cm pixel resolution) aerial photography before and after construction.

8.3 Aquatic Ecology and Stygofauna Assessment

The updated Aquatic Ecology and Stygofauna Assessment has been prepared by Cardno (2019) and is provided in Appendix J. This updated assessment takes into consideration the revised subsidence predictions (as outlined in Chapter 6) and includes the results of additional aquatic ecology studies that have been undertaken since 2014.

Impacts to the swamps and riparian habitats have been assessed by RPS (2019) and are discussed separately in Section 8.2

8.3.1 Existing Environment

8.3.1.1 Aquatic habitat

The revised Study Area for the Aquatic Ecology and Stygofauna Assessment is the area within 600 m of the proposed longwalls (refer to Figure 3.1).

The primary watercourses within and adjacent to this area are the perennial Wolgan River and its tributary, Carne Creek. A number of first, second and higher drainage lines are also located directly above the longwalls.

The Wolgan River is located to the west of the proposed LW1001 to LW1015 generally located outside the 26.5° angle of draw. However, a 100 m section of the river is located just inside the angle of draw to the south of the finishing end of LW1002. The Wolgan River crosses in and out of the Study Area based on the 600 m boundary on the western side of the proposed longwalls. The total length of the river that is located within the Study Area based on the 600 m boundary is approximately 2.8 km.

Carne Creek is situated to the south-east of the proposed longwalls. The creek is located at a minimum distance of 900 m from LW1001 at its closest point to the proposed mining area. A detailed description of the Wolgan River and Carne Creek catchments is provided in Appendix J.

The drainage lines (unnamed) in the western part of the Study Area drain into the Wolgan River and the drainage lines in the eastern and northern parts of the Study Area drain into Carne Creek. The drainage lines have shallow incisions into the natural surface soils which are derived from the Burralow Formation of the Triassic Narrabeen Group. Some sections of the drainage lines have sandstone outcropping, which form a series of steps or drop downs in the steeper sections. The sections of the drainage lines downstream of the shrub swamps have small base surface water flows. Elsewhere, the drainage lines are generally ephemeral, although there are some groundwater seeps from the perched aquifers.

As reported by Cardno (2019) and based on the results of additional field surveys since the original assessment, the perennial sections of Wolgan River, Carne Creek and those drainage lines that flow through the swamps are undisturbed and support a relatively diverse aquatic macroinvertebrate assemblage as well as supporting freshwater crayfish (*Parastacidae*). The fish assemblage supported by these watercourses appears relatively limited, with sparse records of freshwater eels (*Anguilla* sp.) in the Wolgan River and potentially mountain galaxias in Carne Creek. Consistent with the 2014 EIS, no threatened aquatic species are likely to occur within the Study Area.

Also consistent with the 2014 EIS, the majority of Wolgan River and Carne Creek is reported to provide Type 1 – Highly Sensitive Key Fish Habitat (KFH) due to the presence of large rocks and wood debris. No instream aquatic plants have been identified within the Study Area. The third order and higher drainage lines, including those sections flowing through swamps, provide Type 2 – Moderately Sensitive KFH. First and second order drainage lines do not provide any KFH.

Other aquatic (or semi-aquatic) species that have the potential to be supported within the Study Area are the larvae of native dragonflies, including the endangered Hawks Dragonfly and Adam's Dragonfly. No suitable habitat is reported to occur within the Study Area although it does occur within the main channels of the Wolgan River and Carne Creek (outside of the potential impact area).

The Study Area does not contain any critical habitats listed under the Fisheries Management Act 1994 (FM Act) or EPBC Act, or similar Areas of Outstanding Biodiversity Value listed under the BC Act.

8.3.1.2 Stygofauna habitat

Stygofauna comprise highly specialised aquatic macroinvertebrates and (rarely) some fish that are adapted to living in groundwater habitats. The aquifers and aquitards that occur in the amended Project Application Area form three basic groundwater systems:

- The perched groundwater system is discontinuous and generally situated close (within metres) to the ground surface. It is derived from excess rainfall that is unable to infiltrate into the deeper groundwater systems due to the presence of less permeable underlying rock layers.
- The shallow regional groundwater system (AQ4) extends from approximately 100 m below ground to 286 m above the Lithgow Seam. It is located primarily in the Banks Wall sandstone layer of the Narrabeen Group. The flow of groundwater within this system is generally horizontal and occurs along bedding planes and in a north-eastern direction.
- The deep groundwater system is separated from the shallow regional groundwater system by a sequence of interbedded claystone and sandstones of low permeability that comprise the Mount York Claystone. Groundwater from this system drains into the goaf formed by longwall mining and results in most of the mine water inflows.

As reported by Cardno (2019) ongoing sampling of stygofauna in groundwater bores within the Study Area and from other nearby mine areas indicate that stygofauna are present within shallow perched aquifers associated with swamps and in the underlying shallow regional groundwater aquifer both located above the proposed longwalls. They appear less likely to occur in deeper aquifers associated with the coal measures. Only one (1) taxon was sampled from the shallow regional aquifer, though the assemblage present in the perched swamp aquifer appears more diverse and abundant.

8.3.2 Additional Surveys undertaken since 2014

The updated Aquatic Ecology and Stygofauna Assessment (Cardno 2019) is based on the results of the ongoing aquatic ecology monitoring program undertaken by MPR (2010 to 2016) as well as an additional survey undertaken by Cardno (2019). Survey methodologies are generally consistent with those undertaken to support the original assessment and are further detailed in Appendix J.

Since the 2014 EIS, a regional Stygofauna Monitoring and Assessment Plan (SMAP) has also been developed (Centennial 2018) in order to monitor and assess existing communities of stygofauna across a number of Centennial sites located within the Western Coalfield.

The results of this additional Stygofauna monitoring and assessment is reported by Cardno (2019) and forms the basis of the revised impact assessment as summarised below in Section 8.3.3.

8.3.3 Updated Impact Assessment

8.3.3.1 Aquatic Habitat

A summary of the revised subsidence predictions is provided in Table 8-9. A full assessment of potential impacts is provided in Appendix J.

Approximately 38 km of watercourse (creeks and drainage lines) are located directly above the proposed longwalls, with a total of 81 km within the Study Area. As reported by Cardno (2019), this represents less than 5% of watercourses present within the surrounding 600 km^2 wider catchment area. Together with the length of comparable drainage line habitat affected due to previous and planned mining at Springvale Mine this would represent a cumulative loss of approximately 10% of such habitat within the wider catchment area.

Reductions in availability of aquatic habitat would be far more noticeable in the first, second, third and fourth order drainage lines located directly above the longwalls where fracturing and flow diversions are expected to occur. The aquatic habitat provided by first and second order drainage lines is limited, consisting largely of ephemeral habitat that would flow for short periods after rainfall and provide habitat for a limited number of aquatic biota.

Aquatic habitat provided by the third and fourth order drainage lines that flow through the swamps directly above and adjacent to the longwalls is reported to be perennial and more substantial (through still relatively limited, with general shallow and narrow channels). These watercourses are also predicted to experience fracturing and flow diversions, with associated loss of aquatic habitat and associated biota (aquatic macroinvertebrates, including freshwater crayfish).

An increased frequency of drying of largely ephemeral habitat in these watercourses is likely and this would result in relatively severe local impacts at the scale of individual watercourses. In a regional context, impacts to aquatic habitat and biota would be relatively minor.

No more than minor and localised impacts on riparian habitat are expected. There may be some die-back of fringing aquatic vegetation following flow diversions and drainage of pools and subsidence induced rockfalls could damage some vegetation. However, riparian vegetation is abundant throughout the Study Area and wider catchments and the loss of a small amount is expected to have negligible impacts on aquatic ecology. Some minor clearing will be undertaken to facilitate access road construction / upgrades, though again such areas would be a very small proportion of that present in the Study Area and wider catchments. No additional impacts to those already reported in the 2014 EIS are considered likely as a result of the proposed construction of surface infrastructure or access roads.

8.3.3.2 Stygofauna

Stygofauna are especially sensitive to environmental change, having evolved within stable or still water conditions. They also have low mobility and have narrow spatial distributions within their habitat. Due to these constraints a stygofauna can become stranded and die within 48 hours if water is drawn down due to coal mining activities.

Interactions between surface and groundwater on the Newnes Plateau involve recharge to shallow groundwater aquifers and groundwater discharge to surface water (Jacobs 2019). Groundwater discharge to surface water can occur as seepages from exposed cliff faces and bedrock in drainage lines. These discharges contribute to the establishment of hanging swamps and shrub swamps and to surface flow in drainage lines. Extraction of the proposed longwalls is expected to result in disturbance to aquifers resulting in groundwater depressurisation and associated reductions in surface flow in watercourses.

As outlined within Section 8.1.6 and Appendix J, modelling of surface flows undertaken by Cardno (2019) indicated the following potential for decreases in surface flows due to groundwater depressurisation:

- Wolgan River Catchment: Up to approximately 9% reduction in surface flow Wolgan River just downstream of Twin Gully Swamp, reducing to an approximate 2% reduction downstream of the Study Area. A minor 8% reduction in surface flow upstream of Twin Gully Swamp and up to a 28% reduction upstream of Tri-Star Swamp.
- Carne Creek Catchment: Up to approximately 4% reduction in surface flow in Carne Creek adjacent to and downstream of the Study Area, 19% reduction in associated drainage line to the east of the longwalls and a 15% reduction in associated drainage line to the north of the longwalls.

Groundwater depressurisation would also result in a reduction in the water table and a reduction of groundwater levels of up to approximately 10m in perched aquifers associated with swamps overlying the longwalls. This would reduce the availability of habitat for stygofauna. Depending on the magnitude and extent of drawdown, and the ability of stygofauna to migrate with the receding water level, this could result in the loss of stygofauna assemblages from these perched swamp aquifers, representing relatively severe local impacts at the scale of individual swamps. The associated impact to more regional stygofauna biodiversity would depend on the degree of isolation of these affected swamps, and whether any unique taxa or stygofauna genetic diversity were associated with these swamps. The apparent connection of these swamp aquifers with underlying aquifers suggests that they would not necessarily be isolated from each other, and that they may not support stygofauna of particular conservation value.

Overall, aquifers that provide habitat for stygofauna are expected to be impacted by reductions in groundwater levels following mining induced groundwater depressurisation. The potential impact on the perched swamp aquifers present the greatest threat to stygofauna, as the swamp area could dry as the water table drops from underground mining activities. A smaller reduction in swamp water levels by a few metres may result in a less severe impacts to stygofauna; by only reducing habitat and population size, rather than losing population diversity. The actual extent of the potential impact of the stygofauna will depend on the amount of water table drop within the Study Area. However, in the wider context, the APMEP would affect approximately 5 % of the swamp habitat present in the surrounding 100,000 ha.. Together with the area of swamp habitat impacted by previous Angus Place and Springvale longwalls, cumulatively, this would represent a total of approximately 170 ha of swamp habitat, or 15.5 % of that present in the surrounding 100,000 ha area. The abundance of swamp habitat suggests that impacts at the catchment scale would be relatively minor, assuming these swamps provide habitat for similar stygofauna assemblages.

8.3.3.3 Summary of Potential Impacts

The APMEP has been designed to avoid or minimise potential impacts on aquatic ecology and includes the setback of longwalls from major watercourses.

Localised impacts to aquatic habitat and macroinvertebrates will occur following predicted mine subsidence and associated fracturing in streams and ephemeral drainage lines adjacent to and overlaying the proposed longwalls. These predicted impacts, primarily subsidence induced fracturing, groundwater level reductions, flow diversions and loss of aquatic habitat, could potentially be relatively significant at a local scale. As reported by Cardno (2019), these impacts would be relatively minor in the context of the wider catchment area.

No significant impacts to listed threatened species such as Macquarie Perch, Sydney Hawk Dragonfly or Adam's Emerald Dragonfly are expected. These species are very unlikely to occur in drainage lines that traverse the Study Area. Impacts to KFH would be largely restricted to Type 2 – Moderately Sensitive KFH present in watercourses that flow through Twin Gully Swamp and Tri-Star Swamp. These watercourses are expected to experience subsidence induced fracturing and flow diversions that would affect aquatic habitat and associated aquatic biota.

Aquifers that provide habitat for stygofauna are expected to be impacted by reductions in groundwater levels following mining induced groundwater depressurisation. The loss of perched swamp aquifers represent the greatest potential impact to stygofauna than any that would occur in the deeper aquifers. The severity of impacts to stygofauna in perched upland swamp aquifers would depend on the severity and extent of impacts to groundwater levels in swamps. At the scale of individual swamps, impacts to stygofauna could be relatively severe, and there is potential for the predicted reductions in groundwater levels in these swamps to result in the loss of assemblages associated with Twin Gully and Tri-Star swamps. However, in the wider catchment wide context, these impacts would be relatively minor.

8.3.4 Revised Management and Mitigation Measures

The revised statement of commitments (Response to Submission Report, Centennial 2014) committed to the preparation of a regional stygofauna assessment which will:

- Collate existing available information on groundwater bores, water quality and characteristics in Centennial Coal's area of operations throughout the Western Coalfield.
- Use this information to form a prioritisation list of likely areas for GDE to occur.
- Use the prioritisation protocol to identify bores that can be sampled to provide data on the presence and significance of fauna both within and outside mine areas.
- Identify any stygofauna found to a minimum of Family level.
- Advise on the significance of the findings.

- Examine relationship between bore characteristics and presence of stygofauna.

The regional Stygofauna Monitoring and Assessment Plan (SMAP) has since been prepared and implemented.

An updated list of management and mitigation measures based on the APMEP is provided below.

- A comprehensive monitoring plan to assess the potential impacts of mine subsidence on aquatic habitat and biota within watercourses of the Study Area will be implemented. The aims of the recommended monitoring plan are to determine the nature and extent of any subsidence-induced impacts on aquatic ecology and assess the response of aquatic ecosystems to any stream remediation and management works implemented;
- Two types of monitoring sites should be incorporated into the monitoring plan: 'impact' sites that may be subject to mine subsidence impacts during and after longwall extraction and 'control' sites that would provide a measure of the background environmental variability within the catchments as distinct from any mine subsidence impacts;
- Monitoring sites should be established in major watercourses (i.e. Wolgan River and Carne Creek) and in sections of the larger drainage lines predicted to experience impacts due to the proposed longwall mining. Although no more than minor reductions in surface flow are predicted for Carne Creek, it is recommend that this creek is monitored for potential impacts to aquatic habitat and biota as a precautionary approach;
- Detailed methodologies and performance indicators are provided in Appendix J; and
- Additional aquatic ecology studies should be triggered by events such as significant changes in water quality and availability of aquatic habitats. Appropriate aquatic ecology trigger values should be developed following collection of two-years of baseline data. These values may be revised in consultation with relevant stakeholders following analysis of natural variability within the pre-mining baseline data. Each trigger value would correspond to either a negligible or significant impact on the aquatic habitat and/or biota within the Study Area and management actions identified for consideration if thresholds are exceeded.

8.4 Air Quality and Greenhouse Gas Impact Assessment

The following sections summarise the key findings of the Air Quality Impact Assessment (AQIA, EMM, 2019), provided in Appendix J. The AQIA assesses the potential air quality impacts associated with the APMEP on the surrounding environment.

In 2014, SLR Consulting prepared an AQIA for the original APMEP, which sought approval for a maximum of 4 Mtpa of ROM coal (SLR 2014). The updated AQIA (EMM, 2019) draws on data from that assessment, while assessing the existing air quality and meteorological environment, calculating air pollutant emissions and dispersion modelling for the amended APMEP, and providing an assessment of predicted impacts relative to assessment criteria. The assessment has been prepared in accordance with the following documentation:

- Director General's EARs issued 6 November 2012;
- NSW Environment Protection Authority 2016, 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales';
- AEGIS 2015, Australian Greenhouse Emissions Information System; and
- Institute of Air Quality Management 2014, 'IAQM Guidance on the assessment of dust from demolition and construction'.
- The impact assessment criteria applicable to this assessment is defined in the Approved Methods for Modelling (EPA, 2016). These criteria are included in the results tables in Section 8.4.2.5.

8.4.1 Existing Environment

The area surrounding the Angus Place Colliery is characterised by flat terrain directly adjacent to the Newnes State Forest, which increases in elevation moving east (approximately 925 m AHD to 1,180 m AHD). The local air quality environment is likely to be influenced by the terrain variations and active industrial activities in the area. Specifically, local activities such as MPPS, Lidsdale Siding and Springvale Mine, however the Angus Place Colliery has not been included in the assessment air quality impacts associated with the existing environmental conditions due to being in care and maintenance since 2015.

EMM (2019) has identified additional factors that may influence or impact on the local air quality environment:

- wind generated dust from exposed areas;
- dust entrainment and tailpipe emissions from vehicle movements along unsealed and sealed roads;
- seasonal emissions from household wood heaters;
- episodic emissions from bushfires; and
- long-range transport of fine particles into the region.

The AQIA also notes that there are other potential impacts within the existing environment that may contribute to the suspended particulates within the region. These include dust storms and bushfires, which are considered to contribute periodically.

8.4.1.1 Baseline Air Quality Data

Assessment Locations

The area surrounding the APMEP includes a number of private residential properties, with the closest located approximately 1 km south-west of the Angus Place Colliery pit top area. The APMEP includes part of the Newnes State Forest which is used for camping and other recreational activities.

The nearest representative air quality sensitive locations to the APMEP have been identified for the purpose of assessing potential air quality impacts. Details are provided in Table 8-14 and their locations are shown in Figure 8.8.

Table 8-14 Air quality assessment locations

ID	Description	Assessment location type	Easting	Northing
R1	WR1	Residential	229408	6305100
R2	WR2	Residential	229351	6304614
R3	WR3	Residential	229990	6307652
R4	WR4	Residential	231748	6311673
R5	WR5	Residential	232286	6311814
R6	L1	Residential	232286	6311814
R7	L2	Residential	229028	6301777
R8	NF1	Recreation	239483	6300390
R9	NF2	Recreation	237015	6298782
R10	NF3	Recreation	243358	6295836
R11	NF4	Recreation	245299	6297921
R12	NF5	Recreation	242528	6303041
R13	NF6	Recreation	243182	6304671
R14	NF7	Recreation	242516	6307266
R15	NF8	Recreation	238709	6308496
R16	NF9	Recreation	235079	6309656

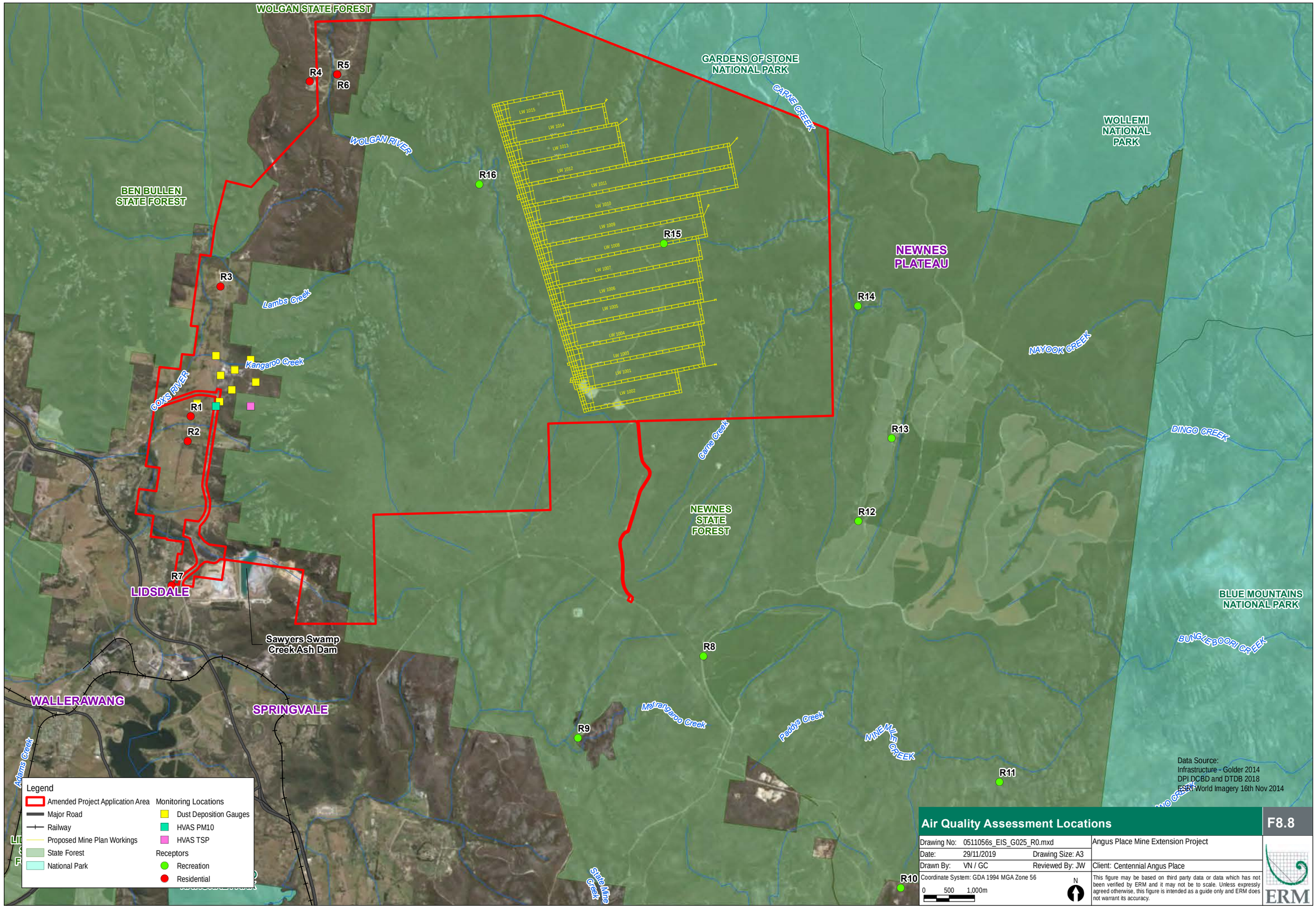
Particular Matter Baseline

The AQIA required existing background air quality data for total suspended particulates (TSP), particulate matter less than 10 micrometres (PM_{10}), particulate matter less than 2.5 micrometres and dust deposition. This data has been used as a background for the cumulative assessment. The Angus Place air quality monitoring network consists of the following monitoring equipment:

- two high-volume air samplers (HVAS) for the recording of PM_{10} and TSP concentrations on a one-in-six day run cycle;
- eight dust deposition gauges for recording monthly dust deposition rates; and
- two meteorological stations recording weather conditions, including wind speed and direction, temperature, solar radiation, rainfall and atmospheric pressure.

