



Extraction Plan Main Report (CLZ (ML1814))

**Cliff Line Zone of First Workings
Extraction Plan (ML1814)**

Airly Mine (SSD_5581)

July 2024

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EXECUTIVE SUMMARY

Airly Mine is an existing underground coal mine situated in the Western Coalfield. It is located approximately 40 kilometres (km) northwest of Lithgow in New South Wales, 170km northwest of Sydney and 4 km to the northeast of Capertee within the Lithgow City Local Government Area in New South Wales. The Airly Mine includes an underground coal mine, a coal handling and preparation plant and associated rail siding and surface infrastructure.

The Airly Mine operates under State Significant Development consent SSD_5581 which includes a series of conditions relating to the management of subsidence impacts and environmental consequences of underground coal mining. This includes the preparation and approval of a suite of management plans prior to carrying out any first workings within the Cliff Line Zone and Zone of First Workings, or second workings.

This Extraction Plan for first workings within the Cliff Line Zone and Zone of First Workings (CLZ) within Mining Lease 1814 (ML1814) and has been prepared in accordance with Condition 7 in Schedule 3 of SSD_5581 and the Extraction Plan Guideline (DPE 2022). This Extraction Plan has been prepared by a team of suitably qualified and experienced persons whose appointment has been endorsed by the Secretary in accordance with Condition 7(a) in Schedule 3 of SSD_5581. This Extraction Plan describes the applicable regulatory framework, mine planning, management and monitoring measures to be implemented to ensure the protection of all surface/subsurface natural and built features and the protection of public safety from subsidence associated with first workings within the Extraction Plan Area.

Airly mine has successfully undertaken first workings within the CLZ in ML1331. Predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed first workings within the CLZ (ML1814) Extraction Plan Area have been revised and are provided in full in the Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b), provided as an attachment to this Extraction Plan.

The revised predictions for this Extraction Plan included assessment of the subsidence effects measured in the current first workings at Airly Mine, including a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331). The subsidence predictions and pillar safety calculations have been assessed at an extraction height of 3.2m. The proposed extraction height remains consistent with the EIS requirements for long-term stable pillars.

The predicted levels of subsidence from first workings proposed in this CLZ (ML1814) Extraction Plan are similar to those provided in the 2014 EIS. The assessed levels of potential impact are similar to those based on the EIS Layout. The performance measures for subsidence for the Airly Mine are outlined in Condition 2 in Schedule 3 of SSD_5581. **At these predicted low subsidence levels, it is unlikely that performance measures of SSD_5581 will be exceeded by the proposed first workings.**

This Extraction Plan, and key sub-management plans, outline the management measures that have been developed to manage any subsidence effects. The Subsidence Monitoring Program outlines the objectives and the proposed monitoring program for monitoring compliance with the relevant performance measures for subsidence impacts to natural and built features, as well as appropriate Trigger Action Response Plans in the unlikely event of an exceedance of a subsidence impact performance measure or if an unexpected impact is detected, including consideration of potential adaptive management or contingency measures.

The Extraction Plan for first workings in CLZ (ML1814) also includes information pertaining to incidents, complaints, notification to agencies, plan review and roles and responsibilities.

1 INTRODUCTION

1.1 Background

Airly Mine is an existing underground coal mine located approximately 40 kilometres (km) northwest of Lithgow in New South Wales, 170km northwest of Sydney and 4 km to the northeast of Capertee, as illustrated on **Figure 1.1**. The mine is partly located within the Mugii Murum-ban State Conservation Area (**SCA**). Centennial Airly Pty Limited (**Centennial Airly**) is the operator of the mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited (**Centennial**).

Development Consent for the Airly Mine Extension Project (**MEP**) was approved on 15 December 2016 subject to the Conditions in Schedule 2 to 6 of State Significant Development 5581 (**SSD_5581**). The consent allows extraction of 1.8 million tonnes of run-of-mine (**ROM**) coal per calendar year for a period of 20 years, which is supplied to both domestic and international markets. As per commitments within the Environmental Impact Statement (**EIS**) for SSD_5581, Airly Mine is implementing a conservative and staged approach to mining, with different mining methods applied in different areas of the mining lease called Mining Zones.¹

An Extraction Plan is required to be approved prior to first workings in the Cliff Line Zone and Zone of First Workings to meet Condition 7 in Schedule 3 of SSD_5581.

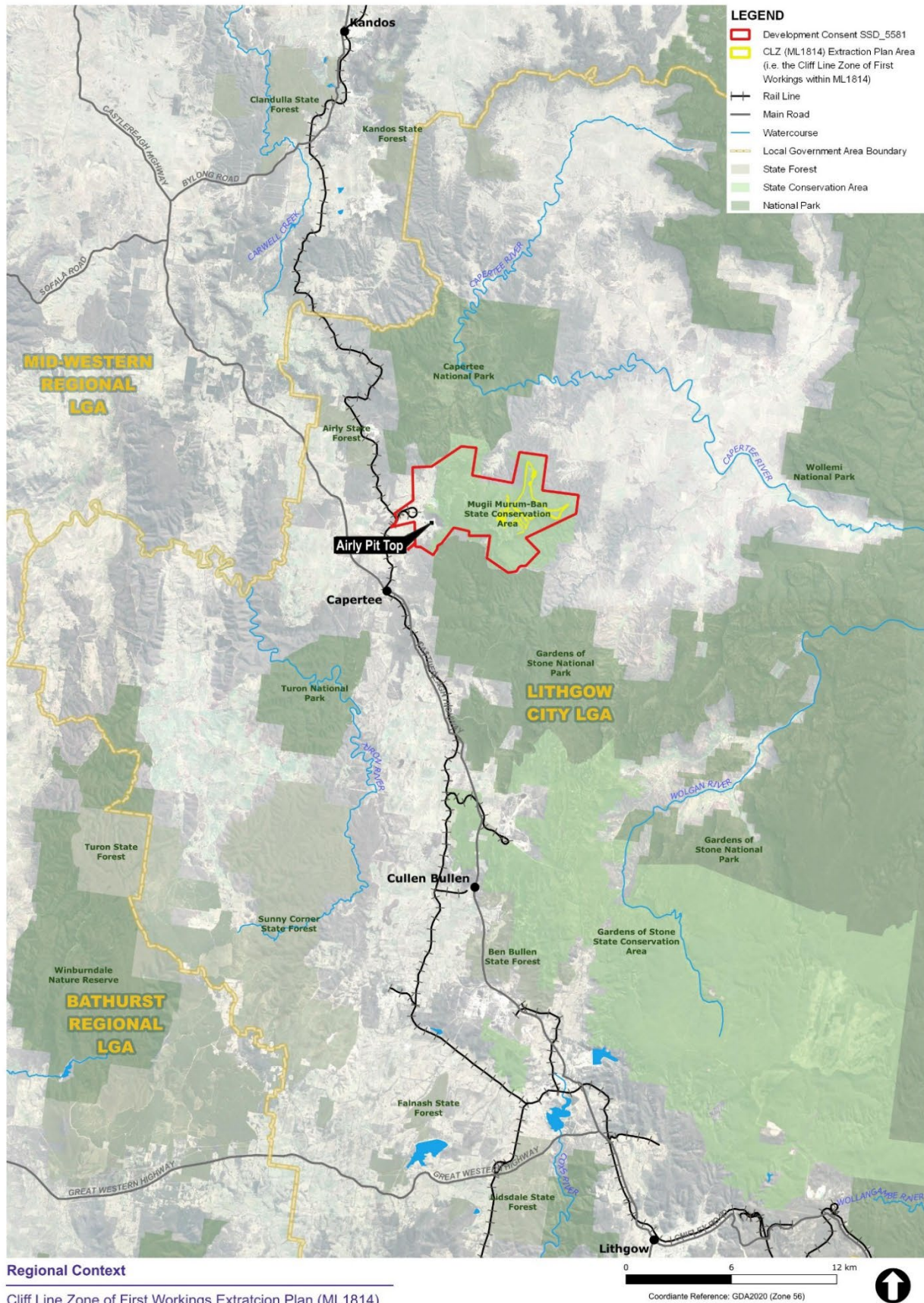
The *Cliff Line Zone of First Workings (ML1814) (CLZ (ML1814)) Extraction Plan* as detailed in the *CLZ (ML1814) Extraction Plan Main Report (the EP Main Report)* and the supporting component plans, continues the conservative approach to mining being implemented by Airly Mine, with the proposed first workings under this Extraction Plan specifically designed to provide long term stable and effectively non-subsiding pillars to protect the surface such that there is no adverse impact. Mine design and implementation is a key element of subsidence impact avoidance and management.

This *CLZ (ML1814) Extraction Plan* describes the applicable regulatory framework, mine planning, management and monitoring measures to be implemented to ensure the protection of all surface/subsurface natural and built features and the protection of public safety from subsidence associated with proposed first workings within the Extraction Plan Area.

The *Extraction Plan Area (EP Area)* is further defined in **Section 1.3**.

¹ Airly Mine has five (5) mining zones approved under development consent SSD_5581 as shown in Figure 2 in Appendix 3 of SSD_5581. These zones provide design criteria for different mining methods based on the differing levels of environmental sensitivity of surface features and depth of cover across the Airly mining leases. Section 8 of the Airly Mine EIS (2014) provides further details on the definitions of each of these approved mining zones if required.

Figure 1.1: Locality Plan



1.2 Purpose and Scope

The purpose of this *EP Main Report* and the supporting sub-management plans is to:

- Provide detailed plans of the project;
- Address all regulatory and related requirements² using a risk based and consultative approach;
- Detail the mine planning and design associated with panel and pillar extraction mining activities, located within the Extraction Plan Area
- Outline potential subsidence effects, subsidence impacts and environmental consequences due to the project;
- Address the key performance measures and objectives for mine design, environmental management and regulatory, with associated indicators;
- Describe the measures that will be implemented to ensure compliance with the subsidence impact performance measures and investigate, mitigate, manage and remediate potential subsidence impacts and environmental consequences; and
- Detail a monitoring and contingency plan for potential subsidence impacts and environmental consequences outside of predictions, including detailed performance indicators for subsidence impact performance measures.

This *EP Main Report* and the supporting sub-management plans have been developed using a risk-based approach and in accordance with:

- Relevant requirements listed under *Condition 7 in Schedule 3* of SSD_5581, which requires an Extraction Plan to be approved prior to carrying out any first workings within the Cliff Line Zone and Zone of First Workings.
- *Extraction Plan Guideline*, NSW Department of Planning and Environment 2022; and
- *Managing Risks of Subsidence Guideline*, NSW Department of Industry, Resources Regulator (**NSWRR**), 2017; and
- *Consultation with all relevant key stakeholders* (potentially affected by subsidence) and the Independent Expert Panel (**IEP**) established by NSW Department of Planning, Housing and Infrastructure (**NSW Planning**) for the project.

² Further details regarding all requirements addressed by this report are provided in Section 2.1 and Attachment B – Relevant Legal and Other Requirements

1.3 Extraction Plan Area

The EP Area, as illustrated on **Figure 1.2**, is defined as:

- The *Cliff Line Zone of First Workings* within ML1814;
- Includes all proposed first workings within the EP Area;
- First workings incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features;
- No secondary extraction is permitted or proposed within the EP Area;
- No surface impacts have been predicted for first workings; and
- The EP Area is wholly located within the Mugii Murum-ban SCA with no private land ownership.

1.4 Relevant Features and Sub-management Plans

The natural and built features relevant to the CLZ (ML1814) Extraction Plan, as illustrated on **Figure 1.2**, are identified in the checklist provided in *Attachment A – Identification of Natural and Built Features Checklist*.

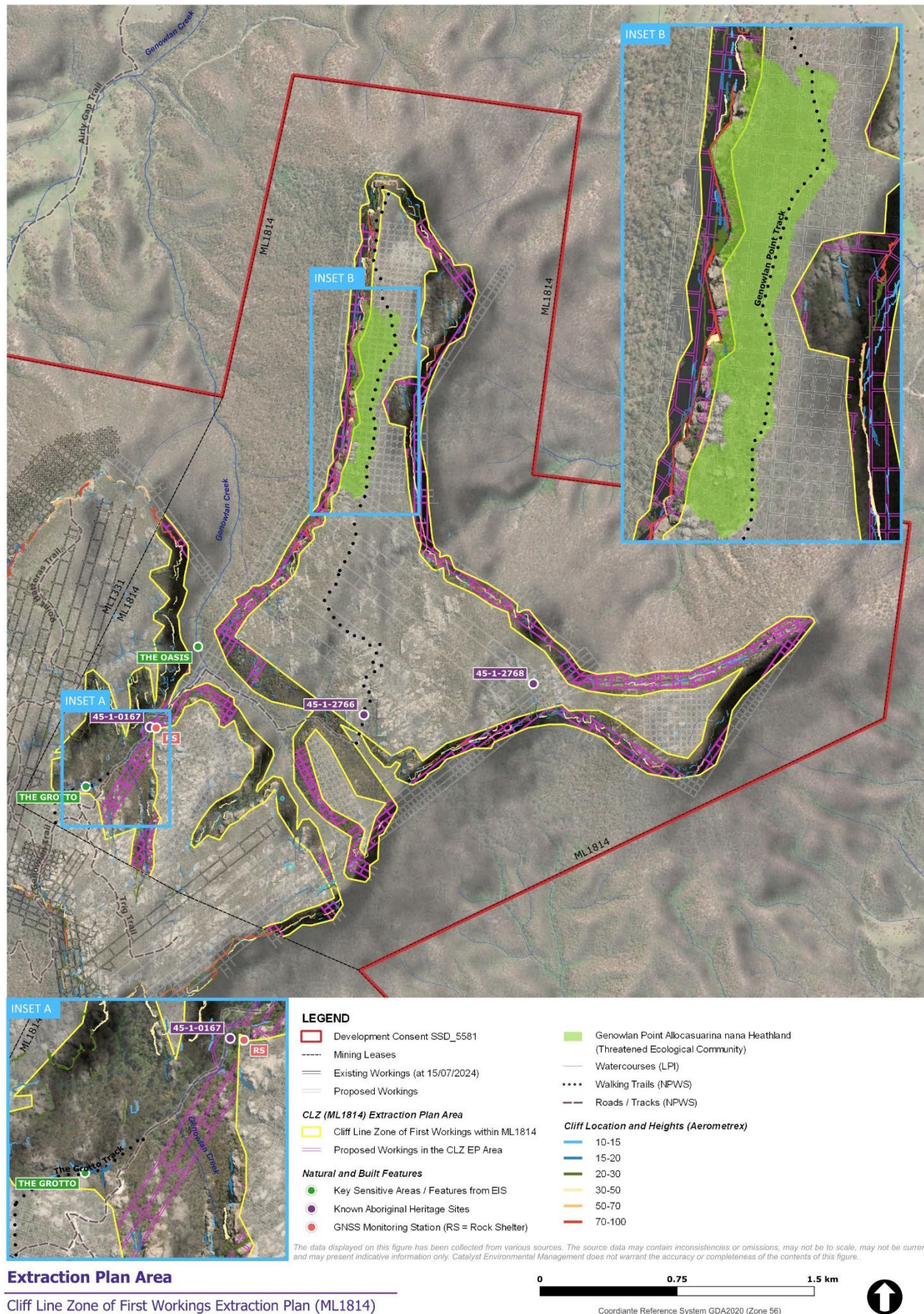
Table 1.1 provides a summary of the natural and built features within the EP Area along with the related Sub-management Plan that the respective features are managed through.

Table 1.1: Relevant Features within the EP Area and Related Management Plans

Key Features Managed and Monitored	Sub-management Plan
Surface Water (quality, flow and stream stability, erosion & sediment control) Groundwater (including downstream alluvial and facultative ecosystems) Monitoring of aquatic ecology <i>Note: no privately owned bores within (or potentially affected by) the EP Area.</i>	Airly Mine Water Management Plan (WMP) <i>(whole of site/consent area) – refer Appendix 1</i>
Cliffs, Minor Cliffs and Pagodas Mugii Murum-ban SCA General Surface Area, including steep slopes and rock outcrops The deeply incised canyons/gorge including an area known as the Grotto Tracks and Trails, Fences & Gates	Land Management Plan for CLZ (ML1814) (CLZ (ML1814) LMP) – refer Appendix 2
Habitat Threatened flora and fauna Endangered Ecological Communities (EEC) Groundwater Dependent Ecosystems (GDE) Aquatic ecosystems	Biodiversity Management Plan for CLZ (ML1814) (CLZ (ML1814) BMP) – refer Appendix 3
Aboriginal heritage site (AHMIS 45-1-0167)	Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) (CLZ (ML1814) ACHMP) – refer Appendix 4
Public Safety / Safety of ‘others’ associated with <i>potential</i> for subsidence. Publicly accessible sections of the EP Area within Mugii Murum-ban State Conservation Area including tracks and trails and general SCA surface area.	Public Safety Management Plan for CLZ (ML1814) (CLZ (ML1814) PSMP) – refer Appendix 5
Details the monitoring program for the EP Area for all Key Features Includes baseline monitoring, as well as during and post mining requirements	Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP) – refer Appendix 6

The scope of management plans for the Extraction Plan was developed in consultation with NSW Planning.

Figure 1.2: Extraction Plan Area (EP Area) and Relevant Features within the EP Area



1.5 Document Structure

An overview of the Extraction Plan and its supporting sub-management plans and studies is provided below.

Extraction Plan Main Report (this document)

Section 2	Includes details on the development of the Extraction Plan, including details of the legal requirements which apply and have been addressed, review of relevant risk assessments and consultation with relevant agencies and other stakeholders within the EP Area
Section 3	Includes an overview of the mine planning and design, overall subsidence predictions related to that mine design, potential impacts from the predicted subsidence, and demonstration of the subsidence predictions meeting the performance objectives
Section 4	Provides an overview and details of subsidence management measures including plans prepared to address impacts to relevant environmental and/or built features. The individual management plans are contained in Appendices to the Extraction Plan
Section 5	Addresses the key elements of how the Extraction Plan is implemented, including trigger action response plans and the adaptive management approach and reporting
Section 6	Provides the details regarding review and key responsibilities for this Extraction Plan
Section 7	Lists the reference documents referred to in this Extraction Plan

Appendix 1 to Appendix 7 contains the key sub-management management plans and graphical plans which have been provided as part of the Extraction Plan.

Appendix 1	Airly Mine Water Management Plan
Appendix 2	Land Management Plan for CLZ (ML1814) (CLZ (ML1814) LMP)
Appendix 3	Biodiversity Management Plan for CLZ (ML1814) (CLZ (ML1814) BMP)
Appendix 4	Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) (CLZ (ML1814) ACHMP)
Appendix 5	Public Safety Management Plan for CLZ (ML1814) (CLZ (ML1814) PSMP)
Appendix 6	Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP)
Appendix 7	Master Trigger Action Response Plan for CLZ (ML1814) (CLZ (ML1814) Master TARP)
Appendix 8	Graphical Plans for CLZ (ML1814)

Attachment A to Attachment I provides copies of the detailed technical assessments and other supporting information to support this Extraction Plan.

Attachment A	Identification of Natural and Built Features Checklist
Attachment B	Relevant Legal and Other Requirements
Attachment C	Subsidence and Environmental Risk Assessment
Attachment D	Stakeholder Consultation
Attachment E	Technical Report: Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b)
Attachment F	Technical Report: Baseline Biodiversity Assessment (RPS, 2023)
Attachment G	Technical Report: Baseline Historic Heritage Assessment (RPS, 2022a)
Attachment H	Technical Report: Baseline Aboriginal Heritage Assessment (RPS, 2022b)
Attachment I	Technical Report: High Level Subsidence, Conductivity and Connectivity Review for The Grotto and The Oasis at Airly Mine (SCT, 2024a) and the addendum Airly Mine Overburden Subsidence and Conductivity Review for The Grotto and The Oasis – Q2 2024 (SCT, 2024b)
Attachment J	Technical Report: Subsidence Impact Assessments for the Natural and Built Features over and near the proposed 500 Mains and HB1 and HB2 Herringbone First Workings in support of the Extraction Plan Application (MSEC, 2024)

2 PLAN DEVELOPMENT AND CONSULTATION

2.1 Statutory Requirements

This Extraction Plan and the supporting management plans have considered all relevant regulatory approvals, leases, licences and guidelines, including the key requirements of Condition 7 in Schedule 3 of SSD_5581, the *Extraction Plan Guideline* (DPE, 2022) and the *Managing Risks of Subsidence Guideline* (NSW RR, 2017).

Airly Mine operates under a number of legislative and regulatory requirements and approvals, the relevant requirements to this Extraction Plan include:

- The conditions of the Development Consent (SSD_5581)
- Mining Leases (i.e. ML 1331 and ML 1814)
- WHS requirements in relation to subsidence
- Other relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL No. 12374) and EPBC Approval (referral 2013/7076), and
- Other relevant State and Commonwealth environmental, planning, mining, safety, and natural resource legislation and guidelines.

Centennial Airly maintains a register of all legislative and regulatory requirements in a compliance database. Applicable requirements of development consent, EIS/Statement of Commitments, and other related approvals, leases, licences and guidelines are presented in *Attachment B – Relevant Legal and Other Requirements*.

The following sections provide an overview of the key related regulatory conditions to the development of this Extraction Plan and supporting sub-plans under Development Consent SSD_5581 and NSW Work Health and Safety legislation as relevant to Mines and Petroleum sites.

2.1.1 Development Consent (SSD_5581)

Condition 7 in Schedule 3 of SSD_5581 provides the planning approval framework for mining activities to be addressed within an Extraction Plan and supporting management plans.

Condition 1 in Schedule 3 of SSD_5581 outlines the requirements relevant to Performance Measures.³

SSD_5581 also contains conditions to be addressed for the preparation of any management plans which are required under the development consent, as such all management plans including this EP Main Report have been prepared in accordance with Condition 2 in Schedule 6.

Attachment B – Relevant Legal and Other Requirements, Tables 1.1 – 1.4, provide a summary of the Development Consent conditions relevant to this Extraction Plan and outlines the section and documents in which each of these conditions have been addressed.

In accordance with Condition 7(a) in Schedule 3 of SSD_5581 this Extraction Plan has been prepared by a team of suitably qualified and experienced persons whose appointment has been endorsed by the Secretary.⁴

³ see Section 5.1

⁴ see Section 2.2.1

2.1.2 Work, Health and Safety Laws (subsidence related)

Airly Mine operates in accordance with its Safety Management System which integrates plans, policies and procedures that enables a systematic approach to establishing and maintaining effective systems to manage health and safety consistent with WHS laws and relevant standards.

This Extraction Plan has been developed to comply with the NSW work health and safety legislation including but not limited to:

- Work Health and Safety Act 2011 (WHS Act)
- Work Health and Safety Regulation 2017 (WHS Regulation)
- Work Health and Safety (Mines and Petroleum Sites) Act 2013 (WHSMP Act), and
- Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 (WHSMP Regulation).

WHS laws have been considered for the Extraction Plan principally within the context of subsidence related risks to public safety, including to public infrastructure and in reference to *Managing Risks of Subsidence Guideline* (NSW RR, 2017).

Attachment B – Relevant Legal and Other Requirements, Section 3, summarises key requirements of relevant Regulations under Work Health and Safety legislation applicable to mines.

2.2 Specialist Assessments

2.2.1 Consultant Suitability and Endorsement

In accordance with Condition 7(a) in Schedule 3 of SSD_5581 this Extraction Plan has been prepared by a team of suitably qualified and experienced persons whose appointment has been endorsed by the Secretary.

Attachment D – Stakeholder Consultation provides the details the suitably qualified and experienced persons and their relevant roles.

2.2.2 Supporting Technical Reports

Cliff Identification (Aerometrex, 2021, 2022; MNC, 2023a, 2023b)

The key objective of the mine design approach is to minimise risk of surface impacts through appropriate mine layout design to reduce subsidence at sensitive high cliffs and escarpments located on the external parts of the Mount Airly and Genowlan Mountain mesas.

Aerometrex (2021, 2022) were engaged by Centennial to identify the cliffs and other sensitive surface features over within ML1814 that satisfied the rock feature definitions in the development consent. The following provides a brief overview of the methodology of cliff identification work undertaken by Aerometrex:

- A Digital Terrain Model (DTM) is generated from classified LiDAR ground point-clouds
- Potential cliff areas are extracted from the DTM and filtered using a semi-automatic approach to meet the major cliff definition (minimum length of 20m, 10m height and minimum slope of 63.4 degree).
- Each identified cliff is then analytically and visually checked against the 3D mesh model.
- A vector file (Shapefile and KML format) is provided with the following attributes:
 - ID: Major Cliff identification ID

- AVG_H: Average height of the cliff
- AVG_L: Average length of the cliff
- MAX_H: Maximum height of small outlying sections of a cliff
- The dataset is split in several areas (Cliffs ID are CB_xx (area1), CC_xx (area2), etc)

Michael Nicholson Consulting Pty Ltd (MNC) was then engaged to undertake site inspections (“ground truthing”) of the cliffs that were identified as being located within the CLZ at Genowlan Creek Valley – Grotto to Oasis (MNC, 2023a) and Central Genowlan – Genowlan Point (MNC, 2023b) to supplement the extensive aerial photogrammetry and cliff identification work that was undertaken previously by Aerometrex (2021, 2022). The objectives of the ground truthing reports (MNC, 2023a, 2023b) were to primarily provide ground truthing verification of the cliff mapping and cliff identification completed in desktop studies by Aerometrex. The site inspection was also undertaken to inspect for any cliffs or other features not previously identified/mapped, as well as inspecting the area to check there were no rock features (i.e. pinch points, overhangs, etc.) that would be particularly sensitive to subsidence ground movements. The key findings of the report are:

- Good positional correlation was noted with cliff segments digitised by MNC and those identified by the Aerometrex process – the site inspection supports using the cliff mapping provided by Aerometrex for developing setbacks to future secondary extraction.
- There were no particularly vulnerable features identified in the EP Area that would need to be avoided through mine design.

The relevant features within the EP Area, including the key cliffs and features identified by these reports, are illustrated on **Figure 1.2**.

Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b)

SCT were engaged to prepare and provide a subsidence prediction and impact assessment report, on the likely impacts of these predicted levels of subsidence on the natural and built features that exist within the EP Area. The Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) provided the subsidence predictions and impact assessment for the Extraction Plan. An addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b) was prepared to review the earlier pillar geometry assessment (SCT, 2023a) for an increased roadway height of 3.2m. The subsidence predictions and impact assessment is discussed in **Section 2.2.3** and **Section 3.2**.

Biodiversity (RPS, 2023)

A Baseline Ecology Assessment was developed by RPS (2023) for the EP Area with the purpose of reviewing the relevant biodiversity information within the region and informing the development of the Biodiversity Management Plan for the Extraction Plan.

Heritage (RPS, 2022a; RPS, 2022b)

A Baseline Historic Heritage Assessment (RPS, 2022a) and Baseline Aboriginal Cultural Heritage Assessment (RPS, 2022b) has been developed for the EP Area with the purpose of reviewing the relevant heritage information to identify heritage items within the region and informing the development of the Heritage Management Plan for the Extraction Plan.

High level subsidence, conductivity and connectivity review for The Grotto and The Oasis at Airly Mine (SCT, 2024)

SCT prepared a review of the potential interaction of mining subsidence with geological structures near The Grotto and The Oasis. The review conducted by SCT provides a thorough assessment and comprehensive evaluation of potential impacts. The report details the considerations and methodologies used to assess the potential subsidence impacts, groundwater characteristics, and surface connectivity for both The Grotto and The Oasis, which incorporated understanding from industry standards, experience at other mines, and experience from Airly Mine in adjacent mining in the vicinity of Gap Creek and miniwall mining to the east and north of The Grotto.

The following provides a summary of the key findings of the report:

1. **Negligible Subsidence Predictions:** The estimated subsidence magnitudes for the planned mining layout and proposed workings have been designed to produce negligible subsidence effects around The Grotto and The Oasis (and the adjacent cliff line zone). The report included assessment of the first workings associated with this Extraction Plan as well as other adjacent proposed workings in other mining zones. Negligible subsidence effects are predicted at The Grotto and The Oasis (and on the adjacent CLZ) based on the estimated subsidence magnitudes of all proposed workings.
2. **Low Impact of Horizontal Movements:** Horizontal movements due to mining extraction are predicted and have been measured to be small at The Grotto and predicted to be negligible at The Oasis. The subcritical mining geometry and low horizontal stress environment at Airly Mine are expected to result in negligible horizontal movements, further minimising potential impacts on these areas.
3. **Consideration of Geological Structures:** The review addressed the potential for increased connectivity from faulting but concluded that the probability of reactivation of faults and lineaments traversing the area and adjacent workings is considered low due to the low stress environment and low stress redistribution from first workings.
4. **Groundwater and Connectivity Assessment:** The assessment found that downward flow can be facilitated by lineaments that may be present between the defined caving zones, although the geometry of the first workings at The Grotto and The Oasis, depth of cover, and the distance from secondary extraction (miniwalls) would make this unlikely.

The assessment concluded that the perched aquifer in the alluvium of The Grotto or The Oasis is not expected to be impacted by adjacent mining.

Airly Mine Overburden Subsidence and Conductivity Review for The Grotto and The Oasis – Q2 2024 (SCT, 2024)

In July 2024, SCT provided an update to the above report incorporating the most recent groundwater monitoring data up to May 2024. This report makes the following conclusions, for details refer to the detailed report provided as Attachment I:

- Review of the available subsidence data, and groundwater monitoring at Airly Mine indicates the planned mining layout nearby The Grotto and The Oasis to have low levels of potential subsidence impacts and effects.
- The estimated subsidence magnitudes for the proposed Central Genowlan main headings mined beneath the CLZ (i.e. 500 Mains Panel) are predicted to have negligible subsidence effects to the adjacent CLZ, The Grotto and The Oasis and have been designed to be long term stable.

Review of potential mining impacts in the vicinity of lineaments

- Baseline conditions currently observed at The Grotto and The Oasis indicate low levels of conductivity along the lineaments. Downward flow can be facilitated by reactivation of lineaments that may be present between defined caving zones, although the geometry of the first workings at The Grotto and The Oasis, depth of cover, and the distance from secondary extraction (miniwalls) would make this unlikely.
- The potential for reactivation of faults and lineaments traversing the area and adjacent workings is considered low due to the low stress environment and low stress redistribution from first workings.
- There is low probability of groundwater impacts at The Grotto and The Oasis due to low levels of predicted subsidence and increased depth of cover compared to Gap Creek.

Review of the potential mining impacts to the groundwater and tributary flow

- A review of the potential mining impacts to the groundwater and tributary flow at Genowlan Creek was conducted after miniwall extraction in the Point Hatteras Panel and Pillar Mining Zone and updated with the 2024 Q1 monitoring results.
- Findings relevant to The Grotto:
 - Little to no variation in pressure head has occurred because of adjacent mining at Point Hatteras in the vicinity of The Grotto.
 - No influence of mining is observed in the standpipe piezometer results.
 - No influence of the adjacent lineament has been observed at the monitoring locations.
- Findings relevant to The Oasis:
 - No influence of mining is observed in the standpipe piezometer results at The Oasis within the perched water table.
 - No influence of the adjacent lineament has been observed at the monitoring locations within the perched water table.
 - Water levels being measured in the Lithgow Seam (approx. 67 m below the alluvium) dropped by 0.51 m in the Q1 2024 monitoring results potentially attributed to the adjacent mining in MW16 (located approximately 575 m away). This may indicate a potential conduit through basement features.
- There is no evidence of impacts to Genowlan Creek surface water flows because of mining.

Subsidence Impact Assessments for the Natural and Built Features over and near the proposed 500 Mains and HB1 and HB2 Herringbone First Workings in support of the Extraction Plan Application (MSEC, 2024)

MSEC was engaged to prepare a supplementary Subsidence Impact Assessment Report (MSEC1447) due to the proposed extraction specific to the 500 Mains Headings which are located near several surface features. In addition to The Grotto and The Oasis, these features are known as; Ultimate Slot, Valley of Dinosaurs and an overhang site that includes a registered Aboriginal Heritage Site (AHIMS 45-1-0167).

The detailed analysis and conservative design outlined in the Subsidence Impact Assessment Report (MSEC1447), presented in full in Attachment J, provide substantial evidence that the proposed CLZ first workings will not result in significant adverse impacts on cliffs and other sensitive geological features, surface water, or ecologically sensitive areas. The use of stable pillars, minimal subsidence predictions, and robust

monitoring strategies all contribute to a mining plan that prioritises environmental protection and sustainable resource extraction.

Cliffs and Other Potentially Sensitive Geological Features:

The extraction plan has been designed with specific measures to protect sensitive geological features, including The Grotto, The Oasis, Ultimate Slot, Valley of Dinosaurs, and an overhang site with a registered Aboriginal Heritage Site. These measures include leaving long-term stable 35 m centred pillars in developing the main headings where they pass through the CLZ Headings, which will not lead to more than 30 mm of subsidence.

Field inspections and subsidence modelling indicate that the predicted subsidence levels are far below the thresholds that could cause damage to these natural features. The stable pillar design and controlled subsidence ensure that these sensitive areas will experience very low ground movements, thereby preventing surface cracking and preserving their structural integrity.

Historical data and site inspections reveal that natural features like cliffs and overhangs in the region have weathered naturally over time and have shown resilience to minor ground movements. The conservative subsidence predictions for the proposed CLZ first workings indicate an extremely low probability of causing instability or damage to these features.

Surface Water and Pooled Water:

The predicted subsidence over sensitive areas such as the Grotto and the Oasis is extremely low, ranging from 10 mm to 30 mm. Such minimal subsidence levels are unlikely to cause any significant alteration to surface water or pooled water regimes.

The extraction plan includes robust monitoring and mitigation strategies to ensure that surface water flow and quality are maintained. The low levels of predicted subsidence are not expected to lead to surface cracking or significant changes in water retention areas, preserving the ecological balance of these sensitive regions.

Ecologically Sensitive Areas:

The extraction plan ensures that no secondary extraction will occur closer to the CLZ than a 26.5° angle of draw (AoD) behind or in front of these cliffs, effectively protecting these features from subsidence-induced damage. This conservative approach has been proven effective in previous mining operations and is expected to prevent any significant impact on The Grotto and The Oasis.

Field inspections and subsidence modelling indicate that the predicted subsidence levels are far below the thresholds that could cause damage to the natural features. Therefore, the risk of significant ecological impacts is negligible.

2.2.3 Review of Previous Subsidence Predictions

This Extraction Plan has primarily relied on the most recently updated predictions of subsidence effects, subsidence impacts and environmental consequences as described in the Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b), provided as Attachment E.

The revised subsidence predictions included assessment of the subsidence effects measured in the current first workings at Airly Mine, including a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331). A number of studies undertaken by SCT (2018, 2019a, 2019b) examined the effect of cliff lines at Airly Mine on pillar loading. The modelling showed that

close to the cliff, calculating pillar stability based purely on the direct weight of overburden strata is likely to underestimate pillar load. As a result of these findings, the revised pillar assessment prepared by SCT (2023a) has incorporated an additional 1MPa of vertical load when calculating the adequacy of the coal pillar sizes for first workings in the CLZ at Airly Mine.

The results of the revised subsidence predictions are consistent with the EIS and previous subsidence predictions as detailed in **Section 3.2**.

No surface impacts have been predicted at these levels of subsidence.

2.3 Risk Assessment

Centennial Airly has undertaken a dedicated ***Subsidence and Environmental Risk Assessment*** (*Stature RA Number: 1001330039⁵*) directly in support of this Extraction Plan which builds on previous risk assessments completed for CLZ EP (ML1331) and provides a risk framework basis for development of the sub-management plans.⁶

The *CLZ (ML1814) Extraction Plan* risk assessment was completed on the 20 June 2023 with key staff from the Airly Mine including the Mine Manager, Statutory Mine Surveyor, Technical Services / Compliance Manager and Environment and Community Superintendent, as well as key EP Project Team members for Heritage, Ecology and the Lead Consultant for the Extraction Plan. The landholder was also represented by a member from the NPWS.

Risks were identified and assessed through the review of known surface and sub-surface features within the EP Area. The risk assessment also specifically assessed key heads of consideration required by the Managing Risks of Subsidence Guideline (NSW RR, 2017).

A risk ranking (low, moderate, significant, high or extreme) was assigned to each risk/hazard in consideration of the Maximum Reasonable Consequence (MRC) for the given controls. The updated risk assessment for CLZ EP (ML1814) identified one significant-risk item (i.e. degradation or loss of *Pultenaea* sp. Genowlan Point population or its habitat). All other risks within the Extraction Plan Area have been assessed as **low to moderate**.

The potential subsidence impacts and environmental consequences are summarised in Section 3 and detailed within each key sub plan.

⁵ Centennial Airly has adopted the Stature Risk Assessment Program which was developed to ensure consistency in all risk assessments across the Centennial operations. The Stature Risk Assessment Program sets out a consequences table and risk ranking matrix for managing identified risks consistent with AS/NZS ISO 31000:2009.

⁶ A copy of the risk assessment is presented as Attachment C

2.4 Avoidance and Minimisation Strategies

Potential environmental consequences during the mining of CLZ (ML1814) will be managed in accordance with the relevant requirements of SSD_5581 and other approvals, through:

- **Avoidance/Mine Design** –extensive modelling has informed the layout of CLZ (ML1814) with pillar sizes specifically designed to be long-term stable and meet the subsidence impact performance measures (**Section 3.1 and 5.1**).
- **Subsidence Monitoring** – visual and survey monitoring and reporting will be conducted to confirm predictions of subsidence effects and potential subsidence impacts and environmental consequences (**Section 4**).
- **Management Measures and Remediation** – implementation of management measures and/or remediation, as required, to address subsidence impacts and/or environmental consequences (in consideration of the potential impacts of the unmitigated impact, including the potential for self-healing or long-term degradation, and the potential impacts of the remediation) (**Section 5**).
- **Trigger Action Response Plan** – implementation of Trigger Action Response Plans in the event an exceedance of a subsidence impact performance measure or if an unexpected impact is detected (**Section 5.4**), including consideration of identified potential contingency measures.
- **Adaptive Management and Contingency Planning** – adaptive management will be implemented where appropriate by reviewing and evaluating the effectiveness of management strategies, and adjusting management strategies to improve performance, particularly following an exceedance of a subsidence (**Section 5.5**).
- **Reporting and Review** – procedures for investigations of incidents (including all exceedances of performance measures) and appropriate response, as well as procedures for quality assurance and review of the management system (**Sections 5.7.1 and 5.6**).

2.5 Consultation

Condition 7(i) in Schedule 3 of SSD_5581 requires the preparation of this Extraction Plan in consultation with key relevant stakeholders as detailed in **Table 2.1**.

Table 2.1: Development Consent Required Consultation

Condition	Consultation Requirement
7.(i) (i)	Subsidence Monitoring Program which has been prepared in consultation with the IEP, Resources Regulator, and BCD
7.(i) (iii)	Water Management Plan which has been developed in consultation with BCD and the Water Division
7.(i) (iv)	Biodiversity Management Plan which has been developed in consultation with DoEE and BCD
7.(i) (v)	Land Management Plan which has been prepared in consultation with the IEP, Resources Regulator, BCD and any affected public authorities
7.(i) (vi)	Heritage Management Plan which has been prepared in consultation with Heritage Division and relevant Aboriginal stakeholders
7.(i) (vii)	Public Safety Management Plan which has been prepared in consultation with the IEP, Resources Regulator and BCD

The Extraction Plan Guideline also prescribe consultation with other key stakeholders, such as the owners and/or operators of both publicly and privately-owned land and infrastructure, and with the community through the mine's Community Consultative Committee (CCC).

The EP Area is wholly located within the Mugii Murum-ban SCA, as such NPWS have also been included in the consultation for this Extraction Plan. There is no private land ownership and no other public or private landholders required to consult with.

A draft (Revision 0) of the Extraction Plan and all key sub-management plans was submitted for consultation purposes in December 2023 to the respective NSW Government departments and/or agencies and has incorporated feedback received to date during scoping and briefing meetings with the NSW PLANNING and Independent Expert Panel completed in September 2022, February 2023 and November 2023.

Revision 1 of the Extraction Plan was submitted on 26 March 2024 and addressed the comments and recommendations received from consultation with various agencies.

Revision 2 of the Extraction Plan has been prepared to incorporate some minor amendments which were outlined in the Centennial Airly response to an NSW Planning Request for Information (RFI) dated 24 May 2024.

Stakeholder feedback provided has been reviewed and addressed as necessary as part of the development and review of this Extraction Plan and key sub-management plans. Applicable consultation records and comment reconciliation tables is provided in *Attachment D – Stakeholder Consultation*.

3 SUBSIDENCE ASSESSMENT

3.1 Mine Planning and Design

Proposed Mining Geometry and Parameters

The Airly Mine EIS in 2014, presented an approach to mining throughout the lease which employed different mining methods in different areas, each targeted to suit each specific area, referred to as ‘mining zones’. A key objective of the approach was to minimise risk of surface impacts by limiting subsidence through appropriate mine design. Sensitive high cliffs and escarpments located on the external parts of the Mount Airly, and Genowlan Mountain mesas are protected by a Cliff Line Zone (CLZ) of First Workings (i.e. no secondary extraction).

The proposed first workings within the CLZ (ML1814) consist mainly of (or parts of) Main Headings. These Main Headings or roadways form the mine ventilation passages and provide access for people, machinery, electrical supply, communication systems, water pump out lines, conveyor, compressed air lines and gas drainage lines. Main Headings, which provide access from the mine entrance to future extraction areas, incorporate mine development of roadways and cut throughs to form long term stable pillars. Mine design is the primary control utilised at Airly Mine for subsidence impact avoidance. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement.

Due to legislation changes for respirable and inhalable dust levels, operationally the mine has increased face and panel ventilation requirements to dilute personnel dust exposure to an acceptable level. The increased ventilation makes the work environment safer, and it requires larger ventilation tubes to be placed in the roadway. Airly Mine proposes to increase the extraction height, from 3.0m to 3.2m (refer to **Section 3.2** for further details of the assessment for this proposed increase).

The proposed mining within the EP Area is illustrated on **Plan 1 - Existing and Future Workings**. The proposed mining layout has been assessed by SCT (2023a; 2023b) as long-term stable. Typical layouts for first workings within the CLZ (ML1814) EP Area includes the following:

- A mining height of 3.2m
- Maximum roadway (bord) width of 5.5m
- Maximum void width of <10m
- Minimum first workings on 35m x 35m pillar centres, *noting minimum pillar size increases for DOC 260m or greater*
- Pillar width to height ratio of >8.0
- Pillar system Factor of Safety (FOS) >2.11 for protection of key surface features (failure probability of > 1 in 1 million)
- DOC within the EP Area ranges from ~90-320m
- Long term stable pillars, and low levels of subsidence, are proposed to protect sensitive areas, including:
 - The Grotto and the Oasis
 - Known Aboriginal Heritage Site (AHIMS 45-1-0167)
 - Large cliffs associated with Genowlan Point, and the
 - Threatened flora species and threatened ecological community including the *Pultenaea* sp. Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland

Mining will primarily be undertaken in accordance with the layout displayed on **Plan 1**, however occasionally minor variations will be required e.g. due to avoidance of geological structure encountered or other operation constraints, including amending layouts for access to future miniwall panels which have not yet been modelled.