The locations of the monitoring equipment are shown within Figure 8.8.

Additionally, EMM (2019) utilised information obtained from the DPIE's air quality monitoring station at Bathurst (hereafter Bathurst AQMS), located approximately 50 km west of the APMEP. $PM_{2.5}$ and PM_{10} concentrations measured at the Bathurst AQMS on an hourly basis between 2014 – 2018 were used to supplement the TSP and PM_{10} concentrations obtained from the Angus Place HVAS (EMM, 2019).


WOLGAN STATE FOREST
GARDENS OF STONE NATIONAL PARK
WOLLEMI NATIONAL PARK
BEN BULLEN STATE FOREST
NEWNES PLATEAU
NEWNES STATE FOREST
BLUE MOUNTAINS NATIONAL PARK
WALLERAWANG
SPRINGVALE
LIDSDALE
Wolgan River
Carne Creek
Lambs Creek
Kangaroo Creek
Coxs River
Nayook Creek
Dingo Creek
Sawyers Swamp Creek Ash Dam
Adams Creek
Mairangano Creek
Paddys Creek
Mine Mt Creek
Bungleboori Creek
State Mine Creek
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
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LW 1013
LW 1012
LW 1011
LW 1010
LW 1009
LW 1008
LW 1007
LW 1006
LW 1005
LW 1004
LW 1003
LW 1001
LW 1002
Legend
Amended Project Application Area
Major Road
Railway
Proposed Mine Plan Workings
State Forest
National Park
Monitoring Locations
Dust Deposition Gauges
HVAS PM10
HVAS TSP
Receptors
Recreation
Residential
Data Source:
Infrastructure - Golder 2014
DPI DCBD and DTDB 2018
ESRI World Imagery 16th Nov 2014
Air Quality Assessment Locations
F8.8
Drawing No: 0511056s_EIS_G025_R0.mxd
Angus Place Mine Extension Project
Date: 29/11/2019
Drawing Size: A3
Drawn By: VN / GC
Reviewed By: JW
Client: Centennial Angus Place
Coordinate System: GDA 1994 MGA Zone 56
0 500 1,000m
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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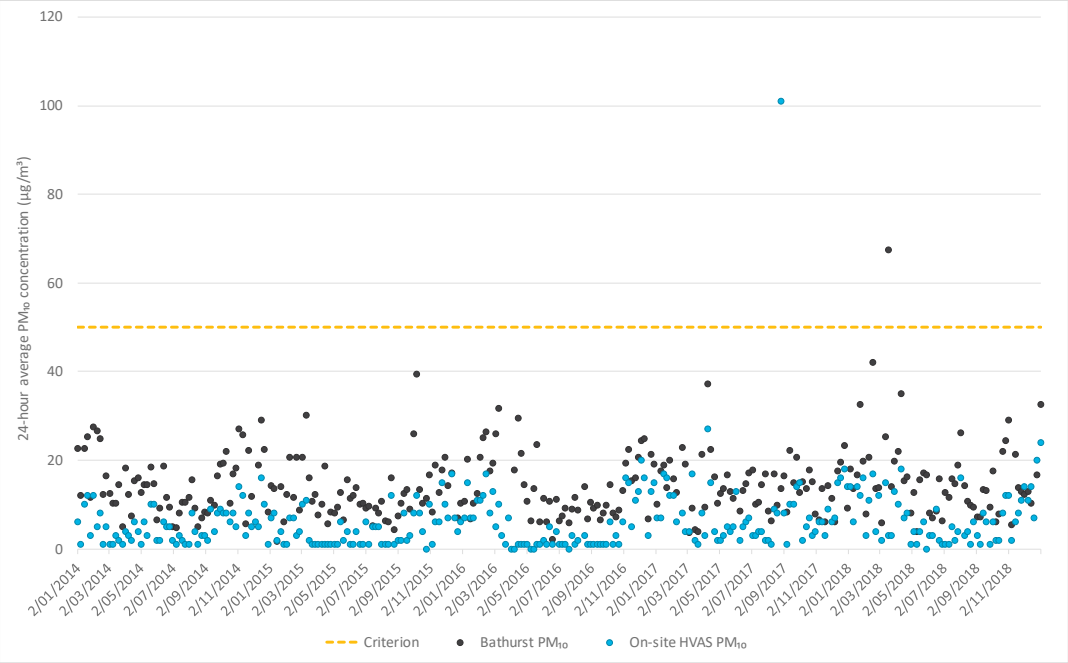
EMM (2019) also identified that the land use and dust-generating activities surrounding the Angus Place Colliery differ to those at the Bathurst AQMS. The dominant dust source from at the Angus Place Colliery is from mining, whereas the dominant dust sources in Bathurst are residential activities.

PM_{10}

As mentioned above, the Angus Place HVAS could not be used alone to establish cumulative impacts, hence EMM compared the Angus Place HVAS and Bathurst AQMS datasets. Coincident 24-hour average PM_{10} concentrations recorded at the two locations were extracted for the period 2014-2018 (EMM, 2019). The following Figure 8.9 shows the comparison between the two monitoring stations.



Source: EMM, 2019

Figure 8.9 Coincident 24-hour average PM_{10} concentrations – Angus Place HVAS and Bathurst AQMS – 2014–2018

EMM (2019) provided the following observations in relation to the comparison of the existing background PM_{10} concentrations:

- there was a similar inter-annual fluctuation in PM_{10} concentrations over the five years at the two sites;
- the Bathurst AQMS recorded higher average PM_{10} concentrations than the Angus Place HVAS for all years of monitoring; and
- on average, the Angus Place HVAS recorded PM_{10} concentrations that were approximately 40% of the concentrations recorded at Bathurst AQMS.

There are two main factors that are considered to contribute to higher concentrations recorded at Bathurst:

- The Bathurst AQMS dataset had a larger number of data points relative to the Angus Place HVAS (one-in-six days). The regional-scale events could have been missed by the HVAS monitoring.

- The Bathurst AQMS dataset features a higher density of urban development and associated emission sources (motor vehicles, domestic heating, etc) than the area surrounding the APMEP.

Table 8-15 presents a summary of statistics for the five years of analysed data from the Bathurst AQMS.

Table 8-15 Statistics for PM10 Concentrations – Bathurst AQMS – 2014–2018

Monitoring year	PM_{10} concentration (µg/m³)		
	Maximum 24-hour average	Annual average	Days > 50 µg/m³
2014	42.8	14.4	0
2015	94.6	13.3	2
2016	34.1	12.4	0
2017	49.9	13.7	0
2018	274.1	18.8	8

Source: EMM, 2019

- The Bathurst dataset is considered to be a conservatively high continuous record of 24-hour average PM_{10} concentrations that better meets the data completeness requirement for a Level 2 AQIA. On that basis, the 2018 calendar year PM_{10} dataset from the Bathurst AQMS has been adopted to represent background concentrations for the assessment (EMM, 2019).
- There were eight days in 2018 when PM_{10} concentrations were already above 50 µg/m³ and there were an additional three days where concentrations at Bathurst AQMS were elevated due to dust storms.

$PM_{2.5}$

The Angus Place Colliery does not undertake monitoring of $PM_{2.5}$ concentrations. In the absence of data from the Angus Place Colliery, background $PM_{2.5}$ concentrations recorded at the Bathurst AQMS were reviewed. The Bathurst AQMS commenced measurement of $PM_{2.5}$ concentrations in April 2016 (EMM, 2019).

Key statistics for the analysed PM2.5 monitoring data from the Bathurst AQMS are presented in Table 8-16.

As was the case for PM10, the presented statistics for 2018 are higher than the 2016 (partial year) and 2017 datasets. Consistent with PM10, the 2018 calendar year PM2.5 dataset from the Bathurst AQMS has been adopted to represent background concentrations for the assessment (EMM, 2019).

Table 8-16 Statistics for PM2.5 concentrations –Bathurst AQMS – 2016–2018

Monitoring year	$PM_{2.5}$ concentration (µg/m³)		
	Maximum 24-hour average	Annual average	Days > 25 µg/m³
2016	15.0	3.8	0
2017	17.5	6.1	0
2018	40.5	7.0	2

Source: EMM, 2019

TSP

TSP concentrations are recorded at Angus Place HVAS on a one-in-six day run cycle. A summary of key statistics for the five years of analysed data from the Angus Place HVAS is presented in Table 8-17.

Table 8-17 Statistics for TSP Concentrations – Angus Place HVAS – 2014–2018

Monitoring year	TSP concentration (µg/m³)	
	Annual average	PM_{10}/TSP ratio
2014	12.1	0.4
2015	11.0	0.4
2016	13.0	0.4
2017	17.8	0.5
2018	16.6	0.4

Source: EMM, 2019

The TSP concentrations showed a similar trend to the PM_{10} concentrations recorded between 2017 and 2018. This was likely due to the drought conditions (and hence increased dust concentrations) across the state during these years. A PM_{10}/TSP ratio was calculated for the Angus Place HVAS with the ratio ranging from 0.4 to 0.5 (EMM, 2019). For consistency with the adopted background concentration for PM_{10}, the ratio calculated at Angus Place HVAS has been applied to the Bathurst AQMS PM_{10} data.

Applying a PM_{10}/TSP ratio of 0.4 to the annual average PM_{10} concentration at Bathurst AQMS for 2018 (of 18.8 µg/m³), results in a conservatively high TSP background concentration of 47.1 µg/m³ (EMM, 2019).

Dust Deposition Baseline

The Angus Place Colliery operates a network of eight dust deposition gauges in the vicinity of the Angus Place pit top. The recorded dust deposition rates were provided by Centennial Angus Place and have been analysed to determine existing dust deposition levels (EMM, 2019), as shown in Table 8-18.

Table 8-18 Annual dust deposition results – Angus Place monitoring network

Monitoring year	Annual average dust deposition levels (g/m²/month)							
	DG1	DG2	DG3	DG4	DG5	DG6	DG7	DG8
2014	0.9	1.3	1.7	1.5	3.1	0.8	1.1	0.5
2015	0.3	1.1	3.4	1.0	0.3	0.5	1.6	0.4
2016	0.2	1.3	0.3	0.5	0.2	1.6	0.3	0.4
2017	1.8	0.6	0.6	0.7	0.2	0.7	0.4	0.5
2018	1.5	1.0	1.1	1.1	0.9	1.0	1.2	1.2
Criterion	**4**							

Source: EMM, 2019

The dust deposition levels for all years of monitoring did not exceed the EPA impact assessment criterion. The highest annual average dust deposition level recorded for the 2018 period was 1.5 g/m²/month at depositional dust gauge DG1. This value has been adopted as background for the AQIA.

8.4.1.2 Summary of Background Values

In summary, EMM (2019) has calculated the following background values that will be adopted for the cumulative assessment:

- 24-hour PM_{10} concentration – daily varying;
- annual average PM_{10} concentration – 18.8 µg/m³;
- 24-hour $PM_{2.5}$ concentration – daily varying;
- annual average $PM_{2.5}$ concentration – 7.0 µg/m³;
- annual average TSP concentration – 47.1 µg/m³; and
- annual average dust deposition – 1.5 g/m²/month.

8.4.2 Impact Assessment

EMM (2019) has considered the potential impacts of both the construction and operational phases of the amended APMEP, with the emissions associated with the amended APMEP likely to consist of the following:

- Construction phase: particulate matter emissions related to the construction of bore pumps and a downcast ventilation shaft; and
- Operational phase: particulate matter emissions from the conveying and transfer of ROM coal, coal sizing, bulldozer on coal stockpiles and wind erosion of the ROM coal stockpile.

8.4.2.1 Meteorology and Climate

To characterise the dispersion meteorology of a region, information is required on the prevailing wind regime, ambient temperatures, rainfall, relative humidity, mixing depth and atmospheric stability. An analysis was undertaken by EMM (2019) based on meteorological data obtained from three local weather station sources, including:

- The Angus Place automatic weather station (AWS), located 250m west of the pit top;
- Marrangaroo (Defence) weather station, located 9.5km south-east of the pit top; and
- Mt Boyce AWS, located 32 km south-east of the pit top (primarily included to obtain cloud content data).

Meteorological data was recorded at Angus Place AWS, between July 2015 and August 2019. The location of the meteorological stations are situated within Figure 8.1.

The analysis demonstrated a similarity across years in the most important parameters for pollutant dispersion, such as wind speed and wind direction. The winds recorded by the Angus Place AWS across all five years were predominately north-easterly and south-westerly winds. Annual average wind speeds ranged between 2.4 m/s and 2.8 m/s. The annual average frequency of calm conditions (wind speeds less than 0.5 m/s) ranged between 2.2% and 2.4%. The inter-annual profiles for air temperature and relative humidity were also comparable between 2015 and 2018. The 2018 dataset showed slightly higher temperature and lower relative humidity, which are indicative of the strong drought conditions occurring during the year.

The 2018 calendar year was deemed representative of meteorological conditions surrounding the APMEP and therefore was adopted as the 12-month modelling period for the purpose of this AQIA.

The annual wind rose for 2018 for Angus Place AWS is shown in Figure 8.10.

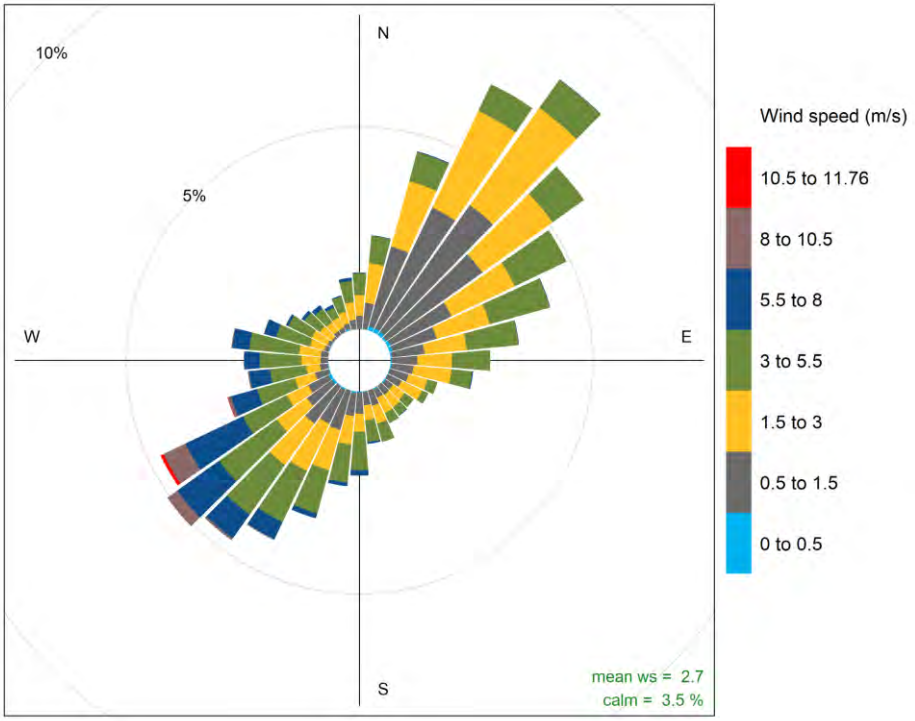


Figure 8.10 Recorded wind speed and direction – Angus Place AWS - 2018

8.4.2.2 Emissions

EMM (2019) has identified sources of atmospheric emissions associated with the amended APMEP including the following:

- conveyor transfer from underground portal;
- conveyor transfer to ROM stockpile;
- bulldozers working on ROM stockpile;
- wind erosion from ROM stockpile;
- conveyor transfer to the coal handling plant (CHP);
- coal sizing;
- conveyor transfer to load-out bin;
- loading coal to trucks; and
- upcast ventilation shafts.

A worst-case emissions scenario has been configured, in order to quantify peak air pollution emissions and associated impacts in the surrounding environment from the amended APMEP operations. The worst-case emissions scenario corresponds to the maximum production (4.5 Mtpa) (EMM, 2019). A detailed explanation of fugitive dust emission estimates are provided in Appendix K (EMM, 2019). In brief, the most significant source of dust emissions during operations are dozer operations at the ROM stockpile, as detailed in Table 8-19 below.

GARDENS OF STONE NATIONAL PARK

CULLEN BULLEN

NEWNES PLATEAU

WOLLEMI NATIONAL PARK

Angus Place AWS

PORTLAND

LIDSDALE

WALLERAWANG

SPRINGVALE

BOM Marrangaroo (Defence)

BLUE MOUNTAINS NATIONAL PARK

MARRANGAROO NATIONAL PARK

LITHGOW

CLARENCE

BOM Mount Boyce AWS

Legend

- Weather Stations
- Amended Project Application Area
- National Park
- Proposed Mine Plan Workings
- Major Road

Data Source:
Infrastructure - Golder 2014
DPI DCBD and DTDB 2018
ESRI World Imagery 16th Nov 2014

Location of Meteorological Stations

F8.11

Drawing No:	0511056s_EIS_G026_R0.mxd		Angus Place Mine Extension Project
Date:	29/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 1,000 2,000m

N

ERM

Table 8-19 Calculated annual TSP, PM10 and PM2.5 emissions – 4.5 Mtpa operational scenario

Emission source	Calculated annual emissions (kg/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Conveyor transfer point from portal	229	53	8
Conveyor transfer to ROM stockpile	229	53	8
Dozer on ROM stockpile	32,323	7,399	711
Wind erosion from ROM stockpile	4,158	2,079	312
Conveyor transfer to CHP	229	53	8
Coal sizing	6,750	2,700	405
Conveyor transfer to load out bin	1,528	351	53
Loading coal to trucks	1,528	351	53
Upcast vent fan (APC-VS1)	4,183	279	209
Upcast vent fan (APC-VS2)	4,183	279	209
Total	**55,340**	**13,594**	**1,976**

Source: EMM, 2019

In order to manage particulate matter emissions from the operational phase, a range of mitigation measures and management practices are required. Proposed dust management measures include the following:

- enclosures at conveyor transfer points;
- water sprays at conveyor transfer points;
- enclosure of coal sizer; and
- watering at coal sizer.

To account for these emission management methods, the following particulate matter emission reduction factors have been applied in the emissions totals.

- conveyor transfer points - 70% reduction for enclosure and 50% watering of materials (NPI 2012); and
- coal sizer - 70% reduction for enclosure and 50% watering of materials (NPI 2012).

8.4.2.3 Air Dispersion Modelling

The dispersion modelling for this assessment was conducted using the CALPUFF modelling system. CALPUFF is the dispersion module of the CALMET/CALPUFF suite of models. The meteorological data for the dispersion modelling was processed using a two-step modelling process. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) prognostic model The Air Pollution Model (TAPM) was used to obtain meteorological data for the site location as step one. Step two uses CALMET to further process the 3D meteorological data field from TAPM with adaptation to fine scale topography for the dispersion modelling with CALPUFF (Exponent, 2011).

The TAPM and CALMET model settings are described in detail within the AQIA (EMM, 2019), and have been selected in accordance with recommendations in EPA (2016) and TRC (2011). Surface observations are included in the modelling (referred to as data assimilation) and are discussed and described in Section 8.4.2.1.

8.4.2.4 Incremental (Project-only) results

EMM (2019) predicted the incremental TSP, PM_{10}, $PM_{2.5}$ concentrations and dust deposition levels from the amended APMEP. The results show that all predicted concentrations and deposition rates are below the applicable NSW EPA impact assessment criterion at all assessment locations.

Table 8-20 presents the predicted incremental TSP, PM10, PM2.5 concentrations and dust deposition levels.

Table 8-20 Incremental (Project operational phase only) concentration and deposition results

Assessment location ID	Predicted incremental concentration (µg/m³) and deposition rate (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R1	3.0	8.2	2.6	1.9	0.6	0.1
R2	0.3	1.3	0.2	0.2	0.0	0.0
R3	0.1	1.0	0.1	0.2	0.0	0.0
R4	0.0	0.1	0.0	0.0	0.0	0.0
R5	0.0	0.0	0.0	0.0	0.0	0.0
R6	0.0	0.3	0.0	0.1	0.0	0.0
R7	0.0	0.2	0.0	0.0	0.0	0.0
R8	0.0	0.0	0.0	0.0	0.0	0.0
R9	0.0	0.0	0.0	0.0	0.0	0.0
R10	0.0	0.0	0.0	0.0	0.0	0.0
R11	0.0	0.0	0.0	0.0	0.0	0.0
R12	0.0	0.0	0.0	0.0	0.0	0.0
R13	0.0	0.0	0.0	0.0	0.0	0.0
R14	0.0	0.0	0.0	0.0	0.0	0.0
R15	0.0	0.0	0.0	0.0	0.0	0.0
R16	0.0	0.0	0.0	0.0	0.0	0.0

Note: Criteria for TSP, PM_{10}, $PM_{2.5}$ are applicable to cumulative (increment + background). Criteria is provided for comparison only.

8.4.2.5 Cumulative Impacts of Air Dispersion Modelling

EMM (2019) evaluated the cumulative air dispersion impacts to determine whether there is an increase in impacts from the proposed works on the existing environment.