Any changes to the proposed mine layout within the EP Area, as illustrated on **Plan 1 - Existing and Future Workings**, will be categorised into one of the following categories and appropriate processes implemented for that change:

1. Insignificant changes permissible without notification:

- Changes to cut-through location which result in pillars that still meet minimum design criteria i.e.:
 - pillar system FOS greater than 2.11;
 - width to height (W/H) ratio of greater the 8;
 - 35m x 35m (centres), *noting minimum pillar size increases for DOC 260m or greater*; and
 - pillar dimensions no less than 1/10 depth of cover.
- Reduction in the number of roadways/headings or cut-throughs
- Move a roadway/heading or cut through up to ½ pillar length (increasing pillar size only) while maintaining minimum design criteria (i.e. pillar centres sizes as per above is achieved)
- Correction of offline driveage
- Driveage of stub to create pit space for storage or other operational requirements which is <10m in length from stub side rib (in solid coal only, or if in pillar maintaining minimum design criteria i.e. pillar centres sizes as per above is achieved)

2. Minor changes permissible with geotechnical assessment and confirmation pillar system remain long-term stable:

- Isolated cases where minimum pillar size is <35m centres, but is >1/10th depth of cover or >10m
- Isolated change in roadway width >5.5 (but void width <10m)
- Irregular shaped pillar determined to be long term stable

3. Moderate changes permissible with geotechnical assessment, notification to IEP and confirmation pillar system remain long-term stable:

- Isolated cases where minimum pillar size is <1/10th depth of cover, with High Risk Activity notification undertaken as per WHS legislation
- Driveage of roadways/headings up to ½ pillar width from proposed workings

4. Significant changes requiring modification of the Extraction Plan:

- Additional roadways
- Change in roadways/headings direction / location greater than ½ pillar width from proposed workings

Notes:

1. All survey mine workings “as executed” are submitted to the NSW Resources Regulator as required under the NSW work health and safety requirements.
2. Regular meetings with the IEP are undertaken where changes implemented by Airly Mine can be reported to the IEP for oversight and confirmation that the mine design still meets the minimum design criteria (and all pillars are long-term stable).
3. The level of geotechnical assessment undertaken will be commensurate with the complexity of the proposed change and may include assessment undertaken in accordance with Airly Mine standard operating procedures through to detailed technical specialist reports.

Mine Schedule and Resource Recovery

First workings within the EP Area are expected to commence in June 2024 and will be ongoing to provide access to future mining areas. Overall the total coal resource in the CLZ within ML1814 is estimated to be **3,674,000 tonnes**. The expected resource recovery from the main headings in the EP Area (first workings only) is **800,000 tonnes**.

The tonnages listed have been based on a design roadway height of 3.2m during first workings development. The specific gravity of the coal (relative coal density) is 1.48. All recovery tonnages are approximate only and may vary depending on final panel layout and geological restrictions.

3.1.1 Mine Layout – Revision 1

Compared to the proposed mining within the EP Area presented in the draft for external consultation (Revision 0), there has been a minor revision to the layout of the 500 Panel in the vicinity of The Oasis.

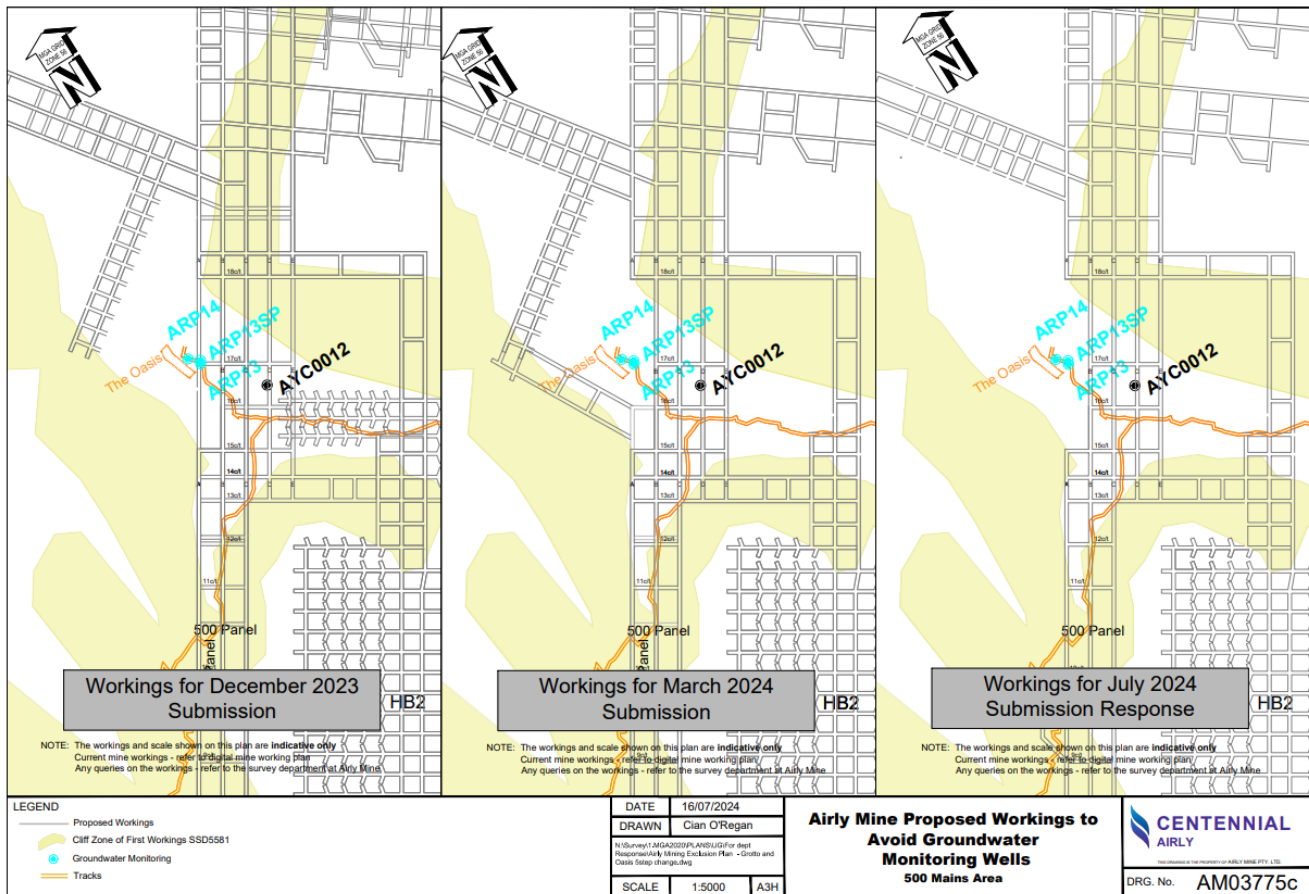
The proposed changes for Revision 1 are highlighted on **Figure 3.1** which shows the original design on the left, with roadways to be removed highlighted blue, and the revised design on the right, with roadways to be added highlighted in red. The revised mine design will:

- Avoid the destruction of the groundwater monitoring wells in the 500 Mains Panel (in the vicinity of The Oasis) to allow for continued monitoring post mining;
- Avoid an area in a probable fault which was identified by in-seam drilling where the throw is expected to be more significant; and
- Result in a slight increase in the amount of workings in the EP Area (noting that the pillars formed are consistent with the mining layout which has been assessed by SCT (2023a; 2023b) as long-term stable therefore potential for impacts remains unchanged by the proposed revision).

Incidentally, the revision will also provide a greater buffer between the proposed first workings and The Oasis, however SCT (2024) have assessed the potential interaction of mining subsidence with geological structures near The Grotto and The Oasis and concluded that the perched aquifer in the alluvium of The Grotto or The Oasis is not expected to be impacted by adjacent mining. The SCT assessment included the proposed mining within the EP Area presented in the draft for external consultation (Revision 0), as well as the proposed changes for Revision 1 and the conclusion was the same.⁷

⁷ Further details are provided in Section 2.2.2 and Attachment I

Figure 3.1: Mine Layout – Revision 1 (500 Mains Panel near The Oasis)



3.1.2 Mine Layout – Revision 2

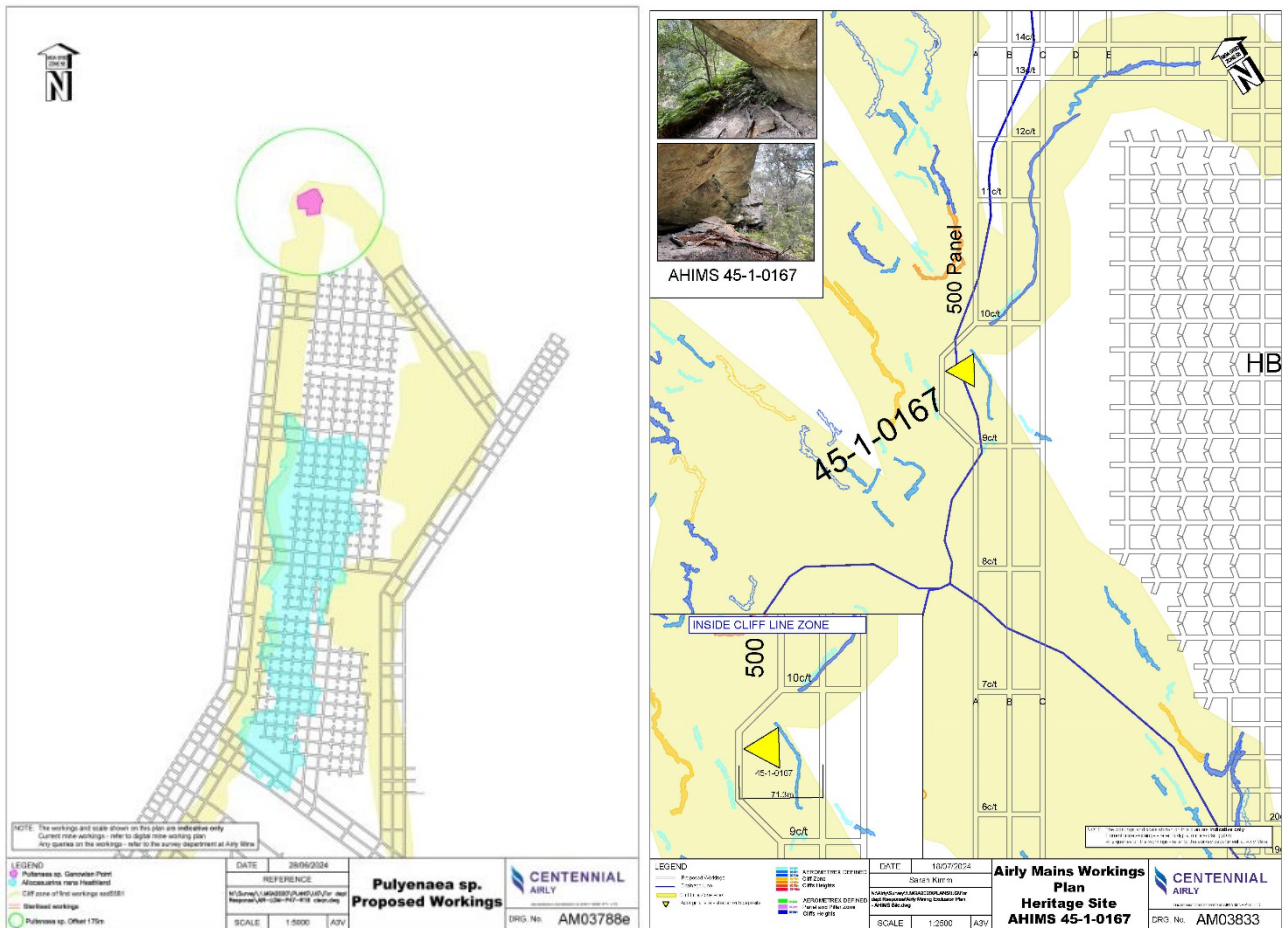
The subsidence predictions and impact assessment does not predict any surface impacts and the IEP have agreed with this prediction, stating in their response “that the proposed first workings within the CLZ can be expected to provide low enough subsidence for sandstone cliff features to be protected from the effects of mining based on experience in the Western Coalfield”, however Centennial Airly is adopting a precautionary approach to the proposed mine design and out of an abundance of caution the proposed workings have been re-designed to:

- avoid directly undermining the known Aboriginal heritage site; and
- provide a buffer of solid coal around the *Pultenaea sp.* ‘Glenowlan Point’ critically endangered species habitat that is equal to 26.5 degrees, or half depth of cover.

This re-design is illustrated on **Figure 3.2**.

The proposed mining within the EP Area, consistent with Revision 2, is illustrated on **Plan 1 - Existing and Future Workings**.

Figure 3.2: Mine Layout – Revision 2



3.2 Subsidence Predictions

In accordance with Condition 7(g) in Schedule 3 of SSD_5581, this Extraction Plan has relied on the most recently updated predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed first workings covered by this Extraction Plan which are provided in the Technical Report: Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b), presented in full in Attachment E.

The primary management strategy being implemented by Airly Mine for the Extraction Plan is impact avoidance through the implementation of a conservative mine design, with specifically designed panel and pillar widths, to have minimal subsidence effects and prevent subsidence impacts.

The revised subsidence assessment report has been used as a basis for developing the performance measures and management actions in response to the predicted impacts from subsidence within the Extraction Plan Area, and provides an assessment on the following:

- Pre-mining condition of natural surface features and existing development within the Extraction Plan Area.
- Assessment of the subsidence effects measured in the current first workings at Airly Mine
- Review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331)

- Predicted impacts on:
 - Surface features, including Cliffs, Minor Cliffs and Pagodas (e.g. cracking, fracturing surface rocks and structures, collapse, or landslides/displaced rocks);
 - Natural features (e.g. topography, rock outcrops, steep slopes);
 - Built features (e.g. 4wd roads, fire trails, walking tracks, property fences and gates);
 - Aboriginal heritage sites; and
 - Water (e.g. ephemeral headwater, flowing creeks and waterways).

The pillar geometry assessment undertaken by SCT (2023a; 2023b) was used to determine the minimum pillar sizes required to meet the design criteria for “long-term stable” pillars including the following design criteria:

- Minimum pillar widths are limited to a width to height (W/H) ratio of greater the 8;
- Minimum pillar dimensions 1/10 depth of cover; and
- Minimum pillar system FOS greater than 2.11.

The design review found that a 3.2m roadway height for 35m pillar centres at a depth of cover greater than 260m would have a FOS <2.11 (and not be considered long-term stable) (SCT, 2023b). The proposed mine plan does not contain any full 35m square pillars under the CLZ at a depth greater than 260m. Two pillars with 35m centres are partially located at depth of cover greater than 260m, however both pillars are adjacent to solid coal barriers and maintain more than 78% of total area at depth less than 260m. These were assessed by SCT (2023b) to be long-term stable.

All pillars at depths greater than 260m have been designed with a larger pillar length, therefore increasing the effective pillar width and associated FOS. Panels proposed to mined within the EP Area are illustrated on **Plan 1 - Existing and Future Workings**. The planned first workings in the CLZ with the 260m DOC contour highlighted are presented on **Figure 3.3**.

The maximum subsidence predictions for the EP Area are consistent with, or less than, the EIS Predictions as shown in **Table 3.1**.

Table 3.1: Maximum Subsidence Predictions with Comparison to Previous Predictions

Predictions	Pillar Stability	Max Subsidence	Max Tilt (mm/m)	Max Strain	
				Tensile (mm/m)	Compressive (mm/m)
This CLZ EP (ML1814) Predictions SCT (2023a; 2023b)	Long Term Stable with minimal subsidence	≤37mm	≤0.61	≤0.18	≤0.25
EIS Predictions Golder (2014b)	Long Term Stable	65mm	0.6-1.1	0.2-0.3	0.2-0.5
Current CLZ EP (ML1331) Predictions Golder (2017)	Long Term Stable, negligible settlement, effectively non-subsiding	<53mm Worst Case (long term flooded and additional pillar loading) Short to medium term <30mm and typical <20mm	0.4-0.9	0.1-0.3	0.1-0.3

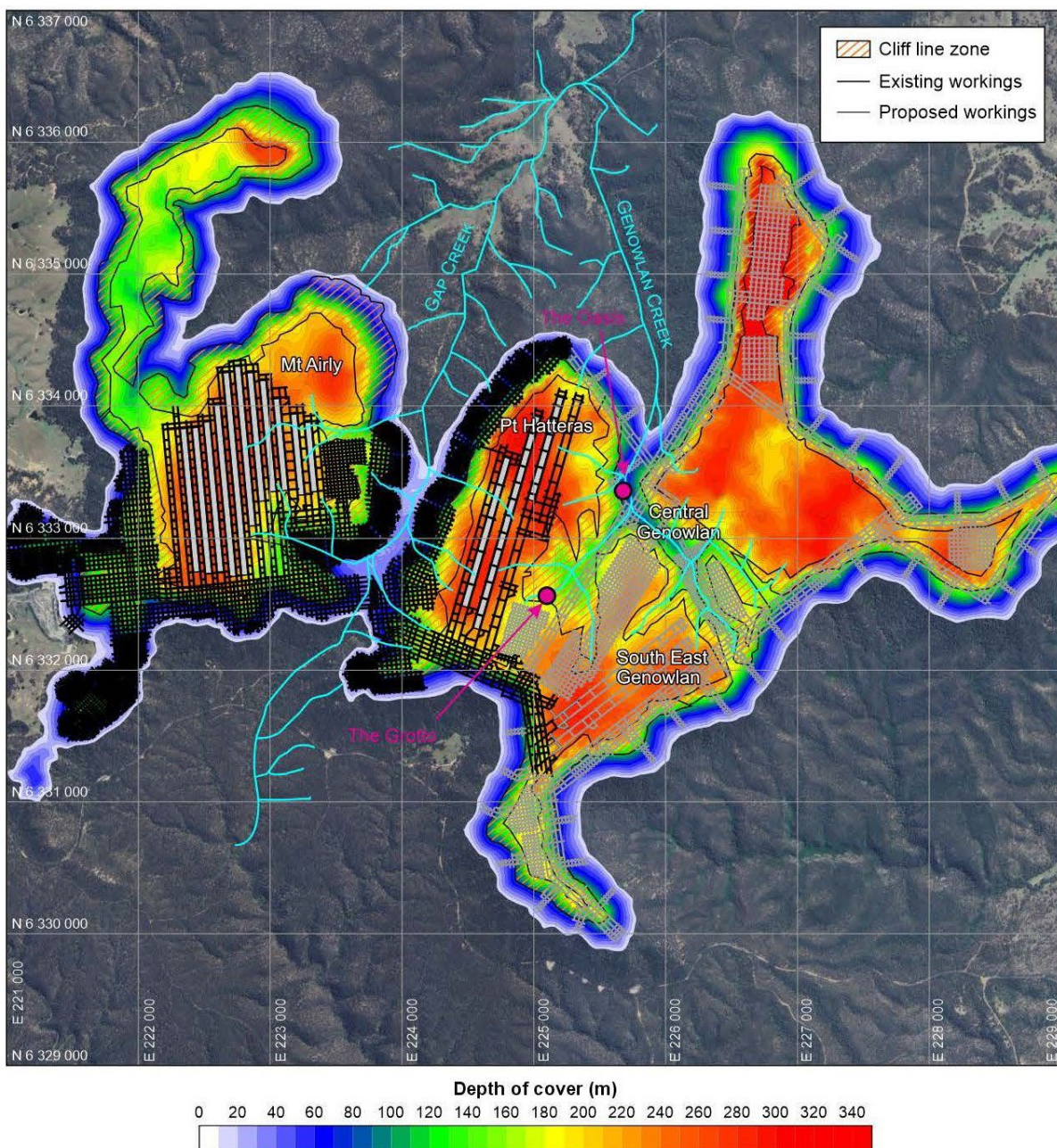
3.3 Potential Environmental Consequences and Impacts

The predicted levels of subsidence from first workings proposed in this CLZ (ML1814) Extraction Plan are similar to those provided in the 2014 EIS. The assessed levels of potential impact are similar to those based on the EIS Layout. The performance measures for subsidence for the Airly Mine are outlined in Condition 2 in Schedule 3 of SSD_5581. **At these predicted low subsidence levels, it is unlikely that performance measures of SSD_5581 will be exceeded by the proposed first workings.**

The environmental consequences of subsidence effects on natural and built features are detailed within each of the relevant sub-management plans (Appendix 1 to Appendix 6).

It is noted by SCT (2023b) that the natural sequence of erosion within the CLZ, through processes such as exposure to the elements and vegetation exploiting natural would be expected to result in naturally occurring rock falls. These naturally occurring events cannot be eliminated through mine design.

Figure 3.3: Planned CLZ First Workings Pillar Geometry and Depth of Cover



4 MONITORING PROGRAM

4.1 Subsidence Monitoring Program

The Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP), presented as Appendix 6 to this Extraction Plan, has been developed in accordance with Condition 7.(i)(i) in Schedule 3 of SSD_5581 and provides the objectives and the proposed subsidence monitoring program.

The CLZ (ML1814) SMP sets out the program for monitoring the subsidence movements and effects associated with proposed first workings within the EP Area and provides a consolidated summary of monitoring for natural and built features. Each relevant sub-management plan includes detailed information including:

- detailed performance measures and indicators;
- monitoring methods, parameters, location, timing, and frequency;
- proposed procedures to record and report on the monitoring results; and
- the capacity of the program to detect early warning of deviations from the performance measures and associated performance indicators.

Key features requiring monitoring are detailed within the following sub plans:

- Surface water flows and quality - Airly Mine Water Management Plan (Appendix 1);
- Groundwater levels, flows and quality - Airly Mine Water Management Plan (Appendix 1);
- Landforms (including Cliffs, Minor Cliffs and Pagodas), - Land Management Plan for CLZ (ML1814) (Appendix 2);
- Biodiversity Management Plan for CLZ (ML1814) (Appendix 3);
- Heritage sites – Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) (Appendix 4); and
- Public safety and safety of others - Public Safety Management Plan for CLZ (ML1814) (Appendix 5).

4.2 Ongoing Baseline Data Collection Program

Complementary environmental monitoring associated with ongoing existing programs required separately to the Extraction Plan (e.g. for site-wide management plans requires separately by Development Consent) provide useful baseline and monitoring information for the EP Area. This includes downstream surface waters, groundwater, biodiversity and aquatic ecology and stream health monitoring.

An outline and overview of environmental monitoring programs to monitor potential subsidence impacts and environmental consequences within the EP Area and over the site as a whole includes:

- **Airly Mine Water Management Plan:**
 - The Airly Mine Water Management Plan (WMP) (GHD, 2024) has been developed to meet broader relevant approvals and licensing requirements for the mine beyond the EP Areas. Monitoring described within the WMP includes:
 - Surface water monitoring
 - Groundwater monitoring
 - Aquatic ecology and stream health
- **Biodiversity Management Plan:**
 - A broadscale Biodiversity Monitoring Program is currently being undertaken at Airly within the Development Consent Area (SSD_5581) as per the Western Region Biodiversity Management Plan – Appendix B Airly (Centennial 2019a) required by consent condition 15, Schedule 4, including;
 - Groundwater dependent ecosystem monitoring
 - Threatened vegetation communities monitoring
 - Threatened flora monitoring
 - Threatened fauna monitoring
- **Remote monitoring of the Surface Environment:**
 - Remote monitoring via LiDAR (40 points per square meter) for monitoring of vertical subsidence is undertaken as part of a whole of mine monitoring survey ahead of proposed mining, including future extraction areas, to be conducted concurrently with monitoring detailed in previous Extraction Plans and the CLZ (ML1814) Extraction Plan.
- **Monitoring ground movement:**
 - Airly Mine has an extensive network of existing (and proposed) Global Navigation Satellite System (GNSS) Monitoring Stations, also known as Continually Operating Reference Stations (CORS) which provide long occupation real time point data. Existing GNSS units within the EP Area, GM10, GM11 and GM 12, were installed in September 2021. The installation of additional proposed GNSS units, including site RS associated with monitoring of Aboriginal Heritage Site (AHIMS 45-1-0167), is subject to receiving approval from NPWS. The GNSS units will be installed prior to commencement of first workings in the EP Area and will collect baseline data through to the commencement of first workings.

The proposed Subsidence Monitoring Program (Appendix 6) has been designed to collect sufficient baseline data for future Extraction Plans.

5 MANAGEMENT, MITIGATION, REMEDIATION AND REPORTING MEASURES

5.1 Performance Measures and Indicators

Performance measures for subsidence for the Airly Mine are outlined in Condition 2 in Schedule 3 of Development Consent SSD_5581⁸. **Table 5.1** presents the performance measures and indicators that have been used when developing the management strategies incorporated in this Extraction Plan and supporting sub-plans.

Table 5.1: Subsidence Impact Performance Measures and Indicators – Key Relevant Features

Feature	Performance Measure (Approved Impact)	Performance Indicator
Gap and Genowlan Creeks	Negligible environmental consequences to water quality and to bed and bank stability	Watercourse quality within or below trigger values developed with reference to historical monitoring data and site-specific guideline values
	No greater environmental consequences than predicted in the EIS to water flows (including baseflow)	Watercourse flow rates and rainfall-runoff response are consistent with the calibrated baseline model during quarterly assessments
Groundwater	Consistent with hydrogeological model predictions	Groundwater level above trigger values (i.e. drawdown less than predicted)
		Groundwater quality within or below trigger values
		Groundwater inflows consistent with predictions
		No complaints regarding groundwater access or quality
Stream Health	Negligible environmental consequences to bed and bank stability for Gap and Genowlan Creeks.	Bed and bank stability maintained or improved
		Erosional processes do not occur as a result of subsidence
		Change in stream gradient does not vary beyond predictions of subsidence modelling
		No connective cracking between the surface and underground workings
		Riparian, channel and environmental scores relating to riparian and instream vegetation within historical range and/or consistent with reference sites
The Grotto	Negligible subsidence impacts or environmental consequences	Presence/absence of mine-induced damage or change to features (no significant rock falls or surface cracking) Watercourse quality and flow volumes within or above historical monitoring data, site-specific guideline values and/or consistent with predictions Evidence of subsidence impacts (to biodiversity) compared to baseline records

⁸ Measures relating to natural and heritage features are presented in Table 1 and measures relating to built features and public safety are presented in Table 2

Table 5.1: Subsidence Impact Performance Measures and Indicators – Key Relevant Features (continued)

Feature	Performance Measure (Approved Impact)	Performance Indicator
Cliffs within a 26.5 degree angle of draw of the Airly underground mine workings	No greater subsidence impacts or environmental consequences than predicted in the EIS (<i>i.e. occasional falls, displacement or dislodgment of boulders or slabs of less than 30m³, or fracturing, that do not impact Aboriginal heritage, EECs or public safety</i>), that in total do not impact more than 2% of the total area of such cliffs.	Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking) Various Parameters relevant to each monitoring method
Pagodas within a 26.5 degree angle of draw of the Airly underground mine workings (other than pagodas affected by the New Hartley interaction zone)		
Minor Cliffs		
Steep slopes		
All other land not covered by a performance measure above	No greater subsidence impacts or environmental consequences than predicted in the EIS	
Walking and 4WD tracks	Use should be maintained wherever practicable in consultation with BCD Damage must be fully repairable and must be fully repaired	Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking) Various Parameters relevant to each method
Threatened species, threatened populations, EECs and Groundwater Dependent Ecosystems (GDEs) , with the exception of those listed below	Negligible environmental consequences	Evidence of subsidence impacts compared to baseline records
Pultenaea sp. Genowlan Point population and Genowlan Point Allocasuarina nana Heathland community	No environmental consequences	Evidence of subsidence impacts compared to baseline records
Aboriginal heritage sites	Negligible environmental consequences	Presence/absence of mine-induced damage or change to features
Public Safety	Negligible additional risk, in consultation with the Resources Regulator and BCD	Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking) Various Parameters relevant to each method
First workings beneath any feature where performance measures in this table require no or negligible environmental consequences and to all first workings beneath cliffs	To remain long-term stable and non-subsiding	Confirm that formation of underground workings for development is implemented as per mine designs in an approved Extraction Plan

5.1.1 Performance Measures for Mine Design and Underground Mining Control

The primary objective of the mine design is to prevent any significant mine induced risk to surface features by providing low levels of subsidence. This minimises potential for environmental impacts and allows built features to remain safe, serviceable and repairable. Accordingly, adherence to the final mine design during implementation (mining) will be monitored as part of Underground Mining Controls⁹. The minimum performance measures for mine design parameters have been used as Condition Red trigger levels within the CLZ (ML1814) Master TARP.

The minimum performance measures for mine design parameters for the current EP Area are based on the commitments in the Consent, EIS or most recent subsidence assessments. The mine design parameters which will be monitored as underground mining control are detailed below in **Table 5.2**.

Table 5.2: Underground Mine Design Requirements – CLZ

Design/Control Aspect	Minimum Performance Measure for the current EP
Mining System Type(s)	First workings
Final Pillar Stability	Long Term Stable with minimal subsidence
Design Cover Depth Range	90-320m
Nominal Mining Height (m) ^a	<3.2m
Nominal Maximum Roadway Width (m) ^a	5.5m
Nominal Maximum Void Width (m)	<10m
Minimum Pillar Factor Of Safety (FOS)	>2.11
Formation of Pillars (Centres)	Minimum first workings on 35m x 35m pillar centres, <i>noting minimum pillar size increases for DOC 260m or greater</i>
Nominal Pillar Width to Height Ratio (average across panel) ^a	>8
Predicted Maximum Subsidence (mm)	Maximum ≤37mm

a) on average as mined

b) in accordance with Condition 1 in Schedule 3 of SSD_5581

c) cliffs as defined by Aerometrex (2021, 2022) and inspected by MNC (2023a, 2023b) based on definitions of consent SSD_5581

5.2 Management and Mitigation Measures

Centennial has developed an integrated, holistic approach to subsidence management for key risks within its operations at a regional, site and EP Area level to provide an appropriate and systematic management approach.

- Regional management plans provide a framework for strategic management under which site plans and EP Area plans are established in accordance with consent conditions.
- Site management plans typically cover all aspects of mining operations (including surface operations and non-subsidence related aspects) as required by other conditions of the development consent.

⁹ see Section 4.1 for a summary of underground mining control monitoring and CLZ (ML1814) SMP (Appendix 6) for details

- Management Plans for individual EP Areas (key sub-management plans) are developed specifically to address Condition 7 (Extraction Plan) in Schedule 3 of SSD_5581 which has a specific focus in terms of both location and context as well as environmental management of subsidence and underground mining operations specifically related to the EP Area.

The key sub-management plans submitted as part of this Extraction Plan include:

- Airly Mine Water Management Plan (Appendix 1);
- Land Management Plan for CLZ (ML1814) (Appendix 2);
- Biodiversity Management Plan for CLZ (ML1814) (Appendix 3);
- Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) (Appendix 4);
- Public Safety Management Plan for CLZ (ML1814) (Appendix 5); and.
- Subsidence Monitoring Program for CLZ (ML1814) (Appendix 6).

The plans have been developed using a risk-based approach to address the management of potential subsidence-related impacts within the EP Area. A copy of each sub-management plan is supplied in Appendix 1 to Appendix 6 of this Extraction Plan. Centennial Airly have undertaken a dedicated subsidence and environmental risk assessment for the EP Area including reference to related risk assessments and supporting studies¹⁰ and has consulted with key stakeholders to determine the content of relevant sub-plans.¹¹

Consultation with government agencies is undertaken as required under Development Consent SSD_5581 as summarised in **Table 5.3**.

Table 5.3: Sub-management Plans, Consultation and Status at time of EP Submission

Management Plan	Summary of Consultation				Status at EP Submission
	<i>Consultation Required^a</i>	<i>Comments Invited from^b</i>	<i>Comments Received by</i>	<i>Comments / Issues Raised</i>	
Airly Mine Water Management Plan	BCD and the Water Division	Airly Mine WMP prepared originally in 2017. Revised in 2024 ^c	N/A	As detailed in Appendix A and Appendix B in the Airly Mine WMP	Final
Land Management Plan for CLZ (ML1814)	IEP, Resources Regulator and BCD	IEP Resources Regulator BCD	Nil	Nil	Final (Rev2)
Biodiversity Management Plan for CLZ (ML1814)	DoEE and BCD	DoEE BCD	Nil	Nil	Final (Rev2)

¹⁰ see Section 2.4, Attachment C – Subsidence and Environmental Risk Assessment and Attachment E to Attachment H

¹¹ see Section 2.6 and Attachment D – Stakeholder Consultation

Management Plan	Summary of Consultation				Status at EP Submission
	Consultation Required ^a	Comments Invited from ^b	Comments Received by	Comments / Issues Raised	
Aboriginal Cultural Heritage Management Plan for CLZ (ML1814)	Heritage Division and relevant Aboriginal stakeholders	Heritage Division	Heritage NSW	Demonstration of consultation requirements, including ongoing consultation and recommendations for consistency with the Western Region - Aboriginal Cultural Heritage Management Plan (Centennial Coal and RPS, 2021)	Final (Rev3)
		relevant Aboriginal stakeholders		Request for 3D photogrammetry to be included in baseline monitoring	
				Wellington Valley Wiradjuri Aboriginal Corporation	
			Warrabinga – Wiradjuri #7 Native title Claimants group	Nil – expressed support of the ACHMP	
Public Safety Management Plan for CLZ (ML1814)	IEP, Resources Regulator and BCD	IEP Resources Regulator BCD	Nil	Nil	Final (Rev2)
Subsidence Monitoring Program for CLZ (ML1814)	IEP, Resources Regulator and BCD	IEP Resources Regulator BCD	Nil	Nil	Final (Rev2)

a) in accordance with Condition 7 in Schedule 3 of development consent SSD_5581

b) Management Plans to be distributed to relevant agencies concurrently with submission to NSW Planning

c) The site WMP was developed in accordance with Condition 13 in Schedule 4 of SSD_5581 including consultation with relevant stakeholders and was originally finalised during 2017. The most recent revision of the WMP has been developed in consultation with relevant stakeholders and in consideration of the mine design for the EP Area. Consultation and approval of the Airly Mine Water Management Plan is separate to the Extraction Plan approval process.

5.3 Remediation and Rehabilitation Measures

Due to the minimal subsidence expected the need to implement remediation/rehabilitation measures for potential impacts are considered unlikely. However, in the event that remediation is required, Airly Mine will undertake remediation in accordance with:

- Conditions 7a)-7c) in Schedule 6 of SSD_5581, noting in particular the requirement to submit a report to NSW Planning describing remediation options and any preferred remediation measures or other course of action;
- Any relevant actions prescribed in the *CLZ (ML1814) Master TARP* developed for this Extraction Plan (or other relevant plans of management);
- The current Rehabilitation Management Plan; and
- In consultation with key stakeholders including any affected land holders and relevant government agencies.

A Response Strategy will be adopted if a significant impact is detected as a result of mining activities within the Extraction Plan area.

5.4 Master Trigger Action Response Plan

A detailed Master Trigger Action Response Plan for CLZ (ML1814) (CLZ (ML1814) Master TARP) has been developed for the Extraction Plan to reflect the commitments of this Extraction Plan and supporting sub-management plans¹². Whilst impacts are not predicted nor expected, the CLZ (ML1814) Master TARP provides a process of tiered and escalating trigger levels for contingency measures should subsidence and impacts be greater than predicted/approved. The CLZ (ML1814) Master TARP applies only to the EP Area (separate TARPs apply to other established EP Areas in various approved mining zones).

Given the mine design specifically to avoid impacts, the CLZ (ML1814) Master TARP includes detailed measures for **Underground Mining Controls** to ensure that the mining geometry is formed as per the approved design specifications that determine the predicted subsidence movements and impacts.

Detailed performance indicators to meet Performance Measures set by development consent SSD_5581 are outlined in the Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP) and incorporated into relevant aspects of the CLZ (ML1814) Master TARP. The contingency plan where a performance indicator has been exceeded is outlined in the CLZ (ML1814) Master TARP. A trigger will result in additional investigations to determine if the exceedance is related to non-mining-factors or is a consequence of mining activity. The response to these exceedances will follow the CLZ (ML1814) Master TARP. Management/ corrective actions can be implemented where required to remedy these non-conformities and report accordingly.

To establish compliance with the performance measures outlined in **Sections 5.1 and 5.1.1**, Airly Mine has established performance indicators for each feature, via escalating triggers and levels of investigation in accordance with the performance indicator levels described in **Table 5.4**.

The CLZ (ML1814) Master TARP details the parameters and associated trigger levels developed for the Extraction Plan, and the CLZ (ML1814) SMP established the appropriate monitoring to demonstrate that subsidence performance satisfies the performance measures for the Airly Mine.

Table 5.4: Performance Indicators & TARP Risk Management Scenarios

Performance Indicator	General Description	Action / Response
Level 1: Condition Green	Operations within predictions, and within approved impacts.	Continued operations and monitoring as normal.
Level 2: Condition Amber	Operations within approved impacts but potentially exceed / exceed predictions.	Review and investigation processes are engaged, with adaptive management as required.
Level 3: Condition Red	Operations exceed approved impact. <i>The approved Performance Measures (criteria thresholds) of Development Consent (and any other relevant approvals) are listed in Condition Red.</i>	Adaptive Management measures are fully engaged as per the CLZ (ML1814) Master TARP and relevant sections of the Extraction Plan, CLZ (ML1814) SMP and other key sub-management plans.

¹² see Appendix 7

5.5 Adaptive Management and Contingency Planning

5.5.1 Centennial Coal Adaptive Management Framework

An Adaptive Management Framework provides for flexible decision making, adjusted to consider uncertainties as management outcomes are understood.

Through feedback to the management process, the management procedures are changed in steps until monitoring shows that the desired outcome is obtained. The monitoring program has been developed so that there is statistical confidence in the outcome.

In adaptive management the goal to be achieved is set, so there is no uncertainty as to the outcome, and conditions requiring adaptive management do not lack certainty, but rather they establish a regime which would permit changes, within defined parameters, to the way the outcome is achieved.

The Centennial Coal Adaptive Management Framework is a process of ongoing testing, learning, monitoring and managing and relies on:

- Description of the environmental value and its role in the landscape, including aspects of an operation that may result in a significant impact to the environmental value (not all aspects of a project will generate impacts);
- A model of the environmental response to certain management actions/decisions, supported by the description of the environment;
- Mechanisms to test the model;
- Engagement with relevant stakeholders in the description of the environment and development of models, model outcomes and management actions/decisions;
- Identification of clear management objectives for each environmental value;
- Monitoring the system using best available technologies and multiple lines of evidence to:
 - Evaluate progress against objectives;
 - Determine the status of the system;
 - Increase our understanding of the system; and
 - Refine the modelling where applicable.

5.5.2 Adaptive Management Strategy for Airly Mine

Airly Mine has sought to eliminate risks and avoid potential impacts to surface features, as the most effective form of management on the risk hierarchy, through an extensive mine design process. Progressive implementation and monitoring of mining within the approved mining zones during the mine schedule affords further opportunity and flexibility for adaptive management if required.

The adaptive management approach at Airly Mine involves monitoring and evaluation against performance measures and associated indicators in the *Master Trigger Action Response Plans for CLZ (ML1814) (CLZ (ML1814) Master TARP)* established for the extraction plan and supporting management plans.

Where performance indicators indicate increasing levels of risk (i.e., where relevant thresholds of conditions green, amber or red are being exceeded), escalating adaptive management measures are engaged in accordance with the CLZ (ML1814) TARP. The process has been successfully implemented in existing

Extraction Plan areas at Airly Mine and has been updated to reflect EIS commitments and consent requirements for the Airly Mine Extension Project, including specific performance measures.

In accordance with Condition 7 (Adaptive Management) in Schedule 6 of SSD_5581, where any exceedance of applicable maximum criteria and/or performance measures has occurred (Condition Red), Centennial will at the earliest opportunity:

- a) Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur
- b) Consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and
- c) Implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary.

Adaptive management measures would follow failure/root cause analysis where appropriate (including review of any observed impacts in EP Areas for potential mining induced causes, acknowledging the dynamic natural environment such as cliffs), and would be undertaken in consultation with relevant stakeholders, and involve review of this management plan.

Centennial Airly's approach to adaptive management allows for modifications to be made to the mine design in the event that performance measures are not met. The mine design is conservative enough in terms of subsidence that changes can be made to the underground operations should impacts be outside the predicted levels before any significantly adverse impact actually occurs. If required, the following actions could be used in isolation or in various combinations to adapt the mine workings to avoid adverse impacts:

- Avoid mining under sensitive surface features
- Change mine dimensions to ensure total extracted voids and pillar sizes are within appropriate limits
- Increase the size of protection zones by commencing or stopping mine workings further away from sensitive features than planned
- Review and undertake appropriate additional monitoring

Each of these actions has the potential to have a significant impact on the feasibility of the operation and would only be undertaken as a considered response to impacts outside predicted values.

5.6 Incidents, Complaints, Exceedances and Non-compliances

Incidents, exceedances and non-compliances may become evident as a result of inspections, monitoring, through audit findings or complaints. Where any exceedance or non-compliance has been identified it will be investigated and the and the steps undertaken in accordance with Condition 7 in Schedule 6 of SSD 5581.¹³

The implementation of corrective actions will be monitored and documented using the Environment & Community Database and reported in the monthly environmental performance report.

A non-compliance will be reported internally and externally to the relevant authorities as per the *Centennial Coal Management Standard 012 External Environmental Reporting* and in accordance with the *Pollution Incident Response Management Plan*. A record of all non-compliance reporting is to be maintained in the Environment and Community Database as well as reported in the Annual Review.

¹³ See Section 5.5.2, steps a) to c).

A non-compliance will be investigated as per the Accident / Incident Investigation procedure in the *Airly Mines Health and Safety Management System* (HSMS). A record of all non-compliance investigations will be maintained in the Environment & Community Database.

5.7 Reporting and Auditing

5.7.1 Reporting and Notifications

Reporting is undertaken in accordance with the requirements of specific requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). Additionally, high potential incident notifications for unexpected subsidence events in relation to the safety of other persons under WHS legislation has also been included.

Airly will submit the following reports as summarised in **Table 5.5** during the first workings as relevant. The frequency of reporting is proposed to be proportionate and reflective of the nature of the current EP Area and no predicted surface impacts with negligible ground movements.