The coincident model prediction and corresponding background value were paired together to derive a cumulative concentration at each receptor location. This was undertaken for both the pollutant and averaging period. Due to the occurrence of exceptional elevated concentration events during the monitoring dataset (eg regional dust storms), the 12th highest cumulative concentration is presented for PM10 and the 3rd highest cumulative concentration is presented for PM2.5 (EMM, 2019).

The cumulative results show that the predicted concentrations and deposition rates for all pollutants and averaging periods are below the applicable NSW EPA impact assessment criteria at all assessment locations (EMM, 2019). The following Table 8-21 provides the predicted cumulative TSP, PM10 and PM2.5 concentrations associated with APMEP activities.

Table 8-21 Cumulative concentrations of TSP, PM10, PM2.5 and dust deposition results

Assessment location ID	Predicted cumulative concentration (µg/m³) and deposition rate (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum[1]	Annual	24-hour maximum[2]	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R1	50.1	47.4	21.5	23.3	7.6	1.6
R2	47.4	45.7	19.1	22.2	7.0	1.5
R3	47.2	45.7	18.9	22.1	7.0	1.5
R4	47.1	45.5	18.8	22.1	7.0	1.5
R5	47.1	45.5	18.8	22.1	7.0	1.5
R6	47.1	45.5	18.9	22.1	7.0	1.5
R7	47.1	45.5	18.8	22.1	7.0	1.5
R8	47.1	45.5	18.8	22.1	7.0	1.5
R9	47.1	45.5	18.8	22.1	7.0	1.5
R10	47.1	45.5	18.8	22.1	7.0	1.5
R11	47.1	45.5	18.8	22.1	7.0	1.5
R12	47.1	45.5	18.8	22.1	7.0	1.5
R13	47.1	45.5	18.8	22.1	7.0	1.5
R14	47.1	45.5	18.8	22.1	7.0	1.5
R15	47.1	45.5	18.8	22.1	7.0	1.5
R16	47.1	45.5	18.8	22.1	7.0	1.5

Note:[1] Due to 11 existing exceedances and exceptional events in the background dataset, the 12th highest cumulative PM_{10} concentration is presented.

[2] Due to two exceedances and exceptional events in the background dataset, the 3rd highest cumulative $PM_{2.5}$ concentration is presented.

8.4.3 Construction Dust Assessment

A construction dust assessment was completed to assess the potential of dust impacts on assessment locations. The construction assessment was based on a risk assessment approach as outlined in the Institute of Air Quality Management's (IAQM's) documentation. The assessment found that there would be no human receptors impacted by construction dust. It showed that there was a medium to low potential of dust impacts to ecological receptors in the area.

The APMEP will include the construction of a bore pump and downcast ventilation shaft, which have the potential to generate dust emissions. The construction activities will likely include the following aspects:

- installation of power supply;
- clearing of vegetation;
- pipe laying;
- installation of joints and pits;
- road restoration;
- drilling of holes;
- concrete slab laying;
- vegetation clearing;
- construction of ponds;
- concrete laying;
- drilling; and
- site rehabilitation.

Given the extension of mining operations will be underground, dust impacts are only expected from construction phase. Dust emissions are predicted to be generated from the construction of a bore pump and downcast ventilation shaft. The construction dust assessment was prepared in accordance with the *'Guidance on the Assessment of Dust from Demolition and Construction 2014'* (IAQM, 2014). The assessment methodology considers the annoyance to dust soiling, risk of health effects and harm to ecological receptors.

The procedure for assessing risks are identified within five steps. The assessment is used to define appropriate mitigation measures to ensure that there will be no significant residual effects (EMM, 2019). The key steps in the procedure are as follows:

- Step 1 – a screening requirement for a detailed assessment based on the proximity of surrounding receptors;
- Step 2 – an assessment of the risk of dust impacts and the sensitivity of surrounding receptors;
- Step 3 – a determination of site-specific mitigation;
- Step 4 – consideration of residual effects and significance; and
- Step 5 – an assessment report (this document).

Professional judgement is required within some steps, and where justification cannot be given a precautionary approach is adopted by EMM (2019).

8.4.4 Greenhouse Gas Assessment

Greenhouse Gas (GHG) emissions were estimated based on the DoEE National Greenhouse Accounts Factors (NGAF) workbook (DoEE 2018). GHG emissions are defined as 'direct' and 'indirect' emissions for reporting purposes. Direct or Scope 1 emissions occur within the boundary of Angus Place Colliery and are a result of the mines activities. Indirect emissions are further broken down into Scope 2 or Scope 3. Scope 2 occur from the generation of the electricity purchased and consumed by Angus Place Colliery, while Scope 3 emissions are associated with all other upstream and downstream activities.

The GHG emission sources included in the AQIA (EMM, 2019) are listed in Table 8-22 and represent the most significant sources associated with the APMEP. Centennial Angus Place has provided estimates of annual diesel and electricity consumption associated with the APMEP. All other data on activity streams have been extracted from the original SLR Report (2014).

The GHG emissions from the APMEP have been estimated using the methodologies outlined in the NGAF workbook, using fuel energy contents and Scope 1, 2 and 3 emission factors for diesel, fugitive emissions, electricity use, SF6 (Sulfur hexafluoride) combustion, oil and grease use, waste disposal and product coal combustion in NSW (EMM, 2019). The following Table 8-22 provides the estimated annual GHG emission during operation of the APMEP (EMM, 2019).

Table 8-22 Estimated annual GHG emissions during operations

Activity/fuel	Scope 1 (t CO_2-e/year)	Scope 2 (t CO_2-e/year)	Scope 3 (t CO_2-e/year)	Total
Diesel combustion	2,168	-	111	2,279
Fugitive emissions	62,698	-	-	62,698
SF_6 combustion	5	-	-	5
Oil and grease consumption	30	-	31	62
Electricity consumption	-	39,360	4,800	44,160
Product coal combustion	-	-	364,500	364,500
Waste disposal	-	-	690	690
Employee travel	-	-	122	122
Total	**64,901**	**39,360**	**370,255**	**474,516**

The significance of APEMP emissions is assessed by comparing annual average GHG emissions against the most recent available total GHG emissions inventories (calendar year 2017) for NSW (128,870 kt CO2-e) and Australia (530,841 kt CO2-e) (EMM, 2019).

Annual average total GHG emissions (Scope 1, 2 and 3) generated by the APMEP's operations represent approximately 0.368% of total GHG emissions for NSW and 0.089% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2017.

8.4.5 Revised Management and Mitigation Measures

Due to the different types of impacts caused by air emissions, a variety of management and mitigation measures is proposed. These different measures are presented within the sub-sections below:

Mitigation measures for the operational phase

In order to control dust emissions during the operation of the APMEP, dust mitigation measures are required. These measures include:

- enclosures at conveyor transfer points;
- water sprays at conveyor transfer points;
- enclosure of coal sizer; and
- watering at coal sizer.

These measures have been taken into account in the emissions estimation and modelling of the operational scenario outcomes (EMM, 2019).

Mitigation measures for the construction phase

As identified within Section 8.4.2.5, a number of steps were completed to assess the potential impacts of dust emissions from the construction phase. Specifically, step 3 involves determining mitigation measures for each of the four potential activities that are identified within step 2.

Recommended mitigation measures are listed below and are routinely employed as 'good practice' on construction sites:

- carry out regular site inspections to monitor compliance with the existing Air Quality and Greenhouse Gas Management Plan, record inspection results, and make an inspection log available to the local authority when asked;
- increase the frequency of site inspections by the person accountable for air quality and dust issues on-site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions;
- keep site fencing, barriers and scaffolding clean using wet methods;
- remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on-site (if they are being re-used on-site cover as described below);
- cover, seed or fence stockpiles to prevent wind whipping;
- ensure all vehicles switch off engines when stationary - no idling vehicles;
- ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate;
- minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate; and
- ensure equipment is readily available on-site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

8.5 Noise and Vibration Impact Assessment

The following sections summarise the key findings of the Noise and Vibration Impact Assessment (NVIA) (EMM, 2019), provided in Appendix L. The NVIA assesses the potential noise and vibration impacts associated with the APMEP on sensitive receptors in the surrounding environment.

In 2014, SLR Consulting prepared an NVIA for the original APMEP, which sought approval for a maximum of 4 Mtpa of ROM coal (SLR 2014). The updated NVIA (EMM, 2019) draws on data from that assessment for the operational noise, while assessing the construction, traffic and operational noise impacts of the amended APMEP. The NVIA predicts the impacts relative to the following key assessment criteria:

- Director General's EARs issued 6 November 2012;
- NSW Noise Policy for Industry (NPfI) (EPA 2017);
- NSW Road Noise Policy (RNP) (DECCW 2011); and
- Assessing Vibration: a technical guideline (DEC 2007).

It is noted that this the NVIA focused primarily on noise impacts, as vibration levels from mine operational activities are predicted to be negligible and below levels of human perception at the nearest residential receivers. Vibration impacts from construction activities are included in the NVIA. No blasting is proposed as part of the APMEP, and has not been assessed further within the construction and operational phase.

8.5.1.1 Existing Environment

The area surrounding the Angus Place Colliery is characterised by flat terrain directly adjacent to the Newnes State Forest, which increases in elevation moving east (approximately 925 m AHD to 1,180 m AHD). A relatively small number of rural residential properties are located along Wolgan Road and in the Upper Wolgan Valley in the vicinity of the mine. Some parts of the APMEP are located within the Newnes State Forest, which is used for recreational purposes.

The operations of the APMEP will be limited during the evening and night-time periods, until noise emissions can be validated. Consideration has been given to likely maximum noise event levels at the nearest residential assessment locations. It is noted that pit-top operations are not proposed to change to that currently approved. As such, the maximum noise levels from pit top operations are expected to be the same as those prior to the mine going into care and maintenance.

Key factors that may influence or impact on the local noise and vibration environment:

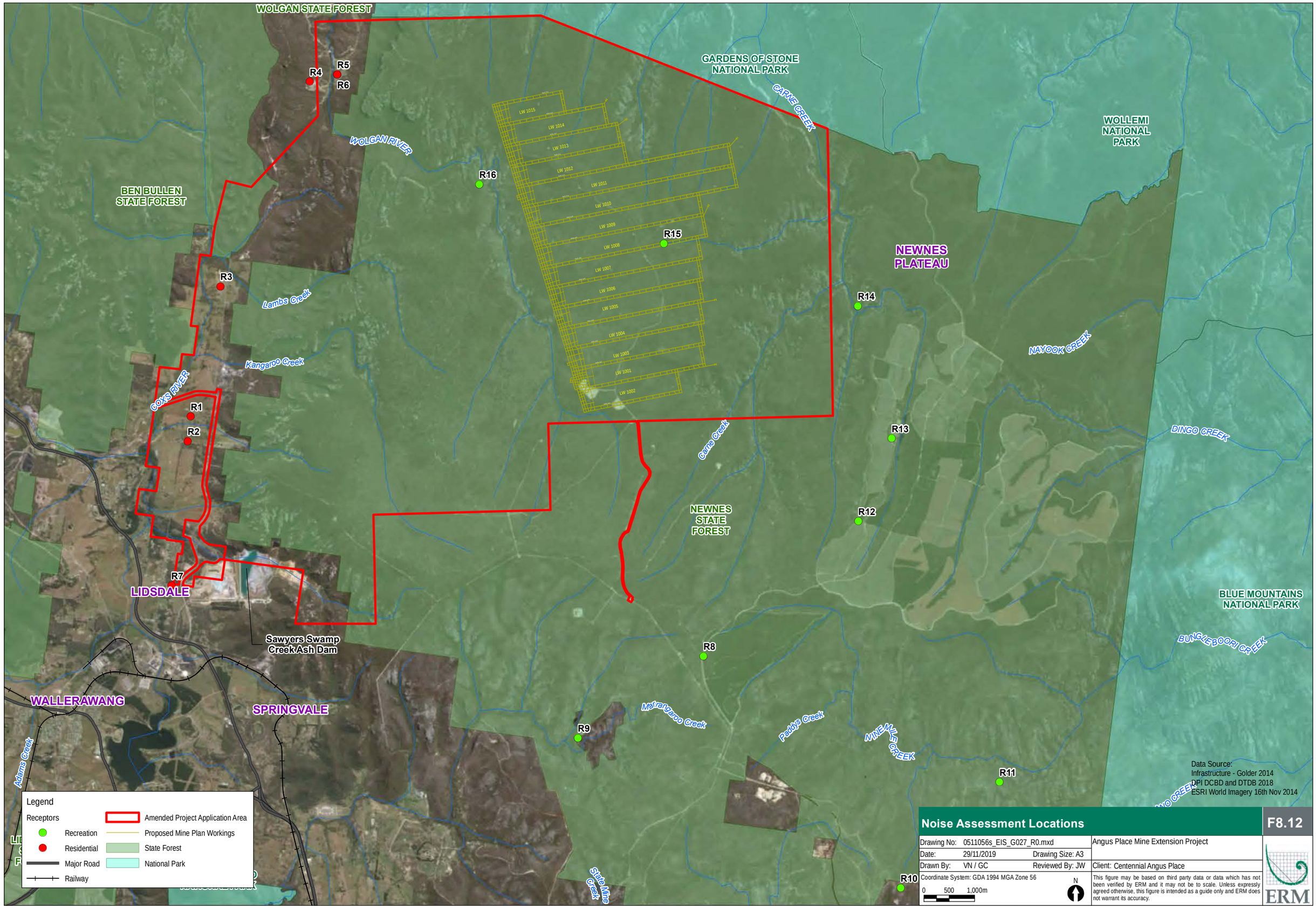
- Operational noise;
- Construction noise; and
- Operational and construction road traffic.

8.5.1.2 Assessment Locations

The area surrounding the APMEP includes a number of private residential properties, with the closest located approximately 1 km south-west of the Angus Place Colliery pit top area. The nearest noise sensitive receptors (herein referred to as assessment locations) are described in Table 8-23 and shown in Figure 8.12.

Table 8-23 Assessment Locations

Receptor	Figure ID *(Figure 8.12)*	Type	Easting	Northing
WR1 (Sharpe)	R1	Residential – rural	229408	6305100
WR2 (Mason)	R2	Residential – rural	229351	6304614
WR3	R3	Residential – rural	229990	6307652
WR4	R4	Residential – rural	231748	6311673
WR5	R5	Residential – rural	232286	6311814
L1	R6	Residential – suburban	229078	6302626
L2 (Nuebeck)	R7	Residential – suburban	229028	6301777
NF1	R8	Recreation	239483	6300390
NF2	R9	Recreation	237015	6298782
NF3	R10	Recreation	243358	6295836
NF4	R11	Recreation	245299	6297921
NF5	R12	Recreation	242528	6303041
NF6	R13	Recreation	243182	6304671
NF7	R14	Recreation	242516	6307266
NF8	R15	Recreation	238709	6308496
NF9	R16	Recreation	235079	6309656



Noise Assessment Locations

F8.12

Drawing No:	0511056s_EIS_G027_R0.mxd		Angus Place Mine Extension Project
Date:	29/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 500 1,000m

N

ERM

8.5.1.3 Existing Mine Noise

The mine has been in care and maintenance since March 2015. A review of noise compliance monitoring reports from December 2010 through to December 2014 was undertaken to gain an understanding of noise emissions from the mine prior to when it was placed into care and maintenance.

A summary of results is provided in Table 8-24. Results of quarterly noise monitoring show that the mine's noise emission levels are at or below and comply with relevant noise limits in accordance with PA 06_0021 and EPL 467

Table 8-24 Approved Noise limits and Quarterly Noise Monitoring Results Summary (2010-2014)

Location	Figure ID *(Figure 8.12)*	Noise limit	Angus Place Colliery noise emission summary
WR1 (Sharpe)	R1	Day 42, Evening 38, Night 36	Angus Place noise emissions generally range between <30 and 37 dB with a maximum $L_{Aeq,15min}$ noise contribution of 39 dB measured in December 2014. The individual monitoring noted noise levels up to 53 dB L_{Amax} from truck loading activities on one occasion, 39 dB from a dozer and 37 dB from general pit-top noise.
WR2 (Mason)	R2	Day 41, Evening 37, Night 35	Angus Place noise emissions generally range between <30 and 32 dB with a maximum $L_{Aeq,15min}$ noise contribution of 35 dB measured in December 2010. The individual monitoring noted noise levels up to L_{Amax} 49 dB from truck loading activities on one occasion, 44 dB from a dozer and 34 dB from general pit-top noise.
L2	R7	Day 44, Evening 40, Night 35	Angus Place noise emissions were generally inaudible and determined to be <30 dB during all compliance noise surveys at this location.

8.5.1.4 Assessing Noise and Vibration

The Noise Policy for Industry (NPfI) is a non-statutory document that provides assessment and management criteria for industry noise sources. The NSW Environmental Protection Authority (EPA) utilises this document to inform their decision-making, in relation to regulating noise impacts from industry uses. The NPfI acknowledges that some industrial sites were designed for higher allowable noise emissions than those outlined in current NSW noise policy and may have been in existence before neighbouring noise-sensitive developments. The range of mitigation options available for such sites can be limited or costly (EMM, 2019).

The process for applying the NPfI to existing sites is outlined in Section 6.1.1 of the NPfI and is summarised as follows as applicable to the APMEP:

1. Undertake an initial evaluation, including whether approvals/licences include noise limits and whether they are being met.
2. Establish relevant PNTLs, in accordance with the NPfI, to establish a benchmark level to assess the need to consider noise mitigation.
3. Measure/predict the noise levels produced by the source in question, having regard to meteorological effects such as wind and temperature inversions.
4. Compare the measured/predicted noise level with the PNTLs.
5. Where the PNTLs are exceeded, assess feasible and reasonable noise mitigation strategies.
6. Develop and refine achievable noise limits that will become goals for the project. This may involve interaction between the regulator and proponent as well as consultation with the community.
7. Monitor compliance with the agreed noise limits, and review and amend the noise performance of the site as required.

The following Table 8-25 provides details of the noise and vibration assessing methodologies, which were utilised for the NVIA.

Table 8-25 Assessing Methodology

Aspect	Assessing Methodology
Operational Noise Limits NPfL Assessment Methodology	
Intrusiveness	The intrusive noise trigger levels require that $L_{Aeq,15\ minute}$ noise levels from the site during the relevant operational periods (ie day, evening and night) do not exceed the rating background level (RBL) by more than 5 dB. The NPfI recommends that the intrusive noise trigger level for evening be set at no greater than the intrusive noise level for daytime and that the intrusive noise level for night-time should be no greater than the intrusive noise level for day or evening. Minimum assumed RBLs have need adopted in accordance with the NPfI and, in turn, result in minimum intrusiveness noise levels for each period
Amenity	The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail and/or community noise. Where the measured existing industrial noise approaches recommended amenity noise level, it needs to be demonstrated that noise levels from new industry will not contribute to existing industrial noise such that amenity noise levels are exceeded. To ensure that total industrial noise levels remain within the recommended amenity noise levels for an area, the project amenity noise level for the subject development is the recommended amenity noise level (outlined in Table 2.2 of the NPfI) minus 5 dB. The Wolgan Road residential assessment locations have been categorised in the NPfI 'rural' amenity category as per the definitions provided in the NPfI, since they were deemed to be in "an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels." The assessment locations within Lidsdale village have been categorised in the NPfI 'suburban' amenity category, since they were deemed to be in "an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry."

Aspect	Assessing Methodology
	Suburban areas will often have evening ambient noise levels defined by the natural environment and human activity.
Project Noise Trigger Levels	PNTLs are the lower of the derived intrusiveness and amenity criteria.
Low frequency Noise	Fact sheet C of the NPfI (EPA 2017) provides guidelines for applying modifying factor corrections to account for low frequency noise emissions. The NPfI specifies that a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels identifies the potential for an unbalanced spectrum and potential increased annoyance. Where a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels is identified, the one-third octave noise levels recorded should be compared to the values in Table C2 of the NPfI (EPA 2017).
Sleep Disturbance	The difficulty in establishing an absolute noise level criterion that would correlate to an acceptable level of sleep disturbance is acknowledged by relevant governing authorities. Historic operations at the mine occurred during the night-time period (10 pm to 7 am) as will the proposed operations. Hence, an assessment of the potential for sleep disturbance is required. The NPfI suggests that a detailed maximum noise level event assessment should be undertaken where night-time noise levels at a residential location exceed: $L_{Aeq,15\ minute}$ 40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or L_{Amax} 52 dB or the prevailing RBL plus 15 dB (whichever is the greater). Guidance regarding potential for sleep disturbance is also provided in the RNP. The RNP calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep. The RNP provides the following conclusions from the research on sleep disturbance: ■ maximum internal noise levels (LAmax) below 50 to 55 dB are unlikely to awaken people from sleep; and ■ one or two noise events per night, with maximum internal noise levels (LAmax) of 65 to 70 dB, are not likely to affect health and wellbeing significantly. It is commonly accepted by acoustic practitioners and regulatory bodies that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60–65 dB calculated at the facade of a residence is unlikely to awaken people according to the RNP. If noise levels over the screening criteria are identified, then additional analysis would consider factors such as: ■ how often the events would occur; ■ the time the events would occur; ■ whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and ■ current scientific literature available regarding the impact of maximum noise level events at night.
Other Assessment Methodology	
Voluntary Land Acquisition and Mitigation Policy	VLAMP describes the NSW Government's policy for voluntary mitigation and land acquisition actions undertaken to address noise (and dust) impacts from State significant mining, petroleum and extractive industry developments.