Table 5.5: Reporting and Notification Requirements

Report	Triggers	Relevant Statutory Conditions	Requirements
Notification of Controlled Action Commencement	Commencement of Controlled Action EPBC 2013/7076	Condition 2 of EPBC 2013/7076	DoEE to be notified in writing of date of commencement of controlled action (including first workings), required within fourteen (14) days after commencement. <i>Note: This condition has been satisfied by Centennial Airly as per details below in footnote 2).</i>
Website Publication	Approval of the management plan by the Minister (NSW Planning); Advice /reports received from the IEP (relevant to this management plan); Completion of the Annual Review Receipt of complaint relating to aspects covered by this Extraction Plan	Condition 7 of EPBC 2013 / 7076 (1 month) Schedule 6, Condition 14(a) of SSD_5581 Schedule 6, Condition 10 of SSD_5581 Schedule 6, Condition 2(g) of SSD_5581	- Copy of this management plan to be published on Centennial Airly website within one (1) month of approval by the Minister (DoEE) and kept up to date (NSW Planning). - Any advice/reports (relevant to this management plan) issued by the IEP are to be published on the Centennial Airly website. - Comprehensive summary of monitoring results of the development. - The last five (5) Annual Reviews to be published on Centennial Airly website. - Protocol for managing complaints (register updated monthly). - Complaints register published on website.
Incident ¹ Reporting	Any set of circumstances that causes or threatens material harm to the environment; and/or breaches or exceeds the limits or performance measures/criteria in development consent SSD_5581 ¹ .	Consent condition 9 (Schedule 6) of SSD_5581.	- Detailed report to be provided to NSW Planning on the incident within seven (7) days of the incident - Secretary of NSW Planning and any other relevant agencies to be notified immediately (including NSW Planning, EPA and DoEE) if material harm to the environment is threatened or caused. - Includes non-compliance with any statutory requirements or exceedance of performance measures.
	Any incident ¹ relating to land in accordance with consent condition 9 (Schedule 6), EPL12374 condition R2, EPBC 2013/7076 Condition 1, or as triggered by the TARP (reporting incidents under Management Plans as per	EPBC 2013/7076 Condition 1, or as triggered by the TARP (reporting incidents under Management Plans as per Schedule 6, Condition 2 of SSD_5581).	- Any additional notifications and reporting as per relevant approved TARP, including actions being undertaken to prevent recurrence. - The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the POEO Act. As per R2.1 of the EPL, notifications to EPA

Report	Triggers	Relevant Statutory Conditions	Requirements
	Schedule 6, Condition 2 of SSD_5581).	EPL12374 condition R2	must be made by phoning the Environment Line service on 131 555. The licensee must provide written details of the above notification to the EPA within 7 days of the date on which the incident occurred, as per R2.2 of EPL.
Duty to notify Resource Regulator of certain incidents - High Potential Incident' Reporting (WHS legislation)	High Potential Incidents ³ that relate to this Extraction Plan	WHS Regulation (Mines and Petroleum Sites, 2022) Section 124 - <i>Duty to notify regulator of certain incidents</i> Section 6 of the Guidelines for Managing Risks of Subsidence (WHS (Mines and Petroleum Sites), February 2017)	Respond in accordance with Section 124: - all reasonable steps must be undertaken to ensure that the regulator is notified after becoming aware of an incident (other than a notifiable incident defined by the Regulations -refer the Safety Management System for details): - Notifications in accordance with the WHS Guide "Notification of Incident and Injury" (April 2018) as per 'Other Incident' category, including: - Notification must be as soon as possible and: - in the case of a high potential incident that resulted in an injury or illness, no later than 48 hours after becoming aware the incident resulted in an injury or illness, or - no later than 7 days after becoming aware of the incident (whichever is earlier). - Notification must be in writing using the Notification of incident and injury form. - Notify key stakeholders including NSW Planning, NPWS as soon as practicable of the above. Note: Whilst unexpected, should an incident actually occur which causes injury (as defined by Schedule 9, Section 12) separate priority notifications apply in accordance with WHS requirements and the mine SMS.
Subsidence Impacts and Environmental Monitoring Report	Reporting of all impacts and environmental monitoring results annually in a combined report with previous EP reporting for which the same survey is performed (i.e. reporting following completion of aerial surveys).	Condition 10, Schedule 6 of SSD_5581 Section 3.6.7 of <i>Extraction Plan Guideline</i> (DPE, 2022)	This report will include: - a comprehensive summary of all impacts, including: - A summary of integrated subsidence monitoring program results (conventional, remote⁴ and underground monitoring); - Results of related environmental monitoring where applicable; - An assessment of impact compliance (if impacts remained within predictions, any which exceed predictions but remained with performance measures and/or performance indicators, and if any impacts exceeded performance measures of consent). - Details of any observed impacts (including full description, location identification using aerial photos and mining layout, photos, targeted inspection results (including photos) and characterisation of the impact in accordance with the relevant TARP). - Details if impacts were likely mining-induced. - Actions to be undertaken to prevent recurrence of any mining induced impacts; - a comprehensive summary of relevant quantitative and qualitative environmental monitoring results. - Any revisions to the TARP undertaken in consultation with stakeholders. - Any other adaptive management measures as relevant

Report	Triggers	Relevant Statutory Conditions	Requirements
Annual Review	Annual Review report required under development consent condition 11 (Schedule 6), SSD_5581.	Condition 11 (Schedule 6), SSD_5581	Report to include: - All aspects detailed in Condition 11(a)-(f), Schedule 6 of consent (detailed in the Extraction Plan and Subsidence Monitoring Program) as relevant to this document. - Information presented in the above periodic Subsidence Impacts and Environmental Monitoring Reports (as per the <i>Extraction Plan Guideline</i> (DPE, 2022)); - The review is required to be submitted by 31st March each year unless otherwise agreed by the Secretary (NSW Planning). Copies of the last five (5) reviews to be published on Centennial Airly website as per Condition 14, Schedule 6 of consent.
Annual Controlled Action Compliance Report (EPBC 2013/ 7076)	Annual report required under EPBC 2013 / 7076	Condition 4 of EPBC 2013 / 7076.	- Compliance report published on Centennial Airly website within 3 months of every annual (12 month) anniversary of commencement of controlled action (first workings). - Details of report in accordance with Condition 4 of EPBC 2013/7076. - Documentary evidence providing proof of date of publication to website and non-compliance with any conditions to be provided to the Department (DoEE) at same time the compliance report is published.
Formal Notification of SCA Access to Mudgee NPWS Office	Contractor requiring monitoring access to the SCA	Routine (or other) monitoring	Notification of proposed access dates/times to be provided to NPWS Area Office in Mudgee prior to accessing the Mugii Murum-ban SCA.

Notes:

- The above table is not intended to and does not represent reporting and notification requirements defined by WHS legislation other than that noted above (including all other 'notifiable incidents') – refer the mine Safety Management System (SMS) for all such requirements. High Potential Incidents under the WHS in relation to subsidence are identified and defined above. Incidents under Development Consent SSD_5581 are defined as "A set of circumstances that causes or threatens material harm to the environment; and/or breaches of exceeds the limits or performance measures/criteria in this consent".
- EPBC Approval 2013/7076 was received from DoEE on 18th May 2017. Centennial Airly provided written notice to DoEE on 29th May 2017 advising the date for commencement of controlled action as Saturday 20th May 2017. For clarity, the notification applies to the entire development consent approval area and was satisfied for activities undertaken in relation to a previous Extraction Plan.
- High Potential Incidents that relate to this Extraction Plan are defined by Section 124 (5) (a) as:

'an event referred to in section 190 (1) (i)-(xviii) that would have been a dangerous incident if a person were reasonably in the vicinity at the time when the incident or event occurred and in usual circumstances a person could have been in that vicinity at that time', relevant Dangerous Incidents listed in section 190(1)(a)-(qi) include:

190 (1) (p) - a failure of ground, or of slope stability control measures, or

190 (1) (q) - rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations or release of gas at the surface, due to subsidence'.

And Section 124 (5) (m) as:

'Any indication from monitoring data of the development of subsidence which may result in damage to any plant or structure or a failure of ground
- The intention of reporting for aerial/remote monitoring results will be to provide relevant and focused reporting and analysis for both mined and unmined areas within the EP Area in each reporting period, whilst assembling significant raw data sets for the entire EP Area which can be further interrogated if required/triggered. Significant raw data collected from high-definition LiDAR and high-resolution 3D photogrammetry throughout the EP Area will initially be processed to detect potential changes relevant to baseline and performance measures/indicators (the process and results of which will be summarised in reports). Detailed analysis and reporting will subsequently be focused on areas mined within each reporting period (including specific features undermined) and if/where change has been detected (including within unmined areas where natural rock falls may occur and within previously mined areas). Detailed analysis and reporting on each and every feature located within the entire EP Area is not intended to be undertaken, although noting aerial monitoring survey data is held for such wherever required.

5.7.2 Periodic Auditing

Comprehensive Independent Environmental Audits of the entire approved development under development consent SSD_5581 are undertaken within 1 year of commencement and every 3 years thereafter (unless directed otherwise) in accordance with Conditions 12 and 13.

Auditing of any rehabilitation undertaken for the mine (including for subsidence if triggered) is undertaken in accordance with the Rehabilitation Management Plan under Condition 27 of development consent SSD_5581.

Additionally, in accordance with section 20(c) of the WHSMP Regulation (2022), auditing will be undertaken in accordance with the Airly Mine Safety Management System (**SMS**), against the performance standards for measuring the effectiveness of all aspects of the SMS, including the methods, frequency and results of the audit process. The audit should also consider the following matters:

- (1) competency of the auditor,
- (2) the person responsible for ensuring the audit is conducted, and
- (3) the person responsible for implementing the results of the audit.

6 PLAN ADMINISTRATION AND RESPONSIBILITIES

6.1 Review of Other Management Plans

To maintain consistency with existing management plans and previous Extraction Plans at the mine, relevant management plans will be reviewed in the event that the following occur:

- Stakeholders raise issues that necessitate a review;
- There are other changes to management requirements (e.g. changes to other related approvals besides consent, such as Mining Lease and/or EPL conditions);
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan;
- Monitoring or audit processes demonstrate that a review is warranted;
- Where otherwise triggered by the CLZ (ML1814) Master TARP;
- Where triggered by (or for) review of other related management plans (if applicable); or
- Every three (3) years as a minimum (where not already triggered above).

Any amendments to relevant management plans will be undertaken in accordance with Consent/relevant approvals and in consultation with key relevant stakeholders where required. Following any significant changes a copy of the amended management plans will be forwarded to NSW Planning and the IEP.

6.2 Review of the Extraction Plan

In accordance with Schedule 6 in Condition 3 of SSD_5581, as a minimum Airly will review this Plan within three months of the following:

- Submission of an incident report;
- Submission of an Annual Review (required 31 March annually);
- Submission of an Independent Environmental Audit; or
- Any modification to the conditions of SSD_5581.

Where this leads to revisions of the document, within four (4) weeks of the review the revised document must be submitted to NSW Planning for the approval of the Secretary. Continual improvement shall be achieved through monitoring, internal and external communication with stakeholders, implementation of corrective and preventative actions and through monitoring progress against the objectives included in the environmental management plans. The reporting framework¹⁴ will document the effectiveness of this Extraction Plan (and the supporting Management Plans) through comparison of the predicted negligible impacts of subsidence against actual outcomes.

Each variation to this Plan will be identified in the Document Control Table at the beginning of this document.

In addition to planning development consent requirements, Airly Mine must review and as necessary revise the risk control measures implemented for subsidence in accordance with Section 15 of the *WHSMP Regulation (2022)*. This is primarily related to public safety which is managed under the Public Safety Management Plan for CLZ (ML1814) (CLZ (ML1814) PSMP) and is also relevant to the Land Management Plan

¹⁴ see Section 5.7.1

for CLZ (ML1814) (CLZ (ML1814) LMP) due to the landscape features which were identified as directly related to potential risk to public safety (including cliffs and pagodas).

Monitoring and review processes¹⁵ will provide essential feedback for:

- Detecting changes,
- Verifying the risk assessments previously conducted,
- Ensuring the effectiveness and reliability of risk control measures, and
- Supporting continual improvement and change management.

In accordance with the *Managing Risks of Subsidence Guideline* (NSWRR, 2017) in triggering and undertaking reviews the following will be considered:

- Risk control for subsidence should be reviewed and revised as necessary when:
 - (1) a significant change from the assumptions used or the results of risk assessments is detected;¹⁶
 - (2) a significant change in the site-specific conditions is identified,¹⁷
 - (3) there are early warnings of abnormal subsidence where significant surface or subsurface features exist,¹⁸
 - (4) the control measure does not control the risk it was implemented to control so far as is reasonably practicable,
 - (5) a new relevant hazard or risk is identified,
 - (6) the results of consultation indicate that a review is necessary,
 - (7) an incident or notifiable incident has occurred, or
 - (8) the results of an audit indicate that a review is necessary
- key stakeholders must, so far as is reasonably practicable, be consulted and the following questions should be addressed:
 - (1) Have all subsidence hazards been identified?
 - (2) Is the mine operator's understanding of subsidence hazards still current and correct?
 - (3) Have the implemented risk control measures been working effectively?
 - (4) Are the risks of subsidence being adequately managed?
 - (5) Have there been any early warnings of changes from the results of risk assessments, which warrant corrective or proactive management actions or the commencement of emergency procedures?
 - (6) Have any incidents of subsidence occurred and what is the learning from the investigations of these incidents?
 - (7) Should the implemented risk control measures be revised according to the results of subsidence monitoring and review?

¹⁵ Airly mine must ensure that any interpretation of subsidence information (e.g. reviewing the risk control measures for subsidence) is carried out only by a competent person.

¹⁶ A change (from the assumptions used or the results of risk assessments) is significant if the implemented risk controls may become less effective or ineffective as a result of this change.

¹⁷ A change in the site-specific conditions is significant if the implemented risk controls may become less effective or ineffective as a result of this change (e.g., identification of geological structures that may cause abnormal subsidence).

¹⁸ In the context of subsidence risk management, the significance of surface or subsurface features is determined by the severity of the potential health and safety consequences if these features are adversely affected by subsidence

6.3 Key Responsibilities

The responsibility for implementation, monitoring and review of the Extraction Plan lies with the Technical Services Manager. The ultimate responsibility for the implementation of the Extraction Plan lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for the current Extraction Plan are outlined in **Table 6.1**.

Table 6.1: Key Personnel and Accountabilities

Position	Responsibility
Mine Manager	- Ensuring that sufficient resources are available to implement and execute the requirements of this Plan - Reporting triggers/non-conformances to external stakeholders
Technical Services Manager	- Coordinate the implementation, monitoring and review of the Extraction Plan - Coordinate underground inspections and subsidence monitoring program associated with this EP and relevant sub-management plans - Coordinate implementation of the mine design and Master TARP - Reporting triggers/non-conformances internally to the mine manager as appropriate - Reporting to NSW Planning and NSW Resources Regulator of subsidence and pillar system performance upon completion of specified monitoring intervals
Production Manager	- Implement mine design - Establish and maintain underground monitoring and inspections program - Auditing as required
Mine Surveyor	- Survey as built initial development pillars - Establish and maintain subsidence monitoring program - Internal reporting as required - Mark up centre lines for driveage in pillars - Produce final mining plan for development workings to be carried out in consultation with the Technical Services Manager
Environment and Community Superintendent	Implementation, monitoring and review of this plan, including: - The carrying out of targeted inspections - The installation and maintenance of signage where required - Reporting triggers/non-conformances internally to the Mine Manager as appropriate - Consulting with land owners, landholders and managers regarding any land management issues arising from subsidence within the EP Area. This includes (but may not be limited to) NPWS, Office of Crown Lands and private landowners within the EP Area (if and as applicable) - Consultation during the review process with relevant stakeholders and distributing this EP and relevant sub-management plans - Coordinating any remediation work as required - Inspecting targeted accessible areas susceptible to tensile and compressive strains and potential cracking as required (e.g. accessible tracks and trails) - Co-ordinating the generation and submission of formal reporting requirements outlined in this Plan - Reviewing this EP and relevant sub-management plans

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ABBREVIATIONS

BMP	Biodiversity Management Plan
CLZ	Cliff Line Zone of First Workings (approved mining zone under consent SSD_5581)
DOC	Depth of Cover
DPE	NSW Department of Planning and Environment (now NSW Planning)
EP	Extraction Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environment Protection License
ESU	Environmental Sustainability Unit (NSW Resources Regulator)
HHMP	Historic Heritage Management Plan
IEP	Independent Expert Panel (post-consent)
IRP	Independent Review Panel (pre-consent)
LCC	Lithgow City Council
LMP	Land Management Plan
MEP	Airly Mine Extension Project
ML	Mining Lease
MOD	Modification to Airly Mine's former Development Consent (DA162/91)
MW	Miniwall (secondary extraction panel)
NPWS	NSW National Parks and Wildlife Service
NSW Planning	NSW Department of Planning, Housing and Infrastructure (formerly DPE)
NSW-RR	NSW Resources Regulator
OEH	NSW Office of Environment & Heritage
PPMZ	Partial Pillar Mining Zone (approved mining zone under consent SSD_5581)
PSMP	Public Safety Management Plan
SCA	State Conservation Area
SSD	State Significant Development
SMP	Subsidence Monitoring Program
SMZ	Shallow Mining Zone (approved mining zone under consent SSD_5581)
TARP	Trigger Action Response Plan
WMP	Water Management Plan

SUB-MANAGEMENT PLANS

APPENDIX 1 Airly Mine Water Management Plan for CLZ (ML1814)

The Airly Mine Water Management Plan can be found at:

<https://www.centennialcoal.com.au/operations/airly/>

APPENDIX 2 Land Management Plan for CLZ (ML1814)



Land Management Plan (CLZ (ML1814) LMP)

**Cliff Line Zone of First Workings
Extraction Plan (ML1814)**

Airly Mine (SSD_5581)

July 2024

A decorative graphic in the bottom right corner consisting of overlapping curved shapes in shades of blue, teal, and purple.

DOCUMENT CONTROL / TITLE BLOCK

EXTRACTION PLAN DETAILS	Title:	Land Management Plan: Cliff Line Zone of First Workings Extraction Plan (ML1814)
	Applicant:	Centennial Airly Mine
	Revision No.:	CLZ (ML1814) LMP_Rev_2 ¹

REVISION

REVISION DETAILS	Revision No.	Details of Revision	Date Sent
	Rev_0	Draft for external consultation	1/12/2023
	Rev_1	Update to address recommendations from consultation	22/03/2024
	Rev_2	Minor amendments to address recommendations from consultation	25/07/2024

¹ An integrated Document Control Procedure is incorporated into Centennial Airly Mine's Safety Management System (SMS). Documents, data and records pertaining to this plan will be managed according to the ***Airly Mine Document and Data Control Management Plan (AIR-MP-1034)***.

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ABBREVIATIONS

BCD	Biodiversity Conservation Division (now BCS)
BCS	Biodiversity, Conservation and Science group within the NSW DCCEEW
BMP	Biodiversity Management Plan
CLZ	Cliff Line Zone of First Workings (approved mining zone under consent SSD_5581)
DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
DPE	NSW Department of Planning and Environment (now NSW Planning)
DPIE	NSW Department of Planning, Industry and Environment (now NSW Planning)
DOC	Depth of Cover
EP	Extraction Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environment Protection License
HHMP	Historic Heritage Management Plan
IEP	Independent Expert Panel (post-consent)
IRP	Independent Review Panel (pre-consent)
LCC	Lithgow City Council
LMP	Land Management Plan
MEP	Airly Mine Extension Project
ML	Mining Lease
MOD	Modification to Airly Mine's former Development Consent (DA162/91)
NPWS	NSW National Parks and Wildlife Service
NSW Planning	NSW Department of Planning, Housing and Infrastructure (formerly DPE)
NSW-RR	NSW Resources Regulator
OEH	NSW Office of Environment & Heritage
PPMZ	Panel & Pillar Mining Zone (approved mining zone under consent SSD_5581)
PSMP	Public Safety Management Plan
SCA	State Conservation Area
SSD	State Significant Development
SMP	Subsidence Monitoring Program
SMZ	Shallow Mining Zone (approved mining zone under consent SSD_5581)
TARP	Trigger Action Response Plan
WMP	Water Management Plan

1 INTRODUCTION

1.1 Background

Airly Mine is an existing underground coal mine located approximately 40 kilometres (km) northwest of Lithgow in New South Wales, 170km northwest of Sydney and 4 km to the northeast of Capertee, as illustrated on **Figure 1-1**. The mine is partly located within the Mugii Murum-ban State Conservation Area (SCA). Centennial Airly Pty Limited (Centennial Airly) is the operator of the mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited (Centennial).

Development Consent for the Airly Mine Extension Project (MEP) was approved on 15 December 2016 subject to the Conditions in Schedule 2 to 6 of State Significant Development 5581 (SSD_5581). The consent allows extraction of 1.8 million tonnes of run-of-mine (ROM) coal per calendar year for a period of 20 years, which is supplied to both domestic and international markets. As per commitments within the Environmental Impact Statement (EIS) for SSD_5581, Airly Mine is implementing a conservative approach to mining, with different mining methods applied in different areas of the mining lease called Mining Zones².

The *Cliff Line Zone of First Workings (ML1814) (CLZ (ML1814)) Extraction Plan* as detailed in the *CLZ (ML1814) Extraction Plan Main Report (the EP Main Report)* and the supporting component plans, continues the conservative approach to mining being implemented by Airly Mine, with the proposed first workings under this Extraction Plan specifically designed to provide long term stable and effectively non-subsiding pillars to protect the surface such that there is no adverse impact. Mine design and implementation is a key element of subsidence impact avoidance and management. The *Extraction Plan Area (EP Area)* is further defined in **Section 1.3**.

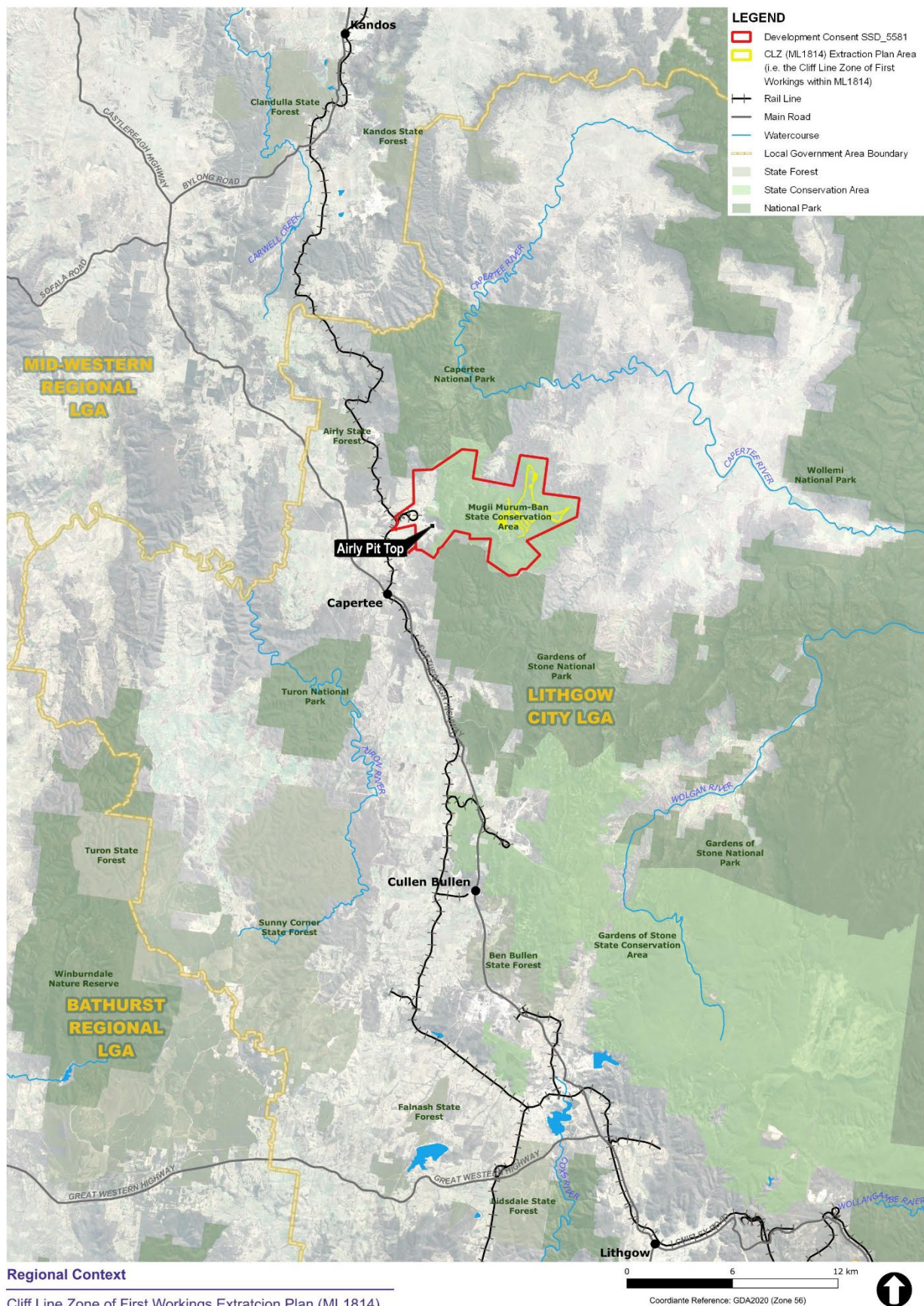
The *EP Main Report* and the supporting component plans have been developed using a risk-based approach and in accordance with:

- Relevant requirements listed under *Condition 7 in Schedule 3* of SSD_5581;
- *Extraction Plan Guideline*, NSW Department of Planning and Environment 2022;
- *Managing Risks of Subsidence Guideline*, NSW Department of Industry, Resources Regulator (NSWRR), 2017; and
- *Consultation with all relevant key stakeholders* (potentially affected by subsidence) and the Independent Expert Panel (IEP) established by NSW Department of Planning, Housing and Infrastructure (NSW Planning) for the project.

An Extraction Plan is required to be developed and approved prior to undertaking any first workings within the Cliff Line Zone and Zone of First Workings, including the development of this *Land Management Plan for CLZ (ML1814) (CLZ (ML1814) LMP)*.

² Airly Mine has five (5) mining zones approved under development consent SSD_5581 as shown in Figure 2 in Appendix 3 of SSD_5581. These zones provide design criteria for different mining methods based on the differing levels of environmental sensitivity of surface features and depth of cover across the Airly mining leases. Section 8 of the Airly Mine EIS (2014) provides further details on the definitions of each of these approved mining zones if required.

Figure 1-1: Locality Plan



1.2 Purpose and Scope

The purpose of this **CLZ (ML1814) LMP** is to meet the requirements under *Condition 7(i)(v) in Schedule 3* of SSD_5581 and associated relevant guidelines, leases and licenses, including outlining the monitoring and management measures to be implemented to address any potential impacts to land (**Section 3.2**) during first workings within the EP Area (**Section 1.3**).

A directly related *Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP)* (Appendix 6 of the EP Main Report) has also been specifically developed for the Extraction Plan to address the project performance measures prescribed by consent SSD_5581, supported by a *Master Trigger Action Response Plan for CLZ (ML1814) (CLZ (ML1814) TARP)* (Appendix 7 of the EP Main Report), including adaptive management measures if required.

1.3 Extraction Plan Area

The Extraction Plan Area (EP Area) is illustrated on **Figure 1-2** and is defined as:

- The *Cliff Line Zone of First Workings* within ML1814;
- Includes all proposed first workings within the EP Area;
- First workings incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features;
- No secondary extraction is permitted or proposed within the EP Area;
- No surface impacts have been predicted for first workings; and
- The EP Area is wholly located within the Mugii Murum-ban SCA with no private land ownership.

1.4 Relevant Features

The features identified within the EP Area, and which are subject to this *CLZ (ML1814) LMP*, as illustrated on **Figure 1-2**, are summarised below and detailed in the following sections:

- **Section 1.4.1** – Cliffs, minor cliffs and pagodas
- **Section 1.4.2** – General Mugii Murum-ban SCA area
- **Section 1.4.3** – Incised gorges (including The Grotto)
- **Section 1.4.4** – Unsealed roads and tracks

1.4.1 Cliffs, Minor Cliffs and Pagodas

Cliffs and pagodas are sensitive features with a primary focus for protection through conservative mine design at Airly Mine. As detailed further below, in addition to detailed studies undertaken for the Airly MEP EIS and approval process, further detailed survey has been undertaken to identify, monitor and manage cliffs and pagodas as defined by development consent SSD_5581.

The term “**Cliff**” has been defined in the SSD_5581 Development Consent as “*Continuous rock face, including overhangs, having a minimum length of 20 metres, a **minimum height of 10 metres** and a minimum slope of 2 to 1 (> 63.4°)*”.

The term “**Minor cliff**” has been defined in the SSD_5581 Development Consent as “*a continuous rock face including overhangs, which has a minimum length of 20 metres and a height **between 5 metres and 10 metres**; and minimum slope of 2 to 1 (> 63.4°)*”.

The relatively high strength of the Narrabeen sandstone units, combined with the presence of near vertical jointing of the rock mass, leads to the formation of sizeable cliffs within Mugii Murum-ban SCA. The sandstone cliffs sit atop the Permian talus slopes and form an external boundary to the upper portion of the two prominent mesas of Mount Airly and Genowlan Mountain.

Tectonic forces and mountain uplift cause fracturing of the sandstone units and result in sub-vertical jointing that can penetrate the full depth of the sandstone unit. Subsequent erosion of the underlying Permian strata to form the surrounding valleys by rivers and streams has caused a removal of support from the overlying sandstone. Over time the continuing removal of support destabilises the sandstone causing it to naturally break off on the pre-existing joints and fall onto the lower talus slopes (i.e. rock falls are a natural process of cliff formation and evolution). The result is a vertical or near vertical rock face that can reach well over 100 m tall in the broader mountain complex area.

Review of time-lapse aerial imagery of the lease areas indicates that the natural frequency of larger scale cliff falls in the area is approximately once every four years. Falls of isolated rocks occur more frequently but are not noticeable at any great distance. Ongoing baseline monitoring of the EP Areas (including the Cliff Line Zone) and other areas yet to be progressively mined will provide further information in relation to incidence of natural rock falls as discussed in **Section 4.2**.

Cliffs within the EP Area have been mapped by Aerometrex in accordance with the definitions of SSD_5581 using GIS analysis of LiDAR point cloud of 4 points per square meter. The studies provided data for the tops and toes of geological features meeting the criteria of Cliffs, as well as sensitivity analysis and verification cross-checks using high resolution 3D Oblique Photogrammetry.

In addition to remote analysis, MNC “ground truthed” cliffs identified by Aerometrex by walking over the mesas near all the cliffs and site inspecting the larger cliffs to check that there are no large overhangs at these cliffs and to confirm that the desktop mapping and identification process did not miss sensitive rock formations/features that could be susceptible to small mining induced subsidence ground movements.

It is noted that subsidence sensitivity increases with height and in certain areas cliffs exceeding 20m and up to ~100m exist within the EP Area. These areas are of key focus for protection and conservative mine design. Key cliffs / features within the EP Area are shown on **Figure 1-3**, with cliffs >70m in height indicated.

The term “**Pagoda**” has been defined in the SSD_5581 Development Consent as “*Conical or sub-conical rock formations, whether smooth, platy, stepped or terraced, generally between 5 and 20 metres in height and that are not cliffs or minor cliffs*”.

Within the land above Airly Mine in general (including beyond the EP Area), pagodas tend to occur mainly at the top of external and internal cliffs and around deeply incised gorges and canyons. Some do occur as isolated rock outcrops within larger plateau landscapes, but these are very minor in comparison to the numbers found around cliffs and gorges.

Pagodas tend to be the most resilient part of the rock mass remaining after erosion and are often bounded on pre-existing joint lines. The behaviour of pagodas when subjected to subsidence differs from sandstone cliffs.

1.4.2 General Mugii Murum-ban State Conservation Area

The EP Area is wholly located within Mugii Murum-ban SCA, a 3,650 hectare area which is bounded to the south by the Glen Davis Road and Gardens of Stone National Park, and to the north by Capertee National Park. Land to the east and west is largely cleared farming land, with some remnant bushland. Lands not included in the Mugii Murum-ban SCA include Airly Gap Trail and several partially cleared private properties along Airly Gap Trail and at the base of the Genowlan mesa (OEH, 2015). Additionally, the Mugii Murum-ban SCA lies within the South Eastern Highlands Bioregion, it is a relatively contiguous system of protected bushland, stretching from the Hunter Valley in the north to Wollondilly River in the south, and including nearby Capertee, Gardens of Stone and Wollemi National Parks (OEH, 2015). Mugii Murum-ban SCA contains a great diversity of ecosystems, supporting several threatened plants and animals. In addition, the Mugii Murum-ban SCA contains four relatively pristine sub catchments which are important in maintaining water quality in creek and river systems in the area (OEH, 2015).

The Mugii Murum-ban SCA managed by NPWS and is a focal point of environmental protection that requires low impact, non-intrusive monitoring and management. The broader Mugii Murum-ban SCA is characterised by a steep and rugged topography with large areas of cliffs and significant rock outcrops dominated by Mount Airly and Genowlan Mountain. There are small areas of flatter land on plateaus and to the west of Mount Airly there are undulating areas. Mount Airly and Genowlan Mountain form an irregular-shaped mesa complex dissected by a low saddle or valley known as Airly Gap, through which Gap Creek flows north beyond the outlier to join Genowlan Creek, which rises in Genowlan Mountain and eventually flows into the Capertee River. The saddle area of Airly Gap provides the primary unsealed access to Mount Airly and conveys the ephemeral headwaters of Gap Creek. A second unsealed 4WD access trail further east leads from Glen Davis Road onto Genowlan Mountain.

Mugii Murum-ban SCA is dominated by two prominent mesas which are major visual features of the Capertee Valley – Mt Airly and Genowlan Mountain, which is the main subject of the current EP Area. Mugii Murum-ban SCA contains extensive and intricate pagoda clusters, numerous deep gorges, canyons and unusual rock formations. These features combine to create an extremely scenic landscape and is a focal point of environmental protection that requires low impact, non-intrusive monitoring and management.

The term “Steep slope” has been defined in the SSD_5581 Development Consent as “an area of land having a gradient between 1 in 3 (33% or 18.3°) and 2 in 1 (200% or 63.4°)”. Steep slopes typically include scree and rubble covered talus slopes below the sandstone cliffs within the angle of repose. These are thickly vegetated, with hardy vegetation communities that endure constant change and are not particularly well watered.

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

In addition to the geodiversity and watercourses of the Mugii Murum-ban SCA, some other relevant characteristics of this area are steep slopes and the native vegetation cover. Thick native vegetation dominates the entire Mugii Murum-ban SCA, including (in places) Endangered Ecological Community’s and threatened flora and fauna species, including within the EP Area. The native vegetation which dominates the Mugii Murum-ban SCA, including threatened flora and fauna species, are managed under the *Biodiversity Management Plan for CLZ (ML1814) (CLZ (ML1814) BMP)* (Appendix 3 of the EP Main Report).

Very low levels of subsidence are predicted within the EP Area, therefore it is expected that the proposed extraction should not cause physical impacts (i.e. surface cracking) that have potential to alter the environment or habitat for this natural vegetation.

The area is of particular significance to the Wiradjuri Aboriginal People and also contains numerous significant historic heritage sites. The Mugii Murum-ban SCA also contains important mineral deposits and is recognised as having economically significant deposits of coal (OEH, 2015).

Prior to gazettal, the area now encompassing Mugii Murum-ban SCA had no formal visitation management and therefore there are minimal visitor facilities. The Mugii Murum-ban SCA is currently used for four-wheel driving, bushwalking, heritage tourism, picnicking, birdwatching, camping and cycling. Information on Mugii Murum-ban SCA visitation is limited but suggests up to 200 four-wheel drive vehicles may enter each year. The main public entry point is via the Airly Gap Trail, a two-wheel drive public road off Glen Davis Road, located west of the current EP Area. Public vehicle access is also provided via the four-wheel drive Genowlan Trail (OEH, 2015) which is located within the current EP Area. The Mugii Murum-ban SCA is considered most suitable for dispersed, self-reliant, nature-based recreation utilising existing visitor nodes and routes.

In addition to managing the broader Mugii Murum-ban SCA, NPWS also currently manage portions of Crown Land (excluding Crown Roads and reserves) under licence from the Division of Crown Lands (NSW DTIRIS), which are in the process of formal transition into the Mugii Murum-ban SCA. These are primarily located within Airly gap located to the west of the current EP Area.

1.4.3 Incised Gorges (including The Grotto and The Oasis)

The Grotto is a narrow slot canyon, or gorge feature, with surrounding internal cliff lines topped by pagoda clusters. The Grotto forms a tributary of Genowlan Creek. Monitoring by Airly Mine has shown the water flow in the Grotto to be ephemeral and rainfall dependent. The sheltered environment along with moisture from surface water and seepage of water from the surrounding sandstones promotes the growth of water loving plants such as fern trees (Golder, 2014a).

The Oasis, also known as Jurassic Park, is located downstream of The Grotto, and beyond the current EP Area, where the gorge becomes wider and allows the accumulation of deeper soil profiles. In this area, regular surface water flow encourages the growth of taller moist forest communities (Golder, 2014a).

The location of The Grotto and The Oasis are shown on **Figure 1-2**. There are minimal workings proposed in the area near and beneath these sensitive features, with 3-roadway heading and larger, 35m x 105m centres, pillars, instead of the 5-roadway heading with the minimum 35m x 35m pillar centres used elsewhere. The predicted subsidence for these sensitive features has been reduced to very low levels to avoid adverse impacts.

1.4.4 Unsealed Roads and Tracks

Unsealed roads and tracks are located within the EP Area. These roads/tracks are only accessible by 4WD vehicles. It is noted that no sealed roads are located within the EP Area. It is unlikely that the unsealed road and track surfaces over the EP Area will be adversely impacted by the proposed first workings, as there is expected to be only very low levels of subsidence which should not cause physical impacts (i.e. surface cracking).

Figure 1-2: Extraction Plan Area (EP Area) and Relevant Features within the EP Area

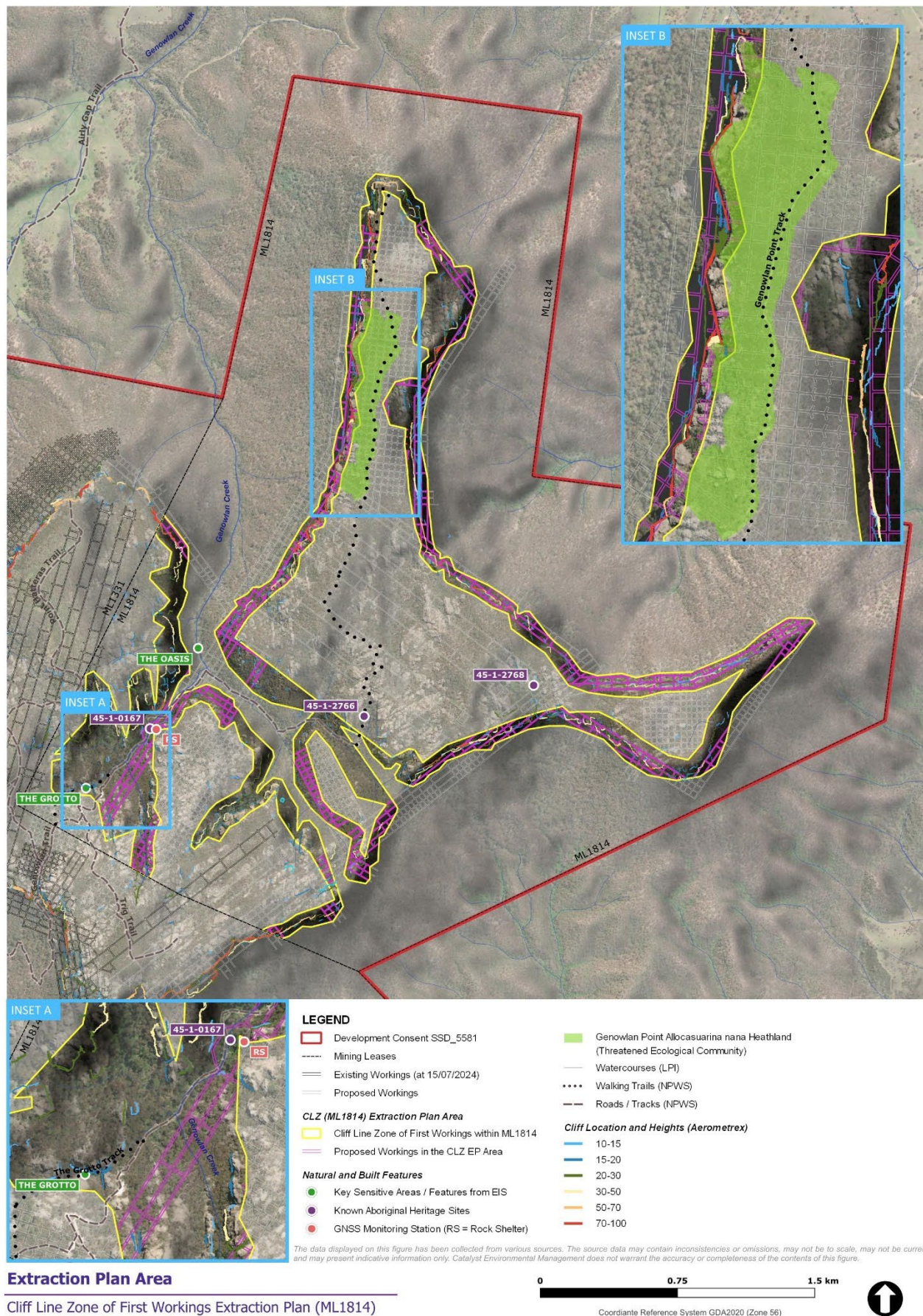
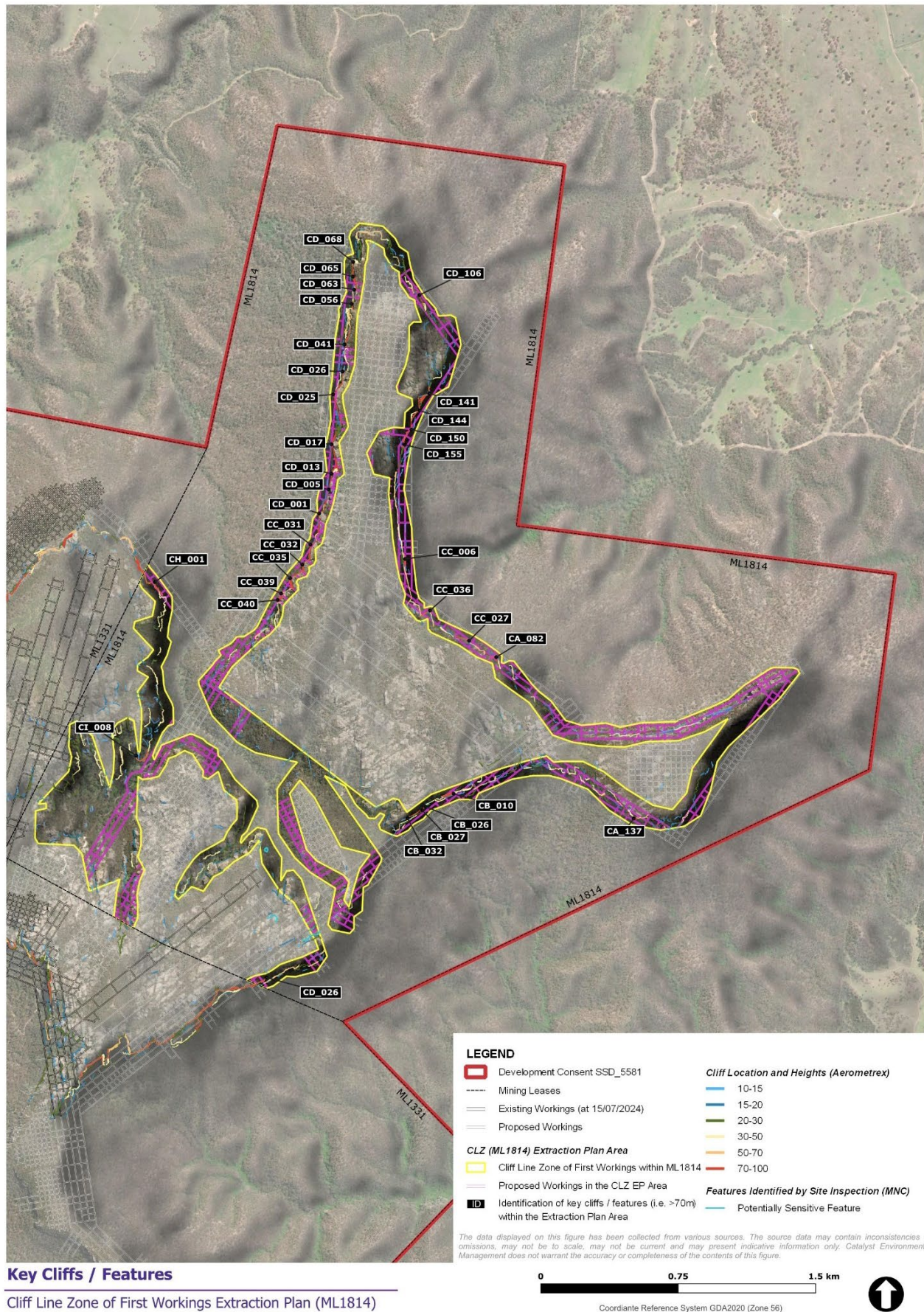


Figure 1-3: Key Cliffs / Features in the EP Area



1.5 Structure of the CLZ (ML1814) LMP

The main text sections of this CLZ (ML1814) LMP include:

- Section 1** Provides an introduction, purpose, scope, extraction plan area, relevant features to land and document structure.
- Section 2** Provides the statutory regulatory requirements, risk identification and consultation.
- Section 3** Provides the predicted subsidence impacts assessment and subsidence performance indicators to be used to assess against the relevant subsidence performance measures for land.
- Section 4** Outlines the monitoring and management measures in place for the key features in the EP Area.
- Section 5** Summarises the management, mitigation, remediation and reporting measures for this CLZ (ML1814) LMP, including relevant performance measures and indicators, contingency response, adaptive management, reporting and auditing.
- Section 6** Provides an outline of the plan administration and roles and responsibilities for this CLZ (ML1814) LMP.
- Section 7** Provides a historical review of references leading to the development of this CLZ (ML1814) LMP.

2 PLAN DEVELOPMENT AND CONSULTATION

2.1 Statutory Requirements

Centennial Airly conducts its operations in accordance with:

- The conditions of the Development Consent (SSD_5581);
- Relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL No. 12374) and Mining Leases (i.e. ML 1331 and ML 1814); and
- other relevant State and Commonwealth environmental, planning, mining, safety, and natural resource legislation and guidelines.

Centennial Airly maintains a register of relevant environmental legislative and regulatory requirements in a compliance database.

The relevant statutory requirements applicable to the *CLZ (ML1814) Extraction Plan* and this supporting CLZ (ML1814) LMP are presented in the EP Main Report (*refer Section 2.1 and Attachment B*).

This CLZ (ML1814) LMP is a component of the EP Main Report and has been prepared specifically to address Condition 7 in Schedule 3 of SSD_5581 which states:

(7) Prior to carrying out any first workings within the Cliff Line Zone and Zone of First Workings (refer to Figure 2 in Appendix 3) or second workings, the Applicant must prepare an Extraction Plan for the relevant workings to the satisfaction of the Secretary. Each Extraction Plan must:

(i)...include a:

(v) Land Management Plan which has been prepared in consultation with the IEP, Resources Regulator, BCD and any affected public authorities, to manage the potential impacts and/or environmental consequences of the proposed underground workings on land in general, with a specific focus on cliffs, pagoda formations, steep slopes and gorges.

This **CLZ (ML1814) LMP** has been developed in accordance with Condition 2 in Schedule 6 of SSD_5581 (management plan requirements). **Table 2.1** details where these conditions have been addressed.

Table 2.1: Land Management Plan Requirements

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section Addressed
The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: a) Detailed baseline data; b) A description of: • The relevant statutory requirements (including any relevant approval, licence or lease conditions); • Any relevant limits or performance measures/criteria; • The specific performance indicators or triggers that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures. c) A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria.	Section 1.4, 4.2 EP Main Report (Section 2.1, Attachment B) Section 5.1 Section 5.4, CLZ (ML1814) TARP Sections 2.1, 5.1, 5.4

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section Addressed
d) A program to monitor and report on the: - Impacts an environmental performance of the development; - Effectiveness of any management measures (see c) above);	Section 4 Sections 5.4, 5.7
e) A contingency plan to manage any unpredicted impacts and consequences	Section 5.5
f) A program to investigate and implement ways to improve the environmental performance of the development over time	Section 5
g) A protocol for managing and reporting any: - Incidents; - Complaints; - Non-compliances with statutory requirements; and - Exceedances of the impact assessment criteria and/or performance criteria; and	Section 5.6
h) A protocol for periodic review of the plan.	Section 6.1

2.2 Specialist Assessments

This CLZ (ML1814) LMP has been informed by cliff identification assessments undertaken by Aerometrex (2021; 2022) and Michael Nicholson Consulting Pty Ltd (MNC) (2023a; 2023b).

The purpose of the cliff identification assessments was to identify and map the locations of cliffs and other sensitive surface features which can then be used as the basis to minimise risk of surface impacts through appropriate mine layout design to reduce subsidence at sensitive high cliffs and escarpments located on the external parts of the Mount Airly and Genowlan Mountain mesas.

Extensive aerial photogrammetry and cliff identification work was undertaken by Aerometrex (2021; 2022). MNC was then engaged to undertake site inspections (“ground truthing”) of the cliffs that were identified as being located within the CLZ at Genowlan Creek Valley – Grotto to Oasis (MNC, 2023a) and Central Genowlan – Genowlan Point (MNC, 2023b).

The relevant features within the EP Area, including the key cliffs and features identified by these reports, are illustrated on **Figure 1-3**.

SCT were engaged to prepare and provide a subsidence prediction and impact assessment report, on the likely impacts of these predicted levels of subsidence on the natural and built features that exist within the EP Area. The Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) provided the subsidence predictions and impact assessment for the Extraction Plan. An addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b) was prepared to review the earlier pillar geometry assessment (SCT, 2023a) for an increased roadway height of 3.2m. The subsidence predictions and impact assessment is discussed in **Section 3.2**.

2.3 Risk Identification and Assessment

Centennial Airly has undertaken a dedicated ***Subsidence and Environmental Risk Assessment*** (*Stature RA Number: 1001330039³*) directly in support of this Extraction Plan which provide a risk framework basis for development of the component management plans.

The *CLZ (ML1814) Extraction Plan* risk assessment was completed on the 20 June 2023 with key staff from the Airly Mine including the Mine Manager, Statutory Mine Surveyor, Technical Services / Compliance Manager and Environment and Community Superintendent, as well as key EP Project Team members for Heritage, Ecology and the Lead Consultant for the Extraction Plan. The landholder was also represented by a member from the NPWS.

Risks were identified and assessed through the review of known surface and sub-surface features within the EP Area. The risk assessment also specifically assessed key heads of consideration required by the Managing Risks of Subsidence Guideline (NSW RR, 2017).

A risk ranking (low, moderate, significant, high or extreme) was assigned to each risk/hazard in consideration of the Maximum Reasonable Consequence (MRC) for the given controls. There were 34 potential risks scenarios assessed during the Risk Assessment; 1 significant, 7 moderate, 23 low and 3 were assessed as not applicable.

The risk assessment determined that the **risk of impact for land features** (noting the extensive controls identified) was **low to moderate** including aspects associated with cliffs and pagodas within the EP Area.

A copy of the risk assessment is included in the EP Main Report (refer Attachment C). Additional details regarding the management and monitoring of subsidence related impacts within the EP Area have been detailed in **Section 4** and **Section 5**.

2.4 Consultation

Condition 7(i)(v) in Schedule 3 of SSD_5581 requires the preparation of this ***CLZ (ML1814) LMP*** in consultation with key relevant stakeholders as detailed below:

- IEP;
- NSW Resources Regulator; and
- Biodiversity, Conservation and Science (BCS) group within the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The outcomes of consultation undertaken for the project is provided in the EP Main Report (refer Attachment D), including copies of relevant correspondence such as project presentations delivered by the mine to key stakeholders and relevant formal correspondence received from key stakeholders.

Stakeholder feedback provided has been reviewed and addressed as necessary as part of the development and review of this Extraction Plan and key component plans.

³ Centennial Airly has adopted the Stature Risk Assessment Program which sets out a consequences table and risk ranking matrix for managing identified risks consistent with AS/NZS ISO 31000:2009.

3 SUBSIDENCE ASSESSMENT

3.1 Mine Planning and Design

The proposed first workings within the CLZ (ML1814) consist mainly of (or parts of) 3 or 5 roadway main headings which provide access to future mining areas. First workings incorporate mine development of roadways / headings and cut throughs to form long term stable pillars.

Mine design is the primary control utilised at Airly Mine for subsidence impact avoidance. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement.

3.2 Subsidence Predictions

Condition 7(g) in Schedule 3 of SSD_5581 and the Extraction Plan Guidelines (DPE, 2022) requires revised predictions of potential subsidence effects, subsidence impacts and environmental consequences to be presented within the Extraction Plan for the EP Area, including any relevant information obtained since the EIS and consent, in consultation with the Independent Expert Panel (IEP).

Subsidence predictions for this Extraction Plan were assessed by SCT (2023a; 2023b) and are presented in full as *Attachment E – Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b)*.⁴

The maximum predicted subsidence for the EP Area are consistent with the EIS Predictions as shown in **Table 3.1**. The predictions included assessment of the subsidence effects measured in the current first workings at Airly Mine, including a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331).

Table 3.1: Maximum Subsidence Predictions with Comparison to Previous Predictions

Predictions	Pillar Stability	Max Subsidence	Max Tilt (mm/m)	Max Strain	
				Tensile (mm/m)	Compressive (mm/m)
This CLZ EP (ML1814) Predictions SCT (2023a; 2023b)	Long Term Stable with minimal subsidence	≤37mm	≤0.61	≤0.18	≤0.25
EIS Predictions Golder (2014b)	Long Term Stable	65mm	0.6-1.1	0.2-0.3	0.2-0.5
Current CLZ EP (ML1331) Predictions Golder (2017)	Long Term Stable, negligible settlement, effectively non-subsiding	<53mm Worst Case (long term flooded and additional pillar loading) Short to medium term <30mm and typical <20m	0.4-0.9	0.1-0.3	0.1-0.3

The predicted subsidence is not expected to cause adverse impacts on the relevant features covered under this CLZ (ML1814) LMP.

⁴ A detailed review of the revised subsidence predictions is provided in the EP Main Report (refer Section 3.2)

4 MONITORING PROGRAM

4.1 Land Features Monitoring Program

Environmental monitoring considerations for land are focused on the key sensitive features of cliffs, minor cliffs and pagodas.

The proposed monitoring program and strategy is developed in consultation with key stakeholders including (but not limited to) the IEP, BCS, NSW Resources Regulator and NPWS, and is detailed within the dedicated *CLZ (ML1814) SMP* (Appendix 6 of the EP Main Report) for the EP Area. The proposed Integrated Subsidence Monitoring Program within the Subsidence Monitoring Program includes:

- **Underground Mining Control** - routine survey of workings and inspections by mining officials to ensure mining is strictly implemented as designed (primary control utilised at Airly Mine for subsidence impact avoidance);
- **Monitoring ground movement** and surface subsidence impacts via Global Navigation Satellite System (GNSS) Monitoring Stations / Continually Operating Reference Station (CORS) – Long occupation real time point data base stations;
- **Remote monitoring of the Surface Environment** via LiDAR (40 points per square meter) – for monitoring of vertical subsidence over the EP Area relative to baseline and Performance Measures;
- **Trigger-based Targeted Surface Inspections** where required (where safely and readily accessible, such as where 4WD trails traverse or are close to the EP Area, and where otherwise triggered by the *CLZ (ML1814) TARP*); and
- **Data Analysis** data analysis and reporting will monitor specifically for change and target:
 - Any areas detected for significant change by remote monitoring results (including pre and post mining areas), triggering further detailed analysis under the *CLZ (ML1814) TARP*, including a process for determining natural or mining-induced rock fall.
 - The process for this detection is detailed further in the *CLZ (ML1814) SMP* and *CLZ (ML1814) TARP* respectively. Data for natural rock falls in areas yet to be mined will also provide additional data to the baseline data set.

Airly Mine will implement the monitoring program applicable to land as specified in **Table 4.1**⁵ and shown on **Figure 4-1** to monitor the development of possible subsidence related environmental impacts. A contingency plan has been developed as a component of this *CLZ (ML1814) LMP* to outline management measures that will be implemented if predicted environmental consequences are exceeded (**Section 5.1**).

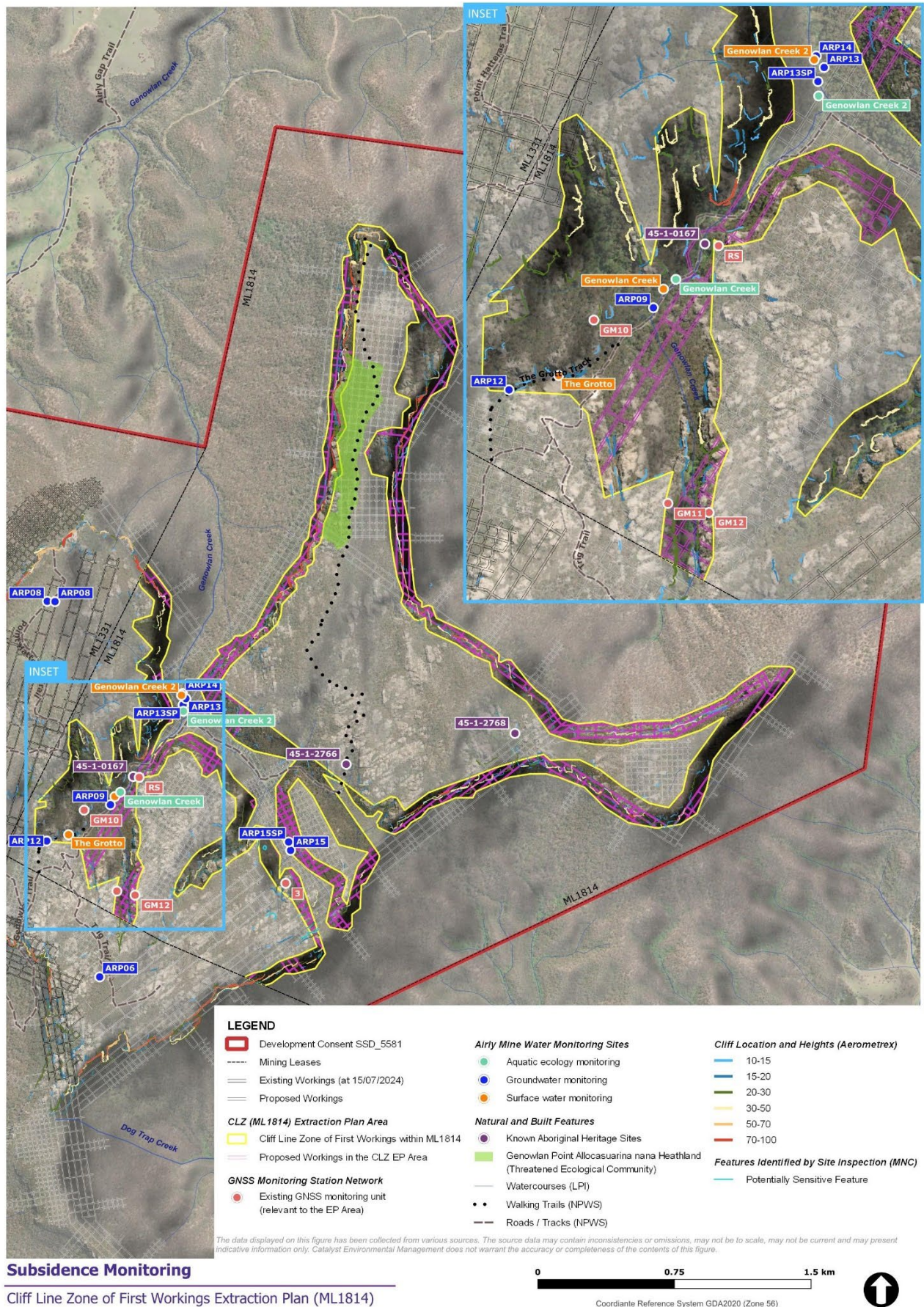
⁵ reproduced from the original within the *Subsidence Monitoring Program for CLZ (ML1814)*, refer to the *CLZ (ML1814) SMP* for full details.

Table 4.1: Land Features Subsidence Monitoring Program Summary

Monitoring Component / Feature (Management Plan)	Purpose/Parameter	Monitoring Method	Frequency & Duration
Cliffs, Minor Cliffs & Pagodas	Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking) Various Parameters relevant to each method	LiDAR	At least two (2) remote aerial monitoring surveys will be undertaken prior to first workings under this Extraction Plan, and ongoing surveys will be undertaken at approximately six-month intervals. At least one survey will be undertaken following completion of first workings under this Extraction Plan. No further detailed analysis after post mining survey has indicated negligible impacts (in the undermined area).
		Targeted GNSS Monitoring Stations	Installed prior to commencement, continuous data from installation, throughout first workings under this Extraction Plan and will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of first workings under this Extraction Plan.
		Targeted visual surface inspections	Only if triggered as per <i>CLZ (ML1814) TARP</i> triggers
General Land Surface (excl. cliffs and pagodas)	Evidence of subsidence impacts compared to baseline records	LiDAR	At least two (2) remote aerial monitoring surveys will be undertaken prior to first workings under this Extraction Plan, and ongoing surveys will be undertaken at approximately six-month intervals. At least one survey will be undertaken following completion of first workings under this Extraction Plan. No further detailed analysis after post mining survey has indicated negligible impacts (in the undermined area).
		Targeted GNSS Monitoring Stations	Installed prior to commencement, continuous data from installation, throughout first workings under this Extraction Plan and will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of first workings under this Extraction Plan.
		Targeted visual surface inspections	Only if triggered as per <i>CLZ (ML1814) TARP</i> triggers
The Grotto	Evidence of subsidence impacts compared to baseline records	LiDAR	At least two (2) remote aerial monitoring surveys will be undertaken prior to first workings under this Extraction Plan, and ongoing surveys will be undertaken at approximately six-month intervals. At least one survey will be undertaken following completion of first workings under this Extraction Plan. No further detailed analysis after post mining survey has indicated negligible impacts (in the undermined area).

Monitoring Component / Feature (Management Plan)	Purpose/Parameter	Monitoring Method	Frequency & Duration
		Targeted GNSS Monitoring Stations	Installed prior to commencement, continuous data from installation, throughout first workings under this Extraction Plan and will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of first workings under this Extraction Plan.
		Undertake surface water quality monitoring in accordance with section 4.2 of the WMP	Undertake surface water quality monitoring in accordance with section 4.2 of the WMP
		Undertake biodiversity monitoring in accordance with section 5 of the CLZ (ML1814) BMP	Undertake biodiversity monitoring in accordance with section 5 of the CLZ (ML1814) BMP
Walking and 4WD tracks	Evidence of subsidence impacts compared to baseline records	LiDAR	At least two (2) remote aerial monitoring surveys will be undertaken prior to first workings under this Extraction Plan, and ongoing surveys will be undertaken at approximately six-month intervals. At least one survey will be undertaken following completion of first workings under this Extraction Plan. No further detailed analysis after post mining survey has indicated negligible impacts (in the undermined area).
		Targeted visual surface inspections	Only if triggered as per CLZ (ML1814) TARP triggers

Figure 4-1: Subsidence Monitoring



4.2 Baseline Monitoring

Baseline monitoring of natural features as they relate to land within the EP Area has commenced and will be obtained by using a combination of the following methods:

- **Landscape Features** (including cliffs and pagodas) using both monitoring ground movement and remote monitoring methods as described (**Section 4.1**) with the EP Area;
 - The installation of the GNSS network is scheduled for completion prior to commencement of development workings with baseline continuous data from installation through to commencement of first workings in the CLZ within ML1814.⁶
 - LiDAR baseline flown in December 2022 and June 2023; an additional survey will be flown prior to first workings in the CLZ within ML1814.
 - High resolution stereo vertical and 3D oblique photogrammetry baseline flown in May 2020, November 2020, May 2021, May 2022 and December 2022.⁷

Further details including methodologies, locations, parameters, frequencies and duration of monitoring is provided in the *CLZ (ML1814) SMP* (Appendix 6 of the EP Main Report).

⁶ Installation of this monitoring equipment is subject to an REF amendment and subsequent approval from NPWS.

⁷ Note, stereo vertical and 3D oblique photogrammetry has been replaced by routine LiDAR survey, however the baseline photogrammetry data may be used for data analysis or comparison against future LiDAR surveys if required.

5 MANAGEMENT, MITIGATION, REMEDIATION AND REPORTING MEASURES

5.1 Performance Measures and Indicators

The approved subsidence impact performance measures are specified under Condition 2 in Schedule 3 of SSD_5581. The performance measures relating to potential subsidence impacts (as they relate to this CLZ (ML1814) LMP) are outlined in **Table 5.1**⁸.

Table 5.1: Relevant Subsidence Impact Performance Measures for Land

Land	Performance Measure	Performance Indicator	Applicability to this EP Area
The Grotto	Negligible subsidence impacts or environmental consequences	Presence/absence of mine-induced damage or change to features (no significant rock falls or surface cracking) Watercourse quality and flow volumes within or above historical monitoring data, site-specific guideline values and/or consistent with predictions Evidence of subsidence impacts (to biodiversity) compared to baseline records	Applicable
Cliffs within a 26.5 degree angle of draw of the Airly underground mine workings.	No greater subsidence Impacts or environmental consequences than predicted In the EIS (<i>le occasional rock falls, displacement or dislodgment of boulders or slabs of less than 30 m³, or fracturing, that do not Impact Aboriginal heritage, EECs or public safety</i>), that in total do not Impact more than 2% of the total area of such cliffs.	Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking) Various Parameters relevant to each monitoring method	Applicable
Pagodas within a 26.5 degree angle of draw of the Airly underground mine workings (other than pagodas affected by the New Hartley interaction zone).			Applicable
Pagodas within a 26.5 degree angle of draw of the New Hartley potential interaction zone (NHSMPIZ)	Not Applicable <i>(NHSMPIZ is located on Mt Airly. Current EP is on Genowlan Mountain)</i>		
Minor cliffs			Applicable
Steep slopes			Applicable
All other land not covered by a performance measure above			Applicable

⁸ extracts from Table 1, under Condition 2 in Schedule 3 of SSD_5581

Additional internal performance measures set by Centennial Airly for the mine design (to be monitored by the underground components of the Subsidence Monitoring Program) are and have been reflected within the CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

To establish compliance with the performance measures, Airly Mine has developed a monitoring program with several integrated components detailed in the CLZ (ML1814) SMP (Appendix 6 of the EP Main Report) (see **Section 4**) and an associated CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

These documents establish appropriate monitoring elements, parameters, and associated trigger levels to demonstrate that the environmental performance satisfies the criteria in Section 5.1 of the EP Main Report.

Table 5.2 contains the performance indicators which have been established for key monitoring aspects with allocated trigger values to define the following key performance scenarios within the CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

Table 5.2: Performance Indicators & TARP Risk Management Scenarios

Performance Indicator	General Description	Action / Response
Level 1: Condition Green	Operations within predictions, and within approved impacts.	Continued operations and monitoring as normal.
Level 2: Condition Amber	Operations within approved impacts but potentially exceed / exceed predictions.	Review and investigation processes are engaged, with adaptive management as required.
Level 3: Condition Red	Operations exceed approved impact. <i>The approved Performance Measures (criteria thresholds) of Development Consent (and any other relevant approvals) are listed in Condition Red.</i>	Adaptive Management measures are fully engaged as per the TARP and relevant sections of the Extraction Plan and the SMP.

5.2 Management and Mitigation Measures

As described in **Section 3.2**, the predicted subsidence levels in the EP Area are minimal and well below levels expected to cause damage or any adverse impacts on the natural features.

The CLZ (ML1814) risk assessment (**Section 2.2**) determined that the risk of impact for land features was **low to moderate**. There are two main management aspects of this CLZ (ML1814) LMP, including:

- Mine design to avoid impacts (**Sections 3.1 and 3.2**);
 - The primary management strategy being implemented is impact avoidance through the implementation of a conservative mine design. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement, and
- Monitoring and management measures (**Sections 4.1 and 4.2**).
 - Monitoring to ensure the mine design is strictly implemented as designed through underground mining controls and monitoring of key landscape features for change (particularly cliffs and pagodas) will be undertaken to confirm that the mine design measures to prevent impact are adequate and remain within consent.

It is noted that management measures associated with public safety aspects of the EP Area are addressed separately within the PSMP (CLZ (ML1814) PSMP).

The EP Area is located in rugged, largely inaccessible, terrain within the Mugii Murum-ban SCA which offers opportunities for self-reliant recreation including four-wheel driving, nature study, camping, mountain biking, bushwalking and birdwatching.

The overall management of Mugii Murum-ban SCA is the responsibility of the NPWS. In consultation with the NPWS, IEP, BCS and NSW Resources Regulator, Airly mine has committed to the following monitoring and management measures, as they related to land in the EP Area, including:

- Develop an Integrated Subsidence Monitoring Program that will provide data for trend analysis, that will inform adaptive management if required (**Section 5.2** (for further details refer to Section 4 of the EP Main Report and CLZ (ML1814) SMP (Appendix 6);

It is expected with the above controls in place, the subsidence performance measures for land will be achieved.

Notwithstanding this, appropriate responses have been conservatively developed for unexpected/higher than predicted subsidence within a **Master Trigger Action Response Plan (TARP)** developed for the Extraction Plan and this CLZ (ML1814) LMP.

5.3 Remediation and Rehabilitation Measures

Due to the minimal subsidence expected the need to implement remediation/rehabilitation measures for potential impacts are considered unlikely. However, if remediation is required, Airly Mine will undertake remediation in accordance with:

- Conditions 7a)-7c) in Schedule 6 of SSD_5581, noting the requirement to submit a report to NSW Planning describing remediation options and any preferred remediation measures or other course of action;
- Any relevant actions prescribed in the CLZ (ML1814) TARP developed for the Extraction Plan;

- The current Rehabilitation Management Plan; and
- In consultation with key stakeholders including any affected land holders and relevant government agencies.

A Response Strategy will be adopted if a significant impact is detected as a result of mining activities within the Extraction Plan area.

5.4 Trigger Action Response Plan

A detailed *CLZ (ML1814) TARP* (Appendix 7 of the EP Main Report) has been developed for the Extraction Plan to reflect the commitments of this CLZ (ML1814) LMP and other related aspects. Whilst impacts are not predicted nor expected, the *CLZ (ML1814) TARP* provides a process of tiered and/or escalating trigger levels for contingency measures should subsidence and impacts be greater than predicted/approved. The *CLZ (ML1814) TARP* applies only to the EP Area (separate TARPs apply to other established EP Areas in various approved mining zones).

Given the mine has been designed specifically to avoid impacts, the *CLZ (ML1814) TARP* includes detailed measures for Underground Mining Controls to ensure that the mining geometry is formed as per the approved design specifications that determine the predicted subsidence movements and impacts.

The *CLZ (ML1814) TARP* includes detailed performance indicators for land management. The contingency plan where a performance indicator has been exceeded is outlined in the TARP. A trigger will result in additional investigations to determine if the exceedance is related to non-mining-factors or is a consequence of mining activity. The response to these exceedances will follow the TARP. Management / corrective actions can be implemented where required to remedy these non-conformities and report accordingly.

5.5 Adaptive Management and Contingency Planning

An Adaptive Management Framework provides for flexible decision making, adjusted to consider uncertainties as management outcomes are understood. The adaptive management approach at Airly Mine is detailed in the EP Main Report (*refer Section 5.2*).

In summary, adaptive management at Airly Mine involves monitoring and evaluation against performance measures and associated indicators in the *CLZ (ML1814) TARP* established for the extraction plan and supporting management plans. Where performance indicators indicate increasing levels of risk (i.e., where relevant thresholds of conditions green, amber or red are being exceeded), escalating adaptive management measures are engaged in accordance with the *CLZ (ML1814) TARP*. The process has been successfully implemented in existing Extraction Plan areas at Airly Mine and has been updated to reflect EIS commitments and consent requirements for the Airly Mine Extension Project, including specific performance measures.

5.6 Incidents, Complaints, Exceedances and Non-Compliances

Incidents, complaints, exceedances and non-compliances are managed accordance with the requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, relevant legislation and regulations, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). Additionally, high potential incident notifications for unexpected subsidence events in relation to the safety of other persons under WHS legislation has also been included. A detailed review of the notification requirements relevant to the Extraction Plan, including this *CLZ (ML1814) LMP*, is provided in the EP Main Report (*refer Section 5.7.1*), including requirements for:

- Incident or non-compliance reporting in accordance with:

- Condition 9 (Incident Reporting) in Schedule 6 of SSD_5581.
 - EPBC 2013/7076 Condition 1, or as triggered by the TARP (reporting incidents under Management Plans as per Condition 2(g) in Schedule 6 of SSD_5581).
 - EPL12374 condition R2
 - WHS Regulation (Mines and Petroleum Sites, 2022) Section 124 - Duty to notify regulator of certain incidents
 - Section 6 of the Guidelines for Managing Risks of Subsidence (WHS (Mines and Petroleum Sites), February 2017
- Managing complaints.

Incidents, complaints, exceedances and non-compliances will be managed in accordance with the requirements detailed in the EP Main Report (*refer Section 5.6*).

5.7 Reporting and Auditing

5.7.1 Reporting

Reporting is undertaken in accordance with the requirements of specific requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). A detailed review of the reporting and notification requirements relevant to the Extraction Plan, including this CLZ (ML1814) LMP, is provided in the EP Main Report (*refer Section 5.7.1*, including requirements for:

- Regular reporting of impacts and environmental monitoring results in accordance with Condition 10 in Schedule 6 of SSD_5581;
- Annual reporting required in accordance with Condition 11 in Schedule 6 of SSD_5581 and separately under EPBC 2013 / 7076;

Reporting and notifications will be undertaken in accordance with the requirements detailed in the EP Main Report (*refer Section 5.7.1*).

5.7.2 Periodic Auditing

Comprehensive Independent Environmental Audits of the entire approved development under development consent SSD_5581 are undertaken within 1 year of commencement and every 3 years thereafter (unless directed otherwise) in accordance with Conditions 12 and 13 in Schedule 6 of SSD_5581.

Auditing of any rehabilitation undertaken for the mine (including for subsidence if triggered) is undertaken in accordance with the Rehabilitation Management Plan under Condition 27 in Schedule 4 of SSD_5581.

Additionally, in accordance with section 20(c) of the WHSMP Regulation (2022), auditing will be undertaken in accordance with the Airly Mine Safety Management System (SMS), against the performance standards for measuring the effectiveness of all aspects of the SMS, including the methods, frequency and results of the audit process. The audit should also consider the following matters:

- (1) competency of the auditor,
- (2) the person responsible for ensuring the audit is conducted, and
- (3) the person responsible for implementing the results of the audit.

6 PLAN ADMINISTRATION AND RESPONSIBILITIES

6.1 Review

In accordance with the requirements under Condition 3 in Schedule 6 of SSD_5581, as a minimum Centennial Airly will review this Plan within three months of the following:

- a) Submission of an incident report;
- b) Submission of an Annual Review (required 31 March annually);
- c) Submission of an Independent Environmental Audit; or
- d) Any modification to the conditions of SSD_5581.

Where this leads to revisions of the document, within four (4) weeks of the review the revised document must be submitted to NSW Planning for the approval of the Secretary. Continual improvement shall be achieved through monitoring, internal and external communication with stakeholders, implementation of corrective and preventative actions and through monitoring progress against the objectives included in the environmental management plans. The reporting framework (refer **Section 5.7**) will document the effectiveness of this document (and the related Extraction Plan) through comparison of the predicted negligible impacts of subsidence against actual outcomes.

Each variation to this Plan will be identified in the Document Control Table at the beginning of this document.

Additionally, to maintain consistency with existing management plans and previous Extraction Plans at the mine, this CLZ (ML1814) LMP will also be reviewed in the event that the following occur:

- Stakeholders raise issues that necessitate a review;
- There are other changes to management requirements (e.g. changes to other related approvals besides consent, such as Mining Lease and/or EPL conditions);
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan;
- Monitoring or audit processes demonstrate that a review is warranted;
- Where otherwise triggered by the CLZ (ML1814) TARP;
- Where triggered by (or for) review of other related management plans (if applicable); or
- Every three (3) years as a minimum (where not already triggered above).

Any amendments to the CLZ (ML1814) LMP will be undertaken in accordance with Consent/relevant approvals and in consultation with key relevant stakeholders where required. Following any significant changes, a copy of the amended CLZ (ML1814) LMP will be forwarded to all relevant stakeholders.

In addition to planning development consent requirements, Airly Mine must review and as necessary revise the risk control measures implemented for subsidence in accordance with section 20 of the *WHSMP Regulation (2022)*. Any review triggered by WHS Legislation Requirements will be addressed via the process identified in the EP Main Report (*refer Section 5.5*) and the CLZ (ML1814) PSMP (Appendix 5 of the EP Main Report).

6.2 Key Responsibilities

The responsibility for implementation, monitoring and review of the CLZ (ML1814) LMP lies with the Superintendent Environment and Community. The ultimate responsibility for the implementation of the CLZ (ML1814) LMP lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for this CLZ (ML1814) LMP are outlined in **Table 6.1**.

Table 6.1: Key Personnel and Accountabilities

Position	Responsibility
Mine Manager	- Ensuring that sufficient resources are available to implement and execute the requirements of this Plan; and - Reporting triggers/non-conformances to external stakeholders.
Technical Services Manager	- Coordinate underground inspections and subsidence monitoring program associated with this CLZ (ML1814) LMP; - Coordinate implementation of the mine design and CLZ (ML1814) TARP. - Reporting triggers/non-conformances internally to the mine manager as appropriate. - Reporting to NSW Planning and NSW RR of subsidence and pillar system performance upon completion of specified monitoring intervals.
Production Manager	- Implement mine design - Establish and maintain underground monitoring and inspections program; - Auditing as required
Mine Surveyor	- Survey as built initial development pillars - Establish and maintain subsidence monitoring program; - Internal reporting as required. - Mark up centre lines for driveage in pillars - Produce final mining plan for first workings to be carried out in consultation with the Technical Services Manager.
Superintendent Environment and Community	Implementation, monitoring and review of this plan, including: - The carrying out of targeted inspections; - The installation and maintenance of signage where required; - Reporting triggers/non-conformances internally to the Mine Manager as appropriate; - Consulting with land owners, landholders and managers regarding any land management issues arising from subsidence within the EP Area. This includes (but may not be limited to) NPWS, Office of Crown Lands and private landowners within the EP Area (if and as applicable); - Reviewing this CLZ (ML1814) LMP, including consultation during the review process with relevant stakeholders; - Coordinating any remediation work as required; - Inspecting targeted accessible areas susceptible to tensile and compressive strains and potential cracking as required (e.g. accessible tracks and trails); and - Co-ordinating the generation and submission of formal reporting requirements outlined in this Plan.

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APPENDIX 3 Biodiversity Management Plan for CLZ (ML1814)



Biodiversity Management Plan (CLZ (ML1814) BMP)

**Cliff Line Zone of First Workings
Extraction Plan (ML1814)**

Airly Mine (SSD_5581)

July 2024

A decorative graphic in the bottom right corner consisting of overlapping curved shapes in shades of blue, teal, and purple.

DOCUMENT CONTROL / TITLE BLOCK

EXTRACTION PLAN DETAILS	Title:	Biodiversity Management Plan: Cliff Line Zone of First Workings Extraction Plan (ML1814)
	Applicant:	Centennial Airly Mine
	Revision No.:	CLZ (ML1814) BMP_Rev_2 ¹

REVISION

REVISION DETAILS	Revision No.	Details of Revision	Date Sent
	Rev_0	Draft for external consultation	1/12/2023
	Rev_1	Update to address recommendations from consultation	22/03/2024
	Rev_2	Minor amendments to address recommendations from consultation	25/07/2024

¹ An integrated Document Control Procedure is incorporated into Centennial Airly Mine's Safety Management System (SMS). Documents, data and records pertaining to this plan will be managed according to the ***Airly Mine Document and Data Control Management Plan (AIR-MP-1034)***.

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(refer to EP Main Report)

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ATTACHMENT F – TECHNICAL REPORT: BASELINE BIODIVERSITY ASSESSMENT (RPS, 2023)	
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ABBREVIATIONS

BCD	Biodiversity Conservation Division (now BCS)
BCS	Biodiversity, Conservation and Science group within the NSW DCCEEW
BMP	Biodiversity Management Plan
CLZ	Cliff Line Zone of First Workings (approved mining zone under consent SSD_5581)
DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
DPE	NSW Department of Planning and Environment (now NSW Planning)
DPIE	NSW Department of Planning, Industry and Environment (now NSW Planning)
DOC	Depth of Cover
EP	Extraction Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environment Protection License
HHMP	Historic Heritage Management Plan
IEP	Independent Expert Panel (post-consent)
IRP	Independent Review Panel (pre-consent)
LCC	Lithgow City Council
LMP	Land Management Plan
MEP	Airly Mine Extension Project
ML	Mining Lease
MOD	Modification to Airly Mine's former Development Consent (DA162/91)
NPWS	NSW National Parks and Wildlife Service
NSW Planning	NSW Department of Planning, Housing and Infrastructure (formerly DPE)
NSW-RR	NSW Resources Regulator
OEH	NSW Office of Environment & Heritage
PPMZ	Panel & Pillar Mining Zone (approved mining zone under consent SSD_5581)
PSMP	Public Safety Management Plan
SCA	State Conservation Area
SSD	State Significant Development
SMP	Subsidence Monitoring Program
SMZ	Shallow Mining Zone (approved mining zone under consent SSD_5581)
TARP	Trigger Action Response Plan
WMP	Water Management Plan

1 INTRODUCTION

1.1 Background

Airly Mine is an existing underground coal mine located approximately 40 kilometres (km) northwest of Lithgow in New South Wales, 170km northwest of Sydney and 4 km to the northeast of Capertee, as illustrated on **Figure 1.1**. The mine is partly located within the Mugii Murum-ban State Conservation Area (SCA). Centennial Airly Pty Limited (Centennial Airly) is the operator of the mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited (Centennial).

Development Consent for the Airly Mine Extension Project (MEP) was approved on 15 December 2016 subject to the Conditions in Schedule 2 to 6 of State Significant Development 5581 (SSD_5581). The consent allows extraction of 1.8 million tonnes of run-of-mine (ROM) coal per calendar year for a period of 20 years, which is supplied to both domestic and international markets. As per commitments within the Environmental Impact Statement (EIS) for SSD_5581, Airly Mine is implementing a conservative approach to mining, with different mining methods applied in different areas of the mining lease called Mining Zones².

The *Cliff Line Zone of First Workings (ML1814) (CLZ (ML1814)) Extraction Plan* as detailed in the *CLZ (ML1814) Extraction Plan Main Report (the EP Main Report)* and the supporting component plans, continues the conservative approach to mining being implemented by Airly Mine, with the proposed first workings under this Extraction Plan specifically designed to provide long term stable and effectively non-subsiding pillars to protect the surface such that there is no adverse impact. Mine design and implementation is a key element of subsidence impact avoidance and management. The *Extraction Plan Area (EP Area)* is further defined in **Section 1.3**.

The *EP Main Report* and the supporting component plans have been developed using a risk-based approach and in accordance with:

- Relevant requirements listed under *Condition 7 in Schedule 3* of SSD_5581;
- *Extraction Plan Guideline*, NSW Department of Planning and Environment 2022;
- *Managing Risks of Subsidence Guideline*, NSW Department of Industry, Resources Regulator (NSWRR), 2017; and
- *Consultation with all relevant key stakeholders* (potentially affected by subsidence) and the Independent Expert Panel (IEP) established by NSW Department of Planning, Housing and Infrastructure (NSW Planning) for the project.

An Extraction Plan is required to be developed and approved prior to undertaking any first workings within the Cliff Line Zone and Zone of First Workings, including the development of this *Biodiversity Management Plan for CLZ (ML1814) (CLZ (ML1814) BMP)*.

² Airly Mine has five (5) mining zones approved under development consent SSD_5581 as shown in Figure 2 in Appendix 3 of SSD_5581. These zones provide design criteria for different mining methods based on the differing levels of environmental sensitivity of surface features and depth of cover across the Airly mining leases. Section 8 of the Airly Mine EIS (2014) provides further details on the definitions of each of these approved mining zones if required.

1.2 Purpose and Scope

The purpose of this **CLZ (ML1814) BMP** is to meet the requirements under *Condition 7(i)(iv) in Schedule 3* of SSD_5581 and associated relevant guidelines, leases and licenses, including outlining the monitoring and management measures to be implemented to address any potential impacts to biodiversity (**Section 3.2**) during first workings within the EP Area (**Section 1.3**).

A directly related *Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP)* (Appendix 6 of the EP Main Report) has also been specifically developed for the Extraction Plan to address the project performance measures prescribed by consent SSD_5581, supported by a *Master Trigger Action Response Plan for CLZ (ML1814) (CLZ (ML1814) TARP)* (Appendix 7 of the EP Main Report), including adaptive management measures if required.

1.3 Extraction Plan Area

The Extraction Plan Area (EP Area) is illustrated on **Figure 1.2** and is defined as:

- The *Cliff Line Zone of First Workings* within ML1814;
- Includes all proposed first workings within the EP Area;
- First workings incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features;
- No secondary extraction is permitted or proposed within the EP Area;
- No surface impacts have been predicted for first workings; and
- The EP Area is wholly located within the Mugii Murum-ban State Conservation Area (SCA) with no private land ownership.

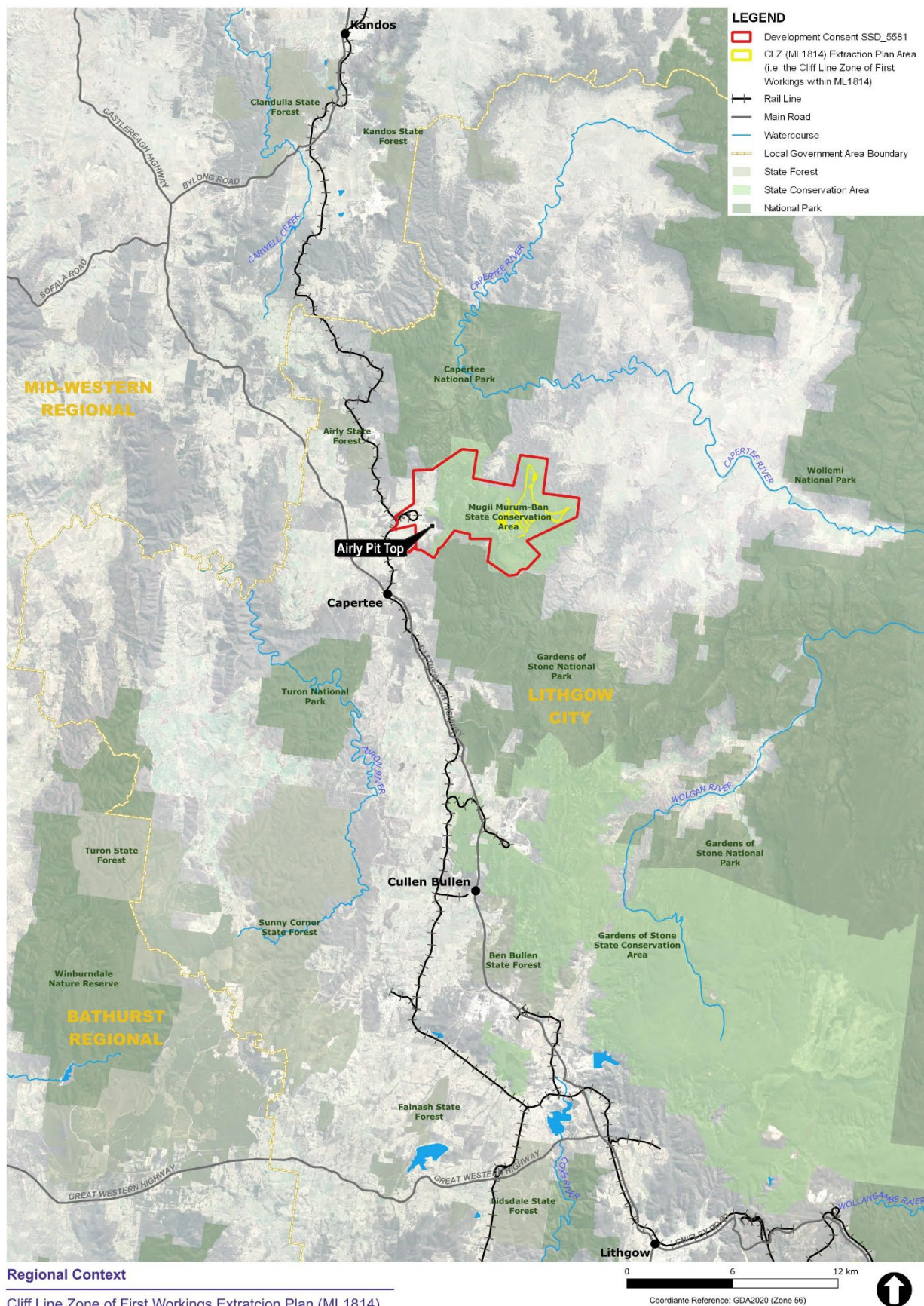
1.4 Relevant Features

The features identified within the EP Area, and which are subject to this *CLZ (ML1814) BMP*, as illustrated on **Figure 1.2**, are summarised below and detailed in the following sections:

- Flora and fauna habitat;
- Threatened flora species and threatened ecological communities (TECs) including the *Pultenaea* sp. Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland;
- Threatened fauna species and their habitats; and
- Sensitive vegetation communities such as 'Facultative Ecosystems' and other and habitat features such as the Grotto and the Oasis.