Aspect	Assessing Methodology
Construction Noise	The Interim Construction Noise Guideline (ICNG) (DECC 2009) has been jointly developed by NSW Government agencies including the EPA and DPIE. The objectives of the guideline relevant to the planning process are to promote a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' management and mitigation measures where required. The guideline recommends standard construction hours where noise from construction activities is audible at residential premises (i.e. assessment locations): ■ Monday to Friday 7 am to 6 pm; ■ Saturday 8 am to 1 pm; and ■ No construction work is to take place on Sundays or public holidays. The ICNG acknowledges that works outside standard hours may be necessary; however, justification should be provided to the relevant authorities. DPIE generally requires that noise emissions from construction associated with mining projects be assessed under the operational noise policy. The ICNG provides a qualitative or quantitative methodology to assess construction noise emissions. The quantitative approach is suited to major construction projects with a typical duration of more than three weeks and has been adopted for the purpose of this assessment. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.
Road Traffic	Assessment of potential noise impact is required from the predicted increase in construction and operational related road traffic. The principle guidance for the assessment of road traffic noise impact on assessment locations is in the Road Noise Policy (RNP). Traffic routes for construction and operational traffic related to the APMEP consist of Castlereagh Highway, Wolgan Road, Ian Holt Drive, Old Bells Line Road, State Mine Gully Road, Glowworm Tunnel Road, Blackfellows Hand Track and Sunnyside Ridge Road. These are categorised as either arterial/sub-arterial or local roads as per the categories provided in the RNP.
Operational and Construction Vibration	The major vibration generating activities will occur during the construction phase of the APMEP, including the operation of mobile equipment such as trenching machine, dozer and trucks. Given the minimum separation distance in the order of 4 km between construction activity and the nearest potentially affected residential locations, vibration levels from these activities are predicted to be negligible and below levels of human perception at the nearest residential receivers. The main vibration generating activities from operations will be the existing pit top coal handling plant and the stockpile dozer. Given the minimum separation distance of approximately 680 m between the mine's pit top and the nearest potentially affected locations, vibration levels from these activities are predicted to be negligible and below levels of human perception at the nearest receivers. Furthermore, vibration levels from the mine's pit top will be unchanged as a result of the APMEP. Given the preceding, a detailed assessment of vibration has not been provided as part of this report.

Sources: EMM, 2019

8.5.2 Impact Assessment

The NVIA (EMM, 2019) evaluated a number of noise and vibration quality matters during construction and operational phase. A summary of the revised NVIA predictions are provided in the following sections for noise and vibration impacts. A full assessment of potential noise and vibration impacts is provided in Appendix L.

The NVIA has considered the potential impacts of both the construction and operational emission for the APMEP, with the emissions associated with the APMEP likely to consist the following:

- Construction phase emission principally related to the construction of bore pumps, a downcast ventilation shaft and road traffic; and
- Operational phase emissions will principally relate to road traffic and dewatering bore pump.

The data for the NVIA comes from a variety of sources such as Centennial Angus Place, the original SLR Report (2014) and government legislation/guidelines.

8.5.2.1 Project Noise Trigger Levels Operations

Project Noise Trigger Levels (PNTLs) are the lower of the derived intrusiveness and amenity criteria. According to EMM (2019) PNTLs have an average noise level at typically 3 dB higher over a 15-minute worst-case assessment period, when compared to an entire day (11 hour), evening (4 hour) and night (8 hour) assessment periods. This assumption is outlined in the NPfI and has been used in this assessment to standardise the time periods for the intrusive and amenity noise levels (EMM, 2019).

Intrusiveness

EMM (2019) has identified that the intrusiveness criteria of $L_{Aeq,15min}$ for relevant operational periods on site (i.e. day, evening and night) do not exceed the relevant RBL by more than 5 dB. Previous observations at the nearest residential locations on Wolgan Road indicate that ambient noise levels are dominated by natural sounds with some limited contribution from road traffic (EMM, 2019). Hence, it is considered appropriate to adopt minimum RBLs as per the NPfI.

Results of previous ambient noise monitoring at Lidsdale, as presented in the original NVIA by SLR (2014), indicated the RBLs ranging from 32 dB to 40 dB in Lidsdale village. Notwithstanding, given the low risk of noise impact at Lidsdale from the mine's operations, a conservative approach has also been applied here with minimum RBLs assumed (EMM, 2014).

Amenity

Assessment locations within Lidsdale have been categorised in the suburban amenity category in accordance with the NPfI definition of a suburban receiver type (i.e. an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry) (EMM, 2019).

All other residential assessment locations have been categorised in the NPfI rural amenity category (i.e. an area with an acoustical environment that is dominated by natural sounds and generally characterised by low background noise levels).

EMM (2019) has identified the potential for other industrial developments to contribute to noise emissions in the area. The project amenity noise level for the APMEP is the recommended amenity noise level minus 5 dB.

In summary, the PNTLs determined for the APMEP are summarised in Table 8-26.

Table 8-26 Project Noise Trigger Levels - Operational Noise

Receptor	Type	Period	Adopted RBL (dB)	Project intrusive noise level, $L_{Aeq,15min}$ (dB)	Project amenity noise level[2], $L_{Aeq,15min}$ (dB)	Project noise trigger level, $L_{Aeq,15min}$ (dB)
WR1 – WR5	Residential – rural	Day	35	40	48	40
		Evening	30	35	43	35
		Night	30	35	38	35
L1 – L2	Residential – suburban	Day	35	40	53	40
		Evening	30	35	43	35
		Night	30	35	38	35
NF1	Recreation	When in use	n/a	n/a	48	48
NF2						
NF3						
NF4						
NF5						
NF6						
NF7						
NF8						
NF9						

Source: EMM, 2019

8.5.2.2 Sleep Disturbance Criteria

EMM (2019) has identified that a detailed maximum noise level event assessment is not required. Please refer to Table 8-27 for specific sleep disturbance screening criteria at residences.

Table 8-27 Sleep Disturbance Screening Criteria at Residences

Assessment location	Adopted Night RBL, dB	Night time noise level event screening criteria, dB	
		$L_{Aeq,15\ minute}$	L_{Amax}
All residential assessment locations	30	40	52

Source: EMM, 2019

8.5.3 Operational Noise Assessment

Operational noise emissions are predicted to satisfy the PNTLs at most assessment locations, with the exception being WR1 during the daytime. At WR1 location, the APMEP noise emissions are predicted to be up to 2 dB above the PNTL. This level of noise is negligible and would not trigger the need to consider additional feasible and reasonable noise mitigation measures, in accordance with the requirements of the NPfL (EMM, 2019).

In relation to operation of the dewatering bore sites, noise from these sites are not expected to contribute to total APMEP noise a levels at residential sites. It is assumed based on the distance of the equipment operation that noise emission are expected to be low during operational activities, specifically within recreational areas (EMM, 2019).

Since the mine is currently in care and maintenance it was not possible to validate the adopted sound power levels or the relevance (or not) of modifying factors to account for annoying noise characteristics. Centennial Angus Place have made a commitment to limit evening and night operations until sound power levels of on-site plant and equipment and off-site noise emissions can be verified. Specifically, evening and night time operations of the CHPP, dozer and truck loading operations will be restricted until noise emissions are validated and compliance with the evening and night time criteria can be demonstrated. Acoustically significant plant and equipment used in the noise model are detailed in Table 8-28.

Table 8-28 Acoustically significant plant and equipment for noise modelling

Item (location)	Sound power level per item (dBA)	Operating during this period		
		Day	Evening	Night
Angus Place Pit Top				
CHPP	108	✓	x	x
Compressor house	110	✓	✓	✓
Ventilation fan	100	✓	✓	✓
Winding building	94	✓	✓	✓
Site conveyors	82/m	✓	✓	✓
Dozer	114	✓	x	x
Coal bin	100	✓	x	x
Trucks loading	103	✓	x	x
Stockpile discharge	96	✓	✓	✓
Ventilation shaft 2 site (APC-VS2)				
Ventilation fan	120	✓	✓	✓
Compressors (x3)	91	✓	✓	✓
Substation	85	✓	✓	✓
Dewatering bore sites (plant at each site)				
Submersible pump (x4)	93	✓	✓	✓
Transformer	83	✓	✓	✓
High voltage switching and control equipment	77	✓	✓	✓

Predicted noise levels for operation of the APMEP (excluding dewatering bore sites) are presented in Table 8-29 for all assessment locations.

Table 8-29 Predicted Operational Noise Levels

Assessment locations	Period	Predicted $L_{Aeq,15min}$ noise level (dB)		PNTL $L_{Aeq,15min}$ (dB)
		Standard	Noise-enhancing	
WR1	Day	38	***42***	40
	Evening	<30	32	35
	Night	<30	33	35
WR2	Day	<35	35	40
	Evening	<30	<30	35
	Night	<30	<30	35
WR3	Day	<30	32	40
	Evening	<30	<30	35
	Night	<30	<30	35
WR4	Day	<30	<30	40
	Evening	<30	<30	35
	Night	<30	<30	35
WR5	Day	<30	<30	40
	Evening	<30	<30	35
	Night	<30	<30	35
L1	Day	<30	<30	40
	Evening	<30	<30	35
	Night	<30	<30	35
L2	Day	<30	<30	40
	Evening	<30	<30	35

Source: EMM, 2019

8.5.3.1 Sleep Disturbance

As identified within Table 8-27 sleep disturbance has defined maximum noise level event assessment criteria. Based on the review of noise compliance reports provided by Centennial, the highest L_{Amax} noise level measured at the closest sensitive reception was 53 dB from truck loading activities on one occasion with maximum noise events generally recorded at below L_{Amax} 50 dB (EMM, 2019).

Consequently, it was predicted that maximum noise levels from operation of the dozer or truck loading activities during the night are predicted to be up to L_{Amax} 50 dB. This level is under noise-enhancing weather conditions (i.e. temperature inversion with winds up to 2 m/s) at the nearest residential assessment location (i.e. WR1) (EMM, 2019). This is below the relevant sleep disturbance maximum screening criteria and generally consistent with the results of previous noise compliance monitoring (EMM, 2019).

8.5.4 Construction Noise

Noise from construction activity associated with the APMEP will have the largest potential to impact users of the recreation areas within the Newnes Plateau. The ICNG provides a noise management level of LAeq,15min 60 dB for passive recreation areas.

Construction noise has been assessed as a predicted area of impact for each construction phase, rather than for each individual assessment location (EMM, 2019).

The proposed construction activities will generally occur during standard construction hours as per the ICNG, with the exception of bore hole drilling and activities associated with vent fan construction. These activities will occur 24 hours per day, 7 days per week due to the requirement for continuous drilling activity. It is expected that there would be minimal overlap in timing of the proposed phases of construction (EMM, 2019).

The construction noise assessment has considered the acoustically worst-case scenario for both standard and out-of-standard-hours construction activity.

Proposed activities associated with construction of the bore pumps and downcast shaft and sound power level of acoustically significant plant and equipment is summarised in Table 8-29. Further, Table 8-30 shows the potential area of construction noise impacts within the Newnes State Forest. The blue shaded area indicates the area predicted to be affected by construction noise levels above 60 dB for activities of different sound power levels. The figure shows that, for the likely worst-case total construction sound power level of 116 dB (orange line), an area of up to 250 m from the construction activity would experience noise levels above the noise management level of 60 dB for passive recreation areas.

Table 8-30 Construction Noise Levels

Construction phase and approximate duration	Description	Acoustically significant plant and equipment	
		Type	Sound power level L_{Aeq},15 minute (dB) per item
Bore Pump Construction			
Services installation 6 months	Installation of 11 kV supply, fibre communications and pump line from vent facility to first borehole.	Trenching machine Excavator Water cart Delivery trucks (x2) Franna crane (x2) TOTAL	104 105 96 103 99 111
Site preparation 2 months	Clearing and levelling of area and installation of temporary fencing.	Excavator Water cart TOTAL	105 96 106
Drilling 2 months	Drill four holes - required to be conducted continuously (ie over 24 hours per day, 7 days per week) and line with steel casings.	Specialist drill rig TOTAL	114 114
Site finishing 2 months	Install concrete slab, transformer and permanent fencing. Surface control (geo-fabric and ballast) and final sediment controls.	Excavator Water cart 100T slewing crane Concrete delivery trucks (x2) TOTAL	105 96 99 105 111
Bore pump installation	Two pumps installed initially with two more in subsequent years.	100T slewing crane Franna crane	99 99

Construction phase and approximate duration	Description	Acoustically significant plant and equipment	
		Type	Sound power level L_{Aeq},15 minute (dB) per item
1 month	Installation conducted by specialist over approximately five days per pump.	Delivery trucks (x2) TOTAL	103 106
Downcast Shaft Construction			
Site preparation 2 months	Clearing and levelling of an area approximately 11.5 ha. Construct new access roads (if required), ponds and tailings storage area.	Dozer Excavator Water cart Grader TOTAL	114 105 96 106 116
Site mobilisation 1 month	Mobilisation of equipment to prepare for shaft drilling activity.	100T slewing crane Franna crane Delivery trucks (x2) Generator TOTAL	99 99 103 99 108
Site establishment 1 month	Establish drilling equipment on-site.	Crane Front-end loader Excavator Delivery trucks (x2) Air compressor Generator Lighting plants (x2) Water pumps Mud mixing plant Workshop TOTAL	99 104 105 103 75 99 75 89 92 99 111
Shaft pre-sink works 60 days	Install fencing and shaft pre-sink cap to prevent inadvertent access. Establish shaft collar and concrete foundation and set up and commissioning of blind boring.	Crane Delivery trucks (x2) Concrete delivery truck Hand tools TOTAL	99 103 105 99 110
Blind boring ~9 months	Blind bore to final depth.	Crane Drill rig Generator Lighting plants (x2) Air compressor Water pumps Mud mixing plant Workshop TOTAL	99 104 99 75 75 89 90 99 107
Site preparation 2 months	Clearing and levelling of an area approximately 11.5 ha. Construct new access roads (if required), ponds and tailings storage area.	Dozer Excavator Water cart Grader TOTAL	114 105 96 106 116
Site mobilisation 1 month	Mobilisation of equipment to prepare for shaft drilling activity.	100T slewing crane Franna crane Delivery trucks (x2) Generator TOTAL	99 99 103 99 108

Construction phase and approximate duration	Description	Acoustically significant plant and equipment	
		Type	Sound power level L_{Aeq},15 minute (dB) per item
Site establishment 1 month	Establish drilling equipment on-site.	Crane Front-end loader Excavator Delivery trucks (x2) Air compressor Generator Lighting plants (x2) Water pumps Mud mixing plant Workshop TOTAL	99 104 105 103 75 99 75 89 92 99 111
Shaft pre-sink works 60 days	Install fencing and shaft pre-sink cap to prevent inadvertent access. Establish shaft collar and concrete foundation and set up and commissioning of blind boring.	Crane Delivery trucks (x2) Concrete delivery truck Hand tools TOTAL	99 103 105 99 110
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Construction phase and approximate duration	Description	Acoustically significant plant and equipment	
		Type	Sound power level L_{Aeq},15 minute (dB) per item
Shaft pre-sink works 60 days	Install fencing and shaft pre-sink cap to prevent inadvertent access. Establish shaft collar and concrete foundation and set up and commissioning of blind boring.	Crane Delivery trucks (x2) Concrete delivery truck Hand tools TOTAL	99 103 105 99 110

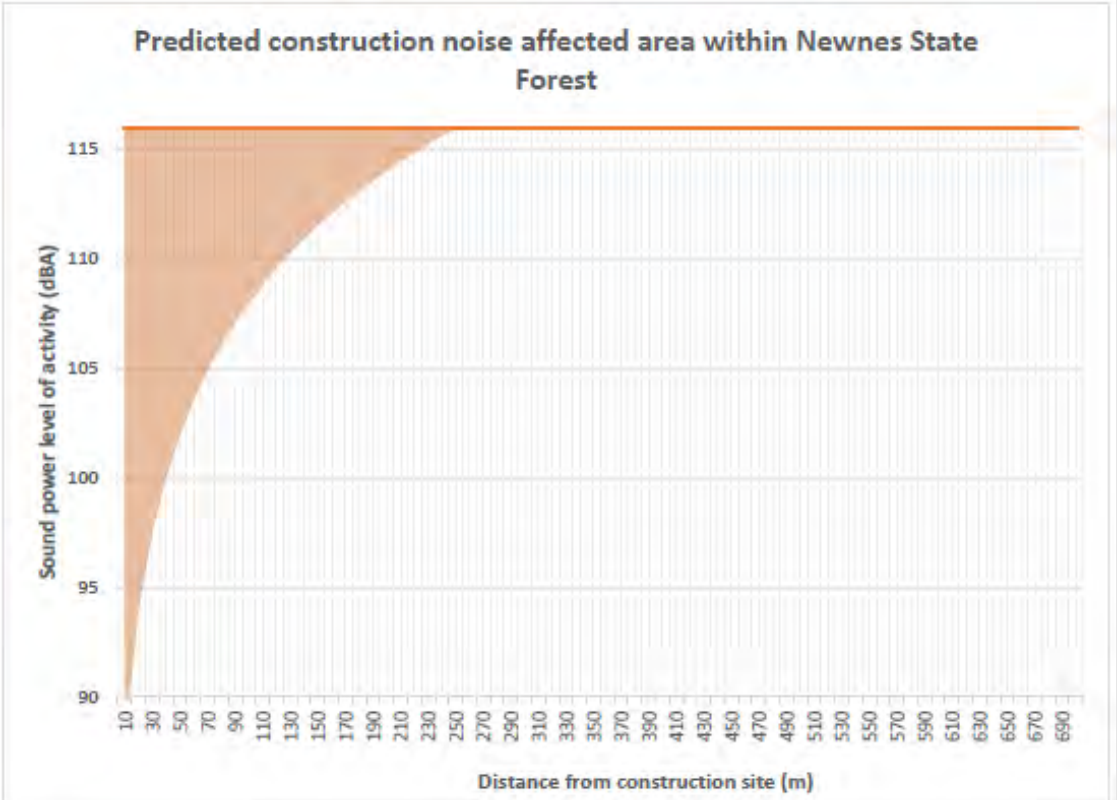


Figure 8.13 Contruction Impacts at Newnes State Forest

8.5.5 Road Traffic Noise Assessment

Proposed road traffic volumes and routes associated with construction and operation of the APMEP are described within Section 8.7 of this Report.

The NVIA utilised the Federal Highway Traffic Noise Model (FHWA) (US Department of Transportation) method to predict road traffic noise levels along routes associated with the APMEP. This prediction method considers traffic flow volume, average speed, percentage of heavy vehicles and road gradient to establish noise source strength. Additionally, this method includes attenuation due to distance, ground absorption and screening from buildings or barriers (EMM, 2019).

The following sub-section have broken road traffic noise impacts between construction and operational phases.

8.5.5.1 Construction

Construction related traffic will primarily be to and from Glowworm Tunnel Road via Old Bells Line of Road and State Mine Gully Road on the Newnes Plateau. The predicted daily construction traffic generation for the APMEP is provided in Table 8-31.

Table 8-31 Project Related Daily Construction Traffic

Construction activity	Light vehicles (LV)	Heavy vehicles (HV)	LV/HV movements
Bore pump construction	37	15.5	74/31
Downcast shaft construction	20	66	40/132
Total	57	81.5	114/163

Source: EMM, 2019

The proposed construction traffic routes and distribution of light and heavy vehicles are described as follows:

- 50% of light vehicles will travel via State Mine Gully Road and Glowworm Tunnel Road;
- 50% of light vehicles via Old Bells Line of Road and Glowworm Tunnel Road; and
- 100% of heavy vehicles via Old Bells Line of Road and Glowworm Tunnel Road.

The nearest potentially affected residential façade locations on State Mine Gully Road are situated approximately 7 m from the road kerb/edge. Existing daily traffic on State Mine Gully Road is estimated at 53 light vehicle movements (EMM, 2019).

Based on the above traffic volumes, the predicted road traffic noise levels at the nearest potentially affected residence on State Mine Gully Road are provided in Table 8-32.

Table 8-32 Road Traffic Noise Results

Road	Receiver type (distance from road)	Existing noise levels $L_{Aeq,1hour}$, dB		Future noise levels $L_{Aeq,1hour}$, dB		Criteria $L_{Aeq,1hour}$, dB		Increase between existing and future, dB	
		Day	Night	Day	Night	Day	Night	Day	Night
State Mine Gully Road	Residence (7 m)	51.0	44.2	54.2	47.6	55	50	+3.2	+3.4

Source: EMM, 2019

EMM (2019) has identified that construction road traffic noise levels are predicted to satisfy the relevant noise criteria for the nearest residential locations.

8.5.5.2 Operation

According to EMM (2019), during operations light vehicles will predominantly require access to the mine's pit top area via Wolgan Road. The nearest residential façade location that is potentially affected by operational traffic is located on Wolgan Road. This sensitive receptor is a minimum distance of approximately 13 m from the kerbside of the road (EMM, 2019).

The proposed APMEP related light vehicle movements for each shift (including a 10% carpooling ratio) are shown in Table 8-33 (EMM, 2019). The total daily light vehicle movements are therefore 502.

Table 8-33 Predicted Daily Light Vehicle Movements

Vehicle movements	Weekday shifts (Monday – Thursday)		
	Morning shift	Afternoon shift	Night shift
Light vehicle numbers (assumes 10% carpooling)	107	72	72
Total light vehicle movements	214	144	144

Source: EMM, 2019

Based on the above, EMM (2019) has identified that the predicted road traffic noise levels at the nearest potentially affected residence on Wolgan Road. These levels are provided in Table 8-34.

Table 8-34 Road Traffic Noise Results

Road	Receiver type (distance from road)	Existing noise levels $L_{Aeq,period}$, dB		Future[1] noise levels $L_{Aeq,period}$, dB		Criteria $L_{Aeq,period}$, dB		Increase between existing and future, dB	
		Day[2]	Night[2]	Day	Night	Day	Night	Day	Night
Wolgan Road	Residence (13 m)	52.1	41.5	53.1	45.9	60	55	+1.0	+4.4

Notes:

1. Levels inclusive of the predicted APMEP operations traffic.
2. Existing day and night traffic noise levels have been predicted based on the assumption that 90% of total daily traffic movements occur during the day period and 10% during the night-time period.
3. Day and night future traffic volumes have considered the proposed shift times and expected arrival and departure time of employees.

Source: EMM, 2019

According to EMM (2019) operational road traffic noise levels are predicted to satisfy the relevant noise criteria for the nearest residential locations. It is noted that traffic associated with the ongoing operation of the boreholes and downcast ventilation shaft will be minimal and therefore potential noise from associated road traffic along the route assessed in Section 8.8 will be negligible (EMM, 2019).

8.5.6 Revised Management and Mitigation Measures

Noise emissions from the mine including the APMEP will continue to be managed in accordance with the existing *Noise Management Plan - Western Region* (NMP 2008). The NMP clearly outlines the noise mitigation and management measures common to all Centennial operations within the western region, where applicable, as well as those specific to the Angus Place Colliery.

The mitigation measures applicable to the Angus Place Colliery are summarised as follows (EMM, 2019):

- a combination of partial and fully enclosed conveyors and conveyor drives;
- regular inspection of conveyor idlers and prompt replacement of damaged or highly worn idlers during maintenance;
- regular maintenance of plant and equipment in accordance with the manufacturer's specifications to ensure optimal operating conditions;
- installation of frequency modulated reversing alarms or "quakers" on mobile plant;
- switching off vehicles and plant when not in use;
- operate mobile plant in a quiet, efficient manner and regular training for relevant personnel;
- selecting low noise plant for operation on-site;
- installing acoustic enclosures around processing plants and sealing all unnecessary openings; and
- speed limits on haul routes.

The NMP also describes the short-term and long-term monitoring program for the mine including both attended and real-time, unattended noise monitoring. The NMP will be updated upon approval of the APMEP.

In addition, Centennial Angus Place will undertake a noise monitoring program to validate the assumptions made in the Noise and Vibration Impact Assessment including the sound power level of on-site plant and equipment and off-site noise emissions. Operations of acoustically significant plant and equipment during the evening and night-time (not modelled to be operational) will be limited until it can be demonstrated that operation of the site can comply with the relevant noise limits at the nearest assessment locations (EMM, 2019).

8.6 Cultural Heritage Impact Assessment

A revised and updated Cultural Heritage Impact Assessment has been prepared by Niche (2019) and is provided in Appendix M.

This updated assessment takes into consideration the revised subsidence predictions (as outlined in Chapter 6) and includes the results of ongoing consultation undertaken in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010a) and the Centennial Western Region Aboriginal Cultural Heritage Management Plan).

8.6.1 Existing Environment

8.6.1.1 Aboriginal Cultural Heritage

The amended Project Application Area lies within the Newnes Plateau region of the upper Blue Mountains and within the western-most boundary of the Sydney Basin, an area with a well-documented Aboriginal history. Traditionally the Blue Mountains were home to three large Aboriginal language groups; the Wiradjuri, the Darug and the Gundungurra (Tindale, 1974).

The region of the Newnes Plateau and the greater Blue Mountains have been the subject of many archaeological studies and investigations. Niche (2019) provides an overview of the regional studies which indicate that the region is likely to have been the focus of Aboriginal occupation, and the abundance of permanent water sources would have provided suitable locations for multiple campsites. A predictive model developed by Bowdler (1981; cited in Niche 2019) suggests that winter on the Newnes Plateau is likely to have been a period of resource richness, with seasonal carbohydrate-rich swamp flora and an abundance of fauna species. The protected gorges and sandstone overhangs would have provided suitable shelter. The abundance of timber and stone resources for the manufacture of tools within the local area, including the amended Project Application Area, would have created further impetus for seasonal or permanent Aboriginal occupation of the Newnes Plateau region.

The previous Cultural Heritage Impact Assessment prepared by RPS in 2014 identified 49 sites registered in the Aboriginal Heritage Information Management System (AHIMS) within the Project Application Area (refer to Figure 8.14).

No additional cultural heritage sites are located within the amended Project Application Area, one Aboriginal Place (listed under the *National Parks and Wildlife Act*) also occurs within the amended Project Application Area. Blackfellows Hand is a rockshelter with art and archaeological deposit and is a significant teaching and occupation site. This rockshelter (AHIMS #45-1-0007) is located outside of the subsidence impact area.

Based on the amended mine design, nine (9) Aboriginal cultural heritage sites are located within 600 metres of the proposed longwalls (refer to Table 8-35 and Figure 8.14).

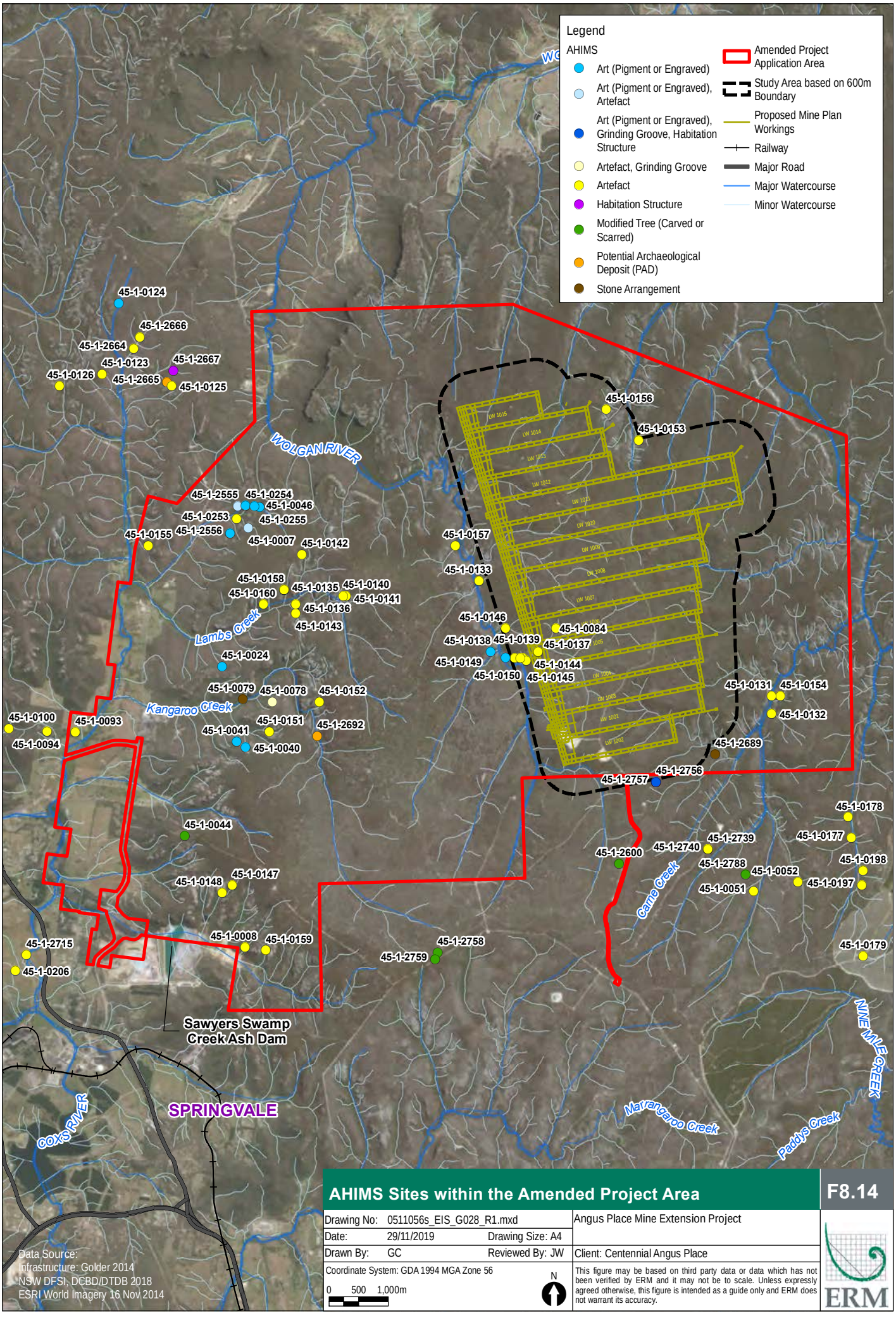

Legend
AHIMS
Art (Pigment or Engraved)
Art (Pigment or Engraved), Artefact
Art (Pigment or Engraved), Grinding Groove, Habitation Structure
Artefact, Grinding Groove
Artefact
Habitation Structure
Modified Tree (Carved or Scarred)
Potential Archaeological Deposit (PAD)
Stone Arrangement
Amended Project Application Area
Study Area based on 600m Boundary
Proposed Mine Plan Workings
Railway
Major Road
Major Watercourse
Minor Watercourse
45-1-0124
45-1-2666
45-1-2664
45-1-0123
45-1-2667
45-1-0126
45-1-2665
45-1-0125
WOLGAN RIVER
45-1-2555
45-1-0254
45-1-0046
45-1-0253
45-1-0255
45-1-0155
45-1-2556
45-1-0007
45-1-0142
45-1-0158
45-1-0135
45-1-0140
45-1-0160
45-1-0141
45-1-0136
45-1-0143
Lambs Creek
45-1-0024
45-1-0079
45-1-0078
45-1-0152
Kangaroo Creek
45-1-0100
45-1-0093
45-1-0094
45-1-0151
45-1-2692
45-1-0041
45-1-0040
45-1-0044
45-1-0148
45-1-0147
45-1-0008
45-1-0159
45-1-2715
45-1-0206
Sawyers Swamp Creek Ash Dam
SPRINGVALE
COXS RIVER
45-1-0156
45-1-0153
45-1-0157
45-1-0133
45-1-0146
45-1-0084
45-1-0138
45-1-0139
45-1-0137
45-1-0149
45-1-0144
45-1-0150
45-1-0145
45-1-0131
45-1-0154
45-1-0132
45-1-2689
45-1-2757
45-1-2756
45-1-2758
45-1-2759
45-1-2600
45-1-0178
45-1-0177
45-1-2740
45-1-2739
45-1-2788
45-1-0198
45-1-0052
45-1-0197
45-1-0051
Came Creek
45-1-0179
NINE MILE CREEK
Marrangaroo Creek
Paddys Creek
Data Source:
Infrastructure: Golder 2014
NSW DFSI, DCBD/DTDB 2018
ESRI World Imagery 16 Nov 2014
AHIMS Sites within the Amended Project Area
F8.14
Drawing No: 0511056s_EIS_G028_R1.mxd
Angus Place Mine Extension Project
Date: 29/11/2019
Drawing Size: A4
Drawn By: GC
Reviewed By: JW
Client: Centennial Angus Place
Coordinate System: GDA 1994 MGA Zone 56
0 500 1,000m
N
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
ERM

Table 8-35 Aboriginal Cultural Heritage Sites within 600m boundary of the longwalls

AHIMS #	Site Type	Photograph *Source: RPS 2014*	Archaeological Significance		Location
			Local	Regional	
45-1-0084	Shelter with Deposit	*Not ground-truthed during the 2014 survey due to access limitations*	Moderate	Low	Directly above the proposed LW1006
45-1-0137	Shelter with Deposit		Low	Low	150m west of the proposed LW1005
45-1-0144	Shelter with Deposit		Low	Low	420m west of the proposed LW1005
45-1-0145	Shelter with Deposit		Low	Low	380m west of the proposed LW1005
45-1-0146	Shelter with Deposit	*Not ground-truthed during the 2014 survey due to access limitations*	Low	Low	570m west of the proposed LW1006
45-1-0149	Shelter with Deposit		Low	Low	460m west of the proposed LW1005

AHIMS #	Site Type	Photograph *Source: RPS 2014*	Archaeological Significance		Location
			Local	Regional	
45-1-0150	Shelter with Deposit		Low	Low	560m west of the proposed LW1005
45-1-0153	Shelter with Deposit		Low	Low	570m north and east of the proposed LW1011 and LW1012, respectively
45-1-0156	Shelter with Deposit	*Not ground-truthed during the 2014 survey due to access limitations*	Low	Low	340m east of the proposed LW1015

8.6.1.2 Historic Heritage

A detailed review of the historical land use within the amended Project Application Area and the broader Lithgow region is provided in Appendix M.

There are two heritage items listed under the Lithgow LEP 2014 within amended Project Application Area - The Meadows (I201) and Maddox Lane Group (I202). A third site, the Woodlands (I199) is just 50m from the boundary of the amended Project Application Area (Figure 8.15 and Table 8-36). None of these sites are located within the 600m boundary to the proposed longwalls.

Table 8-36 Local Heritage Items within the Amended Project Application Area

Local Heritage Item as listed under the Lithgow LEP 2014	Photograph
The Meadows is an item of historical, aesthetic and scientific significance. The fabric suggests that this is a rare and significantly early homestead, kitchen and stables. This cottage appears to predate the Neubeck family who arrived in the area in 1855, though it is close to Frank Neubeck's c. 1920-42 development in Maddox Lane (see below). It is likely that the complex reflects the early period of farming in Lidsdale in the 1840s (SHI 1997, cited in Niche 2019). Located within the south western corner of the amended Project Application Area.	 Source: Lithgow Heritage Inventory

Local Heritage Item as listed under the Lithgow LEP 2014	Photograph
The Madddox Lane Group is of a row of seven cottages constructed for early workers. The Neubeck family arrived from Germany in 1855 and prospered around Lidsdale. In the third generation, Frances Joseph Neubeck opened the first coal mine in Lidsdale in 1910 and the first open-cut colliery for black coal in 1940. He also controlled a significant sawmill in the area, which supplied work for the local building industry. To accommodate his employees, Frank Neubeck built a variety of houses: three of the Maddox St. group were erected in the 1920s, the other four in the early 1940s. Located within the south western corner of the amended Project Application Area.	 Source: Lithgow Heritage Inventory.
The Woodlands, is an important complex situated with a long frontage to Coxs River, incorporating tangible remains of a long-lived highway inn and supplier to Cobb & Co. It has a quite uncommon range of 8 buildings, a well and other early features. Located approximately 50 metres from the south western boundary of the amended Project Application Area.	 Source: Lithgow Heritage Inventory

There are no Commonwealth or State listed Historical Heritage sites located within the amended Project Application Area.

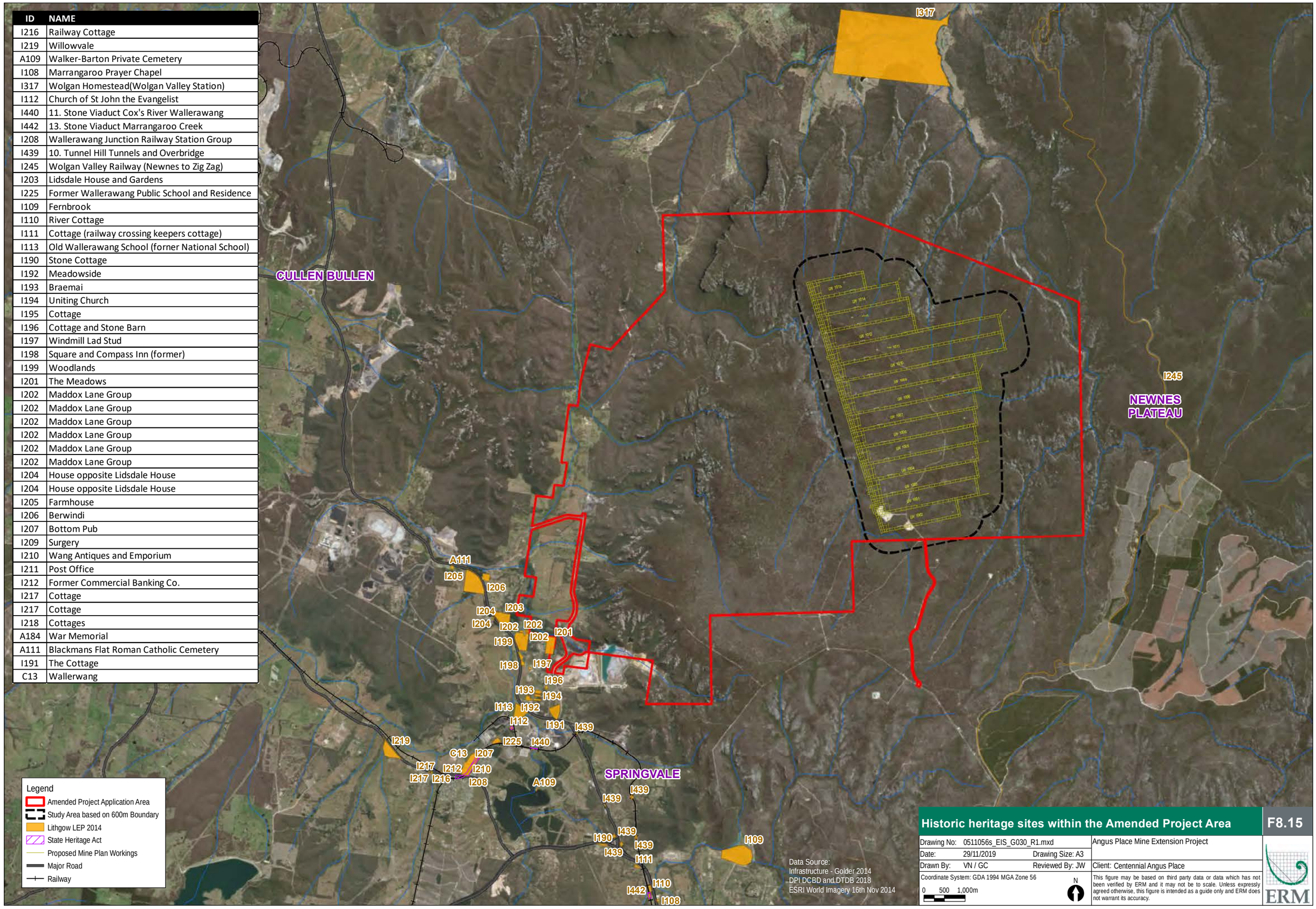
8.6.2 Additional Surveys and Consultation undertaken since 2014

No additional Aboriginal heritage or Historic heritage surveys have been undertaken within the amended Project Application Area since the preparation of the 2014 EIS. The updated Cultural Heritage Impact Assessment has been prepared by Niche (2019) based on updated database searches, ongoing consultation with Aboriginal stakeholders and an assessment of the revised subsidence predictions.

A total of 12 Aboriginal stakeholders (including groups and individuals) registered as having an interest in participating in the consultation process for the original APMEP in 2011. Consultation with all of these parties has been ongoing in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010a) and the Centennial Western Region Aboriginal Cultural Heritage Management Plan. A copy of the updated Cultural Heritage Impact Assessment has been provided to all Registered Aboriginal Parties. Comments were provided by one RAP group, and at their request, their details have been treated as confidential and are not reproduced here.

Since the submission of the 2014 EIS, the regional Aboriginal Cultural Heritage Management Plan has also been finalised and approved by DPIE. This provides a consistent approach to the monitoring and management of all Aboriginal heritage sites within the mining leases and exploration licences for Centennial Coal's western operations encompassing the Angus Place Colliery.

ID	NAME
I216	Railway Cottage
I219	Willowvale
A109	Walker-Barton Private Cemetery
I108	Marrangaroo Prayer Chapel
I317	Wolgan Homestead(Wolgan Valley Station)
I112	Church of St John the Evangelist
I440	11. Stone Viaduct Cox's River Wallerawang
I442	13. Stone Viaduct Marrangaroo Creek
I208	Wallerawang Junction Railway Station Group
I439	10. Tunnel Hill Tunnels and Overbridge
I245	Wolgan Valley Railway (Newnes to Zig Zag)
I203	Lidsdale House and Gardens
I225	Former Wallerawang Public School and Residence
I109	Fernbrook
I110	River Cottage
I111	Cottage (railway crossing keepers cottage)
I113	Old Wallerawang School (forner National School)
I190	Stone Cottage
I192	Meadowside
I193	Braemai
I194	Uniting Church
I195	Cottage
I196	Cottage and Stone Barn
I197	Windmill Lad Stud
I198	Square and Compass Inn (former)
I199	Woodlands
I201	The Meadows
I202	Maddox Lane Group
I202	Maddox Lane Group
I202	Maddox Lane Group
I202	Maddox Lane Group
I202	Maddox Lane Group
I204	House opposite Lidsdale House
I204	House opposite Lidsdale House
I205	Farmhouse
I206	Berwindi
I207	Bottom Pub
I209	Surgery
I210	Wang Antiques and Emporium
I211	Post Office
I212	Former Commercial Banking Co.
I217	Cottage
I217	Cottage
I218	Cottages
A184	War Memorial
A111	Blackmans Flat Roman Catholic Cemetery
I191	The Cottage
C13	Wallerwang



Historic heritage sites within the Amended Project Area

F8.15

Drawing No:	0511056s_EIS_G030_R1.mxd		Angus Place Mine Extension Project
Date:	29/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place

Coordinate System: GDA 1994 MGA Zone 56

0 500 1,000m

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ERM

8.6.3 Updated Impact Assessment

A summary of the revised subsidence predictions is provided in Table 8-37. A full assessment of potential impacts is provided in Appendix M.

Consistent with the 2014 EIS, no historic heritage sites are located within the 600m setback to the proposed longwalls and no impacts are predicted to occur.

The previous heritage assessment prepared by RPS (2014), as documented in the 2014 EIS, identified three Aboriginal heritage sites (#45-1-0084, #45-1-0137 and #45-1-2756/2757) at potential risk of impact through minor spalling of exposed rock faces. As a result of the APMEP, potential impacts have been reduced and only one site is now at risk of being impacted (refer Table 8-37).