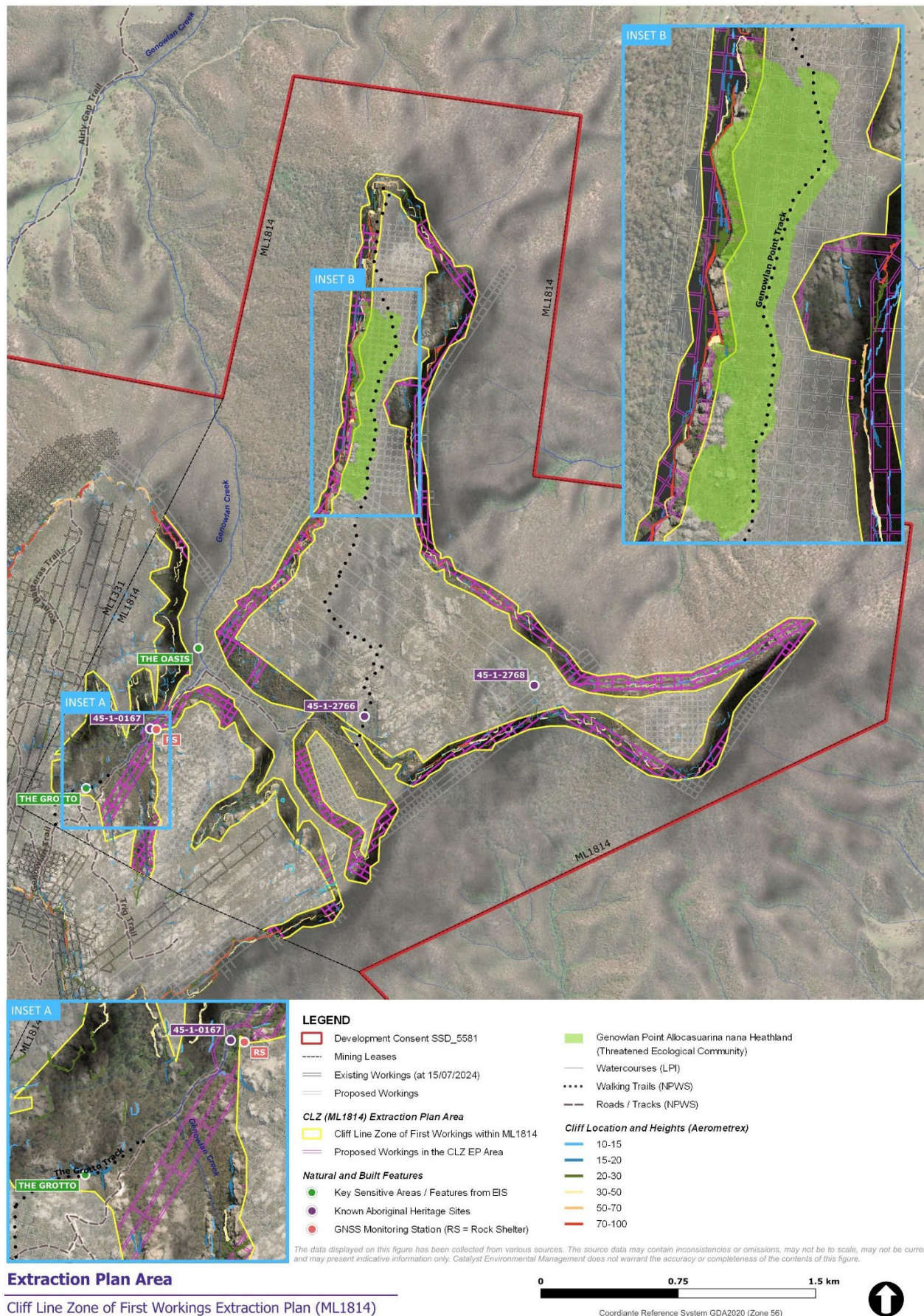
The key biodiversity management features in the EP Area are discussed in further detail in **Section 4**.

Figure 1.1: Locality Plan



The data displayed on this figure has been collected from various sources. The source data may contain inconsistencies or omissions, may not be to scale, may not be current and may present indicative information only. Catalyst Environmental Management does not warrant the accuracy or completeness of the contents of this figure.

Figure 1.2: Extraction Plan Area (EP Area) and Relevant Features within the EP Area



1.5 Structure of the CLZ (ML1814) BMP

The main text sections of this CLZ (ML1814) BMP include:

- Section 1** Provides an introduction, purpose, scope, extraction plan area, relevant biodiversity features and document structure.
- Section 2** Provides the statutory regulatory requirements, risk identification and consultation.
- Section 3** Provides the predicted subsidence impacts assessment and subsidence performance indicators to be used to assess against the relevant subsidence performance measures for biodiversity.
- Section 4** Outlines the monitoring and management measures in place for the key features in the EP Area.
- Section 5** Summarises the management, mitigation, remediation and reporting measures for this CLZ (ML1814) BMP, including relevant performance measures and indicators, contingency response, adaptive management, reporting and auditing.
- Section 6** Provides an outline of the plan administration and roles and responsibilities for this CLZ (ML1814) BMP.
- Section 7** Provides a historical review of references leading to the development of this CLZ (ML1814) BMP.

2 PLAN DEVELOPMENT AND CONSULTATION

2.1 Statutory Requirements

Centennial Airly conducts its operations in accordance with:

- The conditions of the Development Consent (SSD_5581);
- Relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL No. 12374) and Mining Leases (i.e. ML 1331 and ML 1814); and
- other relevant State and Commonwealth environmental, planning, mining, safety, and natural resource legislation and guidelines.

Centennial Airly maintains a register of relevant environmental legislative and regulatory requirements in a compliance database.

The relevant statutory requirements applicable to the *CLZ (ML1814) Extraction Plan* and this supporting CLZ (ML1814) BMP are presented in the EP Main Report (*refer Section 2.1 and Attachment B*).

This CLZ (ML1814) BMP is a component of the EP Main Report and has been prepared specifically to address Condition 7 in Schedule 3 of SSD_5581 which states:

(7) Prior to carrying out any first workings within the Cliff Line Zone and Zone of First Workings (refer to Figure 2 in Appendix 3) or second workings, the Applicant must prepare an Extraction Plan for the relevant workings to the satisfaction of the Secretary. Each Extraction Plan must:

(i)...include a:

(iv) Biodiversity Management Plan which has been prepared in consultation with DoEE and BCD, which provides for the management of potential impacts and/or environmental consequences of the proposed first and second workings on aquatic and terrestrial flora and fauna, with a specific focus on threatened species populations and their habitats, endangered ecological communities and groundwater dependent ecosystems including, but not limited to:

- *Pultenaea sp. Genowlan Point;*
- *Genowlan Point Allocasuarina nana Heathland;*
- *Prostanthera stricta (Mount Vincent Mint-bush); and*
- *Eucalyptus cannonii (Capertee Stringybark).*

This **CLZ (ML1814) BMP** has been developed in accordance with Condition 2 in Schedule 6 of SSD_5581 (management plan requirements). **Table 2.1** details where these conditions have been addressed.

Table 2.1: Biodiversity Management Plan Requirements

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section Addressed
The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: a) Detailed baseline data; b) A description of: • The relevant statutory requirements (including any relevant approval, licence or lease conditions);	Section 5.3 EP Main Report (Section 2.1, Attachment B)

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section Addressed
- Any relevant limits or performance measures/criteria; - The specific performance indicators or triggers that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures.	Section 5.1 Section 6.4, CLZ (ML1814) TARP
c) A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria.	Sections 2.1, 6.1, 6.4
d) A program to monitor and report on the: - Impacts an environmental performance of the development; - Effectiveness of any management measures (see c) above);	Section 4 Sections 6.4, 6.7
e) A contingency plan to manage any unpredicted impacts and consequences	Section 6.5
f) A program to investigate and implement ways to improve the environmental performance of the development over time	Section 6
g) A protocol for managing and reporting any: - Incidents; - Complaints; - Non-compliances with statutory requirements; and - Exceedances of the impact assessment criteria and/or performance criteria; and	Section 6.6
h) A protocol for periodic review of the plan.	Section 7.1

2.2 Specialist Assessments

This CLZ (ML1814) BMP has been informed by a Baseline Ecology Assessment that was developed by RPS (2023) for the EP Area with the purpose of reviewing the relevant biodiversity information within the region.

The key biodiversity management features in the EP Area, as detailed in the Baseline Ecology Assessment, are discussed in **Section 4**. Key biodiversity features include:

- Vegetation communities - The CLZ EP area encompasses 12 PCTs. The vegetation varies from PCT 3686, 3695 and 3865 along ridgetop cliff edges, to PCT 3226 and 3495 within the gullies. See **Section 4.2.1**.
- Threatened Ecological Communities - One threatened ecological community (TEC) occurs in the EP Area, being *Biodiversity Conservation Act 2016* (BC Act) listed Genowlan Point *Allocasuarina nana* Heathland Endangered Ecological Community (EEC). See **Section 4.2.1.1**.
- Groundwater Dependent Ecosystems - no high priority GDEs have been identified within the EP Area however, three facultative ecosystems occur within the gullies of the Grotto and Oasis and along the edges of the Genowlan Point. See **Section 4.2.1.2**.
- Two threatened flora species occur within the EP Area, *Prostanthera stricta* (Mount Vincent Mint Bush; BC Act: Vulnerable; EPBC Act: Vulnerable), and *Pultenaea sp.* Genowlan Point (BC Act: Critically Endangered; EPBC Act: Critically Endangered). See **Section 4.2.2**.
- A total of 40 threatened fauna species occur within the locality (within 10 km of the EP Area, including 24 bird species, ten microbat species, four mammal species (excluding microbat species), and two

reptile species. Due to the mobility of these species and abundance of habitats, these species are presumed to occur within the EP Area. See **Section 4.2.3**.

- Key habitat features (**Section 4.2.3.6**) include:
 - Aquatic habitats in the form of first, second and third order creeks of Genowlan Creek;
 - Sensitive habitat features including the Grotto and Oasis;
 - Sandstone habitats including rocky outcrops, sandstone boulders caves and ledges;
 - Hollow bearing trees;
 - Ground logs and fallen timber;
 - Flowering and fruiting plants including mistletoe species;
 - *Allocasuarina* species; and
 - Koala feed trees.

SCT were engaged to prepare and provide a subsidence prediction and impact assessment report, on the likely impacts of these predicted levels of subsidence on the natural and built features that exist within the EP Area. The Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) provided the subsidence predictions and impact assessment for the Extraction Plan. An addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b) was prepared to review the earlier pillar geometry assessment (SCT, 2023a) for an increased roadway height of 3.2m.

The subsidence predictions and impact assessment is further discussed below in **Section 3.2** of this CLZ (ML1814) BMP.

2.3 Risk Identification and Assessment

Centennial Airly has undertaken a dedicated ***Subsidence and Environmental Risk Assessment*** (*Stature RA Number: 1001330039*³) directly in support of this Extraction Plan which provide a risk framework basis for development of the component management plans.

The *CLZ (ML1814) Extraction Plan* risk assessment was completed on the 20 June 2023 with key staff from the Airly Mine including the Mine Manager, Statutory Mine Surveyor, Technical Services / Compliance Manager and Environment and Community Superintendent, as well as key EP Project Team members for Heritage, Ecology and the Lead Consultant for the Extraction Plan. The landholder was also represented by a member from the NPWS.

Risks were identified and assessed through the review of known surface and sub-surface features within the EP Area. The risk assessment also specifically assessed key heads of consideration required by the Managing Risks of Subsidence Guideline (NSW RR, 2017).

A risk ranking (low, moderate, significant, high or extreme) was assigned to each risk/hazard in consideration of the Maximum Reasonable Consequence (MRC) for the given controls. There were 34 potential risks scenarios assessed during the Risk Assessment; 1 significant, 7 moderate, 23 low and 3 were assessed as not applicable.

³ Centennial Airly has adopted the Stature Risk Assessment Program which sets out a consequences table and risk ranking matrix for managing identified risks consistent with AS/NZS ISO 31000:2009.

The risk assessment determined that the **risk of impact for biodiversity features** (noting the extensive controls identified) was **low to significant** including aspects associated with *Pultenaea* sp. Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland within the EP Area.

A copy of the risk assessment is included in the EP Main Report (refer Attachment C). Additional details regarding the management and monitoring of subsidence related impacts within the EP Area have been detailed in **Section 5** and **Section 6**.

2.4 Consultation

Condition 7(i)(iv) in Schedule 3 of SSD_5581 requires the preparation of this **CLZ (ML1814) BMP** in consultation with key relevant stakeholders as detailed below:

- Department of Climate Change, Energy, the Environment and Water (DCCEEW; formerly DoEE); and
- Biodiversity, Conservation and Science (BCS) group within the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW).

The outcomes of consultation undertaken for the project is provided in the EP Main Report (refer Attachment D), including copies of relevant correspondence such as project presentations delivered by the mine to key stakeholders and relevant formal correspondence received from key stakeholders.

Stakeholder feedback provided has been reviewed and addressed as necessary as part of the development and review of this Extraction Plan and key component plans.

3 SUBSIDENCE ASSESSMENT

3.1 Mine Planning and Design

The proposed first workings within the CLZ (ML1814) consist mainly of (or parts of) 3 or 5 roadway main headings which provide access to future mining areas. First workings incorporate mine development of roadways / headings and cut throughs to form long term stable pillars.

Mine design is the primary control utilised at Airly Mine for subsidence impact avoidance. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement.

3.2 Subsidence Predictions

Condition 7(g) in Schedule 3 of SSD_5581 and the Extraction Plan Guidelines (DPE, 2022) requires revised predictions of potential subsidence effects, subsidence impacts and environmental consequences to be presented within the Extraction Plan for the EP Area, including any relevant information obtained since the EIS and consent, in consultation with the Independent Expert Panel (IEP).

Subsidence predictions for this Extraction Plan were assessed by SCT (2023a; 2023b) and are presented in full as *Attachment E – Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b)*.⁴

The maximum predicted subsidence for the EP Area are consistent with the EIS Predictions as shown in **Table 3.1**. The predictions included assessment of the subsidence effects measured in the current first workings at Airly Mine, including a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331).

Table 3.1: Maximum Subsidence Predictions with Comparison to Previous Predictions

Predictions	Pillar Stability	Max Subsidence	Max Tilt (mm/m)	Max Strain	
				Tensile (mm/m)	Compressive (mm/m)
This CLZ EP (ML1814) Predictions SCT (2023a; 2023b)	Long Term Stable with minimal subsidence	≤37mm	≤0.61	≤0.18	≤0.25
EIS Predictions Golder (2014b)	Long Term Stable	65mm	0.6-1.1	0.2-0.3	0.2-0.5
Current CLZ EP (ML1331) Predictions Golder (2017)	Long Term Stable, negligible settlement, effectively non-subsiding	<53mm Worst Case (long term flooded and additional pillar loading) Short to medium term <30mm and typical <20m	0.4-0.9	0.1-0.3	0.1-0.3

The predicted subsidence is not expected to cause adverse impacts on the relevant features covered under this CLZ (ML1814) BMP.

⁴ A detailed review of the revised subsidence predictions is provided in the *EP Main Report (refer Section 3.2)*

4 BIODIVERSITY MANAGEMENT FEATURES

4.1 Landscape Context

The EP Area lies within the Mugii Murum-ban SCA, with the Gardens of Stone National Park to the south and Capertee National Park to the north and is characterised by steep sandstone escarpments and pagoda rock formations. The elevation of the EP Area varies from 1020 m ASL in the centre of the EP Area to less than 880 m ASL at the extent of the Genowlan Trig rock formation. Genowlan Trig steeply declines into the valley of tributaries of Genowlan Creek in the east and north.

The EP Area is within the Capertee Uplands of the South Eastern Highlands Bioregion (IBRA 7) which is dominated by a temperate climate with significant areas in the north and south at higher elevations having a montane climate with milder summers. The EP Area is on the western margin of the Greater Blue Mountains World Heritage Area that surrounds the western rim of the Sydney Basin, preserving the sandstone-based links between the Sydney, Hunter and Central West regions of New South Wales (DECC 2008). This huge expanse of continuous habitat facilitates the movement of many fauna species across the landscape. Animals move through habitats to obtain food, shelter and breeding resources in response to seasonal resource ability and habitat conditions. Large tracts of habitat are generally required for successful dispersal away from natal areas or seasonal migrations (Van der Ree et al 2007).

The EP Area is dominated by the Newnes Plateau NSW (Mitchell) landscape with a small area of the Sydney Basin Diatremes landscape occurring at Genowlan Point (DECC 2008). The underlying geology of the EP Area comprises primarily of Narrabeen Group—fine-grained lithic sandstone occasionally interbedded with thin shale lenses. It spans four mapped soil landscapes, predominately occurring on the Warragamba soil landscape. The higher elevation points of the EP Area, typically above 1000 m ASL transition into Wollangambe soil landscape, whilst as the terrain drops into lower elevation, the soil landscape transitions into Hassans Walls soil landscape. A small area at Genowlan Point is occurs within the Mount Tomah soil landscape containing fine-grained tertiary basalt (DPE 2020a).

The EP Area occurs within the Capertee River sub-catchment, in the north-west of the Hawkesbury Nepean Catchment Management Authority (CMA). A number of first and second Strahler order streams flow into Genowlan Creek (third Strahler order stream) within the EP area, then on into the Capertee River.

4.2 Terrestrial Ecology

4.2.1 Vegetation Communities

Vegetation within the EP Area and surrounding Mining Lease were previously mapped by DEC (2006a) (VIS_ID 2231). Vegetation mapping was revised by RPS (2014) through both field and desktop assessments including the use of on ground rapid data points and flora quadrats surveys across the Development Consent Area (including the Genowlan Trig EP Area). During the Baseline Assessment (RPS 2023a) vegetation mapping was updated utilising ground truthing of the State Vegetation Type Map (SVTM, DPE 2022d) with vegetation mapping being converted to the current Eastern New South Wales Plant Community Type (PCT) Classification Version 1.1 (DPE 2022b).

PCT's within the EP Area are shown in **Figure 4.1** and are listed in **Table 4.1**.

Table 4.1: Plant Community Types within the EP Area

PCT	PCT Description	Area (ha)
0	Not native vegetation	0.03
3210	Blue Mountains Cool Wet Eucalypt Forest	0.13
3226	Western Blue Mountains Montane Wet Fern Forest	15.19
3480	Capertee-Wolgan Escarpment Dry Forest	0.19
3495	Western Blue Mountains Monkey Gum Gully Forest	29.21
3686	Mount Airly Sandstone Forest	89.99
3687	Newnes Plateau Peppermint-Ash Tall Forest	2.16
3694	Upper Blue Mountains Ridgetop Woodland	1.55
3695	Western Blue Mountains Peppermint Sheltered Forest	12.79
3731	Capertee Conglomerate Grey Gum-Stringybark Forest	2.31
3859	Genowlan Point Heath	2.21
3862	Newnes Plateau Rockplate Heath	1.29
3865	Western Blue Mountains Pagoda Scrub	54.36
Total		211.41

4.2.1.1 Threatened Ecological Communities

One threatened ecological community (TEC) occurs in the EP Area, being *Biodiversity Conservation Act 2016* (BC Act) listed Genowlan Point *Allocasuarina nana* Heathland Endangered Ecological Community (EEC, PCT 3859, refer **Figure 4.2**). Another TEC occurs within the broader Airly Development Consent Area, BC Act and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) White Box – Yellow Box – Blakey’s Red Gum Woodland Critically Endangered Ecological Community (CEEC), though it does not occur within the EP Area (refer to **Figure 4.2**).

4.2.1.2 Groundwater Dependent Ecosystems

RPS (2014) and GHD (2021) assessed the potential for PCT’s to be Groundwater Dependent Ecosystems (GDE) due to their dependency upon groundwater flows and/or shallow aquifers. Groundwater flows were considered too deep to have much interaction with potentially occurring GDEs, however, there were areas of alluvium that contain shallow aquifers within surrounding Airly Mine lease area (**Figure 4.3**). PCT’s which occurred within the ‘shallow aquifer zone’, and hence may have interaction with groundwater, include:

- PCT 3226: Western Blue Mountains Montane Wet Fern Forest;
- PCT 3495: Western Blue Mountains Monkey Gum Gully Forest; and
- PCT 3731: Capertee Conglomerate Grey Gum-Stringybark Forest.

The aforementioned PCT’s were ultimately considered to be ‘**Facultative Ecosystems**’ as opposed to GDEs (see **Figure 4.3**), as these PCT’s are not entirely dependent on groundwater, but potentially have some reliance on groundwater on a seasonal basis or only during extended drought periods, at other times, water requirements may be met by soil or surface water’ (Serov et al 2012). The aforementioned PCT’s occurring elsewhere in the EP Area that do not contain shallow aquifers and are not considered to be completely reliant on groundwater for their persistence.

Figure 4.1: Vegetation Communities

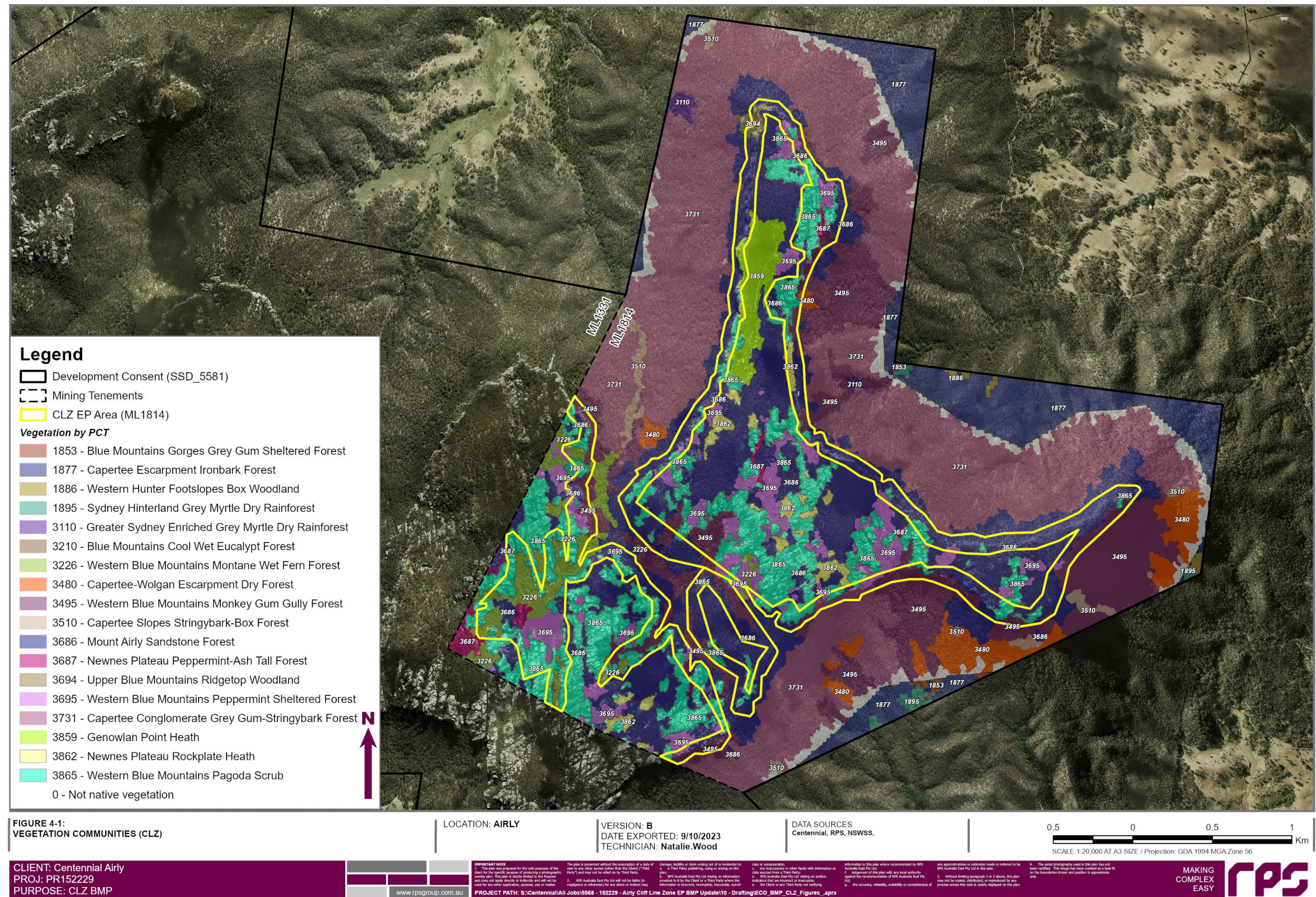


Figure 4.2: Threatened Ecological Communities

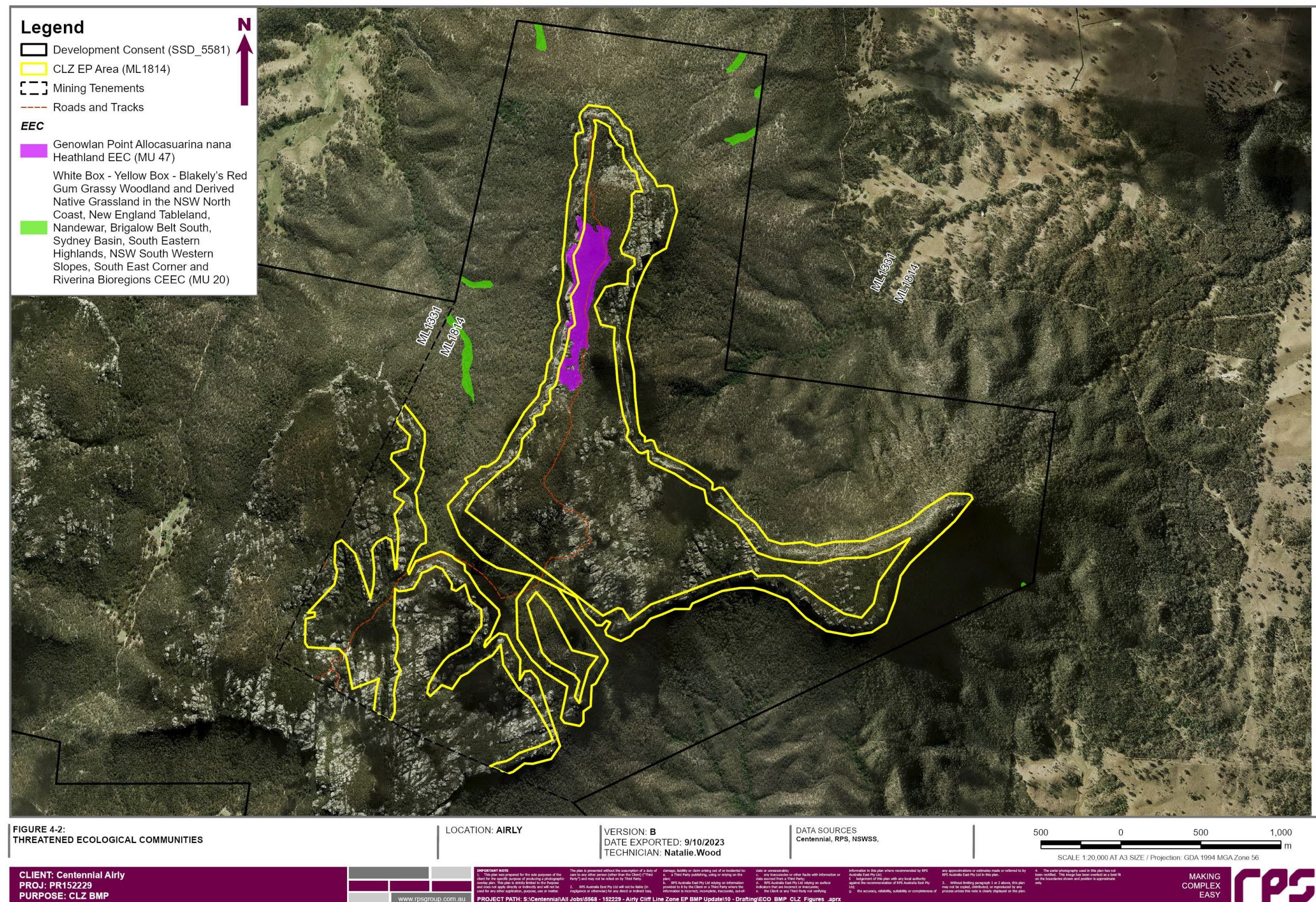
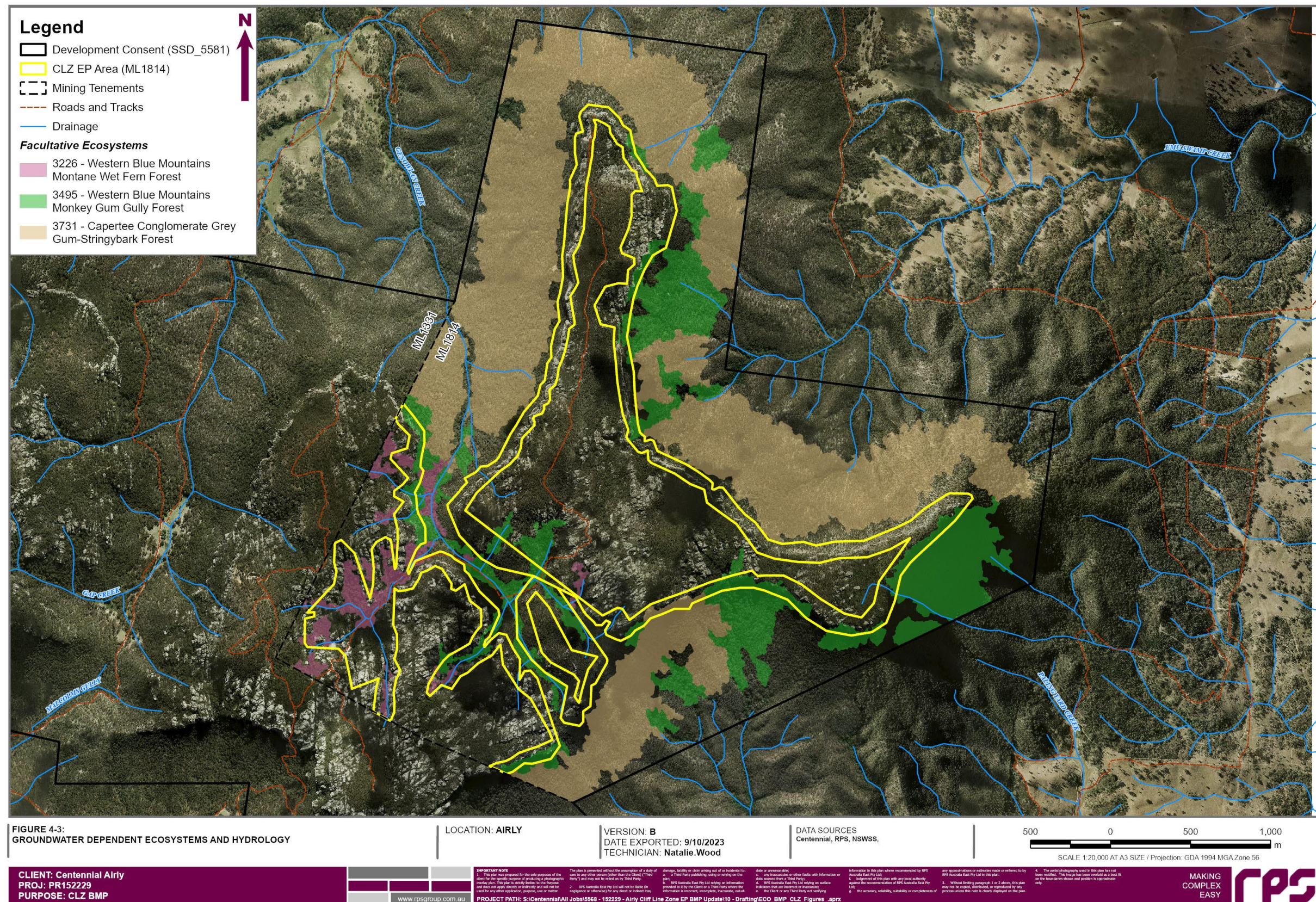


Figure 4.3: Groudwater Dependant Ecosystems



4.2.2 Threatened Flora

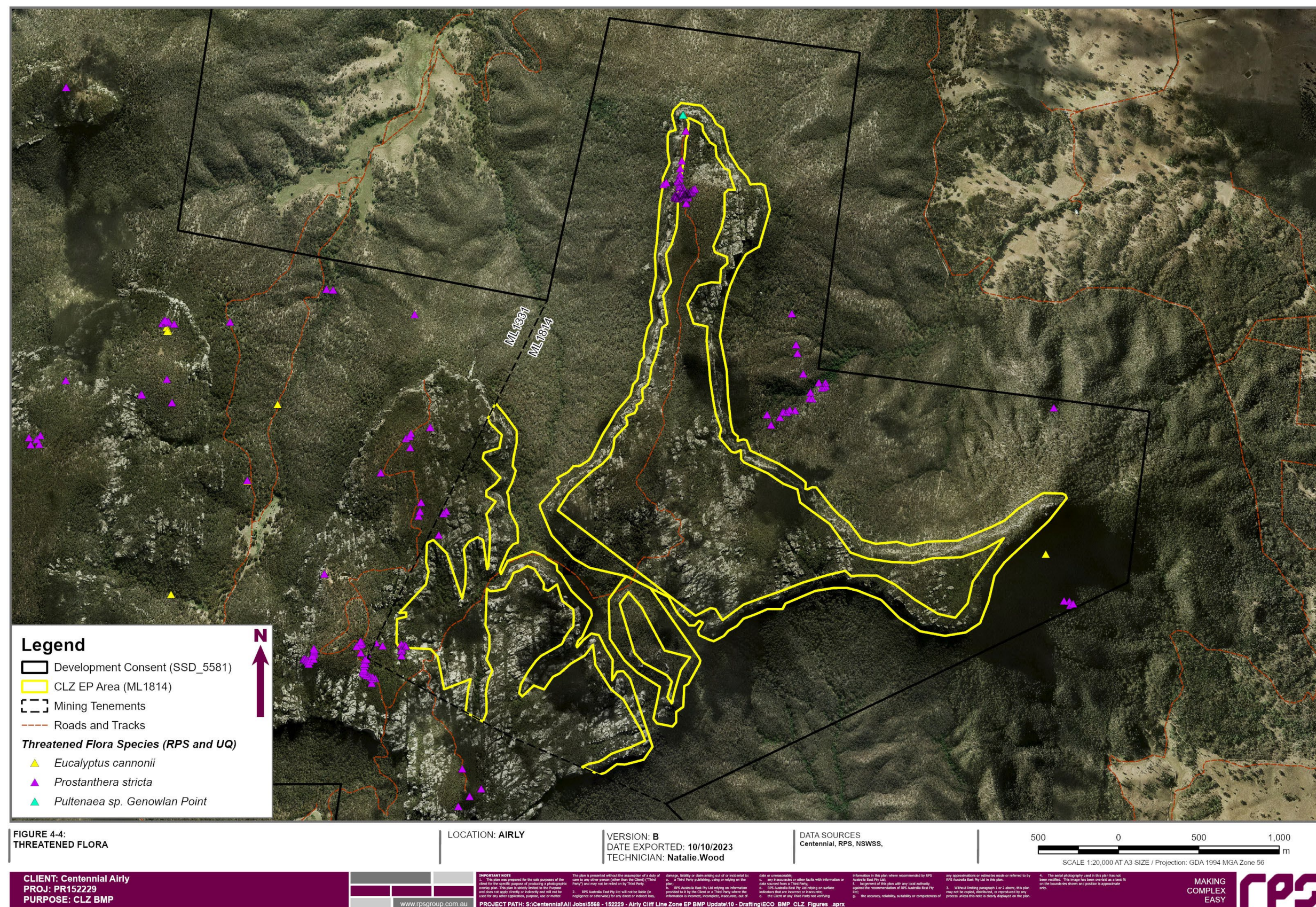
Targeted flora surveys were conducted in 2014 as part of the *Airly Mine 2012-2014 Flora and Fauna Baseline Survey Report* (RPS 2013). Additional seasonal monitoring has added to this dataset which was compiled to inform the Ecology Baseline Assessment Report Pt Hatteras PPMZ EP (RPS 2021), Baseline Biodiversity Report: CLZ EP Area and CLZ (ML1814) EP Area ('The Baseline Report', RPS 2023a) and Airly BMP Seasonal Ecological Monitoring 2022 (RPS 2023b).

Two threatened flora species occur within the EP Area, *Prostanthera stricta* (Mount Vincent Mint Bush; BC Act: Vulnerable; EPBC Act: Vulnerable), and *Pultenaea sp. Genowlan Point* (BC Act: Critically Endangered; EPBC Act: Critically Endangered). Additionally, one threatened flora species is located within Development Consent Area in proximity to the EP Area including, *Eucalyptus cannonii* (Capertee Stringybark; BC Act: Vulnerable).

Negligible subsidence movements are predicted; therefore, these species are not expected to be impacted. Furthermore, first workings mining is not proposed directly under *Pultenaea sp. Genowlan Point* further reducing the risk for potential impact (see **Section 6.2** for management and mitigation measures). A copy of the risk assessment is included in the EP Main Report (refer Attachment C).

The locations of all threatened flora previously identified within the Development Consent Area are displayed in **Figure 4.4**.

Figure 4.4 Threatened Flora



4.2.3 Threatened Fauna

Targeted fauna surveys were conducted as part of the *Airly Mine 2012-2014 Flora and Fauna Baseline Survey Report* (RPS 2013), *Baseline Biodiversity Report CLZ EP Area and CLZ (ML1814) EP Area* (RPS 2023a). Fauna surveys were conducted across the entire Mining Lease (ML1814) and were not contained solely within the EP Area. However, given the contiguous habitats across the Mining Lease Areas and the mobility of fauna, it is likely that most fauna species detected during surveys will occur within the EP Area.

Additional seasonal monitoring has added to this dataset which was compiled to inform the recent *Airly BMP Seasonal Ecological Monitoring 2022* (RPS 2023b). Threatened species database searches, have also identified additional threatened fauna species likely to utilise the EP Area based on habitat suitability, proximal records, connectivity and mobility of the species (DPE 2023).

A total of **40 threatened fauna** species occur within the locality (within 10 km of the EP Area, see **Figure 4.5**) as follows:

- 24 bird species;
- 10 microbat species;
- 4 mammal species (excluding microbat species); and
- 2 reptile species.

4.2.3.1 Birds

A total of **24 threatened bird species** (**Table 4.2**) occur within the locality or have habitat within the EP Area. Of these, three are known to occur within the EP Area (RPS 2023b, UQ 2017). Due to the mobility of bird species and availability of niche habitat features within the EP Area, it is presumed that all threatened bird species may periodically utilise resources in the EP Area.

Table 4.2: Threatened bird species detected or with habitat within the EP Area

Common name	Scientific name	Location	BC Act	EPBC Act
Barking Owl	<i>Ninox connivens</i>	Locality	Vulnerable	Not listed
Black Falcon	<i>Falco subniger</i>	Locality	Vulnerable	Not listed
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	Locality	Vulnerable	Not listed
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	EP Area	Vulnerable	Not listed
Diamond Firetail	<i>Stagonopleura guttata</i>	Locality	Vulnerable	Not listed
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	Locality	Vulnerable	Not listed
Flame Robin	<i>Petroica phoenicea</i>	Locality	Vulnerable	Not listed
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	EP Area	Vulnerable	Endangered
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	EP Area	Vulnerable	Not listed
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	Locality	Vulnerable	Not listed
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	Locality	Vulnerable	Not listed
Little Eagle	<i>Hieraaetus morphnoides</i>	Locality	Vulnerable	Not listed
Little Lorikeet	<i>Glossopsitta pusilla</i>	Locality	Vulnerable	Not listed
Masked Owl	<i>Tyto novaehollandiae</i>	Locality	Vulnerable	Not listed
Painted Honeyeater	<i>Grantiella picta</i>	Locality	Vulnerable	Vulnerable

Common name	Scientific name	Location	BC Act	EPBC Act
Powerful Owl	<i>Ninox strenua</i>	Locality	Vulnerable	Not listed
Regent Honeyeater	<i>Anthochaera phrygia</i>	Locality	Critically Endangered	Critically Endangered
Scarlet Robin	<i>Petroica boodang</i>	Locality	Vulnerable	Not listed
Sooty Owl	<i>Tyto tenebricosa</i>	Locality	Vulnerable	Not listed
Speckled Warbler	<i>Chthonicola sagittata</i>	Locality	Vulnerable	Not listed
Square-tailed Kite	<i>Lophoictinia isura</i>	Locality	Vulnerable	Not listed
Swift Parrot	<i>Lathamus discolor</i>	Locality	Endangered	Critically Endangered
Turquoise Parrot	<i>Neophema pulchella</i>	Locality	Vulnerable	Not listed
Varied Sittella	<i>Daphoenositta chrysoptera</i>	Locality	Vulnerable	Not listed

4.2.3.2 Microbats

A total of **10 threatened microbat species** (Table 4.3) occur within the locality or have habitat within the EP Area. Of these, one is known to occur within the EP Area (RPS 2018, RPS 2021, RPS 2023b, UQ 2014). Due to the mobility of these species and availability of niche habitat features, it is presumed that all threatened microbat species may periodically utilise resources within the EP Area.

Table 4.3: Threatened microbat species detected or with habitat within the EP Area

Common name	Scientific name	Location	BC Act	EPBC Act
Eastern Cave Bat	<i>Vespadelus troughtoni</i>	Locality	Vulnerable	Not listed
Eastern Coastal Free-tailed Bat	<i>Mormopterus norfolkensis</i>	Locality	Vulnerable	Not listed
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	Locality	Vulnerable	Not listed
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	Locality	Vulnerable	Not listed
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	EP Area	Vulnerable	Vulnerable
Little Bentwing-bat	<i>Miniopterus australis</i>	Locality	Vulnerable	Not listed
Little Pied Bat	<i>Chalinolobus picatus</i>	Locality	Vulnerable	Not listed
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	Locality	Vulnerable	Not listed
Southern Myotis	<i>Myotis macropus</i>	Locality	Vulnerable	Not listed
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	Locality	Vulnerable	Not listed

4.2.3.3 Mammals

A total of **four threatened mammal species** (Table 4.4) occur within the locality or have habitat within the EP Area. Of these, three are known to occur within the EP Area (RPS 2013, RPS 2021). Due to the mobility of these species and availability of niche habitat features, it is presumed that all threatened mammal species may periodically utilise resources within the EP Area.

Table 4.4: Threatened mammal species detected or with habitat within the EP Area

Common name	Scientific name	Location	BC Act	EPBC Act
Greater Glider	<i>Petauroides volans</i>	EP Area	Not listed	Endangered
Koala	<i>Phascolarctos cinereus</i>	EP Area	Endangered	Endangered
Spotted-tailed Quoll	<i>Dasyurus maculatus maculatus</i>	EP Area	Vulnerable	Endangered
Squirrel Glider	<i>Petaurus norfolcensis</i>	Locality	Vulnerable	Not listed

4.2.3.4 Frogs

No threatened frogs have been detected within the EP Area. Due to a lack of survey effort, cryptic nature and seasonality of many frog species, threatened frog species may occur within the EP Area. Based on habitat features within the ephemeral tributaries of Genowlan Creek, six threatened frog species have habitat within the EP Area (**Table 4.5**).

Table 4.5: Threatened frog species detected or with habitat within the EP Area

Common name	Scientific name	Location	BC Act	EPBC Act
Booroolong Frog	<i>Litoria booroolongensis</i>	Not detected	Endangered	Endangered
Giant Barred Frog	<i>Mixophyes iteratus</i>	Not detected	Endangered	Endangered
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	Not detected	Vulnerable	Vulnerable
Littlejohn's Tree Frog	<i>Litoria littlejohni</i>	Not detected	Vulnerable	Vulnerable
Red-crowned Toadlet	<i>Pseudophryne australis</i>	Not detected	Vulnerable	Not listed
Stuttering Frog	<i>Mixophyes balbus</i>	Not detected	Endangered	Vulnerable

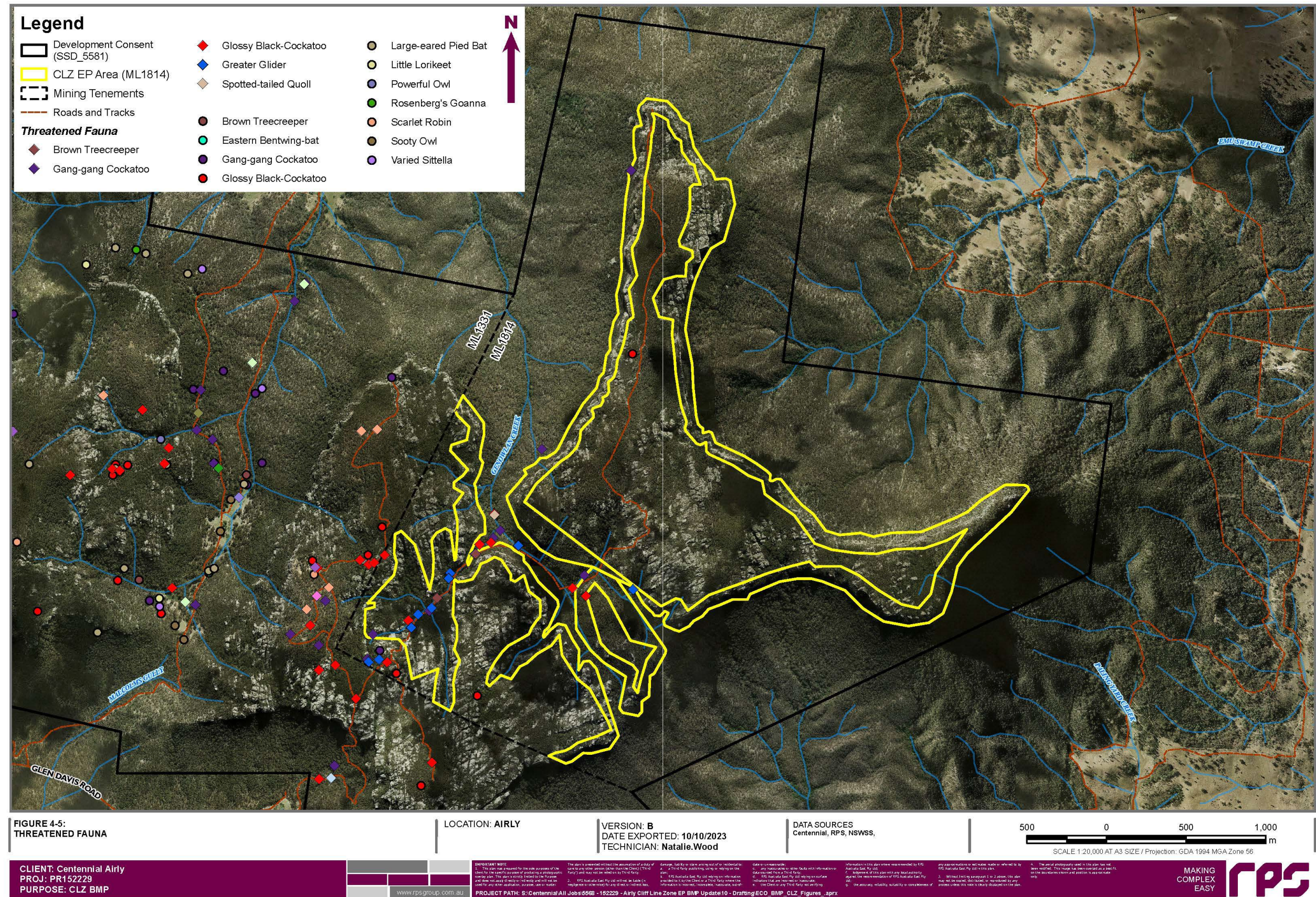
4.2.3.5 Reptiles

A total of **two threatened mammal species** (**Table 4.6**) occur within the locality or EP Area. Of these, one is known to occur within the EP Area (RPS 2021, RPS 2023b). Due to the mobility of these species and availability of niche habitat features, it is presumed that all threatened reptile species may periodically utilise resources within the EP Area.

Table 4.6: Threatened reptile species detected or with habitat within the EP Area

Common name	Scientific name	Location	BC Act	EPBC Act
Broad-headed Snake	<i>Hoplocephalus bungaroides</i>	Locality	Endangered	Vulnerable
Rosenberg's Goanna	<i>Varanus rosenbergi</i>	EP Area	Vulnerable	Not listed

Figure 4.5: Threatened Fauna



4.2.3.6 Habitats

Five broad habitat types occur in the EP area; dry sclerophyll forest, wet sclerophyll forest, heathy woodlands, heath and cleared and cleared areas (RPS 2013, RPS 2023a). The EP area entirely comprises of native vegetation with cleared and disturbed lands only occurring within existing tracks.

Habitats within the EP Area are in abundance and include sandstone habitats, hollow-bearing trees, flowering and fruiting plants, mistletoe, logs and ground timber, aquatic habitats, *Allocasuarina* species, and Koala feed trees.

Sensitive habitat features such as; Genowlan Mountain (including the *Pultenaea* sp. *Genowlan* Point and Genowlan Point *Allocasuarina nana* Heathland), the Grotto and the Oasis occur within the EP Area.

4.2.3.6.1 Sandstone Habitats and Cliffs

Rugged sandstone habitats are a characteristic feature of the EP Area, and include the distinctive pagodas, steep cliffs and escarpments, rocky outcrops or piles of sandstone boulders, caves, crevices and ledges. The EP Area supports an abundance and complexity of sandstone caves and overhangs that offer roosting habitat for threatened obligate cave-roosting microbat species recorded in the EP Area, such as the Large-eared Pied Bat (*Chalinolobus dwyeri*; BC Act: Vulnerable; EPBC Act: Vulnerable).

Sandstone outcrops, overhangs, crevices and ledges provide good habitat opportunities for reptile species; many species of lizards and snakes rely heavily on sandstone cracks and crevices for shelter. The Broad-headed Snake (*Hoplocephalus bungaroides*; BC Act: Endangered; EPBC Act: Vulnerable) is also likely to associate with rock crevices and under flat sandstone rocks on exposed cliff edges locally.

4.2.3.6.2 Hollow Bearing Trees

Hollow-bearing trees are known to be common within the EP Area and surrounds and include a diversity of eucalypt species of various ages. Smaller trees of woodland communities typically support smaller trunk and branch hollows whereas forest communities in sheltered gullies, support large trees and large branch hollows.

Characteristics of hollows dictate the suitability of hollows for different fauna groups or species. The abundance and variations in hollows are reflected by the high diversity and abundance of hollow-dependent fauna species recorded within the locality. Hollow-dependent fauna are defined as species that rely on tree hollows for shelter, roosting, or nesting at some stage in their life cycle. Several threatened hollow-dependent species occur in the EP Area, including Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable, EPBC Act: Endangered), Glossy Black-Cockatoo (*Calyptorhynchus lathamii*; BC Act: Vulnerable, EPBC Act: Vulnerable), Little Lorikeet (*Glossopsitta pusilla*; BC Act: Vulnerable), Sooty Owl (*Tyto tenebricosa*; BC Act: Vulnerable), Squirrel Glider (*Petaurus norfolcensis*, BC Act Vulnerable) and Greater Glider (*Petauroides Volans*; EPBC Act: Vulnerable).

4.2.3.6.3 Flowering Plants

The EP Area supports an abundance of flowering plants including a diversity of myrtaceous species, such as eucalypts, and other flowering species such as banksias and acacias. These species offer foraging resources including nectar, pollen, Eucalypt sap and Acacia gum to threatened arboreal mammals including Greater Glider (*Petauroides volans*, EPBC Act: Endangered) and Squirrel Glider (*Petaurus norfolcensis*, BC Act: Vulnerable). The foraging resources EP Area also supports foraging resources for nectar-feeding threatened birds such as Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*, BC Act: Vulnerable), Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable, EPBC Act: Endangered), Little Lorikeet (*Glossopsitta pusilla*; BC Act: Vulnerable), Painted Honeyeater (*Grantiella picta*; BC Act: Vulnerable; EPBC Act: Vulnerable) and Regent Honeyeater (*Anthochaera phrygia*; BC Act: Critically Endangered; EPBC Act: Critically Endangered).

4.2.3.6.4 Mistletoes

Mistletoe was common throughout the EP Area; the fruits of many mistletoe species show a range of attributes that are attractive to many animals, as they are large, sweet and conspicuous. Mistletoes are also a valuable foraging resource for the threatened Regent Honeyeater (*Anthochaera phrygia*; BC Act: Critically Endangered; EPBC Act: Critically Endangered) and Little Lorikeet (*Glossopsitta pusilla*; BC Act: Vulnerable).

4.2.3.6.5 Aquatic Habitats

There are several mapped first and second order creek lines and a third order creek (Genowlan Creek) within the EP Area. All creeks are ephemeral and flow into the main tributary of Genowlan Creek then on into the Capertee River. These habitats may offer habitat to threatened frogs such as the threatened *Mixophyes iteratus* (Giant Barred Frog, BC Act: Endangered, EPBC Act Vulnerable), BC Act: Endangered, EPBC Act: Endangered) and *Pseudophryne australis* (Red-crowned Toadlet, BC Act: Vulnerable) and Giant Burrowing Frog (*Heleioporus australiacus*, BC Act: Vulnerable, EPBC Act: Vulnerable).

Further discussion on aquatic ecology is provided in **Section 4.2.6**.

4.2.3.6.6 Allocasuarina species

The Glossy Black-Cockatoo (BC Act: Vulnerable) has a restrictive diet and feed only on the seeds in cones of She-oak (i.e. *Casuarina* and *Allocasuarina* spp). She-oak, specifically *Allocasuarina littoralis* (Black She-oak) and *Allocasuarina nana* (Dwarf She-oak) are widespread within the EP Area. *Allocasuarina* spp. are a specialist foraging resource for the Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable) which feeds solely on the seed cones on this genus. It is these discarded cones (termed 'orts') that can be used to quantify the amount of time that Glossy-Black Cockatoos spend foraging in stands of She-oaks and estimate foraging periods (RPS 20223a).

4.2.3.6.7 EP Area Koala Feed Trees

The EP Area is located within the Central and Southern Tablelands Koala management area within (State Environmental Planning Policy [Biodiversity and Conservation] 2021). Several key Koala feed trees for this management area occur within the EP Area across all the PCTs present, with the exception of PCT 3731 heath community. Trees preferred by the Koala that are present on site include:

- *Eucalyptus blakelyi* (Blakely's Redgum);
- *Eucalyptus cannonii* (Capertee Stringybark);
- *Eucalyptus cypellocarpa* (Monkey Gum);
- *Eucalyptus fastigata* (Brown Barrel);
- *Eucalyptus macrorhyncha* (Red Stringybark);
- *Eucalyptus piperita* (Sydney Peppermint);
- *Eucalyptus polyanthemos* (Red Box); and
- *Eucalyptus punctata* (Grey Gum).

4.2.4 Hydrology

Airly Mine lies within the Capertee River catchment, which is part of the Greater Hawkesbury/Nepean catchment. The Capertee River flows in a south-east direction to its confluence with the Wolgan River to form the Colo River, which ultimately contributes to the Hawkesbury River and Broken Bay.

The following four major creek systems are located within the Airly Mine Lease Area:

- Airly Creek;
- Emu Swamp Creek;
- Gap-Genowlan Creek; and
- Torbane-Oaky Creek.

All of the watercourses draining the Airly Mine site area are ephemeral. Generally, these watercourses flow for relatively brief periods following significant rainfall events. Flows within Airly Creek, Oaky Creek, Coco Creek and Genowlan Creek become perennial outside the site boundary.

4.2.5 Surface water monitoring

Surface water and aquatic ecology baseline assessments and monitoring has been undertaken within waterways in the Airly Mine Lease Area biannually since spring 2015 as per Section 5.4.2 of the Water Management Plan (GHD 2018).

Surface water monitoring includes water quality, flow and aquatic ecology (GHD 2020). Monitoring sites and types are summarised below in **Table 4-7**.

Table 4-7: Surface water monitoring sites (GHD 2020)

Creek System	Monitoring Location	Monitoring type
Airly Creek	Airly Creek Upstream	- Water quality - Aquatic Ecology
	Airly Creek	Aquatic Ecology
	Dog Trap Creek	Aquatic Ecology
Gap-Genowlan Creek	Gap Creek	- Water quality - Flow - Aquatic Ecology
	The Grotto	Water quality
	Genowlan Creek	- Flow - Aquatic Ecology
	Genowlan Creek 2	- Water quality - Aquatic Ecology
Torban-Oaky Creek	Torban Creek	Aquatic Ecology

4.2.6 Aquatic ecology monitoring

Aquatic ecology monitoring has involved biannual assessment of seven sites across the Airly Mine Lease Area. Macroinvertebrate, water and sediment samples have been collected from biannually where sufficient water was present. Instream habitat surveys have also undertaken noting the condition of the riparian zone and instream vegetation.

Overall, the aquatic habitat in Genowlan Creek was determined to be in the best condition (GHD 2018). The combination of low nutrient and metal concentrations and diverse habitat availability at the site supports a diverse macroinvertebrate community which is largely sensitive to pollution. The macroinvertebrate communities at The Grotto and Gap Creek monitoring sites also contain pollution sensitive trace and there is little disturbance related to human activities at these sites.

Airly Creek, Torban Creek and Dog Trap Creek were more highly disturbed by grazing and agricultural land use. Monitoring sites in these catchments were dominated by pollution dominant taxa. The similarity of the macroinvertebrate communities in the Airly Creek sites upstream and downstream of the surface facilities area indicated that there was no impairment of the community at the downstream site associate within overland flows from Airly Mine (GHD 2018).

The most recent aquatic ecology monitoring (GHD 2020) has found that there was no evidence of impacts on water quality, sediment quality, macroinvertebrate communities or instream habitat due to mining operations

in 2020. Airly Creek impact site contained similar water quality and macroinvertebrate communities to Airly Creek background site and baseline sites Torbane Creek and Dog Trap Creek, reflecting the influence of surrounding land use (i.e. grazing and agriculture) and underlying geology on water quality, and limited instream habitats. Improved macroinvertebrate condition was observed at upland baseline sites on Genowlan Creek which reflects the minimal anthropogenic disturbance, and generally improved water, sediment and instream habitat quality, relative to the lowland sites.

4.2.6.1 Stygofauna Baseline

Stygofauna samples were collected from three bores over four sampling events between May 2013 and June 2014. Additional monitoring was undertaken in March and December 2016 and February and August 2017. Additional post-EIS monitoring was undertaken in March and December 2016, February and August 2017, November 2018, April 2019 and October 2020. Stygofauna have been collected in low densities and diversity during stygofauna monitoring conducted between 2018 and 2021 (GHD 2018, 2020, 2021).

5 BIODIVERSITY MONITORING PROGRAM

5.1 Terrestrial Ecology

5.1.1 Current Biodiversity Monitoring

A **broadscale Biodiversity Monitoring Program** is currently being undertaken at Airly within the **Development Consent Area (SSD_5581)** as per the Western Region Biodiversity Management Plan – Appendix B Airly (Centennial 2019a) required by consent condition 15, Schedule 4.

The broader monitoring program within the Mining Lease Area **includes the current EP Area (CLZ ML1814)**. The monitoring program commenced in 2012 by the University of Queensland (UQ) and was further developed and refined in 2015 by RPS whereby it has been carried out annually by RPS to present. The monitoring program has been conducted in line with the Development Consent (SSD-5581) except for the areas which have restricted access and are being monitored by NSW National Parks and Wildlife Service (NPWS) (*Pultenaea sp.* Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland Endangered Ecological Community (EEC).

The current Biodiversity Monitoring Program has been reviewed and updated within the context for the current EP Area (CLZ) taking into consideration previous and recent monitoring results (RPS 2023b) and recommendations. This allows for the wealth of information obtained from previous monitoring efforts to be integrated into the baseline data and design.

Currently, the monitoring program includes the following (RPS 2023b):

Flora

- Eighteen permanent 50 m transects incorporating a 5 x 5 m floristic plot for *Prostanthera stricta*;
- Tree health assessment for 28 individual *Eucalyptus cannonii* noting tree condition, tree size and contextual data;
- Four Biodiversity Assessment Method (BAM) plots to assess vegetation condition and species richness within *White Box – Yellow Box – Blakely's Red Gum Woodland* Endangered Ecological Community (CEEC); and
- Ten BAM Plots and five rapid aquatic assessments modified from the Australian River Assessment System (AUSRIVAS) methodology to monitor facultative GDE's vegetation condition and stream health.
- An additional vegetation monitoring plot is also proposed to be installed further downstream of the Oasis to measure changes in cover of each stratum (tree, shrub, forb and grass cover etc.).

Monitoring and management measures for *Pultenaea sp.* Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland EEC is being undertaken by NPWS.

Fauna

- Assessment of permanent survey sites within suitable habitat dominated by *Allocasuarina littoralis* to assess the percentage cover of *Allocasuarina* species, presence of chewed orts and presence of the Glossy Black- Cockatoo (*Calyptorhynchus lathami*);
- Assessment of known owl roosts (pellet presence), call playback, songmeter or targeted call playback and spotlighting for large forest owls and Koalas;
- 30-minute surveys across permanent transects across the Lease Area and opportunistic surveys targeting threatened diurnal bird species known to occur;

- Targeted surveys via echolocation recording apparatus (Anabat) at ten foraging/roosting sites and flyways of cave-dwelling microbats;
- Targeted trapping surveys, remote cameras and opportunistic sightings in suitable habitats for other targeted species [Spotted-tailed Quoll (*Dasyurus maculatus*), Broad-headed Snakes (*Hoplocephalus bungaroides*), Rosenberg's Goanna (*Varanus rosenbergi*) and Koalas (*Phascolarctos cinereus*)];
- Opportunistic surveys of all terrestrial vertebrates; and
- Camera trapping and opportunistic sightings for feral species.

5.1.2 Monitoring Design

The principles of a Before-After-Control-Impact (BACI) monitoring design were applied in the initial UQ monitoring program (UQ 2014). In a BACI design, data is simultaneously collected at 'impact' and 'control' sites, before and after an impact occurs, thus establishing a comparative quantitative dataset suitable for determining causation where significant change is detected within an 'impact site'.

However, for reasons relating to monitoring site placement, all the 'control' sites are located within the Development Consent Area (SSD_5581) have progressively transitioned into 'impact' sites as new miniwalls were established. This is more akin to a Before-After monitoring framework. Such a framework is capable of detecting change however is insufficiently robust to identify causation (i.e. is change related to bushfire, rainfall, drought or from originating from operational activities).

5.1.2.1 Monitoring Design Corrections

Additional control sites are required to maintain the BACI monitoring model as originally intended (UQ 2014). A number of control and impacts sites were added during the 2022 seasonal monitoring (RPS 2023b) to improve the reliability of monitoring analysis (i.e. increased power in statistical analysis), therefore a minimum of two transects for *Prostanthera stricta* have been installed within each EP Area.

Monitoring methodologies have been updated in-line with the advancement of technologies where feasible, practical and flexible. For example, previously, surveys for forest owls have been conducted by means of active searches for evidence of recent activity. However, this can be enhanced by the deployment of song meters which would reduce the effect of error, observer bias and allow for increased consistency between years. As a wide range of fauna species use vocalizations for a variety of vital functions, the use of bioacoustics can be applied across different groups of fauna proving it versatile methodology (e.g. low cost surveys for the koala and frog species).

5.1.3 Monitoring Program

A summary of the biodiversity values relevant to this EP Area is provided in **Section 4**. Key biodiversity values are to be monitored at both 'impact' and 'control' sites across the Development Consent Area and EP Area annually prior to, during and after impact.

To date, monitoring performed within the EP Area is considered baseline monitoring as underground mining is yet to commence. **Table 5-1** describes the monitoring stratification, parameters and frequency for each biodiversity value within the broader Airly Development Consent Area and within the EP Area. Refer to **Figure 5.1**, **Figure 5.2** and **Figure 5.3** for monitoring locations.

Table 5-1: Biodiversity Monitoring Program – Terrestrial Biodiversity

Biodiversity Value	Repetition / Site Type	Stratification Location	Method	Timing	Responsibility	EP Area
Vegetation Communities						
White Box – Yellow Box – Blakey’s Red Gum Woodland CEEC	Four sites	Permanently established plots within the CEEC within the Airly Development Consent Area	BAM Plot survey to assess vegetation condition and presence of exotic species.	Annually in Spring/Summer	Centennial Airly Ecologist	Site specific (Centennial 2019a); Airly (Centennial 2018; Centennial 2019b)
Genowlan Point <i>Allocasuarina nana</i> Heathland EEC	N/A. Carried out by NSW NPWS	Genowlan Point	N/A. Carried out by NSW NPWS	N/A	NSW NPWS	This EP Area (CLZ ML1814) Site specific (Centennial 2019a); Airly (Centennial 2018; Centennial 2019b)
Facultative GDEs	Ten sites	Permanently established plots in facultative GDEs within the Airly Development Consent Area	Ten BAM Plots and five rapid aquatic assessments	Annually in Spring/Summer	Centennial Airly Ecologist	This EP Area (CLZ ML1814) Pt Hatteras MW 13-16 BMP (Centennial 2021).
Flora						
<i>Prostanthera stricta</i> ¹	Eleven impact and seven control sites	Representative sample of known locations of <i>Prostanthera stricta</i> across the Airly Development Consent Area and EP Area.	Point intercept method and floristic density plots	Annually in Spring/ Summer	Centennial Airly Ecologist	This EP Area (CLZ ML1814) All
<i>Eucalyptus cannonii</i>	28 trees	Representative sample of known locations of <i>Eucalyptus cannonii</i> across the Airly Development Consent Area.	Tree condition, crown extent, growth changes and associated species assessment.	Annually in Spring/Summer	Centennial Airly Ecologist	Site specific (Centennial 2019a); Airly (Centennial 2018; Centennial 2019b); Pt Hatteras MW 13-16 BMP (Centennial 2021)

Biodiversity Value	Repetition / Site Type	Stratification Location	Method	Timing	Responsibility	EP Area
<i>Pultenaea sp.</i> <i>Genowlan Point</i>	N/A. Carried out by NSW NPWS	Genowlan Point	N/A. Carried out by NSW NPWS	N/A	NSW NPWS	This EP Area (CLZ ML1814) Site specific (Centennial 2019a);
Fauna						
Birds	Six Glossy-black Cockatoo sites	Areas of She-oak (<i>Casuarina spp.</i> and <i>Allocasuarina spp.</i> , but specifically <i>Allocasuarina littoralis</i>) across the Airly Development Consent Area and EP Area	Percent cover of <i>Allocasuarina</i> species, the presence and quantity of orts and presence of Glossy-black Cockatoos.	Annually in Summer	Centennial Airly Ecologist	This EP Area (CLZ ML1814) All
	Large forest owl sites	Valleys, known roosts and other areas of potential habitat within the Airly Development Consent Area	Assessment of known owl roosts (pellet presence), call playback, songmeter or targeted call playback and spotlighting	Annually in Spring/Summer	Centennial Airly Ecologist	This EP Area (CLZ ML1814) Site specific (Centennial 2019a); Airly (Centennial 2018; Centennial 2019b); Pt Hatteras MW 13-16 BMP (Centennial 2021)
	7 Diurnal bird sites	Across the Airly Development Consent Area	30 minute surveys across permanent transects	Annually in Spring/Summer	Centennial Airly Ecologist	Site specific (Centennial 2019a); Airly (Centennial 2018; Centennial 2019b)
Microbats	10 foraging and/or roost and flyway sites	Foraging and roosting sites and flyways within the Airly Development Consent Area	Anabat units to detect presence of microbat species	Annually in Summer	Centennial Airly Ecologist	This EP Area (CLZ ML1814) All

Biodiversity Value	Repetition / Site Type	Stratification Location	Method	Timing	Responsibility	EP Area
Mammals (excluding microbats) and reptiles	Infrared camera trap sites to conduct: - Vertebrate census - Pest species census	Gully habitats and rock habitats within the Airly Development Consent area and EP Area in conjunction with the reptile census.	Baited stationary infrared cameras to determine presence and count	Annually in Summer	Centennial Airly Ecologist	This EP Area (CLZ ML1814) All
	Koala sites (in conjunction with the Large Forest Owl sites)	Valleys and other areas of potential habitat within the Airly Development Consent Area in conjunction with Large Forest Owl census.	Stationary song meter installation to determine presence	Annually in Summer	Centennial Airly Ecologist	This EP Area (CLZ ML1814) Site specific (Centennial 2019a); Airly (Centennial 2018; Centennial 2019b); Pt Hatteras MW 13-16 BMP (Centennial 2021)
	Gliders - Greater Glider and Squirrel Glider	Valleys and other areas of potential habitat within the Airly Development Consent Area in conjunction with Large Forest Owl census.	Targeted call-playback/spotlighting	Annually in Summer	Centennial Airly Ecologist	This EP Area (CLZ ML1814) Site specific (Centennial 2019a); Airly (Centennial 2018; Centennial 2019b)

Shaded rows are directly associated with this CLZ (ML1814) BMP, whilst the non-shaded rows occur as part of the specific Airly Biodiversity Management Plan (RPS 2017a).

Figure 5.1: Vegetation Monitoring

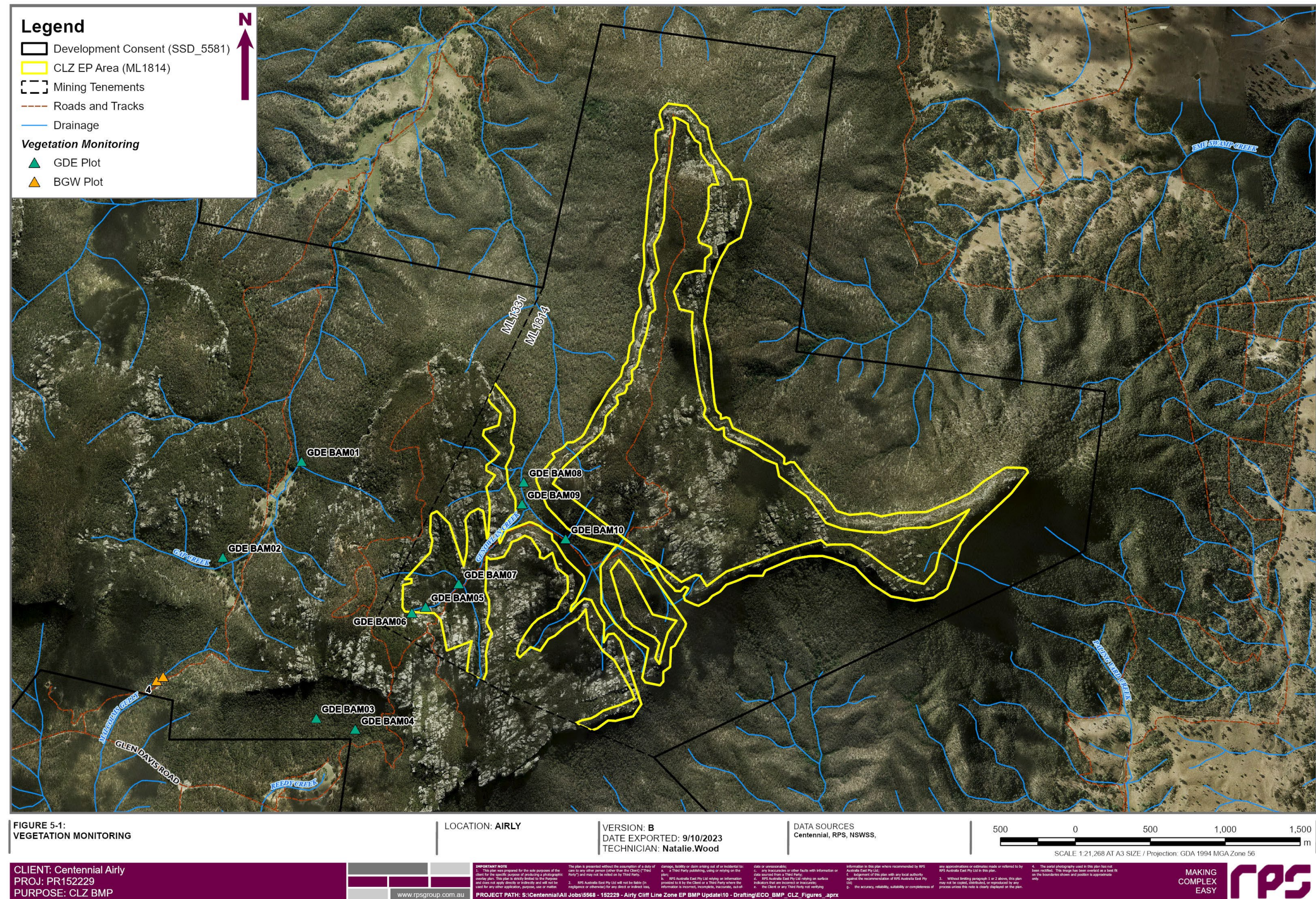


Figure 5.2: Flora Monitoring Locations

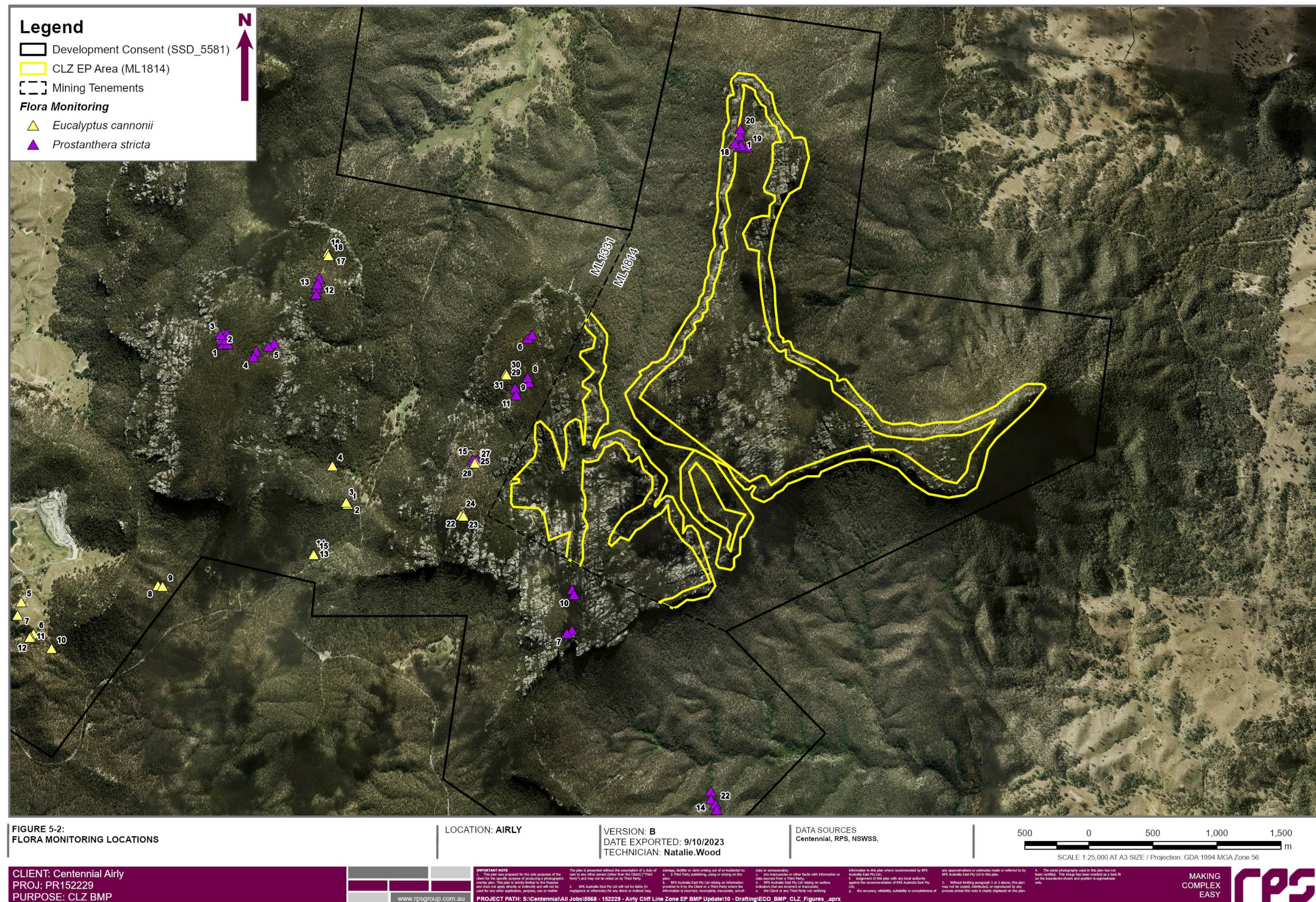
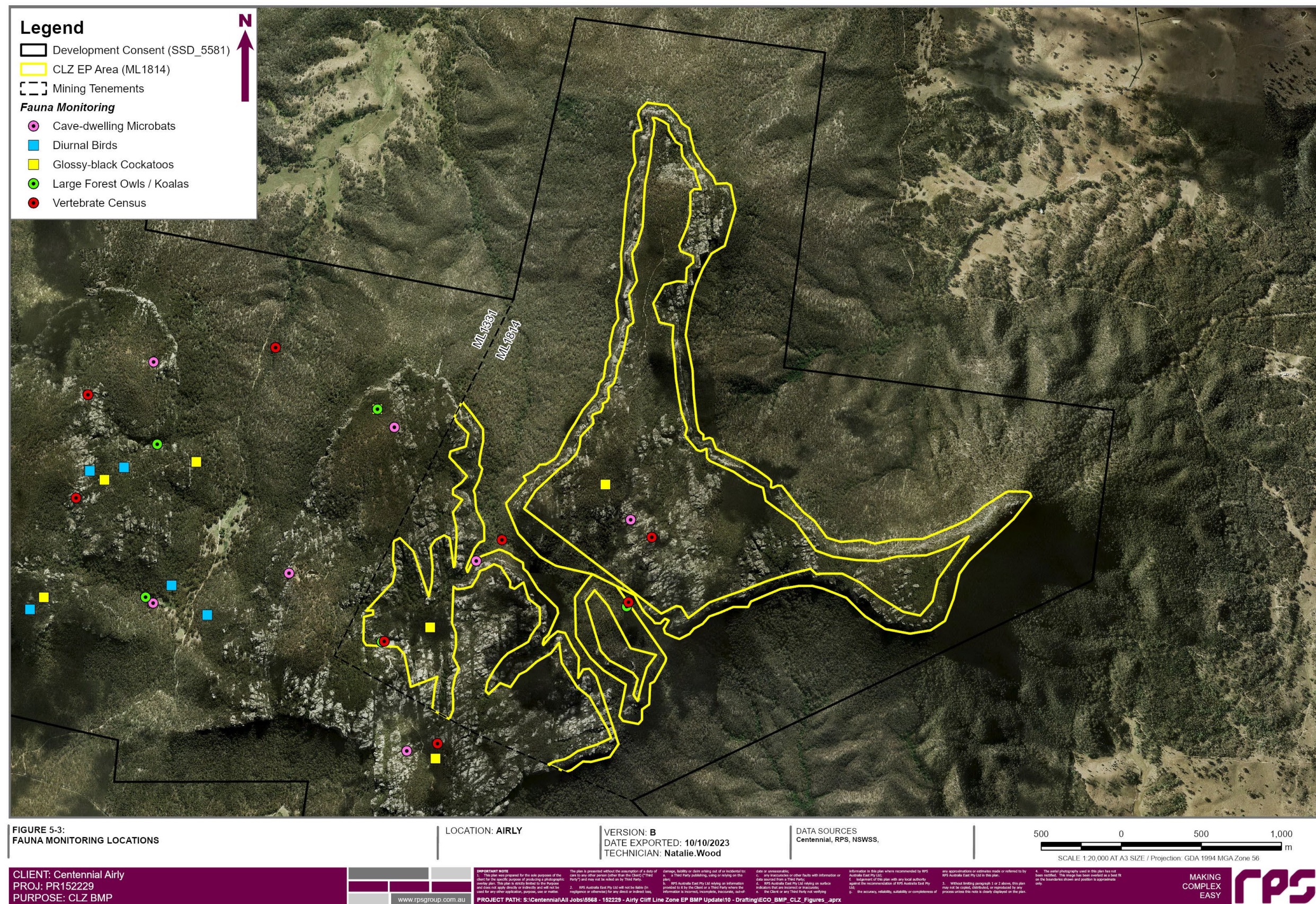


Figure 5.3: Fauna Monitoring Locations



5.1.4 Monitoring Methods

5.1.4.1 Vegetation Communities

NSW National Parks and Wildlife Service (NPWS) are responsible for the monitoring of Genowlan Point *Allocasuarina nana* Heathland Endangered Ecological Community (EEC). Monitoring of White Box – Yellow Box – Blakey’s Red Gum Woodland CEEC is undertaken as per the broadscale Biodiversity Monitoring Program as per the Western Region Biodiversity Management Plan – Appendix B Airly (Centennial 2019a).

‘Facultative’ GDEs occurring within the EP Area are monitored using both BAM plots (i.e. measuring flora composition, vegetation structure and ecological function as defined by the BAM 2020) and a rapid aquatic assessment modified from the Australian River Assessment System (AUSRIVAS) methodology. Ten GDE BAM plots and five rapid aquatic assessments have been established at the base of Pt Hatteras (control) and the Grotto to establish baseline and gather repeated monitoring data.

5.1.4.2 Flora

NSW National Parks and Wildlife Service (NPWS) are responsible for the monitoring of *Pultenaea* sp. *Genowlan Point*. Monitoring of *Eucalyptus cannonii* is monitored as per the broadscale Biodiversity Monitoring Program as per the Western Region Biodiversity Management Plan – Appendix B Airly (Centennial 2019a).

5.1.4.2.1 *Prostanthera Stricta* (Mount Vincent Mint-bush)

P. stricta is monitored using 50 m long point intercept transects located across the management area. Start and end points coordinates are staked out and these coordinates are accurately recorded using a differential GPS unit.

The point intercept method is used to determine the density of *P. stricta* populations across 18 50 m transects, including 16 impact and two control sites. Any section of *P. stricta* seen to be overhanging or underneath the transect lines is measured to the nearest 5 mm. (Elzinga et al, 2001). Once transect point data is recorded, a percentage cover score is calculated for each transect. Additionally, floristic data within 5 x 5 m plots is also collected. These plots are carried out at the start of each transect with the aim to record all vascular flora present at the time of the survey.

5.1.4.3 Fauna

During all other monitoring events, all vertebrate fauna species observed or heard opportunistically were recorded.

5.1.4.3.1 Birds

5.1.4.3.1.1 Glossy Black-Cockatoos

Monitoring for evidence of Glossy Black-Cockatoos was undertaken in February and December 2022. Glossy Black-Cockatoos have a particular diet and feed only on the seeds in cones of She-oaks (*Casuarina* and *Allocasuarina* sp., but specifically *Allocasuarina littoralis* (Black She-oak) within the Airly mining lease. Those cones, referred to as ‘orts’ are then discarded, leaving evidence of Glossy Black- Cockatoo activity. The orts can thus be used to detect recent activity of Glossy Black-Cockatoos in the locality.

Monitoring involves surveying for the presence of chewed orts within six 50 x 50 m stands of *Allocasuarina littoralis* in order to determine recent utilisation of the habitat as shown in Figure 2 3. Attributes measured within each 50 m² search area include:

- Per cent canopy cover;
- Per cent *Allocasuarina* species cover;
- Presence of orts; and
- Presence of Glossy black-cockatoos.

Additionally, if any Glossy-Black Cockatoo individuals were observed outside of these plots they are recorded by GPS location and photos are taken where practicable.

5.1.4.3.1.2 Diurnal Birds

Threatened bird monitoring is undertaken as per the broadscale Biodiversity Monitoring Program as per the Western Region Biodiversity Management Plan – Appendix B Airly (Centennial 2019a). As no change in bird species diversity has been detected (RPS 2023b), no additional bird monitoring transects are proposed for this **CLZ (ML1814) BMP**.

5.1.4.3.2 Microbats

Deployment of Anabat detectors to be used to record ultrasonic bat calls of targeted cave-dwelling bats that are known to occur in specific habitat types within the Airly Development Consent Area to detect the presence/absence of threatened microbat species. two anabat detectors are located within this EP Area.

5.1.4.3.3 Mammals (excluding microbats) and reptiles

Deployment of baited stationary infrared cameras over the monitoring period across both gully and rocky habitats to target threatened mammals, threatened reptiles and pest species.

5.1.4.4 Finalisation of Monitoring

Finalisation of monitoring activities is not currently specified. Adaptive management allows for the review of the monitoring program as per the Consent Conditions. Reporting for the broader monitoring program will remain relevant to this BMP until the completion of potential subsidence movements and effects, as referred to in the EP-Subsidence Monitoring Program (EP-SMP).

5.2 Aquatic Ecology

5.2.1 Aquatic Ecology Monitoring Program

Aquatic Ecology monitoring is undertaken in accordance with Section 4.5.2 of the Water Management Plan (GHD 2021), which has been developed in consultation with key agencies including the Commonwealth DCCEW, NSW Environment Protection Authority (EPA) and the NSW Department of Primary Industries – Water (DPI Water). Monitoring requirements outlined by GHD (2021) are summarised below.

Aquatic ecology monitoring occurs biannually in spring and autumn at the locations shown in **Figure 5.4** (GHD 2020) and listed in **Table 5-2**.

Table 5-2: Aquatic Ecology monitoring sites

Site name	Monitoring type	Latitude	Longitude	Altitude (m AHD)
Dop Trap Creek	Aquatic ecology	33.13475°	150.11087°	401
Gap Creek	Water quality, flow and aquatic ecology	-33.09753°	150.04483°	701
Genowlan Creek	Flow and aquatic ecology	-33.10456°	150.06123°	827
Genowlan Creek 2	Water quality and aquatic ecology	-33.10860°	150.05760°	890
Torbane Creek	Aquatic ecology	-33.08764°	150.00706°	666
Airly Creek Upstream	Water quality and aquatic ecology	-33.11967°	150.00018°	715
Airly Creek	Water quality and aquatic ecology	-33.12286°	150.00262°	714

Aquatic ecology monitoring methodology include:

- Sampling, sorting and identification of macroinvertebrates, associated with pool edge habitat in accordance with the Australian Rivers Assessment System (AUSRIVAS) protocols (Turak. et al. 2004);
- Assessment of the condition of the aquatic habitat using modified NSW AUSRIVAS field sheets and riparian, channel and environmental inventory;
- Measurements of DO, EXC, pH, temperature and turbidity just below the surface of the water column and at depth where sufficient water is available; and
- Collection of surface water and sediment grab samples for water and sediment quality analysis.

Further detail of the aquatic ecology monitoring methodology and regional sampling extent is provided in the Western Region Biodiversity Monitoring Program and Water Management Plan (GHD 2021).

5.2.2 Stygofauna Monitoring Program

Monitoring of stygofauna is undertaken in accordance with Section 4.4.3 of the Water Management Plan (GHD 2021) and is summarised below.