Table 8-37 Updated subsidence predictions for Heritage items

Item	Updated Subsidence Impacts (Niche 2019 and MSEC 2019)
Aboriginal Heritage Sites within 600m boundary of the longwalls	
#45-1-0084	The potential for adverse impacts on Site #45-1-0084, including fracturing and movement on existing bedding planes and joints, is approximately 10 %. The fracturing and movement could result in rockfalls where the rock is marginally stable. The potential for rockfalls at this site is considered to be less than 10%. The site was not ground-truthed during the 2014 survey due to access limitations and it will require survey prior to the commencement of any secondary extraction that may impact on this site to ensure that accurate baseline data is available to enable accurate monitoring and reporting of any subsidence related impacts.
#45-1-0137 #45-1-0144 #45-1-0145 #45-1-0146 #45-1-0149 #45-1-0150 #45-1-0153 #45-1-0156	The remaining Aboriginal heritage sites are located at distances between 150 m and 570 m outside the proposed mining area. These sites are predicted to experience less than 20 mm vertical subsidence. Whilst these sites could experience very low levels of vertical subsidence and far-field horizontal movements, they are not expected to experience measurable tilts, curvatures or strains. No adverse physical impacts are expected for any of these sites.

8.6.4 Revised Management and Mitigation Measures

8.6.4.1 Aboriginal Cultural Heritage

All Aboriginal heritage in the amended Project Application Area will continued to be managed and monitored in consultation with the Registered Aboriginal Parties and in accordance with the Western Regions Aboriginal Cultural Heritage Management Plan (2017). Monitoring of all Aboriginal Heritage sites within 600m of the longwalls will be undertaken prior to, during and at the completion of mining. Any management actions required will be developed in consultation with the relevant Registered Aboriginal Parties and DPIE.

Only one site is at risk of being impacted by the APMEP. This site (#45-1-0084) was not ground-truthed during the 2014 survey due to access limitations and will require additional attempts to locate the site prior to the commencement of mining in the vicinity of the rock shelter to ensure that reliable baseline data is available to enable accurate monitoring and reporting of any subsidence related impacts.

Should this site be relocated, baseline recording must include the following:

- Detailed archival recording;
- Archival quality photos; and
- The designation of at least six survey control points for monitoring.

8.6.4.2 Historic Heritage

Consistent with the requirements of the 2014 EIS, in the event that unexpected historical archaeological remains are identified within the amended Project Application Area, works should cease and an archaeologist engaged to assess the condition and significance of the find. Should the find be determined to be of heritage significance (local or State), the Heritage Council should be notified under s.146 of the NSW Heritage Act 1977. Depending on the nature of the site, additional assessment and possibly an excavation permit may be required prior to the recommencement of excavation in the affected area.

General Heritage Commitments

Consistent with the requirements of the 2014 EIS, all site workers and major contractors should complete a heritage induction so they are aware of their obligations under the *National Parks and Wildlife Act 1974.*

In the unlikely event that skeletal remains are identified, work must cease immediately in the vicinity of the remains and the area cordoned off. NSW Police are to be contacted in first instance. No further action is to be taken until the Police provide written advice to the proponent on how to progress. If determined to be Aboriginal, the proponent must contact the Enviro line (on 131 555), and a suitably qualified archaeologist and representatives of the local Aboriginal community stakeholders determine an action plan for the management of the skeletal remains, formulate management recommendations and to ascertain when work can recommence.

8.7 Traffic Impact Assessment

The following section summarises the key findings of the revised Traffic Impact Assessment (TIA) (EMM, 2019, refer to Appendix N).

EMM (2019) considers the potential impacts of the proposed APMEP, in the context of the existing coal handling approvals under the current Angus Place Planning Approval (PA 06_0021), the Western Coal Services Project Development Consent (SSD-5579) and the Springvale Mine Extension Project Development Consent (SSD-5594).

8.7.1 Existing Environment

The existing traffic that is generated from the mine utilises local and regional sealed roads via Wolgan Road, north of Lidsdale (refer to Figure 8.16).

Table 8-38 describes the surrounding road networks that are currently utilised by operational based traffic.

Table 8-38 Existing Road Network

Existing Impacted Roads	Description
Wolgan Road	Wolgan Road is a sealed two-lane two-way rural road. It has a mainly urban cross-section, with kerbs and parking lanes and a 50 km/hr speed limit for approximately 2–3 km north of the Castlereagh Highway through to the village of Lidsdale. The road then adopts a more rural cross section with an 80 km/hr speed limit as it approaches the mine access intersection.
Castlereagh Highway	The Castlereagh Highway is a major regional highway that connects from the Great Western Highway at Marrangaroo, near Lithgrow. The Castlereagh Highway generally provides two sealed lanes with road speeds of 100 km/hr. The road speed is reduced in the vicinity of the Lidsdale Village area to 80 km/hr.
Ian Holt Drive	Ian Holt Drive is a two-lane, two-way sealed road. It has a 50 km/hr speed limit throughout its length, which is approximately 2–3 km from the Castlereagh Highway to the village of Lidsdale, where it connects with Wolgan Road. The road is currently very lightly trafficked in relation to its design standard and the frontage properties are primarily rural with low traffic generating characteristics.
Chifley Road	Chifley Road is approximately 20 km long and connects Lithgow in the west to Bell in the east. Most sections of Chifley Road are two-way, two-lane sealed roads and some parts have additional overtaking/climbing lanes or increased shoulder widths to improve road safety. The general road width is approximately 9 m–13 m. It is an approved 19 m B-double route by RMS.
Old Bells Line of Road	Old Bells Line of Road is an approximately 8.7 km long unsealed road, which starts from Chifley Road (near the Zig Zag Railway) and ends at the intersection with State Mine Gully Road and Glowworm Tunnel Road. At the southern end of Old Bells Line of Road, an approximately 2.6 km long unnamed track connects to Clarence Colliery Road, near the Hanson's Clarence Quarry access intersection.
State Mine Gully Road	State Mine Gully Road is a 6.2 km long two-way part sealed and part unsealed road north of Lithgow. It connects Atkinson Street in Lithgow to the south to the intersection of Old Bells Line of Road/Glowworm Tunnel Road in the north. The road alignment is level and relatively straight in the south, becoming steeper and winding in the north, where the road rises to the level of the Newnes Plateau.
Glowworm Tunnel Road	Glowworm Tunnel Road is an approximately 27 km long two-way unsealed road in the Newnes State Forest. It links Glow Worm Tunnel Walking Track to the north and Old Bells Line of Road and State Mine Gully Road to the south. The road alignment along this section of Glowworm Tunnel Road is generally straight and level.
Blackfellows Hand Trail	Blackfellows Hand Trail is an approximately 10 km long two-way unsealed fire trail in the Newnes State Forest. It connects Glowworm Tunnel Road in the east to a private road near the mine in the west. The road alignment is generally level with relatively few bends.
Sunnyside Ridge Road	Sunnyside Ridge Road is an approximately 10 km long two-way unsealed fire trail in the Newnes State Forest. It extends in a generally northerly direction from the intersection with Blackfellows Hand Trail and Beecroft Track. There is currently minimal through traffic usage as the access from the northern end is restricted to off road vehicle use only.

Source: EMM, 2019

The mine is currently in care and maintenance with a reduced workforce of 20-30 employees, mainly working day shift hours. This is significantly less than the previously approved workforce of 300 full time employees and proposed workforce of 450 full time employees working across three shifts.

8.7.2 Updated Impact Assessment

The updated TIA prepared by EMM (2019) evaluated the potential impacts of the proposed new construction and the increased number of employees the APMEP would generate during the operational phase. A summary of the revised traffic impact prediction is provided in the following section for both construction and operation. A full assessment of potential traffic generation impacts is provided in Appendix N.

The TIA does not consider coal haulage impacts as coal will be transported via conveyor or private surface coal haul roads, in accordance with the Springvale Coal Services Project Development Consent (SSD-5579). It is proposed that these arrangements will continue as part of the APMEP. Consequently, there will be no public roads used in the transporting of coal. The prediction of traffic impacts on local roads during operational phase has focused on light vehicle movements only.

8.7.2.1 Construction Phase

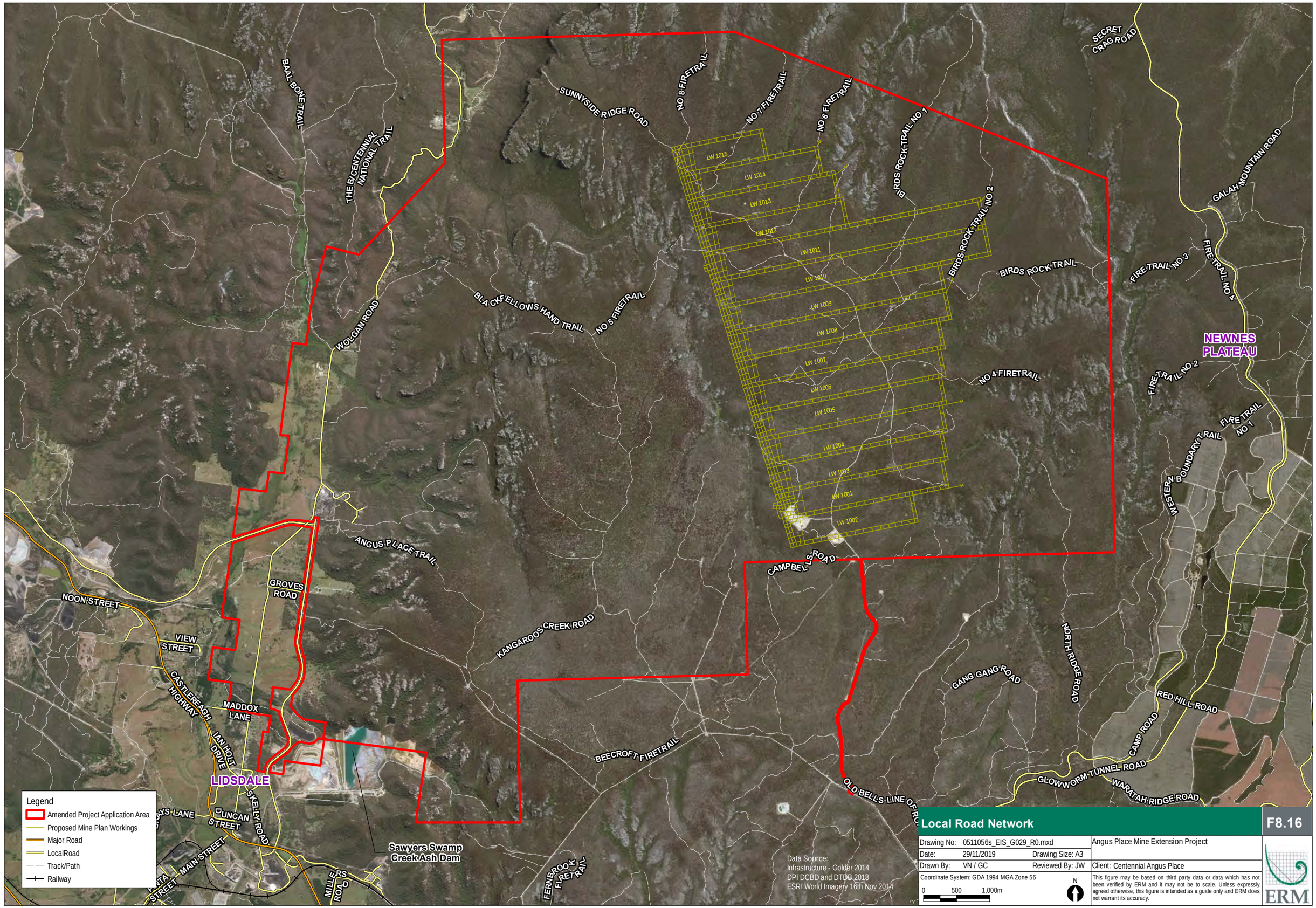
Centennial Angus Place is proposing construction of bore pumps and a downcast shaft, which will generate traffic during the 13 month and 21 month construction periods, respectively. These activities will attract a number of light vehicles used by workers and heavy vehicles carrying equipment and building materials. It is expected that these vehicles will be most active between 6:00 am to 7:00 am and between 3:00 pm to 4:00 pm. This is due to there being only one shift change and deliveries unlikely to occur outside of working hours. Table 8-39 provides the predicted daily construction traffic generation.

Table 8-39 Predicted Project Related Construction Traffic

Construction activity	Employee rates	Light vehicles (LV)	Heavy vehicles (HV)	LV/HV movements
Bore pump construction	56	37	15.5	74/31
Downcast shaft construction	20	20	66	40/132
Total	**76**	**57**	**81.5**	**114/163**

As shown in Table 8-39 the majority of heavy vehicles are associated with the proposed downcast shaft construction phase. This is due to the requirement for shaft lining material, with the length of the lining material will determining the number of heavy vehicles required. EMM (2019) has applied to a worst-case construction scenario to best model the potential traffic impacts.

The APMEP related construction traffic is proposed to be managed by distribution of the vehicles across two separate routes. This will reduce the potential impact on the road network infrastructure and surrounding communities.



Local Road Network

F8.16

Drawing No:	0511056s_EIS_G029_R0.mxd		Angus Place Mine Extension Project
Date:	29/11/2019	Drawing Size: A3	
Drawn By:	VN / GC	Reviewed By: JW	Client: Centennial Angus Place
Coordinate System: GDA 1994 MGA Zone 56			This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

The following traffic distribution are proposed:

- Route 1 (i.e. light vehicles only):
  - 50% of light vehicles via State Mine Gully Road and Glowworm Tunnel Road.
- Route 2 (i.e. light and heavy vehicles):
  - 50% of light vehicles via Old Bells Line of Road and Glowworm Tunnel Road; and
  - 100% of heavy vehicles via Old Bells Line of Road and Glowworm Tunnel Road.

APMEP related vehicle movements during construction will push some of the unsealed rural roads into a higher Austroads threshold band, however due to the temporary nature of APMEP related construction activities, no long-term significant impacts on the road network during construction are anticipated (EMM, 2019).

8.7.2.2 Operational Phase

EMM (2019) has assessed the potential impact during the operational phase of the APMEP, based on the assumption that the existing access arrangements to the pit top will be maintained, with the majority of workforce traffic predicted to continue to use the intersection of Wolgan Road, situated on the Castlereagh Highway.

As shown in Table 8-40, the Angus Place Colliery will continue to have more employees working on weekdays, when compared to weekends. Therefore, this assessment has focussed on the impact on the road network on weekdays only. A 10% carpooling ratio has also been applied to the assessed vehicle movements.

Table 8-40 Predicted Daily Light Vehicle Movements

Staff	Weekday shifts (Monday – Thursday)			Weekend shifts (Friday – Sunday)	
	Morning shift (6:00 am–4:00 pm)	Afternoon shift (2:00 pm–12:00 am)	Night shift (10:00 pm–8:00 am)	Morning shift (6:00 am–6:00 pm)	Night shift (6:00 pm–6:00 am)
Surface and underground mine staff (including deputies and trades)	82	70	70	80	80
Contractors	5	8	8	4	3
Apprentices/trainees	2	-	-	-	-
Administration staff	30	2	2	2	2
Total	**119**	**80**	**80**	**86**	**85**

The proposed light vehicle movements under each shift (including a 10% carpooling ratio) is shown in Table 8-41. The total daily light vehicle movements are therefore predicted to be 502.

Table 8-41 Predicted Daily Light Vehicle Movements During Operation

Predicted Daily Light Vehicle Movements During Operation

Operational activity	Morning Shift (6:00 am 4:00 pm)	Afternoon Shifts (2:00 pm – 12:00 am)	Night shifts (10.00 pm – 8:00am)
Light vehicles numbers	119	80	80
Light vehicle numbers (assumes 10% carpooling)	107	72	72
Total	**214**	**144**	**144**
	502		

As outlined within EMM (2019), the daily light vehicle movements during the APMEP's operation is proposed to be managed by distributing the vehicles through separated routes. This is a predicted distribution based on an analysis of post codes for the Springvale Mine workforce and will reduce the potential impact on the road network infrastructure and surrounding communities. The following traffic distribution are proposed:

- 20% originating locally near Lidsdale (north of Castlereagh Highway);
- 20% originating locally near Wallerawang (south of Castlereagh Highway);
- 20% originating regionally from the west (travelling to or from the west via Ian Holt Drive and Castlereagh Highway); and
- 40% originating regionally from the east (travelling to or from the Lithgow area).

Overall, additional APMEP related daily light vehicle movements during operations will contribute to a 209.2% increase in traffic on Wolgan Road (south of the mine access intersection). While the construction traffic volumes proposed will result in traffic volumes higher than the design standard for the road, the width and condition of this section of Wolgan Road is still considered to be generally compliant and acceptable as the future daily traffic volume is at the lower range of the revised threshold band (EMM, 2019).

Design standard for all other roads assessed in the TIA will remain within acceptable limits, and therefore road width assessments remain generally compliant with the relevant Austroads design standard.

8.7.2.3 Impact on Existing Intersections

There are four intersections that have been assessed by EMM (2019):

- Chifley Road/Petra Avenue/Old Bells Line of Road;
- Castlereagh Highway/Wolgan Road/Main Street;
- Castlereagh Highway/Ian Holt Drive; and
- Wolgan Road/Angus Place Mine access road (i.e. the mine access intersection for the pit top area).

EMM (2019) has considered four traffic peak hours that are predicted to impact on the intersections and concludes that overall, APMEP related vehicle movements during the construction and operational phases will have negligible impacts on these intersections.

8.7.2.4 Impact on Road Safety

EMM (2019) includes an analysis of reported crashes on the surrounding road network. According to personal injury related accidents recorded within the Transport for NSW (TfNSW) interactive history database, there have been 25 accidents in the five (5) years between 2013 and 2018, with details of these incidents included in the TIA (refer to Appendix N).

A review of incidents found that many of the reported accidents were human behaviour error such as speeding and fatigue. It is noted that no accidents have been recorded for Ian Holt Drive, Glowworm Tunnel Road, Blackfellows Hand Trail and Sunnyside Ridge Road, and the current traffic safety conditions along the assessed road network are considered acceptable and safe, with good intersection visibility at all locations.

To further mitigate against traffic related safety impacts from the APMEP, employees should be made aware of key matters before employment is commenced, including:

- varying speed limits along sealed and unsealed roads;
- be aware of driving on unsealed roads in severe weather conditions;
- general road safety rules (e.g. do not drive under the influence of alcohol and medication); and
- fatigue management measures.

8.7.2.5 Impact on public and active transport

The closest public transport services are not within a desirable walking distance, therefore, the APMEP related workforce is not expected to walk, cycling or take public transport.

Existing public transport services are not expected to be impacted by the APMEP.

8.7.2.6 Availability of car parking

During operations, the APMEP workforce will use existing car parking spaces on-site at the mine's pit top area. During construction, the APMEP construction workforce will park at the active work areas within Newnes State Forest.

It is estimated the future maximum demand for car parking will likely be during the Sunday night and Monday morning shift changeover period. It is assumed that 10% of cars travelling to the mining site will be carpooling, meaning that there will be a demand of 184 car parks. This is less than the current car parking capacity of 203 spaces provided at the Angus Place Colliery pit top area as shown on so there is more than sufficient capacity to cater for demand.

8.7.3 Cumulative Impacts

EMM (2019) evaluates the cumulative traffic impacts to determine whether there is an increase in impacts from the proposed works on the existing environment.

During construction, roads within and adjacent to Newnes Plateaus and Newnes State Forest may also be used by construction-related vehicle movements associated with the construction of a new buried pipeline within Newnes State Forest to connect Clarence Colliery's existing water management infrastructure to the SDWTS. Construction of the proposed pipeline is expected to take approximately 18 months and is expected to have a peak construction workforce of approximately 60 people. Table 8-42 shows the predicted additional daily construction traffic movements, which have been combined to show the cumulative daily traffic increase over the impacted roads and intersections.

Table 8-42 Minor Road Daily Traffic Volumes for Assessed Roads

Road	Location	Forecast daily traffic volume for 2019[1]	Daily construction traffic movements for the project	Daily construction traffic movements for the proposed pipeline	Future total daily traffic movements
Sunnyside Ridge Road	North of Blackfellows Hand Trail/Beecroft Track intersection	37	277	0	314
Blackfellows Hand Trail	West of the picnic area intersection to Beecroft Track	42	277	16	335
Glowworm Tunnel Road	North of the construction compound for the proposed pipeline to the picnic area intersection	96	277	16	389
Glowworm Tunnel Road	Between Old Bells Line of Road and the construction compound for the proposed pipeline	96	277	82	455
State Mine Gully Road	Within rural area north of Lithgow	53	58	26	137
Old Bells Line of Road	East of Glowworm Tunnel Road	40	219	56	315
Old Bells Line of Road	North of Chifley Road	40	219	44	303

The results were compared with the future daily traffic increases for the affected minor roads and intersections for the APMEP alone. This indicated that part of the assessed route on Newnes Plateau has potential to be significantly affected under a concurrent construction scenario for the APMEP, specifically Glowworm Tunnel Road and Blackfellows Hand Trail respectively.

According to EMM (2019), under a concurrent construction scenario, combined total daily traffic movements along Glowworm Tunnel Road will be up to approximately 455 daily vehicle movements, thereby exceeding the recommended threshold of 150 daily vehicle movements for an unsealed minor road.

As the construction impacts are not long term it is anticipated that impacts can be mitigated within a construction traffic management plan (CTMP) and Driver Code of Conduct procedures. These mitigation measures are to be prepared prior to the commencement of construction activities, and implemented during construction.

8.7.4 Revised Management and Mitigation Measures

Due to the temporary nature of construction-related impacts on unsealed roads within Newnes State Forest and surrounds, the assessed rural road network is considered acceptable to carry the additional daily traffic movements. However, it is recommended that a road maintenance program be implemented for the affected unsealed rural roads within Newnes State Forest, namely Old Bells Line of Road, Glowworm Tunnel Road, Blackfellows Hand Trail and Sunnyside Ridge Road.

The road maintenance program should include measures such as regrading of the road surface to repair potholes and road corrugations at three monthly intervals during construction, and a commitment by Centennial to restore the road surface to its pre-construction condition at the completion of construction. Construction and speed management signage should also be implemented along the affected sections of the unsealed road network.

It is recommended that a CTMP and Driver Code of Conduct be prepared prior to commencement of construction and incorporate the road maintenance program and other traffic control measures to be implemented throughout the APMEP construction.

The APMEP workforce should also be made aware of a number of traffic-related safety matters prior to commencement of their employment, including:

- varying speed limits on sealed and unsealed roads;
- general road safety rules (e.g. do not drive under the influence of alcohol and medication);
- be aware of driving on dirt road in severe weather condition; and
- fatigue management measures.

8.8 Social-Economic Impact Assessment

The following sections summarise the key findings of the Economic Impact Assessment (EIA) (AIGIS Group, 2019) and Social Impact Assessment (SIA) (Hansen-Bailey, 2019), provided in Appendix F and Appendix O. The combined summary of the SIA and EIA (referred to as SEIA within this Report), provides a social- economic assessment of impacts associated with the APMEP on the surrounding community. The EIA and SIA were prepared by the following consultants:

- AIGIS Group prepared the EIA (2019) and the original 2014 APMEP; and
- Hansen Bailey prepared the SIA (2019), but did not prepare the original SIA (2013), which was undertaken by James Marshall and Co.

The SEIA reviews relevant information for both social and economic impacts on the community associated with two scenarios, being if the APMEP being approved or not. The updated SEIA (AIGIS, 2019 and Hansen Bailey, 2019) draws on data from the original assessment as well as updating the criteria based on current legislation.

The SEIA predicts the impacts relative to the following key assessment criteria:

- Director General's Environmental Assessment Requirements (ERAs) issued 6 November 2012;

Economic

- Section 4.12 (formerly Section 78A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- The NSW Government Department of Planning and Environment (DPE) *Guidelines for the economic assessment of mining and coal seam gas proposals* (December 2015); and
- The NSW Government Department of Planning and Environment (DPE) *Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals* (April 2018).

Social

- NSW Department of Planning and Environment's (DPE) Director General's EARs for the APMEP; and
- Transitional arrangements as outlined in the Social Impact Assessment Guidelines for State Significant mining, petroleum and industry development (NSW SIA Guideline) (Department of Planning and Environment, 2017).

8.8.1 Existing Environment

The area surrounding the Angus Place Colliery is characterised by flat terrain directly adjacent to the Newnes State Forest, which increases in elevation moving east (approximately 925 m AHD to 1,180 m AHD). A relatively small number of rural residential properties are located along Wolgan Road and in the Upper Wolgan Valley in the vicinity of the mine. Some parts of the APMEP are located within the Newnes State Forest, which is used for recreational purposes (EMM, 2019).

Lithgow LGA, where the APMEP is located, has a strong history of power generation and coal mining activity. Within the Lithgow LGA the mining industry is:

- The largest single industrial contributor to the economy by a significant margin (AIGIS Group, 2019); and
- The second largest industry by employment, with an employment share of 11.1% in 2016 (AIGIS Group, 2019).

On this basis the SEIA reviews the social and economic framework of the surrounding area.

8.8.2 Baseline Assessment and Methodology

8.8.2.1 Economic Baseline Methodology

In accordance with relevant legislation, the APMEP must have a 'project base case', which is based on the local social and economic outcomes of the surrounding environment to the amended APMEP. AIGIS (2019) has identified key factors that may influence the 'base case' (BAU) of the EIA:

- Withholding of consent for the APMEP. This would effectively lead to cessation of ongoing care and maintenance (C&M) work on the site. Centennial would essentially be obliged to commence decommissioning, rehabilitation and ultimately cessation of all works on the site.
- Given that the approach adopted by Centennial is essentially to sequence the resumption of production at Angus Place off the end of production at Springvale Mine, failure to obtain consent would result in closure of both mines, at the expiration of Springvale Mine's consent (31 December 2028).

8.8.2.2 Social Baseline Methodology

The SIA utilised a baseline of information from a variety of desktop sources, including, but not limited to, the following aspects:

- Local and State town planning legislation and interactive mapping;
- Existing commissioned reports i.e. cultural heritage, biodiversity etc.;
- Analysis of existing submission and complaints;
- Government online reports i.e. biodiversity values etc.;
- Geographical statistics;
- ABS LGA data sets in relation to Lidsdale community dynamics; and
- Local history data i.e. settlement patterns.

Relevant parts of international and NSW social guideline requirements were utilised to determine the social dynamics of the region, based on the above-mentioned desktop sources and on-ground community consultation. Hanson Bailey (2019) provided a summary of the SIA methodology against key phases in the SIA process in Table 8-43 below.

Table 8-43 Social Methodology

Phase	Methodology
Phase 1 – Preparation	
Development of stakeholder engagement strategy	Initial stakeholder identification and analysis. Preparation of Stakeholder Engagement Plan (SEP).
Define social area of influence	Review of APMEP components, corporate policies and guidelines, and analysis of background material to define the APMEP's social area of influence.
Phase 2 – Community Profiling	
Socio-demographic analysis	Analysis of Australian Bureau of Statistics (ABS) Census data and other relevant social and community indicators and data sets to develop a detailed social profile of the communities of interest (Wallerawang-Lidsdale, Portland and Lithgow). Areas of community vulnerability have been identified through demographic analysis of particular indicators. Review of socio-economic statistics relevant to the Indigenous community.
Analysis of historic and contemporary issues and opportunities	Literature review (including review of local media) and analysis of historical accounts of the region to understand previous and emerging issues and opportunities within the community, as well as Angus Place Mine. Engagement with select stakeholders from nearby communities to inform historic analysis and validate historic issues and opportunities.
Guidelines analysis	Review corporate and operational standards, policies and programs relevant to the SIA.
Phase 3 – Scoping of Impacts and Opportunities	
Scoping of impacts and opportunities	Stakeholder engagement including: ■ Face-to-face and telephone interviews with residents of Wallerawang-Lidsdale and broader Lithgow LGA; and ■ Community information sessions to allow input from landholders in proximity to the Project Application Area and wider community on the impacts and opportunities of the APMEP. Review of Centennial Angus Place complaints register for various mining operations in the Lithgow LGA including Angus Place Mine and Springvale Mine. Review of submissions received in response to the public exhibition of the original Angus Place Mine Extension EIS and other proposed projects in the local area including Springvale Mine Extension Project and modifications, and Springvale Water Treatment Project and modifications.

Phase	Methodology
	Analysis of relevant media including coverage of the cessation of mining at Angus Place in 2014, the closure of the Wallerewang Power Station, and the 2016 Springvale stand down event. Review and analysis of the findings of broader engagement data.
Phase 4 – Assessment of Impacts and Opportunities	
Analysis of impacts and opportunities	Review and analysis of historical responses by nearby communities (Wallerawang-Lidsdale and Portland) to mining. Review of relevant case studies e.g. the cessation of mining at Angus Place in 2014, the closure of WPS, and the 2016 Springvale stand down event. Prediction of social impacts associated with the APMEP.
Phase 5 – Identification of Management and Enhancement Strategies	
Social impact management and residual risk rating	Identification and development of strategies to address predicted APMEP impacts and enhance opportunities.
Phase 6 – Significance Assessment	
Social Risk Matrix	Analysis of social impact significance.

8.8.3 Social - Economic Impact Assessment

The potential social-economic impacts and opportunities have been evaluated in the SEIA and discussed within the following sub-sections:

- Cost-benefit Analysis;
- Employment and economic opportunities;
- Community liveability;
- Values and aspirations;
- Access and use of public land; and
- Cumulative impacts.

8.8.3.1 Cost- Benefit Analysis

The collective public interest of households in NSW and the economic benefit of the APMEP to the NSW community are the focus of the Cost- Benefit Analysis (CBA) (AIGIS, 2019). The principal estimates provided in the CBA assessment assume Present Values (PV) and Net Present Values (NPV) at the discount rate of 7%, with sensitivity testing at 4% and 10% (AIGIS, 2019). The CBA includes an analysis of the following aspects:

- Royalties;
- Economic benefit to works;
- Aggregate economic benefit;
- Net public infrastructure costs;
- Loss of surplus to other industries; and
- Distributional impacts.

The abovementioned aspects are associated with the economic benefit and cost of the APMEP. The economic benefit of the APMEP was calculated by analysing the money coming into the community from the proposed APMEP and comparing how the money benefited or contributed to the community's economic status.

To analyse the economic benefit aspects (royalties and employee benefits etc.) of the CBA assessment, the following economic models were undertaken (Please refer to Table 8-44):

- Monte Carlo Analysis output; and
- Estimate of labour surplus data.

In relation to the economic cost aspect of the APMEP (net public infrastructure costs; loss of surplus to other industries and distributional impacts), the quantitative or monetised assessment of costs essentially relates to valuations of environmental and related effects and their associated social aspects that can be validly calculated (AIGIS, 2019). These are relevant for consideration from the perspectives of both the CBA and the Local Effects Analysis (LEA).

The effects listed in the guidelines were used as a starting point, however, as the APMEP does not involve any additional surface infrastructure that is not already subject of an existing approval, or which requires expansion of the existing surface footprint of the mine, assessments for certain effects provided for in the guidelines, such as biodiversity effects and visual amenity are not assessed (AIGIS, 2019).

In relation to the economic cost aspect of the APMEP (net public infrastructure costs; loss of surplus to other industries and distributional impacts), the quantitative or monetised assessment of costs essentially relates to valuations of environmental and related effects and their associated social aspects that can be validly calculated (AIGIS, 2019). These are relevant for consideration from the perspectives of both the CBA and the Local Effects Analysis (LEA).

The effects listed in the guidelines were used as a starting point, however, as the APMEP does not involve any additional surface infrastructure that is not already subject of an existing approval, or which requires expansion of the existing surface footprint of the mine, assessments for certain effects provided for in the guidelines, such as biodiversity effects and visual amenity are not assessed (AIGIS, 2019).

Table 8-44 Estimate of Economic Benefit

Estimate of Economic Benefit		
Economic Benefit	**Estimation Assumptions**	**Modification Effects**
NSW Government royalties	Refer to Annexure 3, of EIA Report	Assessed PV ≈$138.8 million
Employee benefit – all positions	Refer to Annexure 2, of EIA Report	Assessed PV ≈ $137.6 million
Other Federal, State and Local government taxes, rates etc.	Refer to Annexure 1, of EIA Report	Not quantitatively estimated
Total economic benefit PV		**≈ $276.4 million**

Sensitivity Analyses and Economic Benefit			
Labour surplus discount Rate ($ million)			
	4%	**7% (Central)**	**10%**
Royalties	193.4	**138.8**	102.4
Employee benefit	182.4	137.6	107.2
Total economic benefit	375.8	276.4	209.6
Monte Carlo Analysis ($ million)			
	95% CI lower	**Simulation Mean**	**95% CI upper**
Royalties	138.7	**139.1**	139.4
Employee benefit	137.6	**137.7**	137.8
Total economic benefit	276.3	**276.8**	277.2

Source: AIGIS 2019

In relation to the economic cost aspect of the APMEP (net public infrastructure costs; loss of surplus to other industries and distributional impacts), the quantitative or monetised assessment of costs essentially relates to valuations of environmental and related effects and their associated social aspects that can be validly calculated (AIGIS, 2019). These are relevant for consideration from the perspectives of both the CBA and the Local Effects Analysis (LEA).

The effects listed in the guidelines were used as a starting point, however, as the APMEP does not involve any additional surface infrastructure that is not already subject of an existing approval, or which requires expansion of the existing surface footprint of the mine, assessments for certain effects provided for in the guidelines, such as biodiversity effects and visual amenity are not assessed (AIGIS, 2019).

Those effects that can be monetised are presented in Table 8-45. The method employed for valuations is benefit transfer, as described in the Technical Notes (DPE 2019:10), which also describes the limitations of the method. Those limitations were taken into consideration in determining which effects could be valued.

Table 8-45 Assessment of Environmental, Social and Transport Costs

Description of impact	Assessment assumptions	Assessment outcome
Aboriginal Cultural Heritage	Nine Aboriginal cultural heritage sites within angle of draw (one considered as at risk of subsidence impact): $8.15 per capita p.a. for each 1,000 places protected); SA3 population (46,612) assumed (as the locality)	PV = $32,024 (2020-2053, effects notionally assumed from commencement of full operations 2025).
Groundwater	Qualitative assessment. Some elements of assessment of surface water impacts are interrelated.	-

Description of impact	Assessment assumptions	Assessment outcome
Surface water	Total principal area of impact 2km + 0.2km (drainage line 6) is 2.2km. 6,000 households assumed as per methodology described in Annexure 4, of the EIA Report.	PV = $176,090 (assumed for full APMEP assessment period 2020 – 2053)
Air quality	$PM_{2.5}$ emissions (1.976 tonnes per year); unit damage cost $29,000/tonne, operational stage.	PV = $439,753 (underestimate, as this excludes pre and post-production stages).
GHG	Refer to Table 4 (t CO_2-e) volumes; Annexure 5, of the EIA Report (pricing/cost assumptions)	PV =$35,768,481 (underestimate, as this excludes pre and post-production stages).
Noise & vibration	*Not quantitatively assessed*	-
Traffic	*Not quantitatively assessed*	-
Aquatic ecology & stygofauna	*Not quantitatively assessed*	-
Subsidence	Impacts accounted for in assessments for Aboriginal cultural heritage, groundwater and surface water	-
Total Assessment		PV = $36,433,960 (≈ $36.4 million)

Source: AIGIS 2019

Net Public Infrastructure Costs

Net public infrastructure costs were assessed as part of the previous EIS, as no costs would be imposed from the APMEP on the local council, and by association the community (utilities connection will be assessed under a separate approval cover). Given the APMEP is an existing mine with established infrastructure, no increase in public infrastructure costs will be imposed on the NSW community (AIGIS, 2019).

In the BAU case however, there is a high likelihood of costs being imposed on state-owned and/or operated infrastructure. This is particularly in respect of transport infrastructure, as alternative fuel sources for MPPS would need to be sourced from more distant producers. Alternatively sourced fuel would most likely be transported by rail, with a likelihood of some component of road transport.

Given the proximity of the MPPS to the APMEP, certain settlements in the Local Government Area (LGA), particularly Lidsdale and Wallerawang would be most exposed to impacts from alternative fuel sources. The use of alternate fuels will reduce the volume of coal transferred to MPPS via the existing conveyor.

Distributional Impacts

It is unlikely that there would be distributional impacts from the proposed APMEP, as limited economic effects will occur from the closure of Springvale Mine. This is because the APMEP will not cause a material change and operate in a similar capacity to Springvale Mine. In relation to the BAU consideration, the following is noted:

- Impacts on public infrastructure and other industries, have been considered and determined not be an impact due to the existing distribution measures;
- Less efficient coal delivery methods, due to the distance to sources coal from other areas to power MPPS; and
- The effect of distributional impacts on the regional economy, particularly Lithgow LGA if the mine did not go ahead. As Lithgow Council strategy document includes coal mining as an integral economic contributor to the local community.

Net Economic Cost/Benefit of the Project

The Net Present Value (NPV) for the CBA element of the APMEP is presented in Table 8-46 which is combined data of Table 8-44 and Table 8-45. The table also reports the Cost-Benefit Ratio (CBR) for these APMEP assessments (AIGIS, 2019).

Table 8-46 CBA Estimate of net economic cost/benefit ($ million)

CBA Estimate of Net Economic Cost/Benefit ($ million)

Economic Benefit	**PV @ 4%**	**PV @ 7% (central)**	**PV @ 10%**
Assessed benefit	375.8	**276.4**	209.6
Assessed cost	51.5	**36.4**	26.7
Project CBA NPV	324.3	**240**	182.9
Project CBR	7.3	**7.6**	7.9

Source: AIGIS 2019

According to AIGIS (2019), the direct benefit of the APMEP to NSW at each discount rate is significantly greater than the assessed costs. Certain cost assessments, such as for greenhouse gas emissions, are considered low estimates. This is a consequence of the periods over which they were assessed, which excluded pre-and post-operational periods.

Sensitivity Testing – Alternative Benefit and Cost Assumptions

The guidelines indicate a series of additional sensitivity testing parameters, which essentially test the central assumptions of the CBA based on adjustment of operating outcomes (DPE, 2015:18). The adjustment parameter was determined by the ratio between output during the ‘shoulder’ or ramp-up period and average annual output in full production. The adjustment was applied across all years of the assessment period, to permit calculation of a conservative (i.e. highest cost) estimate (AIGIS, 2019).

Consequently, based on price adjustments, this outcome cannot be considered as material (AIGIS, 2019).

8.8.3.2 Employment and Economic Opportunities

The economic impact of the APMEP, including consideration of employment opportunities is assessed through the SEIA (AIGIS Group, 2019) and is consequently not replicated in full in the SIA. A summary is provided within Table 8-47.

Table 8-47 Employment and Economic Opportunities

Economic Considerations	Description
Employment Generation and Labour Market Dynamics	The APMEP is forecast to require 450 full time workers during the operation of the mine. This is the same amount of workers currently working at Springvale Mine. It is predicted that no material change in the work force will change, which will not cause a social impact to the surrounding community.
Economic Opportunities	As mentioned in the EIA, there are large financial implications of the APMEP. Specifically: ■ $139 million in royalties; ■ $383 million spend with regional suppliers; and ■ $1,664 million spend with NSW based suppliers. Due to the above economic potential, the APMEP will continue to the support the local community, which relies on mining to stimulate their local economy. If the APMEP did not go ahead, the local community would be impacted, as Springvale and APMEP care and maintenance will eventually cease.
Economic and Industry Diversity	The Lithgow LGA is heavily dependent on mining and many consider the town to be a 'mining town'. The Lithgow City Council (LCC) has recognised that need for diversification of industries away from mining, to support the town in the long term. Centennial acknowledges the potential impacts of the APMEP on other industries within the region. They have committed to continue to liaise with LCC in relation to the cessation of mining.
Transitional Economy	As mentioned above, LCC want to transition their economy away from mining to ensure a sustainable future for the region. The Lithgow REDS provides a framework for securing greater economic diversity across the Lithgow LGA. The Lithgow REDS recognises that each of the mining and power generation operations across the Lithgow LGA have an end date. However, economic diversification across the LGA will take time. The APMEP project life presents a realistic timeframe for LCC to target for economic diversification.
Sustained Energy Security	The APMEP will provide sustained energy security, as Springvale is scheduled to close by 2024. If the APMEP was not to proceed, there may not be sufficient energy supply to support the MPPS. In such a circumstance energy sources would be required from elsewhere to power the MPPS. Meaning jobs would be taken away from the region.

Source: Henson Bailey, 2019

8.8.3.3 Community Liveability

The community liveability assessment reviewed all environmental and social quality impacts within the area on residents, employees and visitors.

Community Strength and Identity

The local Lithgow community has experienced periods where mining had ceased in recent times, such as the Springvale Mine stand down and the care and maintenance of Angus Place. During the community consultation for the APMEP, residents identified the following impacts experienced during a downturn in mining activities:

- Less local spending;
- Reduced involvement in the community and community events;
- Increased anxiety amongst previously employed workers and their families;
- The loss of families from the area and resultant fracturing of social connections. Some participants in the SIA consultation noted that several families moved out of the area when Angus Place Colliery was placed on care and maintenance, and those residents that stayed found work within and outside of Lithgow LGA (sometimes travelling further distances to their place of employment); and
- Reduction in commercial activity both within the smaller communities e.g. Wallerawang but also in the larger centre of Lithgow.

If the APMEP was not to go ahead and the Springvale mine closed in 2024, the City would likely decline significantly. Mining is a key part of the local community and its identity. The direct removal of this aspect would directly affect the community on a social and economic level.

Road Safety and Accessibility

SIA consultation findings indicate a low level of concern in relation to the potential impacts from the APMEP on road safety, pedestrian safety and accessibility. Where an impact could occur, it will be managed within the Construction Traffic Management Plan (CTMP), please refer to Section 8.7 of this Report.

Residential Amenity

Noise, vibration, traffic and air quality were all determined to be key residential amenity issues within the SEIA. Overall, the impacts from these amenity concerns on residents was considered to be negligible, as they would be mitigated within management plans. Please refer to Sections 8.4, 8.5 and 8.7 of this Report for specific management and mitigation measures.

Health and Wellbeing

There were no specific health and wellbeing concerns identified as part of the SEIA. However, some health and wellbeing impacts may occur if the APMEP did not proceed in relation to jobs being lost that would cause direct and indirect impacts, such as metal health conditions. As such, it has been determined that there would be significant positive health and wellbeing impacts if the APMEP was approved.

8.8.3.4 Values and Aspirations

The SEIA has assessed the potential impact of the APMEP on Indigenous and non-Indigenous cultural and environmental values and aspirations. The APMEP may give rise to damage and/or permanent loss of valued natural and cultural attributes, such as swamps, cliffs and rock pagodas.

Section 8.6.4 of this Report describes the mitigation and management measures for cultural and historical heritage proposed.

8.8.3.5 Access and Use of Public Land

A number of access areas are required as part of the APMEP, specifically within the Newnes Plateau. The Newnes Plateau forms part of the local identity and due to the proposed construction works of the APMEP, some access tracks may be temporarily restricted.

The impact of the construction works is considered to be minor as the majority of infrastructure will be located away from the main public use areas on the Newnes Plateau.. Centennial Angus Place already has an existing agreement with Forestry Corporation of NSW to maintain access tracks in Newnes Plateau, which will be extended to the proposed APMEP works. This maintenance agreement benefits the local community, by allowing safe access to a recreational area for the community to enjoy (Hansen Bailey, 2019).

Consequently, the overall impact of construction works on access and use of public land is considered negligible.