Monitoring occurs biannually in spring and autumn at groundwater bores ARP05, ARP09, ARP14, ARP15SP and ARP11 (GHD 2021) as displayed in **Figure 5.4** as per the Water Management Plan (GHD 2021). Two water monitoring locations occur with the EP Area; Genowlan Creek and Genowlan Creek 2. Stygofauna monitoring methodology includes:

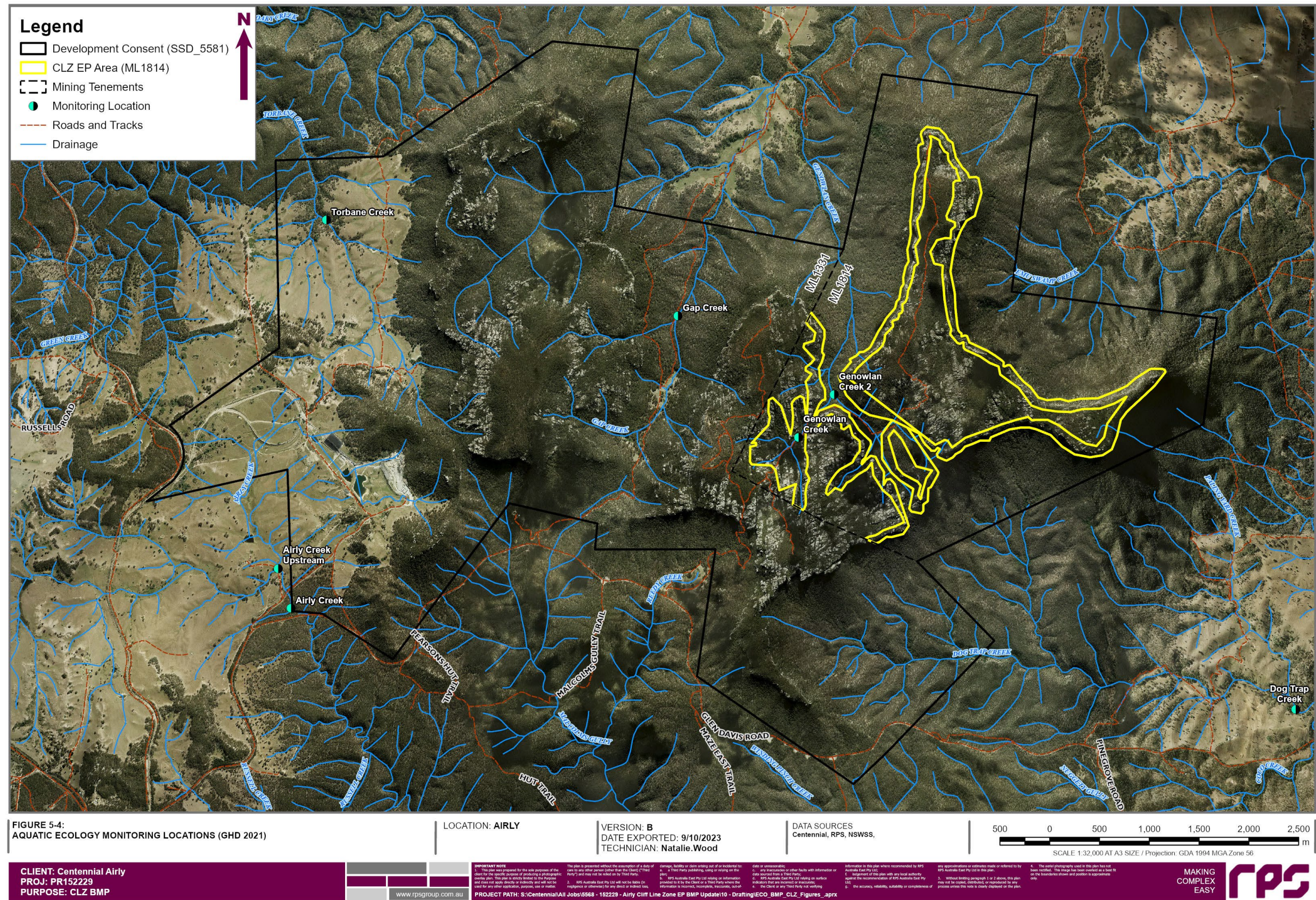
- Measurement of groundwater quality parameters including alkalinity, DO, EC, pH, temperature and turbidity.
- Sampling of groundwater bores and identification of stygofauna in accordance with guidelines by WA EPA (2007; 2013).

Monitoring is considered baseline at potentially affected locations until the commencement of underground mining within the EP Area whereby it then becomes impact monitoring. Further detail of the stygofauna monitoring methodology and regional sampling extent is provided in the Western Region Stygofauna Monitoring and Assessment Plan.

5.3 Baseline Monitoring

Baseline monitoring of natural features as they relate to biodiversity within the EP Area has commenced in 2022 and 2023, as reported in Baseline Biodiversity Report CLZ (ML1814) EP Area and CLZ (ML1814) EP Area and Airly BMP Seasonal Ecological Monitoring (RPS 2023a; RPS 2023b) using a combination of the methods in **Section 5.1**. This EP Area is considered to be in baseline until mining commencing, in which subsequent years of monitoring will form the baseline dataset for statistical analysis. See baseline reports in **Appendix A: Baseline Monitoring**

Figure 5.4. Aquatic Ecology Monitoring Locations (GHD 2021)



6 MANAGEMENT, MITIGATION, REMEDIATION AND REPORTING MEASURES

6.1 Performance Measures and Indicators

The approved subsidence impact performance measures are specified under Condition 2 in Schedule 3 of SSD_5581. The performance measures relating to potential subsidence impacts (as they relate to this CLZ (ML1814) BMP) are outlined in **Table 6.1**⁵.

Table 6.1: Relevant Subsidence Impact Performance Measures for Biodiversity

Biodiversity	Performance Measure	Performance Indicator	Applicability to this EP Area
Threatened species and their habitats, and Groundwater Dependent Ecosystems (GDEs), with the exception of those listed below	Negligible environmental consequences	Presence/absence of mine-induced damage or change to habitat or species present	Applicable
<i>Pultenaea</i> sp. Genowlan Point population and Genowlan Point <i>Allocasurina nana</i> Heathland community	No environmental consequences	Presence/absence of mine-induced damage or change to habitat or species present	Applicable

Additional internal performance measures set by Centennial Airly for the mine design (to be monitored by the underground components of the Subsidence Monitoring Program) are and have been reflected within the CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

To establish compliance with the performance measures, Airly Mine has developed a monitoring program with several integrated components detailed in the CLZ (ML1814) SMP (Appendix 6 of the EP Main Report) (see **Section 4**) and an associated CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

These documents establish appropriate monitoring elements, parameters, and associated trigger levels to demonstrate that the environmental performance satisfies the criteria in Section 5.1 of the EP Main Report.

Table 6.2 contains the performance indicators which have been established for key monitoring aspects with allocated trigger values to define the following key performance scenarios within the CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

Table 6.2: Performance Indicators & TARP Risk Management Scenarios

Performance Indicator	General Description	Action / Response
Level 1: Condition Green	Operations within predictions, and within approved impacts.	Continued operations and monitoring as normal.
Level 2: Condition Amber	Operations within approved impacts but potentially exceed / exceed predictions.	Review and investigation processes are engaged, with adaptive management as required.
Level 3: Condition Red	Operations exceed approved impact. <i>The approved Performance Measures (criteria thresholds) of Development Consent (and any other relevant approvals) are listed in Condition Red.</i>	Adaptive Management measures are fully engaged as per the TARP and relevant sections of the Extraction Plan and the SMP.

⁵ extracts from Table 1, under Condition 2 in Schedule 3 of SSD_5581

6.2 Management and Mitigation Measures

As described in **Section 3.2**, the predicted subsidence levels in the EP Area are minimal and well below levels expected to cause damage or any adverse impacts on the natural features.

The *CLZ (ML1814) risk assessment (Section 2.2)* determined that the risk of impact for biodiversity features was **low to significant**. There are two main management aspects of this *CLZ (ML1814) BMP*, including:

- Mine design to avoid impacts (**Sections 3.1 and 3.2**);
 - The primary management strategy being implemented is impact avoidance through the implementation of a conservative mine design. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement,
 - The mine design has been changed to avoid mining directly beneath the *Pultenaea* sp. Genowlan Point population and Genowlan Point *Allocasurina nana* Heathland community, and
- Monitoring and management measures (**Sections 4.1 and 4.2**).
 - Monitoring to ensure the mine design is strictly implemented as designed through underground mining controls and monitoring of key landscape features for change (particularly cliffs and pagodas) will be undertaken to confirm that the mine design measures to prevent impact are adequate and remain within consent.

Airly mine has committed to the following monitoring and management measures, as they relate to biodiversity in the EP Area, including:

- Develop an Integrated Subsidence Monitoring Program that will provide data for trend analysis, that will inform adaptive management if required (**Section 6.2** (for further details refer to Section 4 of the EP Main Report and CLZ (ML1814) SMP (Appendix 6);
- Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.

It is expected with the above controls in place, the subsidence performance measures for biodiversity will be achieved. Notwithstanding this, appropriate responses have been conservatively developed for unexpected/higher than predicted subsidence within a **Master Trigger Action Response Plan (TARP)** developed for the Extraction Plan and this *CLZ (ML1814) BMP*.

6.3 Remediation and Rehabilitation Measures

Due to the minimal subsidence expected the need to implement remediation/rehabilitation measures for potential impacts are considered unlikely. However, if remediation is required, Airly Mine will undertake remediation in accordance with:

- Conditions 7a)-7c) in Schedule 6 of SSD_5581, noting the requirement to submit a report to NSW Planning describing remediation options and any preferred remediation measures or other course of action;
- Any relevant actions prescribed in the *CLZ (ML1814) TARP* developed for the Extraction Plan;
- The current Rehabilitation Management Plan; and

- In consultation with key stakeholders including any affected land holders and relevant government agencies.

A Response Strategy will be adopted if a significant impact is detected as a result of mining activities within the Extraction Plan area.

6.4 Trigger Action Response Plan

A detailed *CLZ (ML1814) TARP* (Appendix 7 of the EP Main Report) has been developed for the Extraction Plan to reflect the commitments of this CLZ (ML1814) BMP and other related aspects. Whilst impacts are not predicted nor expected, the *CLZ (ML1814) TARP* provides a process of tiered and/or escalating trigger levels for contingency measures should subsidence and impacts be greater than predicted/approved. The *CLZ (ML1814) TARP* applies only to the EP Area (separate TARPs apply to other established EP Areas in various approved mining zones).

Given the mine has been designed specifically to avoid impacts, the *CLZ (ML1814) TARP* includes detailed measures for Underground Mining Controls to ensure that the mining geometry is formed as per the approved design specifications that determine the predicted subsidence movements and impacts.

The *CLZ (ML1814) TARP* includes detailed performance indicators for biodiversity management. The contingency plan where a performance indicator has been exceeded is outlined in the TARP. A trigger will result in additional investigations to determine if the exceedance is related to non-mining-factors or is a consequence of mining activity. The response to these exceedances will follow the TARP. Management / corrective actions can be implemented where required to remedy these non-conformities and report accordingly.

6.5 Adaptive Management and Contingency Planning

An Adaptive Management Framework provides for flexible decision making, adjusted to consider uncertainties as management outcomes are understood. The adaptive management approach at Airly Mine is detailed in the EP Main Report (*refer Section 5.2*).

In summary, adaptive management at Airly Mine involves monitoring and evaluation against performance measures and associated indicators in the *CLZ (ML1814) TARP* established for the extraction plan and supporting management plans. Where performance indicators indicate increasing levels of risk (i.e., where relevant thresholds of conditions green, amber or red are being exceeded), escalating adaptive management measures are engaged in accordance with the *CLZ (ML1814) TARP*. The process has been successfully implemented in existing Extraction Plan areas at Airly Mine and has been updated to reflect EIS commitments and consent requirements for the Airly Mine Extension Project, including specific performance measures.

6.6 Incidents, Complaints, Exceedances and Non-Compliances

Incidents, complaints, exceedances and non-compliances are managed accordance with the requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, relevant legislation and regulations, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). Additionally, high potential incident notifications for unexpected subsidence events in relation to the safety of other persons under WHS legislation has also been included. A detailed review of the notification requirements relevant to the Extraction Plan, including this *CLZ (ML1814) BMP*, is provided in the EP Main Report (*refer Section 5.7.1*), including requirements for:

- Incident or non-compliance reporting in accordance with:

- Condition 9 (Incident Reporting) in Schedule 6 of SSD_5581.
 - EPBC 2013/7076 Condition 1, or as triggered by the TARP (reporting incidents under Management Plans as per Condition 2(g) in Schedule 6 of SSD_5581).
 - EPL12374 condition R2
 - WHS Regulation (Mines and Petroleum Sites, 2022) Section 124 - Duty to notify regulator of certain incidents
 - Section 6 of the Guidelines for Managing Risks of Subsidence (WHS (Mines and Petroleum Sites), February 2017
- Managing complaints.

Incidents, complaints, exceedances and non-compliances will be managed in accordance with the requirements detailed in the EP Main Report (*refer Section 5.6*).

6.7 Reporting and Auditing

6.7.1 Reporting

Reporting is undertaken in accordance with the requirements of specific requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). A detailed review of the reporting and notification requirements relevant to the Extraction Plan, including this CLZ (ML1814) BMP, is provided in the EP Main Report (*refer Section 5.7.1*, including requirements for:

- Regular reporting of impacts and environmental monitoring results in accordance with Condition 10 in Schedule 6 of SSD_5581;
- Annual reporting required in accordance with Condition 11 in Schedule 6 of SSD_5581 and separately under EPBC 2013 / 7076;

Reporting and notifications will be undertaken in accordance with the requirements detailed in the EP Main Report (*refer Section 5.7.1*).

6.7.2 Periodic Auditing

Comprehensive Independent Environmental Audits of the entire approved development under development consent SSD_5581 are undertaken within 1 year of commencement and every 3 years thereafter (unless directed otherwise) in accordance with Conditions 12 and 13 in Schedule 6 of SSD_5581.

Auditing of any rehabilitation undertaken for the mine (including for subsidence if triggered) is undertaken in accordance with the Rehabilitation Management Plan under Condition 27 in Schedule 4 of SSD_5581.

Additionally, in accordance with section 20(c) of the WHSMP Regulation (2022), auditing will be undertaken in accordance with the Airly Mine Safety Management System (SMS), against the performance standards for measuring the effectiveness of all aspects of the SMS, including the methods, frequency and results of the audit process. The audit should also consider the following matters:

- (1) competency of the auditor,
- (2) the person responsible for ensuring the audit is conducted, and
- (3) the person responsible for implementing the results of the audit.

7 PLAN ADMINISTRATION AND RESPONSIBILITIES

7.1 Review

In accordance with the requirements under Condition 3 in Schedule 6 of SSD_5581, as a minimum Centennial Airly will review this Plan within three months of the following:

- a) Submission of an incident report;
- b) Submission of an Annual Review (required 31 March annually);
- c) Submission of an Independent Environmental Audit; or
- d) Any modification to the conditions of SSD_5581.

Where this leads to revisions of the document, within four (4) weeks of the review the revised document must be submitted to NSW Planning for the approval of the Secretary. Continual improvement shall be achieved through monitoring, internal and external communication with stakeholders, implementation of corrective and preventative actions and through monitoring progress against the objectives included in the environmental management plans. The reporting framework (refer **Section 6.7**) will document the effectiveness of this document (and the related Extraction Plan) through comparison of the predicted negligible impacts of subsidence against actual outcomes.

Each variation to this Plan will be identified in the Document Control Table at the beginning of this document.

Additionally, to maintain consistency with existing management plans and previous Extraction Plans at the mine, this CLZ (ML1814) BMP will also be reviewed in the event that the following occur:

- Stakeholders raise issues that necessitate a review;
- There are other changes to management requirements (e.g. changes to other related approvals besides consent, such as Mining Lease and/or EPL conditions);
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan;
- Monitoring or audit processes demonstrate that a review is warranted;
- Where otherwise triggered by the CLZ (ML1814) TARP;
- Where triggered by (or for) review of other related management plans (if applicable); or
- Every three (3) years as a minimum (where not already triggered above).

Any amendments to the CLZ (ML1814) BMP will be undertaken in accordance with Consent/relevant approvals and in consultation with key relevant stakeholders where required. Following any significant changes, a copy of the amended CLZ (ML1814) BMP will be forwarded to all relevant stakeholders.

In addition to planning development consent requirements, Airly Mine must review and as necessary revise the risk control measures implemented for subsidence in accordance with section 20 of the *WHSMP Regulation (2022)*. Any review triggered by WHS Legislation Requirements will be addressed via the process identified in the EP Main Report (*refer Section 5.5*) and the CLZ (ML1814) PSMP (Appendix 5 of the EP Main Report).

7.2 Key Responsibilities

The responsibility for implementation, monitoring and review of the CLZ (ML1814) BMP lies with the Superintendent Environment and Community. The ultimate responsibility for the implementation of the CLZ (ML1814) BMP lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for this CLZ (ML1814) BMP are outlined in **Table 7.1**.

Table 7.1: Key Personnel and Accountabilities

Position	Responsibility
Mine Manager	- Ensuring that sufficient resources are available to implement and execute the requirements of this Plan; and - Reporting triggers/non-conformances to external stakeholders.
Technical Services Manager	- Coordinate underground inspections and subsidence monitoring program associated with this CLZ (ML1814) BMP; - Coordinate implementation of the mine design and CLZ (ML1814) TARP. - Reporting triggers/non-conformances internally to the mine manager as appropriate. - Reporting to NSW Planning and NSW RR of subsidence and pillar system performance upon completion of specified monitoring intervals.
Production Manager	- Implement mine design - Establish and maintain underground monitoring and inspections program; - Auditing as required
Mine Surveyor	- Survey as built initial development pillars - Establish and maintain subsidence monitoring program; - Internal reporting as required. - Mark up centre lines for driveage in pillars - Produce final mining plan for first workings to be carried out in consultation with the Technical Services Manager.
Superintendent Environment and Community	Implementation, monitoring and review of this plan, including: - The carrying out of targeted inspections; - The installation and maintenance of signage where required; - Reporting triggers/non-conformances internally to the Mine Manager as appropriate; - Consulting with land owners, landholders and managers regarding any land management issues arising from subsidence within the EP Area. This includes (but may not be limited to) NPWS, Office of Crown Lands and private landowners within the EP Area (if and as applicable); - Reviewing this CLZ (ML1814) BMP, including consultation during the review process with relevant stakeholders; - Coordinating any remediation work as required; - Inspecting targeted accessible areas susceptible to tensile and compressive strains and potential cracking as required (e.g. accessible tracks and trails); and - Co-ordinating the generation and submission of formal reporting requirements outlined in this Plan.

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- RPS (2022a). *Airly Extraction Plan for the Cliff Line Zone ML1814 and CLZ (ML1814) Extraction Plan Area Historical Heritage Management Plan Update & Phase 1 Baseline Historical Heritage Assessment (Report No. PR152234-1)*
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APPENDIX A: BASELINE MONITORING

AIRLY BMP SEASONAL ECOLOGICAL MONITORING

Flora and Fauna Monitoring Report 2022



5261
V2
07 March 2023

REPORT

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
0	Internal review	Jess Graham			
1	Draft report for client review	Jess Graham and Tara Boreham	Angus McClelland		27/02/2023
2	Final report for client review with updated microbat analysis	Jess Graham and Tara Boreham	Angus McClelland	Tara Boreham	06/03/2023

Approval for issue

Tara Boreham



7 March 2023

This report was prepared by RPS within the terms of RPS' engagement with its client and in direct response to a scope of services. This report is supplied for the sole and specific purpose for use by RPS' client. The report does not account for any changes relating the subject matter of the report, or any legislative or regulatory changes that have occurred since the report was produced and that may affect the report. RPS does not accept any responsibility or liability for loss whatsoever to any third party caused by, related to or arising out of any use or reliance on the report.

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EXECUTIVE SUMMARY

Centennial Airly Pty Ltd (Centennial Airly) operates an approved coal mining lease to extract thermal coal at Airly and Genowlan Mountains, which form part of the Mugii Murum-ban State Conservation Area (SCA). Approval for the Airly Mine is specified under State Significant Development 5581 (SSD-5581).

Biodiversity monitoring throughout the Development Consent Area for SSD-5581 (i.e. the management area) is currently being undertaken in compliance with the Biodiversity Management Plan Western Region (Western Region BMP; Centennial 2019) and relevant Extraction Plan (EP) specific Biodiversity Management Plans (BMPs) required by consent Schedule 4, Condition 15 of SSD-5581.

Areas of biodiversity significance within the management area include *Biodiversity Conservation Act 2016* (BC Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed threatened ecological communities (TECs), Groundwater Dependant Ecosystems (GDEs) and BC Act and EPBC Act threatened species and their habitats, situated within the management area, including:

- TECs:
 - *Allocasuarina nana* Heathland; and
 - White Box – Yellow Box – Blakely's Red Gum Woodland Critically Endangered Ecological Community (CEEC).
- GDEs
 - MU 13: Tableland Gully Ribbon Gum - Blackwood - Apple Box Forest; and
 - MU 21: Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest.
- Threatened flora:
 - *Prostanthera stricta* (Mount Vincent Mint-bush);
 - *Eucalyptus cannonii* (Capertee Stringybark); and
 - *Pultenaea* sp. Genowlan Point.
- Threatened fauna:
 - Glossy-black Cockatoos (*Calyptorhynchus lathamii*);
 - Forest owls;
 - Woodland birds; and
 - Cave-dwelling Microchiropteran bats (microbat).

The monitoring program has been and will continue to be conducted in line with SSD-5581 with the exception of the areas which have restricted access and are being monitored by NSW National Parks and Wildlife Service (NPWS) [i.e. *Pultenaea* sp. Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland].

This annual monitoring addresses the biodiversity-related conditions of consent outlines in SSD-5581. Schedule 3, Condition 2 of the SD-5581 development consent specifies the following performance measures:

1. Gap and Genowlan Creeks: Negligible environmental consequences to water quality and to bed and bank stability; no greater environmental consequences than predicted in the EIS to water flows (including baseflow).
2. The Grotto: Negligible subsidence impacts or environmental consequences.
3. Threatened species, threatened populations, EECs and groundwater dependent ecosystems (with the exception of those listed below): Negligible environmental consequences.
4. *Pultenaea* sp. Genowlan Point population and Genowlan Point *Allocasuarina nana* Heathland community: No environmental consequences.

This monitoring report comprises information pertaining to performance measure three and provides baseline biodiversity data for the performance measures one and two. Performance measure 4 is addressed in a separate monitoring report prepared by National Parks and Wildlife Services (NPWS).

The 2022 monitoring results have displayed that threatened species, threatened populations, EECs and groundwater dependent ecosystems are still persisting in the management area, with negligible environmental consequences. Further discussion is provided below.

White Box – Yellow Box – Blakely's Red Gum Woodland CEEC

The mean native species richness in 2022 has not significantly changed since 2020, however has significantly increased since the 2015 to 2018 monitoring years. Vegetation integrity (VI) scores have been calculated for year 2019 to 2022 in line with the Biodiversity Assessment Method (BAM; DPE 2020) of which the 2022 structure and VI scores are significantly higher in comparison to 2020.

Groundwater Dependent Ecosystems

Ten GDE plots were established in the 2022 monitoring period to establish baseline condition for future EP BMPs. GDE plots consist of photo monitoring BAM plots and a 50 m rapid aquatic assessment based on a modified form of the Australian River Assessment System (AUSRIVAS) methodology where suitable.

Exotic flora species

A total of 26 exotic species were detected in the management area. This is six more than recorded within the 2021 monitoring period, however ten more monitoring locations were added in the 2022 monitoring period. In the 2022 monitoring period, there has been a reduction of exotic species cover within the BAM plots. BAM plot 1 has the highest weed cover due to a high grass cover of *Phalaris aquatica* within the riparian area. All weed species require management requirements under the *Biosecurity Act 2015*.

Prostanthera stricta

Four additional 50 m monitoring transects were installed, and two were re-established to provide supplementary controls, and for repetition with Extraction Plan BMP areas. Transects were stratified into BMP locations to provide power for statistical analysis as follows:

- Genowlan Point (Control);
- Genowlan Trig (Control);
- Gully (Control);
- Mt Airly (Impact); and
- Pt Hatteras (Impact).

Across all transects, the % cover of *P. stricta* has significantly increased since 2020. At Mt Airly, the % cover of *P. stricta* has significantly increased in 2022, since 2018, 2019, and 2020 which is likely linked to higher than average rainfall patterns and population recovery since the controlled burn across Mount Airly in 2018. The % cover of *P. stricta* at Pt Hatteras has not significantly changed.

Eucalyptus cannonii

A total of 28 *E. cannonii* individuals were monitored of which ten were newly installed for EP specific BMPs. Individual *E. cannonii* trees measured based on tree condition (canopy density and extent %), size (height and diameter) and contextual data. Data was averaged across the population based on the monitoring location of the individuals.

The following significant *E. cannonii* results were identified by the analysis:

- Crown density has not significantly changed since 2016/2017 monitoring years at the Mt Airly population.
- Crown density has significantly increased within the control population since 2016/2017.
- The average crown extent within the Mt Airly population has significantly decreased since 2021.
- No significant variation in height or DBH has been observed across the populations.

Crown density increases may be correlated with higher than average rainfall over the past two years, and the transition into La Nina. It is unclear why crown extent has decreased; however crown extent may not be the most reliable indicator of tree health as it varies with tree age. Generally, as a tree ages, crown extent is likely to be proportionally less, when compared to the size of the tree. Therefore, crown density may be a more reliable indicator of tree health.

Glossy-black Cockatoos (*Calyptorhynchus lathamii*)

Four additional plots were established for EP specific BMPs and photo-monitoring has been established at each location. The presence of Glossy black-cockatoos was confirmed through opportunistic sightings of individuals and the presence of 'orts' at eight separate monitoring locations.

Forest owls

No roost sites displayed evidence of use (i.e. white wash and pellets) and Site 2 remains inaccessible due to landslides. However, a Sooty Owl (*Tyto tenebrosa*; BC Act: Vulnerable) was observed during spotlighting and recorded on songmeter at the base of Mt Airly.

Woodland birds

Five of the 64 bird species recorded are listed as threatened under the BC Act which include Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable; EPBC Act: Endangered), Glossy Black-Cockatoo (*Calyptorhynchus lathamii*; BC Act: Vulnerable; EPBC Act: Vulnerable), Diamond Firetail (*Stagonopleura guttata*; BC Act: Vulnerable) and Speckled Warbler (*Chthonicola sagittata*; BC Act: Vulnerable). The speckled warbler is a new threatened bird species detected within the management area, by means of camera trap. No significant changes were noted in bird species richness, therefore it is deemed that the bird species richness across the management area is stable.

Cave-dwelling microbats

Two of the three target microbat species were detected at a definite confidence level during both spring and summer surveys, being the Eastern Horseshoe-bat (*Rhinolophus megaphyllus*) and the Large-eared Pied-bat (*Chalinolobus dwyeri*; BC Act: Vulnerable; EPBC Act: Vulnerable). Whilst not definite, it is likely that given the high number of calls, and location at a known bat roost, the Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*) is also roosting in the management area. The adits continue to support a maternity colony of Eastern Horseshoe Bats.

Other targeted fauna/vertebrate census

Of the 16 native vertebrate species (excluding birds and microbats) detected during the 2022 monitoring period, one is listed as threatened under the BC Act and/or EPBC Act. Rosenberg's Goanna (*Varanus rosenbergi*; BC Act: Vulnerable) was observed at Point Hatteras for the third year in a row.

Feral species

Four feral fauna species were recorded on camera traps during the 2022 monitoring period including European cattle on one occasion, feral cats on two occasions, feral pigs on two occasions, and European foxes on six occasions. Feral species activity has increased since last year, however no feral dogs were recorded this year.

Centennial Airly actively participate in feral species management strategies (Airly Cat Trapping Program, Local Land Services District Wild Dog Control, engaging third-party feral species control). In 2022 Centennial Airly employed Apex Enviro Solutions to conduct pest control work across Airly Pit Top, Carinya Offset Area and Benrnina. This program resulted in the removal of 81 pigs, one fox and two cats. Pest control is an ongoing recommendation that is upheld by Centennial.

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Appendices

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Appendix D Fauna Species List
Appendix E Bat Call Analysis

1 INTRODUCTION

Centennial Airly Pty Ltd operates an approved coal mining lease to extract thermal coal at Airly and Genowlan Mountains, which form part of the Mugii Murum-ban State Conservation Area (SCA; **Figure 1-1**). Approval for the Airly Mine is specified under State Significant Development 5581 (SSD-5581).

Biodiversity monitoring throughout the Development Consent Area for SSD-5581 (i.e. the management area) is currently being undertaken in compliance with the relevant Biodiversity Management Plans required by consent Schedule 4, Condition 15 of SSD-5581. BMPs relevant to Centennial Airly are summarised in **Table 1-1** and as displayed in **Figure 1-2**.

Table 1-1: Centennial Airly BMPs

BMP	Version/ Date	Baseline Years
Biodiversity Management Plan Western Region (Western Region BMP)	Final v3/ August 2019	2015-2016
Biodiversity Management Plan: Mt Airly Panel and Pillar Zone Extraction Plan (Mt Airly BMP)	Final/ March 2019	2016-2017
Biodiversity Management Plan for Cliff Line Zone of First Workings within ML1331 (ML1331 CLZ BMP)	Final/ January 2018	2015-2016
Biodiversity Management Plan: Pt Hatteras Panel and Pillar Mining Zone Extraction Plan (Pt Hatteras BMP)	Rev 1/ October 2021	2021-2022
Biodiversity Management Plan: MW17-19 Panel & Pillar Mining Zone Extraction Plan (MW17-19 BMP)	Draft/ October 2022	2022-2023
Biodiversity Management Plan for Cliff Line Zone within ML1331 & ML1814 (CLZ ML1814 BMP)	Draft/ TBA	2022-2023

1.1 Management area

The management area is defined as the Airly Mine Consent Boundary, as shown in **Figure 1-1**, and is located on and around the mesas (i.e., isolated escarpments) at Mount Airly and Genowlan Mountain within the Mugii Murum-ban SCA. This area contains a range of habitat types such as dry eucalypt forests, wet forests, gullies and gorges, and heath scrubs on rocky outcrops.

Vegetation communities mapped within the management area include over 365 hectares (ha) of sandstone escarpment and pagoda features (RPS 2014, DEC 2004) identified by the Department of Planning and Environment (DPE) as sensitive to longwall mining subsidence (i.e. potential to destabilise slopes and escarpments, ultimately altering habitat niches). Therefore, monitoring the species that are present, their ecology and natural variation before, during and after mining is integral in assessing any impacts incurred by underground mining.

Areas of biodiversity significance within the management area include *Biodiversity Conservation Act 2016* (BC Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed threatened ecological communities (TECs), Groundwater Dependant Ecosystems (GDEs) and BC Act and EPBC Act threatened species and their habitats, situated within Centennial owned lands, including:

- Threatened flora:
 - *Prostanthera stricta* (Mount Vincent Mint-bush);
 - *Eucalyptus cannonii* (Capertee Stringybark); and
 - *Pultenaea* sp. Genowlan Point.
- Threatened fauna:
 - Glossy-black Cockatoos (*Calyptorhynchus lathami*);
 - Forest owls;
 - Woodland birds; and

- Cave-dwelling Microchiropteran bats (microbat).
- TECs:
 - *Allocasuarina nana* Heathland; and
 - White Box – Yellow Box – Blakely's Red Gum Woodland.
- GDEs
 - MU 13: Tableland Gully Ribbon Gum - Blackwood - Apple Box Forest; and
 - MU 21: Capertee - Wolgan Slopes Red Box - Grey Gum - Stringybark Grassy Open Forest.

Monitoring within the management area was developed by the Centre for Mine Land Rehabilitation (CMLR) and was commenced in 2012 by the University of Queensland (UQ), with RPS further refining the program since 2015. The monitoring program has been and will continue to be conducted in line with SSD-5581 with the exception of the areas which have restricted access and are being monitored by NSW National Parks and Wildlife Service (NPWS) [i.e. *Pultenaea sp.* Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland].

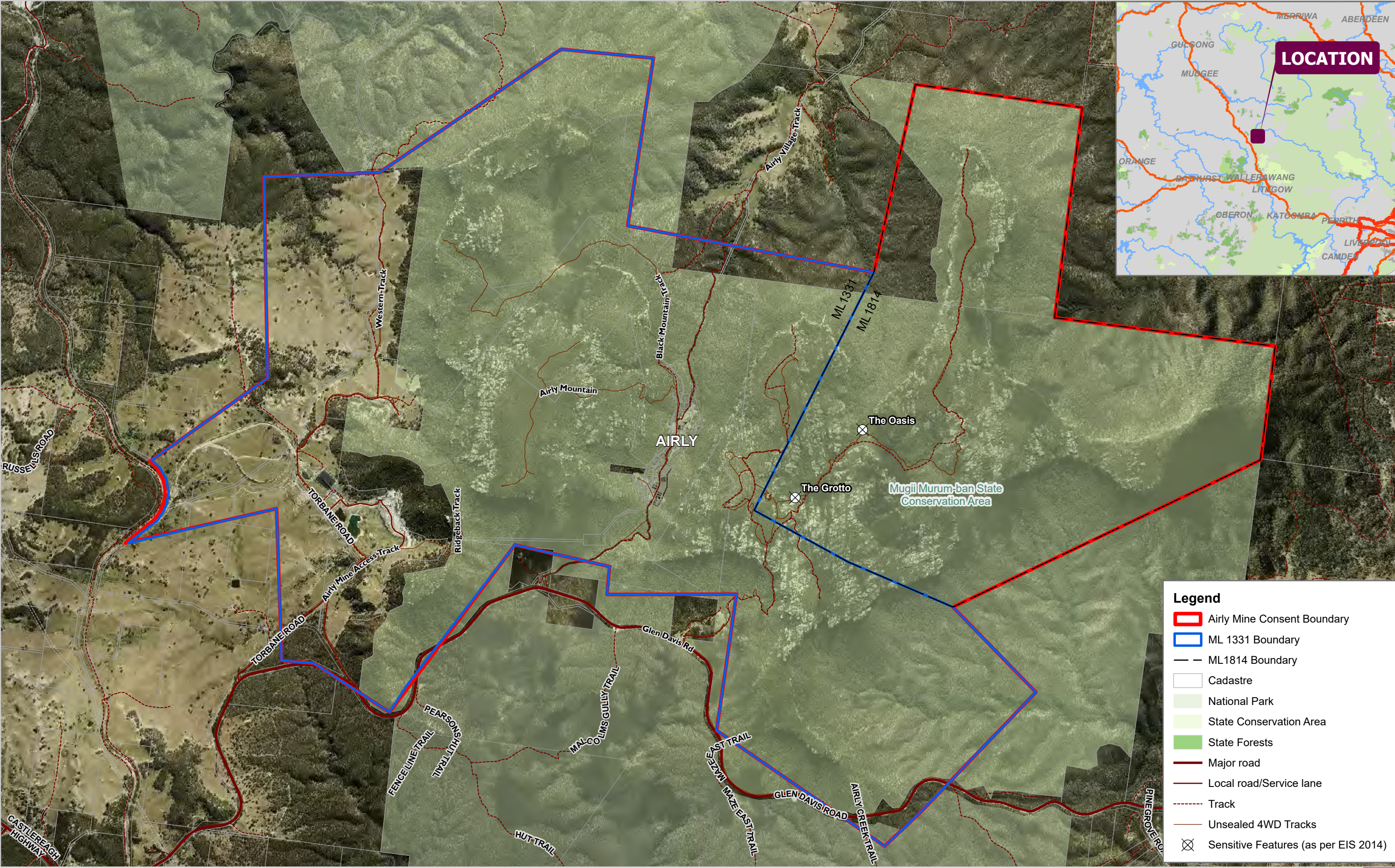
Previous flora and fauna monitoring for the Airly Mine was developed and implemented by the CMLR and was based on a Before-After-Control-Impact (BACI) approach and has been ongoing since 2012. The 2022 monitoring by RPS is based on the prior monitoring program with variation where necessary to reflect operational circumstances.

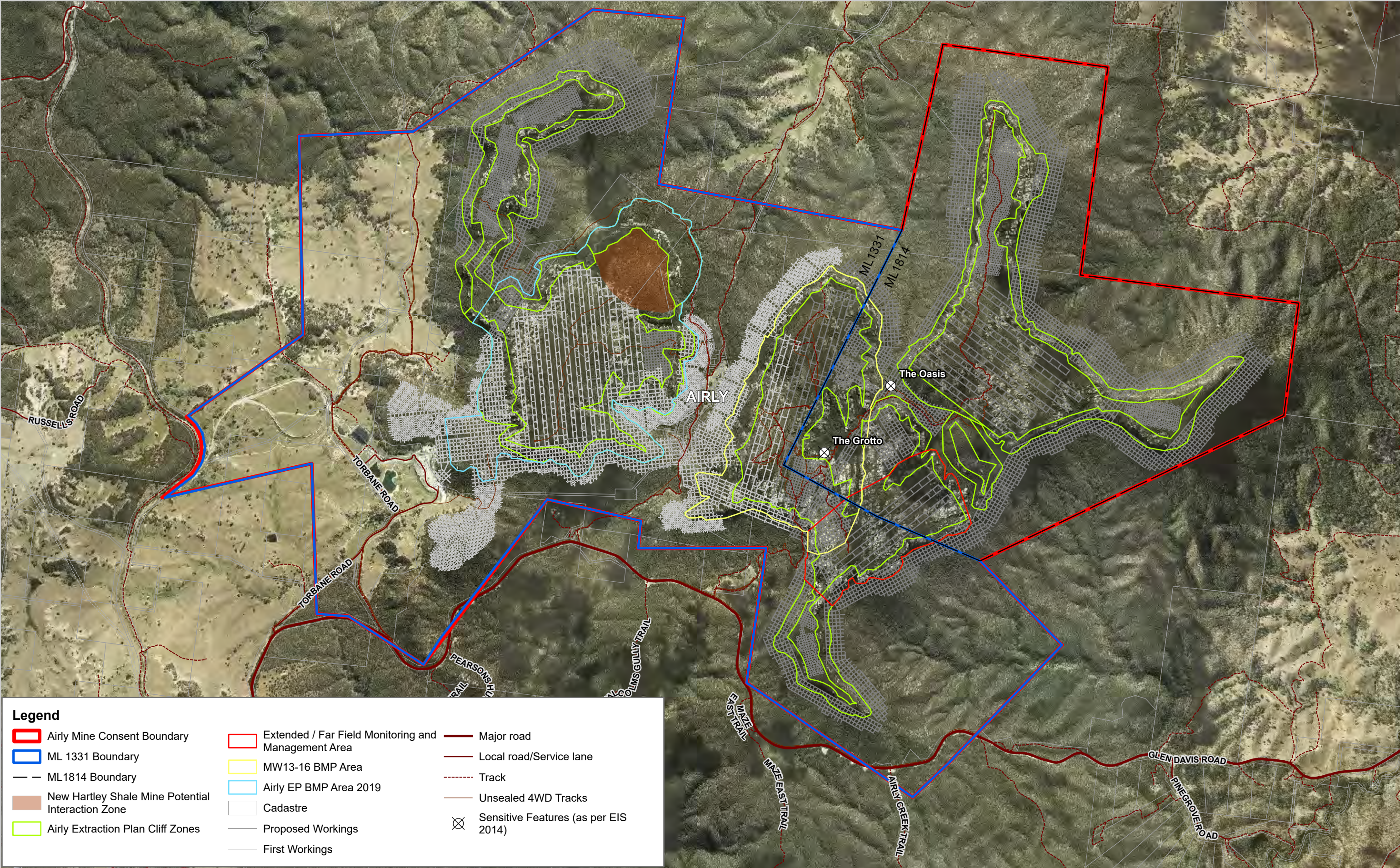
1.2 Objectives

This report documents the methods and results obtained from the 2022 BMP monitoring works as specified in the relevant BMPs for the management area (see **Table 1-1** & **Figure 1-2**). Discussion and recommendations are provided where relevant to compliance matters.

The objectives of this monitoring program are to:

- Identify any significant changes in the habitat quality and/or species presence as a result of the mining operations;
- Make an assessment of the seasonal data to determine if key performance measures (see **Table 1-2**) are being met;
- Collect data to inform baseline condition for future BMPs (i.e., Biodiversity Management Plan for Cliff Line Zone within ML1331 & ML1814).





Legend

Airly Mine Consent Boundary

ML 1331 Boundary

ML1814 Boundary

New Hartley Shale Mine Potential Interaction Zone

Airly Extraction Plan Cliff Zones

Extended / Far Field Monitoring and Management Area

MW13-16 BMP Area

Airly EP BMP Area 2019

Cadastre

Proposed Workings

First Workings

Major road

Local road/Service lane

Track

Unsealed 4WD Tracks

Sensitive Features (as per EIS 2014)

1.3 Compliance

This annual monitoring addresses the biodiversity-related conditions of consent outlines in SSD-5581. Specific environmental conditions are defined in Schedule 3, Condition 2 as outlined in **Table 1-2**.

Table 1-2: Biodiversity related subsidence impact performance measures (Schedule 3 - condition 2 SSD-5581)

Biodiversity Feature	Performance Measure
1. Gap and Genowlan Creeks	Negligible environmental consequences to water quality and to bed and bank stability No greater environmental consequences than predicted in the EIS to water flows (including baseflow)
2. The Grotto	Negligible subsidence impacts or environmental consequences
3. Threatened species, threatened populations, EECs and groundwater dependent ecosystems (with the exception of those listed below)	Negligible environmental consequences
4. <i>Pultenaea</i> sp. Genowlan Point population and Genowlan Point <i>Allocasurina nana</i> Heathland community	No environmental consequences

This monitoring report comprises information pertaining to performance measure three and provides baseline biodiversity data for the performance measures one and two (**Table 1-2**). Performance measure 4 is addressed in a separate monitoring report prepared by National Parks and Wildlife Services (NPWS).

The following BMP priorities and the sections in which they are addressed in this report are provided in **Table 1-3** below.

Table 1-3: Biodiversity monitoring requirements

Biodiversity monitoring	Location addressed in report
<i>Prostanthera stricta</i> (Mount Vincent Mint-bush)	Section 3.2.1
<i>Eucalyptus cannonii</i> (Capertee Stringybark)	Section 3.2.2
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland (MU20; PCT 703))	Section 3.1.1
Groundwater Dependant Ecosystems (GDE)	Section 3.1.2
Weeds	Section 3.1.3
Glossy-black Cockatoos (<i>Calyptorhynchus lathami</i>)	Section 3.3.1
Large Forest Owls	Section 3.3.2
Diurnal birds, including threatened and regionally significant woodland bird species	Section 3.3.3
Cave-dwelling microbats	Section 3.3.4
Vertebrate census/ other targeted fauna	Section 3.3.5
Feral species	Section 3.3.6

METHODS

2.1 Overview

2.1.1 Monitoring approach

The Sustainable Minerals Institute (SMI CMLR) applied the principles of a Before After Control Impact (BACI) monitoring design in developing the monitoring program in the BMP (SMI CMLR 2013). In a BACI design, data is simultaneously collected at 'Impact' and 'Control' sites, before and after an impact occurs, thus establishing a comparative quantitative dataset suitable for determining causation where significant change is detected within an 'impact site'.

2.1.2 Airly Monitoring Program

Annual flora and fauna monitoring at Airly Colliery in 2022 was completed on 31st January to 4th February, and December 12th to 15th.

The monitoring methods performed in the annual monitoring program are in line with the BMPs outlined in **Table 1-1**. Details on which methods were completed in the February and December monitoring events are provided below in **Table 2-1**. The location of each monitoring site is illustrated in **Figure 2-1** to **Figure 2-3**.