8.8.3.6 Cumulative Impacts

The potential for cumulative social impacts from major projects proposed in the Lithgow LGA and adjoining LGAs has been considered to be low. This is because no other major projects are in close proximity to contribute to cumulative impact on a local amenity scale (Hansen Bailey, 2019). The following reasons are provided to support the conclusion that no cumulative impacts will occur from the APMEP:

- The APMEP would have negligible additional impacts on population, social infrastructure or housing given the anticipated workforce sourcing arrangements, and as such there is low potential for cumulative impacts on these factors;
- In a scenario in which one other project of similar size was constructed in the same timeframe as the APMEP, cumulative demand for mine construction workers is unlikely to result. This is because of the small construction workforce associated with the APMEP;
- Lithgow residents currently experience the cumulative impacts of mine and power generation related activity on the road network outside of Newnes Plateau. The APMEP would represent a continuation of Springvale Mine's existing contribution to these cumulative impacts, but would not significantly intensify impacts; and
- The Lithgow community is experienced in managing the cumulative impacts of mining operations, so a degree of resilience to impacts is likely (as demonstrated in the historical development of the communities of Wallerawang, Lidsdale and Portland).

8.8.4 Revised Recommendations

An updated list of recommendations based on the APMEP is provided below:

Economic Impact Assessment

- The recommendations proposed by specialist consultants in respect of addressing environmental effects should be employed to the extent practicable;
- Centennial execute the appropriate environmental offset strategy as proposed, to further mitigate predicted effects;
- Centennial continue its programs of community consultation and engagement, with local and regional stakeholders in particular; and
- Recommendations from the Social Impact Assessment (Hansen Bailey 2019) in respect of managing such impacts be employed by Centennial, should those be supplementary to existing initiatives.

Social Impact Assessment

- Continue to provide funds to the Community Contribution Fund to the LCC, which will provide annual financial payments to Council;
- Undertake a Social Baseline Review of all communities of interest, every five years;
- Continuation of the Western Region Combined CCC;
- All environmental incidents, including community complaints, are recorded in the Environment and Community Database (ECD), or its equivalent;
- An Adaptive Management Framework is developed to account for uncertainties and to improve management responses for all impacts to environmental and cultural values;
- Centennial shall commence the preparation of a Mine Closure SIA and Management Plan at least five years prior to the potential Mine Closure; and
- Implement the Swamp Offset Strategy.

9. EVALUATION OF MERITS

9.1 Suitability of the Site

The existing Angus Place Colliery commenced operations as a bord and pillar mine in 1949, known then as Newcom Colliery. The first approval for a longwall mine was granted in 1979 and is apporved within Mining Lease 1434 under a Planning Approval granted in 2006 (PA 06_0021) which will expire in 2024. Centennial applied to NSW DPIE (formerly DPE), to extend the mine for another 25 years of operation (2014 EIS). The application (SSD 5602) was put on hold in 2015 as the mine was put into care and maintenance due to coal commodity prices dropping.

Approval of the APMEP is required to maintain employment opportunities within the immediate area, due to the scheduled closure of Springvale Mine in 2024.

9.2 Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) is an internationally recognised concept, which has been adopted by the Commonwealth and States of Australia. In NSW's ESD principles have been adopted within the EP&A Act under Section 6 (2) of the *Protection of the Environment Administration Act 1991*, which identifies the four ESD principles. The four ESD principles are:

- precautionary principle;
- Inter-generational equity;
- Conservation of biological diversity and ecological integrity; and
- Improved valuation, pricing and incentive mechanisms.

The purpose of the ESD principles is to provide effective integration of economic, environmental, social and equity considerations in decision-making processes. ESD aims to provide for the needs of present generations without compromising the ability of future generations to meet their own needs. The following Table 9-1 provides a summary of the commitments that the APMEP will meet in relation to the four ESD principles.

Table 9-1 ESD Principles and Commitments

ESD Principles	Definitions	APMEP Commitments
Precautionary principle	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Public and private decisions should be guided by careful evaluation to avoid serious or irreversible damage to the environment wherever practicable, and an assessment of the risk-weighted consequences of various options.	All potential environmental impacts have been studied extensively as part of the original EIS and the Amendment Report. All studies have been based on best practice guidelines, monitoring data and legislative requirements. The results are being provided to the NSW Government to independently assess the application and review the studies commissioned by Centennial Angus Place. As the APMEP is a conservative mine design proposed for land that is already highly modified by an existing mine. It is acknowledged that the mine will be located beneath endangered swamps, and this may cause drying of the swamps. However, the impacts to these swamps will be localised. Additionally, an offset will be implemented to compensate for the potential impact to these swamps.

ESD Principles	Definitions	APMEP Commitments
		The APMEP will have environmental impacts and Centennial Angus Place has invested significantly in research, the outcomes of which have been used to modify the design to minimise these impacts. However, given the overall impact of the mine, it is unlikely that this proposal will cause significant damage to the environmental values of the region. Centennial Angus Place is committed to providing all necessary information to ensure they are approved and operating within the core ESD principles.
Inter-generational equity	The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations	The principles of social equity has been addressed in the Amendment Report through the assessment of economic and social impacts within Section 8.8 of this Report. Currently coal is the basis of power generation within NSW, although a transition away from coal is underway However, for the near future, coal within the Lithgow area is required to power the MPPS. Coal mining for MPPS and international exports provide economic and social stability to the Lithgow area. Centennial Angus Place is committed to working with LCC and the State government to ensure that they are well placed to support the community into the future.
Conservation of biological diversity and ecological integrity	Conservation of biological diversity and ecological integrity should be a fundamental consideration in environmental planning and decision-making processes. Biodiversity refers to the variety of all life. Environmental and species impact statements are one way that this principle is enacted.	The biological diversity and ecological integrity values of the area have been assessed. The environmental impact to biological diversity and ecological integrity will be localised. Management plans and offset strategies have been developed to support this principle and protect values. Centennial Angus Place is committed to implementing management plans and offset strategies to mitigate against any potential environmental harm that may be caused by the APMEP.
Improved valuation, pricing and incentive mechanisms	Environmental factors should be included in the valuation of assets and services, such as: ■ polluter pays – those who generate pollution and waste should bear the cost of containment, avoidance or abatement;	Resources are required to be managed for the benefit of society. To achieve this, economic efficiency should be sought for current and future generations. Centennial Angus Place will pay royalties and other taxes to the local, state and Commonwealth government.

ESD Principles	Definitions	APMEP Commitments
	■ the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste; and ■ environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.	Additionally, offsets will be paid to mitigate against the potential environmental harm caused to the swamps. Centennial Angus Place will be injecting approximately 2186 million directly and indirectly into the local and state government. With the proposed management plans and mitigation measures imposed improved valuation, pricing and incentive mechanisms can be achieved.

9.3 Community Consultation

Changes to the mine design associated with the APMEP have been based on feedback and submissions on the 2014 EIS process and an increased understanding of swamp impacts. Based on submissions on the 2014 EIS, including recommendations from environmental stakeholders and subsequent environmental monitoring data, it was decided to increase the minimum setback distance between the edge of the nearest longwall mining void and the boundary of the Gardens of Stone National Park boundary to 1000m.

This change to the mine design involved the shortening of each of longwalls 1008 – 1015 (inclusive) by between 200m and 1800m relative to the 2014 EIS.

In order to minimise impacts to Trail 6 Swamp, Longwall 1015 was also shortened to ensure that the swamp will not be directly undermined. Avoiding impacts to NPSS and NPHS through further mine design measures and/or avoidance of lineaments is not considered feasible.

To ensure the mine remains economically viable, a consistent void width of 360m has been adopted.

9.4 Legislative Framework

The APMEP has been assessed with full consideration of the applicable legislative requirements of the Commonwealth and State, along with the local planning and environmental frameworks of the Lithgow LGA. Chapter 4 of this Report details the specific permissibility of the APMEP, in relation to statutory requirements and relevant strategic planning policies.

9.4.1 Section 4.15 (1) of the EP&A Act

Section 4.15 (1) of the EP&A Act describes the 'matters for consideration'. The following Table 9-2 provides a summary on Section 4.15 (1) and how these matters have been addressed within the Amendment Report.

Table 9-2 Matters for Consideration

Statutory Requirements	Summary
(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality	The likely impact of the development has been discussed in Section 6, 7 and 8 of this Report. The impacts have been considered, with management and mitigation measures developed to reduce the likely environmental impact.
(c) the suitability of the site for the development,	Please refer to Section 9.1 of this Report.
(d) any submissions made in accordance with this Act or the regulations,	The original EIS Report was placed on public exhibition 2014. During this period the public was invited to provide submissions which were considered by the Minister. A number of amendments were made to the original EIS, before it was placed on hold. The Amendment Report will be placed on public exhibition in relation to the updated or revised components of the application.
(e) the public interest.	The APMEP is of public interest because of the positive socio-economic benefits that will arise, as identified within Section 8.8 of this Report. The socio-economic benefits are a defining component of this application, due to the important role that coal mining has within the Lithgow region. It is anticipated that the socio-economic benefits discussed within Section 8.8, can be achieved and will offset the localised environmental impacts.

9.5 Updated Environmental Impacts

As detailed within Chapter 8, the potential environment impacts of the APMEP have been identified and updated management and mitigation measures proposed. Table 9-3 summarises the updated environmental impacts.

Table 9-3 Summary of Environmental Impacts

Environmental Issues	Evaluation	Mitigation Measures	Summary/Merits
Aquatic Ecology	■ The APMEP has been designed to avoid or minimise potential impacts on aquatic ecology and includes the setback of longwalls from major watercourses. ■ It is acknowledged that localised impacts to aquatic and macroinvertebrates may occur; and ■ Groundwater depressurisation will occur and is the greatest potential impact to stygofauna.	■ The revised statement of commitments includes the preparation of a regional stygofauna assessment. ■ Updated management and mitigation measures have been undertaken and will be adopted into the existing regional Stygofauna assessment.	Potential impacts to the aquatic environment from groundwater depressurisation or reduced localised flow has been identified, however, the amended mine design has committed to a number of management and mitigation measures which will ensure that the environmental impact to aquatic habitat value is minimised.
Air Quality	■ Potential air quality impacts may be associated with the construction of additional surface infrastructure; and ■ Operational phase air quality impacts are negligible, in light of the distance from sensitive receptors to the APMEP.	■ The revised statement of commitments includes a number of management and mitigation measures associated with temporary construction impacts; and ■ To manage air quality aspects during mining operations, an Air Quality Management Plan will be prepared and will include all revised management and mitigation measures.	There will be a temporary impact to the immediate air quality from construction works. However, there are few residential dwellings within close proximity to the works. It is considered that this environmental effect will have acceptable impacts.
Cultural Heritage	■ The APMEP has the potential to impact one culturally significant site - #45-1-0084 rock shelter.	■ Centennial Angus Place is committed to locating the rock shelter prior to the mining commencing to ensure accurate monitoring and reporting of any subsidence related impact. This is to ensure reliable baseline data is available to enable accurate monitoring and reporting of any subsidence related impacts; and	The previous heritage assessment prepared by RPS (2014), as documented in the 2014 EIS, identified three Aboriginal heritage sites (#45-1-0084, #45-1-0137 and #45-1-2756/2757) at potential risk of impact through minor spalling of exposed rock faces.

Environmental Issues	Evaluation	Mitigation Measures	Summary/Merits
		■ To manage all heritage aspects, a Heritage Management Plan has been previously prepared and will be updated with all revised management and mitigation measures.	As a result of the APMEP, potential impacts have been reduced and only one site is now at risk of being impacted.
Traffic and Transport	■ Due to the temporary nature of the construction related impacts from traffic, the revised traffic impact assessment found marginal environmental impact would occur.	■ The revised statement of commitments includes a number of management and mitigation measure relating to minimising the temporary impact of construction based traffic, including the preparation of a Construction Traffic Management Plan	As the construction impacts are not long term it is anticipated that impacts can be mitigated. No additional impacts to those proposed within the 2014 EIS are predicted to occur.
Biodiversity	■ Subsidence related impacts have the potential to indirectly impact biodiversity values; and ■ Construction of surface infrastructure will directly impact biodiversity values within the disturbance footprints.	■ The revised statement of commitments includes management measures for direct and indirect impacts through a Swamp Monitoring Program, Swamp Offset Strategy and Biodiversity Management Plan. All updated management and mitigation measures for the amended APMEP will be implemented.	Infrastructure will be designed to avoid and minimise impacts on bushland and threatened species by avoiding areas of high biodiversity value, confining construction to pre-disturbed areas and established access tracks where possible. Where impacts cannot be avoided, the actual offset liabilities will be offset in accordance with the BC Act. Any environmental consequences assessed to be greater than negligible to THPSS and their associated threatened species will be offset in accordance with the NSW Biodiversity Offset Scheme and the Commonwealth EPBC Act Environmental Offsets Policy. These are additional impacts to those reported within the 2014 EIS although they are based on our increased understanding of swamp impacts and not a new impact.

Environmental Issues	Evaluation	Mitigation Measures	Summary/Merits
Water Impacts	■ The greatest potential impact from the Project is from subsidence impacting on hydraulic conductivity; and ■ Groundwater drawdown impact on swamps.	■ The revised statement of commitments includes a number of management and mitigation measures including continued monitoring of the groundwater and surface water network.	During mining, the APMEP will meet the requirements of the State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 for neutral or beneficial effect on water quality for a continuing development. From 2020 all mine inflows from existing workings will be transferred to the Springvale Water Treatment Project for desalination and beneficial reuse at the Mount Piper Power Station. In general, with the exception of predicted water table declines at THPSS, the amended APMEP would also meet with the Level 1 Minimal Impact Considerations for highly productive, porous rock aquifers.

9.6 Conclusion

The Lithgow LGA has a long history of coal mining dating back to the 1800s. The town of Lithgow and nearby communities were established on the foundations of coal mining. There are several coal mines operating in the region, including Springvale Mine in close proximity to APMEP (Hansen Bailey, 2019). It is this history that prevails today, as coal mining continues to be the economic basis of the region.

The project will have environmental impacts particularly in relation to the swamps. Redesign of the mine has minimised these impacts and Centennial Angus Place is committed to management of impacts and contributions to offsetting.

Consequently, the impacts and benefits of the APMEP favour the public interest, as coal mining is a key aspect of the Lithgow identity and its way of life. If the APMEP were not to go ahead, it would cause significant direct and indirect social and economic impacts to this region and its people and jeopardise future coal supply options to the Mount Piper Power Station, potentially impacting on reliable electricity generation.

10. REVISED STATEMENT OF COMMITMENTS

This chapter details the revised Statement of Commitments to outline all proposed environmental management and mitigation measures proposed to reduce adverse environmental impacts associated with the APMEP.

Centennial is committed to the identification, mitigation and management of potential risks from the continued operations of the Angus Place Colliery. Key management plans are already developed and in place to manage and monitor the performance of these operations. These management plans, where applicable, will be updated in accordance with the updated revised Statement of Commitments provided in Table 10-1 below. An updated listed of detailed mitigation measures for APMEP are provided in Appendix C.

If approval is granted for the APMEP Centennial Angus Place will adopt the Statement of Commitments throughout the APMEP. Where practical, monitoring programs and management plans will be developed and implemented regionally across Centennial's western operations. This will include, but not be limited to, monitoring programs and management plans related to water (surface and groundwater), biodiversity, noise, air quality, Aboriginal heritage and Historic heritage.

Table 10-1 Revised Statement of Commitments

Desired Outcome	Action
Project Construction Phase	
1. Construction Traffic and Transport	
Construction related impacts on the road network are limited.	A Construction Traffic Management Plan (CTMP) and Driver Code of Conduct will be developed and implemented. The CTMP shall include the following key recommendations (EMM 2019): ■ Road maintenance program implemented for the affected unsealed rural roads within Newnes State Forest, namely Old Bells Line of Road, Glowworm Tunnel Road, Blackfellows Hand Trail and Sunnyside Ridge Road; ■ Construction and speed management signage; ■ Varying speed limits on sealed and unsealed roads information and management techniques; ■ General road safety rules (e.g. do not drive under the influence of alcohol and medication); ■ Awareness of driving on dirt roads in severe weather condition information and management techniques; and ■ Fatigue management measures information and management techniques.
Impacts from construction activities are minimised	All auxiliary infrastructure that may be required to be installed will be subject to a Construction and Environmental Management Plan (CEMP).

Desired Outcome	Action
Project Operational Phase	
2. Surface Water and Groundwater	
All surface water and groundwater impacts are minimised to the greatest extent possible.	A Water Management Plan will be prepared for the Angus Place Colliery to take into consideration the APMEP, any conditions of consent and the commitments detailed in Section 8.1.8 of the Amendment Report.
	Additional flow and water quality monitoring sites will be established at the bottom end of Trail Six/Japan Swamp, Birds Rock Swamp and Crocodile Swamp.
	Annual stream condition monitoring will be implemented at key locations along water courses that overly or are within 600m of the proposed extraction area. Monitoring will comprise a combination of photographic monitoring and site observation to identify influences of sedimentation or scouring.
3. Biodiversity	
Ensure all biodiversity impacts are minimised to the greatest extent possible.	A Biodiversity Management Plan for the Angus Place Colliery to take into consideration the APMEP, any conditions of consent and the commitments detailed in Section 8.2.5 and Section 8.3.4 of the Amendment Report.
	Vegetation clearing associated with surface infrastructure will be minimised as far as practicable and be within the assessed Impact Envelope for the APMEP.
	A comprehensive monitoring plan to assess the potential impacts of mine subsidence on aquatic habitat and biota within watercourses of the Study Area will be implemented.
Ensure any impacts to biodiversity are offset in accordance with relevant policies	The proposed Swamp Offset Strategy will be implemented to compensate for impacts to THPSS.
	The actual liability for vegetation clearing associated with surface infrastructure will be calculated and offset in accordance with the BC Act within 12 months of impacts being realised.
4. Aboriginal and Historical Heritage Management	
Ensure that identified and unidentified Aboriginal sites are appropriately managed.	The Western Region Aboriginal Cultural Heritage Management Plan will be updated to take into consideration the APMEP, any conditions of consent and the commitments detailed in Section 8.6.4 of this Amendment Report.
Ensure that identified and unidentified Historic heritage sites are appropriately managed.	The Western Region Aboriginal Cultural Heritage Management Plan will be updated to take into consideration the APMEP, any conditions of consent and the commitments detailed in Section 8.6.4 of the Amendment Report.

Desired Outcome	Action
5. Noise and Vibration	
All noise impacts are minimised to the greatest extent possible.	The Western Region Noise Management Plan will be updated to take into consideration the APMEP, any conditions of consent and the commitments detailed in Section 8.4.5 of the Amendment Report.
	Centennial Angus Place will undertake a noise monitoring program to validate the assumptions made in the Noise and Vibration Impact Assessment including the sound power level of on-site plant and equipment and off-site noise emissions. Operations of acoustically significant plant and equipment during the evening and night-time (not modelled to be operational) will be limited until it can be demonstrated that operation of the site can comply with the relevant noise limits at the nearest assessment locations.
6. Air Quality and Greenhouse Gas	
All air quality impacts are minimised to the greatest extent possible.	The Western Region Air Quality and Greenhouse Gas Management Plan will be updated to take into consideration the APMEP, any conditions of consent and the commitments detailed in Section 8.4.5 of the Amendment Report.
7. Social- Economic Impacts	
	All updated social and economic recommendations detailed in Section 8.8 of the Amendment Report shall be implemented.

11. CONCLUSION

The Angus Place Colliery approval and its subsequent modifications remain current and authorises the extraction of up to 4 million tonnes of run of mine (ROM) coal per annum. The current project approval will expire in August 2024 and a new Development Consent is required to ensure Angus Place Colliery is operational beyond this date. This Amendment Report outlines the proposed changes to the APMEP from the 2014 EIS and includes an assessment of the environmental, social and economic impacts associated with the Project.

Coal mining is an essential component to the Lithgow and surrounding regions identity. LCC recognise that transitioning away from coal mining is important to secure the regions ongoing success. However, for the near future coal mining is this regions stability and ensures social and economic harmony. The social and economic output of the Project will continue to provide direct and indirect employment and flow on benefits to the Lithgow Government Area and the surrounding region. There will be an injection of approximately $2,186 million into the local, regional and state economies over the life of the amended APMEP.

The amended APMEP presents a revised mine design which has been designed based on the latest findings about the impacts of subsidence on natural resources. These modifications include:

- Shortening longwalls to provide a minimum setback from the Gardens of Stone National Park of 1000 m to reduce the risks of subsidence related impacts on the National Park;
- Shortening longwalls to avoid directly undermining the Trail 6 Newnes Plateau Shrub Swamp; and
- To ensure the mine remains economically viable, an increase in the void widths to some longwalls has been proposed to provide a consistent 360 m wide longwall void width across the entire 1000 panel longwall mining area.

These mine plan changes have resulted in the number of longwalls being reduced from 19 to 15 with an overall reduction in the mine plan footprint when compared to what was presented in the 2014 EIS.

Subsidence-related impacts are expected at Tri-Star Swamp, Twin Gully Swamp, Trail Six Swamp and the hanging swamps within their catchments. Impacts to THPSS-associated threatened species are also likely in these locations. In accordance with the BC Act and EPBC Act, any environmental consequences assessed to be greater than negligible to THPSS and their associated threatened species will be required to be offset in accordance with the NSW Biodiversity Offset Scheme and the Commonwealth EPBC Act Environmental Offsets Policy. This Amendment Report and supporting technical assessment have taken a conservative stance by assuming total loss of THPSS within the amended Project Application Area, thereby presenting the maximum potential ecosystem and species credit liability.

The social and economic impacts of Springvale's closure is also an important aspect to consider as part of the proposed APMEP. Springvale Coal Mine (owned by Centennial) currently employs 450 full-time mine workers and is scheduled for closure in 2024. The APMEP, once developed, will provide continued employment opportunities for up to 450 full time employees. This will ensure that the current social and economic climate on the Lithgow region would remain relatively stable.

In summary, while it is recognised that the APMEP will have some environmental impacts as identified above, it will also secure significant social and economic benefits. On the basis that avoidance, management, mitigation and offset measures will be adopted, the Project as amended is submitted for consideration.

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