Table 2-1: Target Species and Monitoring Methods

Biodiversity Value	Monitoring Methodology	Data Analysis	Timing
<i>Prostanthera stricta</i>	Permanent 50 m transects incorporating a 5 x 5 m floristic plot	Comparison of data collected from permanent monitoring sites. Statistical analysis comparing years e.g. T-test.	Annually in Spring/Summer
<i>Eucalyptus cannonii</i>	Sample existing known individual <i>E. cannonii</i> Targeted surveys for additional potential habitat	Comparison of data collected from permanent monitoring sites. Statistical analysis comparing years e.g. T-test.	Annually in Spring/Summer
White Box – Yellow Box – Blakely's Red Gum Woodland EEC	Permanent 20 m x 50 m floristic plots	Comparison of data collected from permanent monitoring sites. Statistical analysis comparing years e.g. T-test.	Annually in Spring/Summer
Ground Water Dependant Ecosystems (GDEs)	Permanent 20 m x 50 m floristic plots	Comparison of data collected from permanent monitoring sites. Statistical analysis comparing years e.g. T-test.	Annually in Spring/Summer
Glossy black-cockatoo	Assessment/count of orts and percent cover within established plots of known stands of Allocasuarina trees	Statistical analysis comparing before and after e.g. T-test.	Annually in Summer
Diurnal birds	30 minute bird transects at permanent plots and opportunistic sightings	Statistical analysis comparing species richness of woodland bird species and change on a year to year basis.	Annually in Spring/Summer
Large forest owl roost and koalas	Assessment of known owl roosts (pellet presence) Call Playback Songmeter or Targeted callplayback/spotlighting	Presence/absence.	Annually in Spring/Summer

Biodiversity Value	Monitoring Methodology	Data Analysis	Timing
Microbats	Anabats deployed at 8 permanent locations	Presence/absence. Statistical analysis comparing species richness of woodland bird species and change on a year to year basis.	Annually in Summer
Vertebrate census	Stationary infrared cameras set at target areas of suitable habitat for Spotted-tailed Quoll and Rosenberg's Goanna	Presence/absence.	Annually in Spring/Summer
Feral species	Recording the location of any feral species -data to be supplied to NPWS at end of survey each year.	Compare presence/absence.	Annually in Spring/Summer

2.1.3 Limitations

In reviewing the design of the SMI CMLR (2013) monitoring program it is noted that it resembles a more simplistic Before-After monitoring framework. This is apparent in the transition of 'control' sites to 'impact' sites as the mining face progresses. As indicated in a BACI monitoring model, a 'Before-After' model is able to detect change over time; however, is unable to accurately define causation for this change (i.e. is it mining related?). While repeated measures methods have been adopted for most monitoring activities (i.e. sampling the exact same area or transect), a Before-After monitoring framework cannot distinguish between the effects of external unrelated variables such as bushfire, rainfall or drought and those originating from operational activities. These design flaws are irreconcilable unless the program is revised to include control sites that are permanent quarantined from an operational related impact.

2.2 Landscape context

Landform data and a weather data is analysed to provide context of the management area. Details on landscape context include:

- Interim Biogeographic Regionalisation for Australia (IBRA);
- IBRA Sub Region;
- NSW (Mitchell) Landscape;
- % Native vegetation cover;
- Connectivity features; and
- Rivers and streams.

The Bureau of Meteorology (BOM) and Geoscience Australia provides the weather details for all survey periods collected from Lithgow (Cooerwull) {station 063226}. This is compared to

2.3 Vegetation community

The following sections detail the monitoring methods utilised in the 2022 surveys for the sensitive vegetation communities:

- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland is listed as Critically Endangered Ecological Community (CEEC) under the BC Act and critically endangered under the EPBC Act.
- GDEs or 'facultative ecosystems':
 - MU 3: Hillslope Talus Mountain Gum – Brown Stringybark – Grey Gum – Broad-leaved Hickory Moist Forest; and
 - MU 21: Capertee – Wolgan Slopes Red Box – Grey Gum – Stringybark Grassy Open Forest.

Classification of the vegetation communities are detailed in **Table 2-2** Error! Reference source not found..

Table 2-2 Conversion of PCT classifications.

New PCT	Parent MU – PCT	Formation	TEC
3510 – Capertee Slopes Stringybark-Box Forest	MU 20 – 703 – Blakely's Red Gum – Yellow Box – Rough-barked Apple grassy woodland of the Capertee Valley, Sydney Basin Bioregion	Grassy Woodlands	- BC Act Listed CEEC (Part) White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland - EPBC Act Listed CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland
3495 – Western Blue Mountains Monkey Gum Gully Forest	MU 3 – 941 – Hinterland riverflat eucalypt forest	Forested Wetlands	Not a TEC
3226 – Western Blue Mountains Montane Wet Fern Forest	MU 21 – 1615 – Monkey Gum – <i>Eucalyptus blaxlandii</i> shrubby open forest on basalt of the Sydney Basin	Southern Escarpment Wet Sclerophyll Forests	Not a TEC

2.3.1 White Box – Yellow Box – Blakely's Red Gum Woodland

BWG plots were monitored using plots measuring flora composition, vegetation structure and ecological function as defined by the Biodiversity Assessment Methodology (BAM). Four established BAM plots have been used to gather repeated monitoring data, the location of these plots illustrated in **Figure 2-1**. These plots were originally established to collect data under the previous BioBanking Assessments Method (BBAM), with data collection transitioned to BAM methodology following the commencement of the BC Act and implementation of BAM guidelines.

2.3.1.1 Biodiversity Assessment Method

The BAM method involves estimating the vegetation composition, structure and function to determine the vegetation integrity. Flora species observed within the 20 x 20 m (400 m²) plot were assigned to a growth form as listed in **Table 2-4** and given a score of abundance and coverage. High threat weed species were identified. The method used to measure these attributes is detailed in the BAM 2020 (State of NSW 2020). Vegetation condition scores comprising of a composition score, structure score, function score and vegetation integrity score were calculated using the BAM Calculator (BAM-C).

Landscape context necessary for understanding vegetation communities and using the BAM-C are displayed in **Table 2-3**.

Table 2-3 Landscape context of the management area.

Landscape context	
Interim Biogeographic Regionalisation for Australia (IBRA)	South Eastern Highlands
IBRA Sub Region	Capertee Uplands
NSW (Mitchell) Landscape	Newnes Plateau
% Native vegetation cover	90
Connectivity features	Connectivity through Mugii Murum-ban SCA and Greater Blue Mountains Area
Rivers and streams	Multiple first, second and third order streams including Genowlan Creek

The start and end points of each BAM plot (i.e. 50 m central transect) are marked with wooden stakes and labelled. Location data for each of these points was recorded using a differential GPS. Photographs were taken of each BAM plot from a standardised point at an approximate height of 1.5 m. A horizontal field of

view of approximately 40 degrees is achieved, which is within the central angle of view for human vision (i.e. 40-60 degrees).

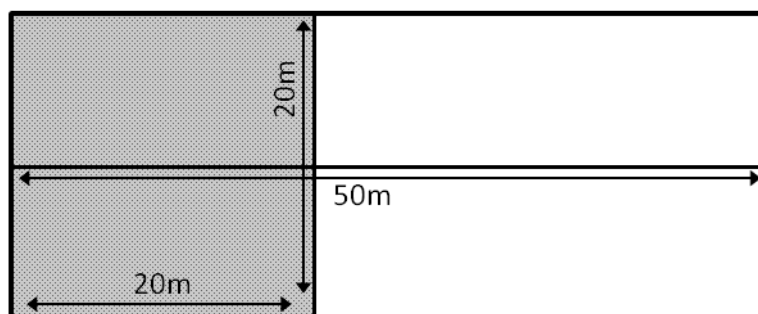


Plate 2-1: BioMetric Plot Dimensions

Table 2-4: BAM growth form groups and attributes

Composition (20 x 20 m plot)	Structure (20 x 20 m plot)	Function (20 x 50 m plot)
a) Tree Richness (TR)	a) Tree Cover (TC)	a) Number of large trees (No.LT)
b) Shrub Richness (SR)	b) Shrub Cover (SC)	b) Tree regeneration (TR)
c) Grass and grass-like Richness (GGR)	c) Grass and grass-like Cover (GGC)	c) Tree stem size class (TSSC)
d) Forb Richness (FR)	d) Forb Cover (FC)	d) Total length of fallen logs (TLFL)
e) Fern Richness (FeR)	e) Fern Cover (FeC)	e) Litter cover (1m ² subplots x 5) (LC)
f) Other Richness (OR)	f) Other Cover (OC)	f) High threat exotic vegetation cover (THE)
		g) Hollow-bearing trees (HBT)

Vegetation structure

The structural complexity and age structure of vegetation was quantified by counting the number of large trees [i.e. > 50 cm diameter at breast height (DBH)], presence of tree canopy species regeneration and tree stem size classes (i.e. presence of trees with a DBH of 5-9 cm, 10-20 cm, 20-30 cm, 30-50 cm, 50-80 cm and >80 cm). This was measured for the 1,000 m² plot.

Hollow-bearing Trees

The number of hollow-bearing trees were counted within the 1,000 m² plot.

Fallen Log Length

The total linear length of fallen logs exceeding 10 cm in diameter were measured within the 1,000 m² plot.

Litter Cover

The per cent cover of dead litter cover was estimated in five, 1 m² quadrats within the 1,000 m² plot.

2.3.1.2 Data analysis

Data is compared with previous seasons data to determine if any change has occurred. A One-Way ANOVA (Excel V2212 Analysis ToolPak) is used to compare if BAM and vegetation integrity scores (VIS) differs across years at a 5% significance level (i.e. $p < 0.05$). If change is detected, two-tailed t-tests are conducted to determine if the current monitoring season is the cause for change (both negative and positive effects) at a significance level of 5% (i.e. $p < 0.05$).

2.3.2 Groundwater Dependent Ecosystems

GDE plots were monitored using plots both BAM plots (i.e. measuring flora composition, vegetation structure and ecological function as defined by the BAM) and a rapid aquatic assessment modified from the Australian River Assessment System (AUSRIVAS) methodology. Ten GDE BAM plots and five rapid aquatic assessments have been established at the base of Pt Hatteras and the Grotto for the Pt Hatteras BMP and CLZ ML1814 BMP to establish baseline and gather repeated monitoring data. The location and method applied at these plots are summarised in **Table 2-5** and shown in **Figure 2-1**.

Table 2-5: Location, PCT and monitoring method of GDE plots

Plot	BMP Location	PCT	Monitoring method
1	Pt Hatteras	3495/941	• BAM plot
2	Pt Hatteras	3495/941	• BAM plot
3	Control	3495/941	• BAM plot
4	Control	3495/941	• BAM plot
5	Grotto (CLZ ML1814 BMP)	3226/1615	• BAM plot • Rapid aquatic assessment
6	Grotto (CLZ ML1814 BMP)	3226/1615	• BAM plot • Rapid aquatic assessment
7	Grotto (CLZ ML1814 BMP)	3226/1615	• BAM plot • Rapid aquatic assessment
8	Grotto (CLZ ML1814 BMP)	3226/1615	• BAM plot • Rapid aquatic assessment
9	Grotto (CLZ ML1814 BMP)	3495/941	• BAM plot
10	Grotto (CLZ ML1814 BMP)	3495/941	• BAM plot • Rapid aquatic assessment

2.3.2.1 Biodiversity Assessment Method

See **Section 2.3.1.1**.

2.3.2.2 Rapid aquatic assessment

A rapid aquatic assessment modified from the AUSRIVAS methodology. The start and end points of each 50 m GDE plot are marked with wooden stakes and labelled. Location data for each of these points was recorded using a differential GPS. Photographs were taken of each GDE plot from a standardised point at an approximate height of 1.5 m. A horizontal field of view of approximately 40 degrees is achieved, which is within the central angle of view for human vision (i.e. 40-60 degrees).

The following assessments are conducted during each monitoring period:

- a. Stream condition:
 - i. Flow width (m) averaged from set distance along the stream (5 m, 15 m, 25 m, 35 m, 45 m);
 - ii. Max flow width (m);
 - iii. Min flow width (m);
 - iv. Soil moisture $\pm 3\%$ VWC averaged from set distance along the stream (5 m, 15 m, 25 m, 35 m, 45 m);
 - v. Clarity/sediment load (0 [no clarity] – 5 [clearest]);
 - vi. Erosion (0 [no signs of erosion] – 5 [severe]).
- b. Stream type:
 - i. Stream flow type:

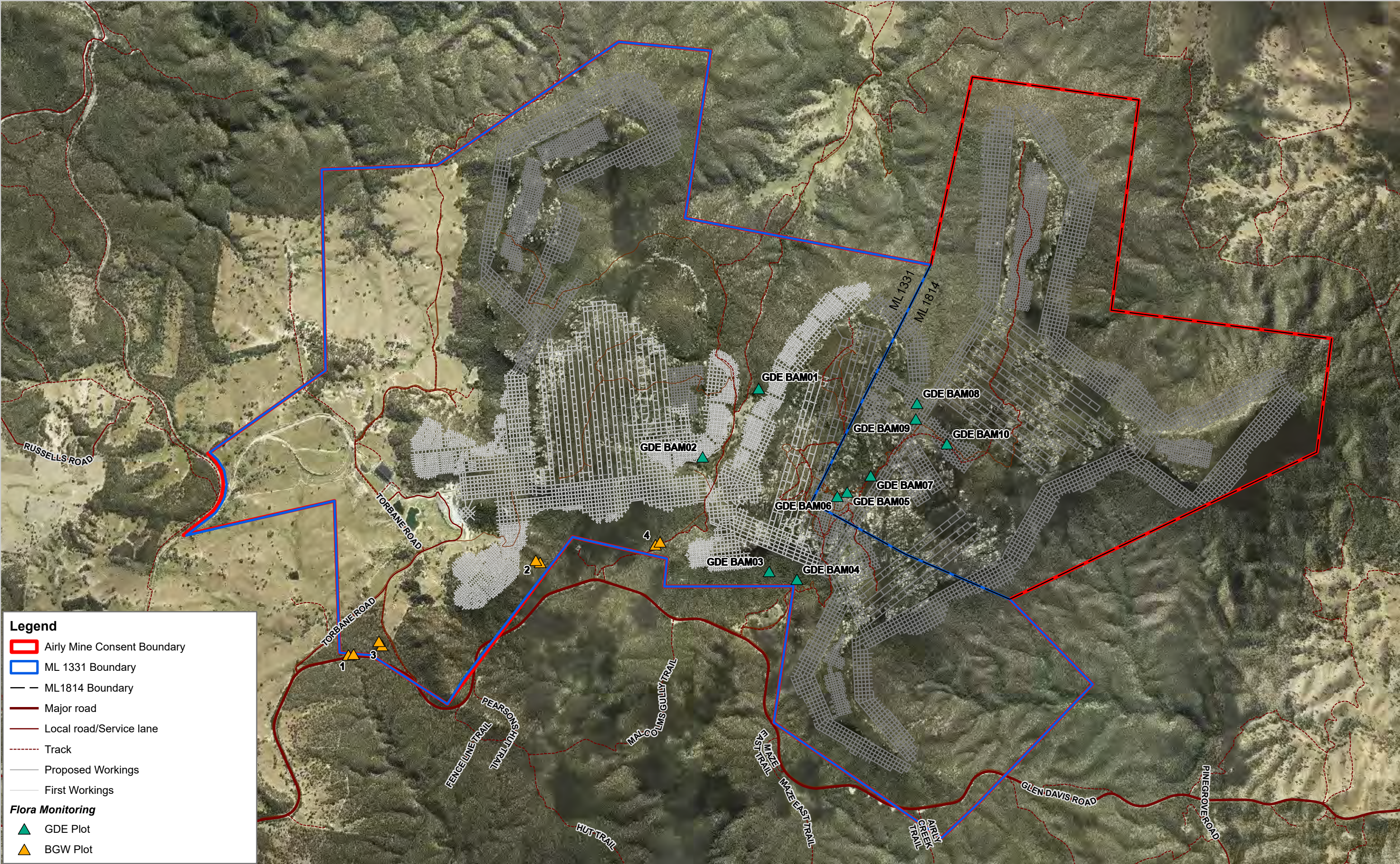
1. Pooling;
2. Flowing;
3. Continuous;
4. Discontinuous;
5. Riffles.
- ii. Aquatic vegetation type:
 1. Submerged;
 2. Floating;
 3. Emergent.
- iii. Substrate type:
 1. Bedrock;
 2. Boulder (>256mm);
 3. Cobble (64-256mm);
 4. Pebble (16-64mm);
 5. Gravel (2-16mm);
 6. Sand (0.06-2mm);
 7. Clay/Silt (<0.06mm).
- iv. Bank slope:
 1. Flat <10°;
 2. Low 10 – 30°;
 3. Moderate 30 – 60°;
 4. Steep 60 – 80°;
 5. Vertical 80 – 90.

2.3.2.3 Data analysis

Data is compared with previous seasons data to determine if any change has occurred. A One-Way ANOVA (Excel V2212 Analysis ToolPak) is used to compare if native plant species richness and BAM scores differs across years at a 5% significance level (i.e. $p < 0.05$). If change is detected, two-tailed t-tests are conducted to determine if the current monitoring season is the cause for change (both negative and positive effects) at a significance level of 5% (i.e. $p < 0.05$).

2.3.3 Exotic species

Exotic species establishment was estimated in conjunction with the BAM plots. Within the 20 x 20 m quadrant at each site the total cover and abundance of exotic species was recorded. Total exotic species is calculated and exotic species with a cover of 3% or greater are discussed.



Legend

- Airly Mine Consent Boundary
- ML 1331 Boundary
- ML 1814 Boundary
- Major road
- Local road/Service lane
- Track
- Proposed Workings
- First Workings

Flora Monitoring

- GDE Plot
- BGW Plot

2.4 Flora

The following sections detail the monitoring methods utilised in the 2022 surveys for the threatened flora species:

- *Prostanthera stricta* (Mount Vincent Mint-bush; BC Act: Vulnerable); and
- *Eucalyptus cannonii* (Capertee Stringybark; BC Act: Vulnerable).

2.4.1 *Prostanthera stricta* (Mount Vincent Mint-bush)

Sixteen *P. stricta* monitoring transects were surveyed in 2022. Their transect ID and location within the management area based on the EP specific BMPs is summarised in **Table 2-6**.

Table 2-6 *P. stricta* monitoring locations.

Location within management area	Transect ID	Comment
Genowlan Point (Control)	T18	Established in 2022 monitoring period
	T19	
	T20	
Genowlan Trig (Control)	T7	T10 re-established in 2022. Currently control plots but will be undermined within MW17-19 EP.
	T10	
Gully (Control)	T22	T22 established in 2022. T10 re-established in 2022
	T14	
Mt Airly (Impact)	T1	Controlled burn across Mt Airly occurred in 2018.
	T2	
	T3	
	T4	
	T5	
	T12	
	T13	
Pt Hatteras (Impact)	T6	T15 re-established in 2015
	T8	
	T9	
	T15	

P. stricta is monitored using 50 m long point intercept transects located across the management area. Start and end points coordinates are staked out and these coordinates are accurately recorded using a differential GPS unit.

The point intercept method was used to determine the density of *P. stricta* populations across 18 50 m transects including four plots which were established, and two that were re-established. See **Figure 2-2** for monitoring locations. Any section of *P. stricta* that was seen to be overhanging or underneath the transect lines were measured to the nearest 5 mm. (Elzinga et al, 2001). Once transect point data was recorded, a percentage cover score was calculated for each transect. Additionally, floristic data within 5 x 5 m plots is also collected. These plots were carried out at the start of each transect with the aim to record all vascular flora present at the time of the survey.

2.4.1.1 Data analysis

Data is compared with previous seasons data to determine if any change has occurred. A One-Way ANOVA (Excel V2212 Analysis ToolPak) is used to compare if the cover of *P. stricta* differs across years at a 5% significance level (i.e. $p < 0.05$). If change is detected, two-tailed t-tests are conducted to determine if the current monitoring season is the cause for change (both negative and positive effects) at a significance level of 5% (i.e. $p < 0.05$). This is repeated for each monitoring location (i.e. Mt Airly, Pt Hatteras, Control).

2.4.2 *Eucalyptus cannonii* (Capertee Stringybark)

Individuals of threatened species *E. cannonii* are permanently monitored. A total of 28 *E. cannonii* locations were monitored of which ten were newly installed at Pt Hatteras to establish the baseline data for MW13-16 BMP. See **Figure 2-2** for monitoring locations. The following assessments are conducted during each monitoring period:

- a. Supporting data:
 - i. Tree species;
 - ii. Location;
 - iii. Photograph (trunk and canopy); and
 - iv. Date and time.
- b. Tree condition data
- c. Tree size data; and
- d. Contextual data:

See **Table 2-7** for further definitions.

Table 2-7: Tree condition data and definition

Parameter	Definition
Condition	
Crown density ratio	the amount of crown branches, foliage and reproductive structures that blocks light visibility through the crown. Each tree species has a normal crown that varies with the site, genetics, tree damage, etc.
Crown extent ratio	is a percentage determined by dividing the live crown length by the actual tree length;

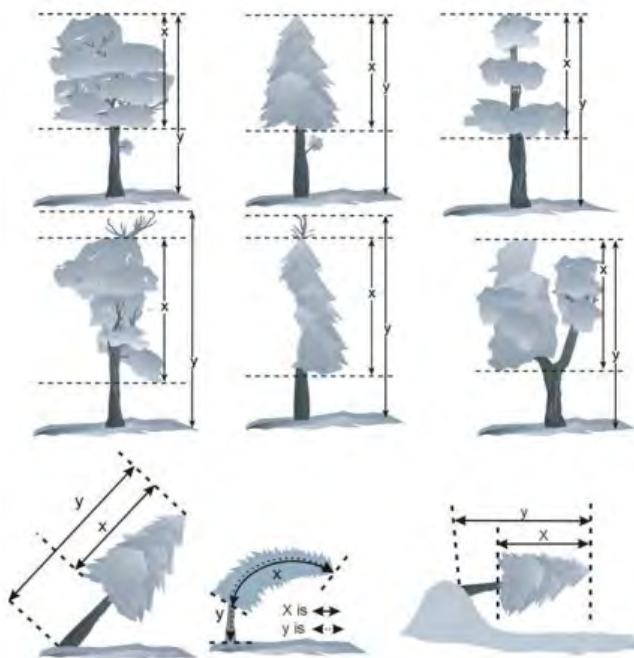


Plate 2-2: Crown extent ratio (UVM 2005)

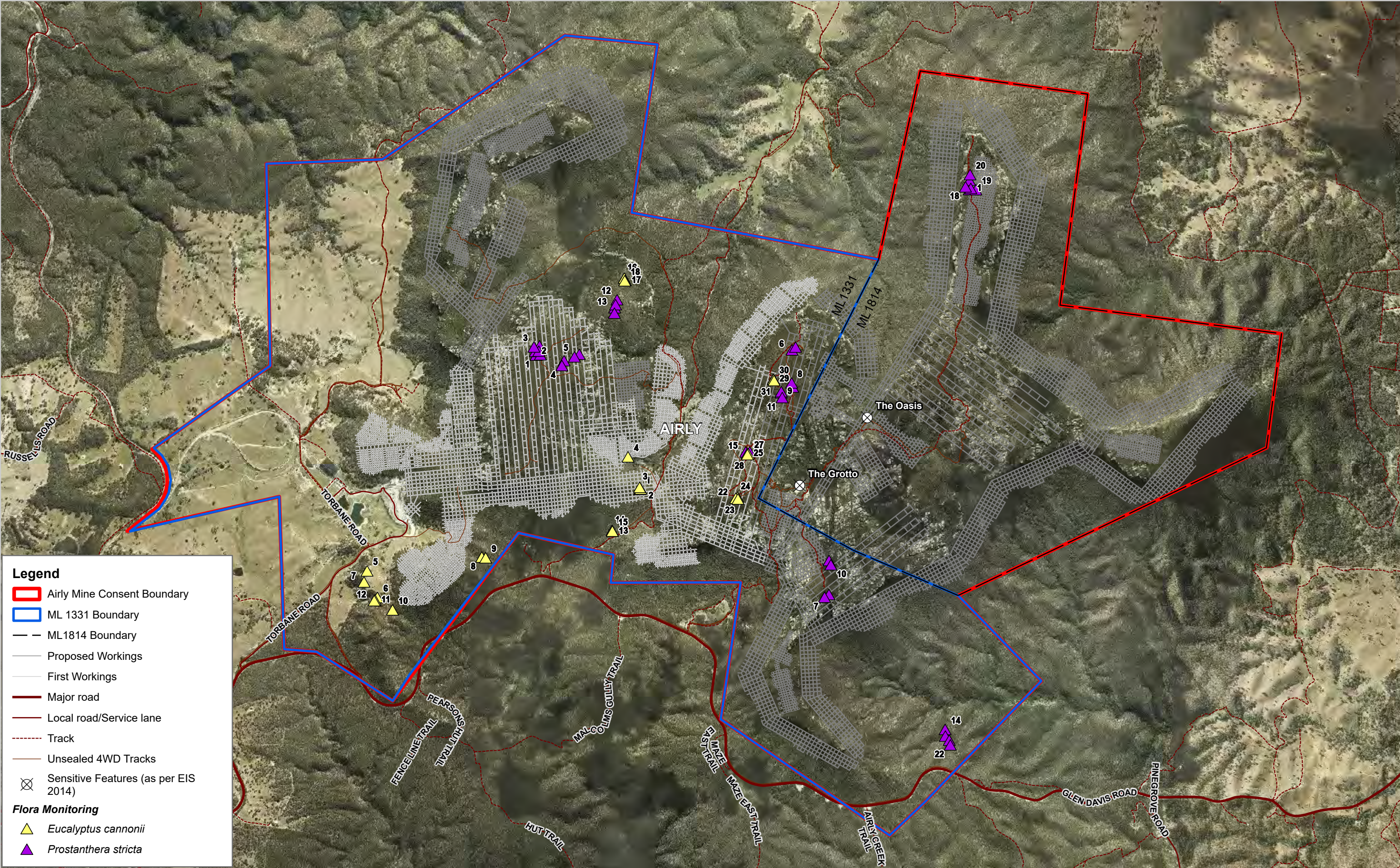
Tree size

Height	Height from ground to top of canopy in meters
--------	---

Parameter	Definition
Diameter at Breast Height (DBH)	Diameter of the tree at breast height (~1.5 m off the ground) recorded in cm
Context	
Subsidence	
Erosion	
Weed presence	

2.4.2.1 Data analysis

Tree condition data is compared with previous seasons data to determine if any change has occurred in score across the trees at the monitoring locations (i.e. Mt Airly, Pt Hatteras; Control). A two-tailed t-tests is conducted to determine if the current monitoring season differs (both negative and positive effects) from previous monitoring years at each location at a significance level of 5% (i.e. $p < 0.05$).



Legend

Airly Mine Consent Boundary

ML 1331 Boundary

ML 1814 Boundary

Proposed Workings

First Workings

Major road

Local road/Service lane

Track

Unsealed 4WD Tracks

Sensitive Features (as per EIS 2014)

Flora Monitoring

Eucalyptus cannonii

Prostanthera stricta

THREATENED FLORA MONITORING LOCATIONS

FIGURE 2.2

CLIENT: Centennial
PROJ: AU213005261
LOCATION: Airly

MAP: Figure 4
VERSION: A
DATE EXPORTED: 2/02/2023
TECHNICIAN: Natalie Wood

DATA SOURCES
Centennial, RPS, NSWSS,

0.500.511.5

Km

SCALE 1:32,000
A3 SIZE / Projection: GDA2020 MGA Zone 56



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PROJECT PATH: S:\Centennial\All Jobs\5261 - 151160 - Airly BMP Seasonal Ecological Monitoring 2022\10 - Drafting\03_Projects\01_ProjectBase\02_ReportFigures.aprx

2.5 Fauna

2.5.1 Glossy black-cockatoos

Monitoring for evidence of Glossy Black-Cockatoos was undertaken in February and December 2022. Glossy Black-Cockatoos have a particular diet and feed only on the seeds in cones of She-oaks (*Casuarina* and *Allocasuarina* sp.), but specifically *Allocasuarina littoralis* (Black She-oak) within the Airly mining lease. Those cones, referred to as 'orts' are then discarded, leaving evidence of Glossy Black- Cockatoo activity. The orts can thus be used to detect recent activity of Glossy Black-Cockatoos in the locality.

Monitoring involves surveying for the presence of chewed orts within six 50 x 50 m stands of *Allocasuarina littoralis* in order to determine recent utilisation of the habitat as shown in **Figure 2-3**. Attributes measured within each 50 m² search area include:

- Per cent canopy cover and per cent *Allocasuarina* species cover;
- Presence of orts; and
- Presence of Glossy black-cockatoos.

Additionally, if any Glossy-Black Cockatoo individuals were observed outside of these plots they are recorded by GPS location and photos are taken where practicable.

2.5.1.1 Data analysis

Data is compared with previous seasons data to determine if any change has occurred at the monitoring locations (i.e. Mt Airly, Pt Hatteras; Control). A two-tailed t-tests is conducted to determine if the *Allocasuarina* species cover in the current monitoring season differs (both negative and positive effects) from previous monitoring years at each location at a significance level of 5% (i.e. $p < 0.05$).

2.5.2 Forest owls

Monitoring for evidence of large forest owls was undertaken in February 2022. This monitoring targets previously known areas of owl activity (e.g. roost or sighting), looking for any evidence of Powerful Owls, Sooty Owls and Masked Owls presence within these areas. The method for monitoring these species is discussed below.

- Visiting areas of previous sightings/roosts and recording any evidence of owl pellets and/or individuals;
- Call playback using a megaphone, broadcasting calls to seek a response;
- Spotlighting across two nights following call playback; and
- Installation and analysis of song meter data across a survey week in summer.

The location of owl roost/previous sighting sites, spotlighting, call playback and song meter placement completed in 2022 are displayed in **Figure 2-3**.

2.5.3 Woodland birds

Threatened woodland bird species are monitored using permanent transects, diurnal bird surveys and opportunistic surveys throughout the management area. Previously established sites are used to continue monitoring for threatened bird species and allow for comparisons between seasons/years. Sites included four habitat types; grassland, woodland, wet forest and pagoda shrubland, the locations of which are shown in **Figure 2-3**. Target bird species are listed in **Table 2-8**.

Table 2-8: Target Bird Species

Scientific Name	Common Name	Conservation Status
<i>Anthochaera phrygia</i>	Regent Honeyeater	Critically Endangered under EPBC Act Critically Endangered under BC Act
<i>Meliphaga gularis</i>	Black-chinned Honeyeater	Vulnerable under BC Act

Scientific Name	Common Name	Conservation Status
<i>Climacteris picumnus</i>	Brown Treecreeper	Vulnerable under BC Act
<i>Stagonopleura guttata</i>	Diamond Firetail	Vulnerable under BC Act
<i>Petroica phoenicea</i>	Flame Robin	Vulnerable under BC Act
<i>Petroica boodang</i>	Scarlet Robin	Vulnerable under BC Act
<i>Melanodryas 18acropus18 cucullata</i>	Hooded Robin	Vulnerable under BC Act
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	Vulnerable under BC Act Endangered under EPBC Act
<i>Pachycephala inornata</i>	Gilbert's Whistler	Vulnerable under BC Act
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	Vulnerable under BC Act Vulnerable under EPBC Act
<i>Glossopsitta pusilla</i>	Little Lorikeet	Vulnerable under BC Act
<i>Grantiella picta</i>	Painted Honeyeater	Vulnerable under BC Act Vulnerable under EPBC Act
<i>Ninox strenua</i>	Powerful Owl	Vulnerable under BC Act
<i>Tyto tenebricosa</i>	Sooty Owl	Vulnerable under BC Act
<i>Chthonicola sagittatus</i>	Speckled Warbler	Vulnerable under BC Act
<i>Daphoenositta chrysoptera</i>	Varied sittella	Vulnerable under BC Act
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	Vulnerable under BC Act
<i>Artamus cyanopterus</i>	Dusky Woodswallow	Vulnerable under BC Act

The methodology includes prescribed transects, conducted for approximately 20 minutes by two Ecologists with all birds observed and heard being documented. Variables that may influence bird presence include type of habitat disturbance, amount of flowering vegetation, and weather conditions.

2.5.3.1 Data analysis

Data is compared with previous seasons data to determine if any change has occurred in at the monitoring locations (i.e. Mt Airly, Pt Hatteras; Control). A two-tailed t-tests is conducted to determine if the species diversity in the current monitoring season differs (both negative and positive effects) from previous monitoring years at each location at a significance level of 5% (i.e. $p < 0.05$).

2.5.4 Cave-dwelling microbats

Anabats (microbat vocalisation recording devices) were used to record ultrasonic bat calls of targeted cave-dwelling bats that are known to occur in specific habitat types within the Management Area. Anabats were deployed at ten sites including two adit roosts (a horizontal passage leading into a mine) to evaluate foraging habitat and roosting habitat. Target microbat species are listed in **Table 2-9**. Anabat locations for 2022 are provided in **Figure 2-3**.

Table 2-9: Target Microbat Species

Scientific Name	Common Name	Conservation Status
<i>Miniopterus orianae oceanensis</i>	Eastern Bentwing-bat	Vulnerable under BC Act Sensitive to geological instability
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe bat	Protected under BC Act Sensitive to geological instability
<i>Chalinolobus dwyeri</i>	Large-eared Pied bat	Vulnerable under BC Act and EPBC Act Sensitive to geological instability

The identification of bat echolocation calls recorded during surveys was undertaken using Anabat Insight (Titley Electronics, Version 2.0.2) software. Reference calls were obtained from the NSW database and from the authors personal collection. Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being:

- Definite – Pass identified to species level and could not be confused with another species;
- Probable – Pass identified to species level and there is a low chance of confusion with another species;
- Possible – Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species;
- Species group – Pass could not be identified to species level and could belong to one of two or more species. Occurs more frequently when passes are short or of poor quality; and
- Unknown – Either background 'noise' files or passes by bats which are too short and/or of poor quality to confidently identify.

2.5.4.1 Data analysis

Data is compared with previous seasons data to determine if any change has occurred between years. A two-tailed t-tests is conducted to determine if the native species diversity in the current monitoring season differs (both negative and positive effects) from previous monitoring years at each location at a significance level of 5% (i.e. $p < 0.05$).

2.5.5 Vertebrate census

During all other monitoring events, all vertebrate fauna species observed or heard opportunistically were recorded. The inventory is aimed at the following:

- Recording basic presence/absence of all vertebrates within the management area, regardless of their potential sensitivity to undermining or conservation status;
- Detecting new or rare species that may require future monitoring, but have not been recorded within the management area previously; and
- Detection of feral fauna species.

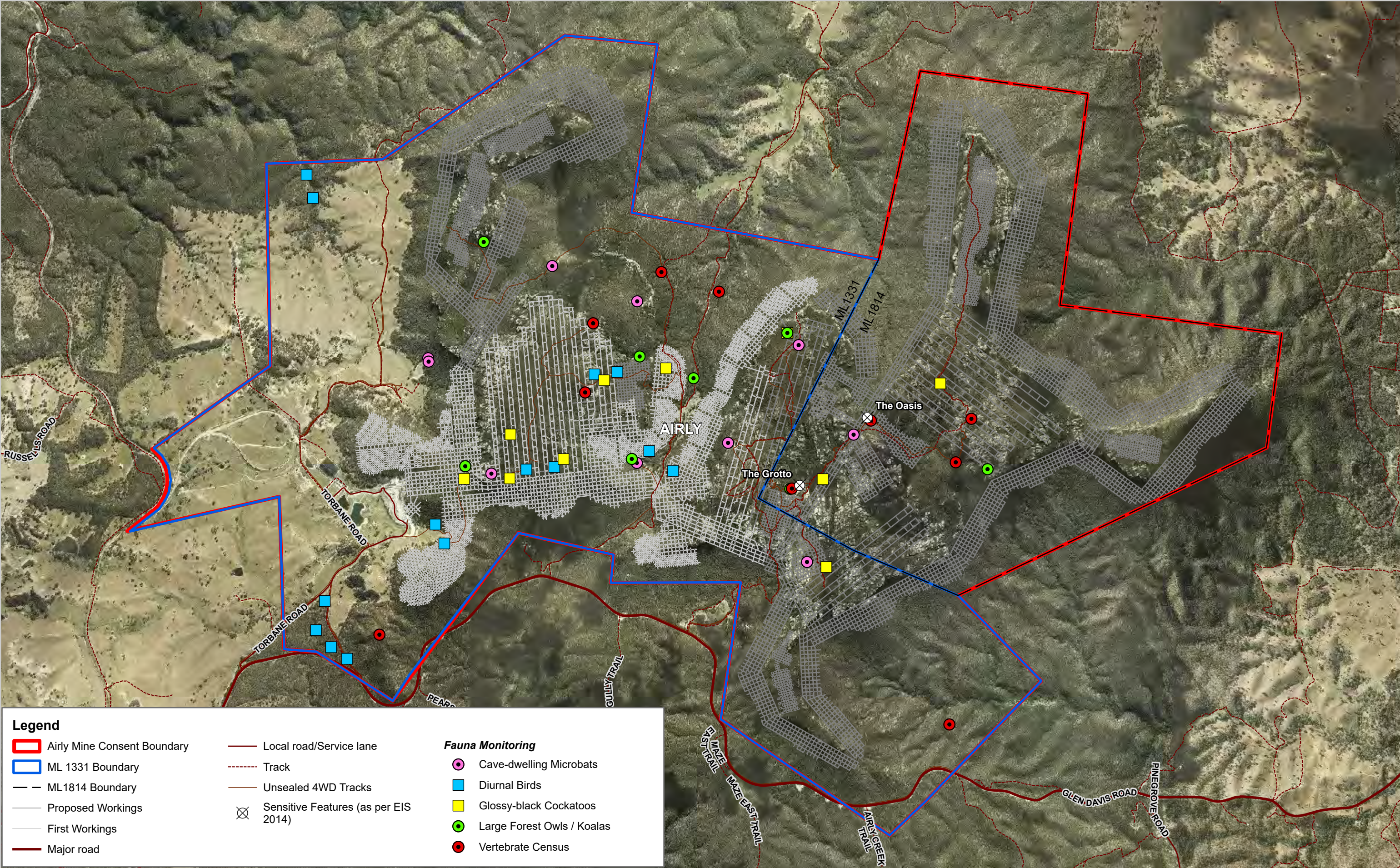
Stationary infrared cameras were deployed during fauna monitoring periods in areas of suitable habitat as shown in **Figure 2-3**. Fauna targeted by camera trap placement included the threatened Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) and Rosenberg's Goanna (*Varanus rosenbergi*) which have previously been detected within the Airly mining lease site. Gully habitats were targeted for the Spotted-tailed Quoll, whereas lower lying rocky habitats were targeted for the Rosenberg's Goanna. At each location, a tin of sardines was used to attract the species. **Table 2-10** lists the additional target fauna for the program.

Table 2-10: Additional Target Fauna Species

Scientific Name	Common Name	Conservation Status
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Vulnerable under BC Act Endangered under EPBC Act Sensitive to habitat alteration
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	Vulnerable under BC Act
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	Endangered under BC Act Vulnerable under EPBC Act
<i>Phascolarctos cinereus</i>	Koala	Endangered under BC Act Endangered under EPBC Act

2.5.5.1 Data analysis

Data is compared with previous seasons data to determine if any change has occurred between years. A two-tailed t-tests is conducted to determine if the native species diversity in the current monitoring season differs (both negative and positive effects) from previous monitoring years at each location at a significance level of 5% (i.e. $p < 0.05$).



Legend

- Airly Mine Consent Boundary
- ML 1331 Boundary
- ML 1814 Boundary
- Proposed Workings
- First Workings
- Major road

- Local road/Service lane
- Track
- Unsealed 4WD Tracks
- Sensitive Features (as per EIS 2014)

Fauna Monitoring

- Cave-dwelling Microbats
- Diurnal Birds
- Glossy-black Cockatoos
- Large Forest Owls / Koalas
- Vertebrate Census

2.6 Weather

The Bureau of Meteorology (BOM) and Geoscience Australia provides the weather details for all survey periods as outlined in **Table 2-11** and **Table 2-12**. Weather data is collected from Lithgow (Cooerwull) {station 063226}.

Table 2-11: Temperature, Rainfall and Day Length during the February 2022 Monitoring Period

Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)	Sun Rise – Sun Set
31/01/2022	14.2	27.4	0	05:21 – 19:05
01/02/2022	17.4	27.9	0.2	05:22 – 19:04
02/02/2022	11.5	21.3	3.8	05:23 – 19:04
03/02/2022	7.8	18.0	2.0	05:24 – 19:03
04/02/2022	10.6	16.4	0	05:25 – 19:02

BOM- <http://www.bom.gov.au/climate/dwo/202102/html/IDCJDW2075.202102.shtml>

Geoscience AUS- <http://www.ga.gov.au/geodesy/astro/sunrise.jsp>

Table 2-12: Temperature, Rainfall and Day Length during the December 2022 Monitoring Period

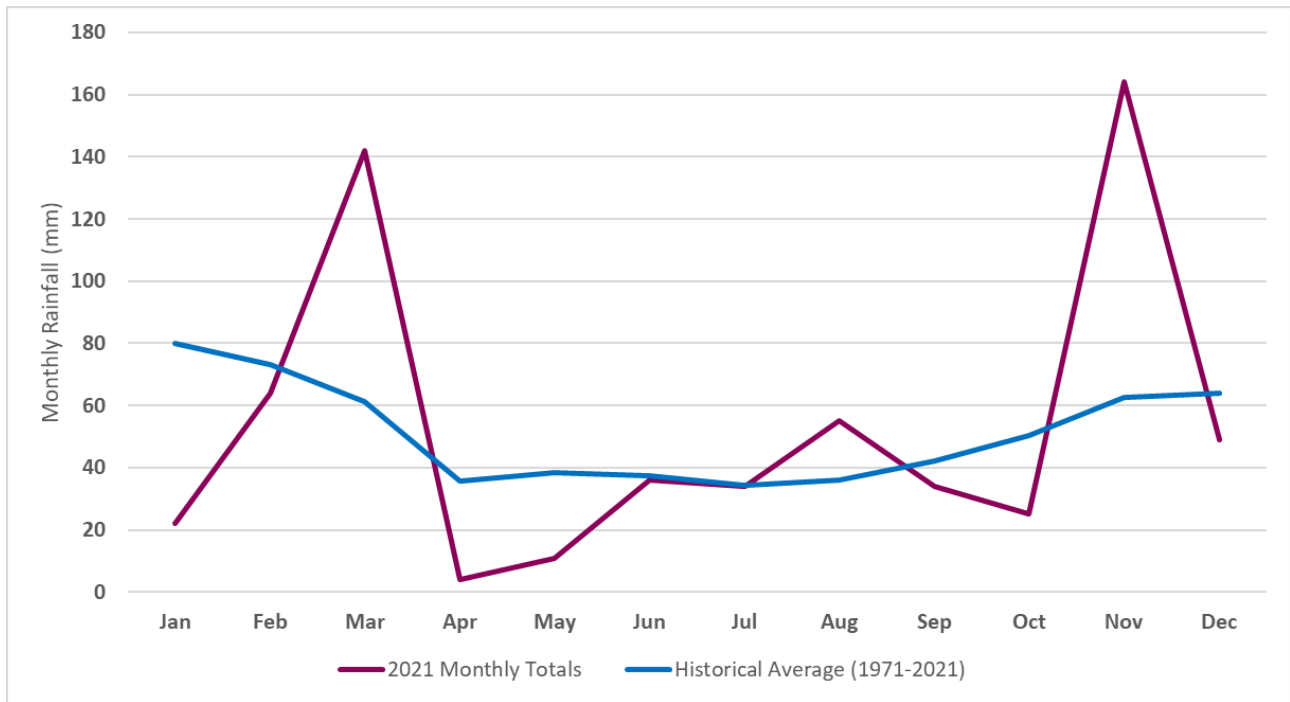
Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)	Sun Rise – Sun Set
12/12/2022	16.5	21.1	0	04:43 – 19:03
13/12/2022	5.9	18.5	17.6	04:43 – 19:04
14/12/2022	6.2	14.7	0	04:44 – 19:04
15/12/2022	3.4	18.3	0.4	04:44 – 19:05
12/12/2022	16.5	21.1	0	04:43 – 19:03

BOM- <http://www.bom.gov.au/climate/dwo/202102/html/IDCJDW2075.202102.shtml>

Geoscience AUS- <http://www.ga.gov.au/geodesy/astro/sunrise.jsp>

Rainfall for 2021 and 2022 are displayed in **Graph 3 1** and **Graph 3 2** below. Rainfall in 2021 was sporadic, with significant peaks and lows. Periods of high and low rainfall in 2022 were generally consistent with previous rain fall patterns of 2021. The average rainfall across 2021 was 85mm, around 17mm more than the historical average.

Rainfall in 2022 was less the previous year, averaging 124 mm per month, 53mm less than the historical average (BOM 2021). Rainfall was above the historical average 9 months of the year with significant rainfall events occurring in January, March and July 2022.



Graph 2-1: 2021 monthly rainfall (mm) compared to historical average monthly rainfall (1971-2021) for Glen Alice (BOM 2021).



Graph 2-2: 2022 monthly rainfall (mm) compared to historical average monthly rainfall (1971-2022) for Glen Alice (BOM 2022).

3 RESULTS

3.1 Vegetation community

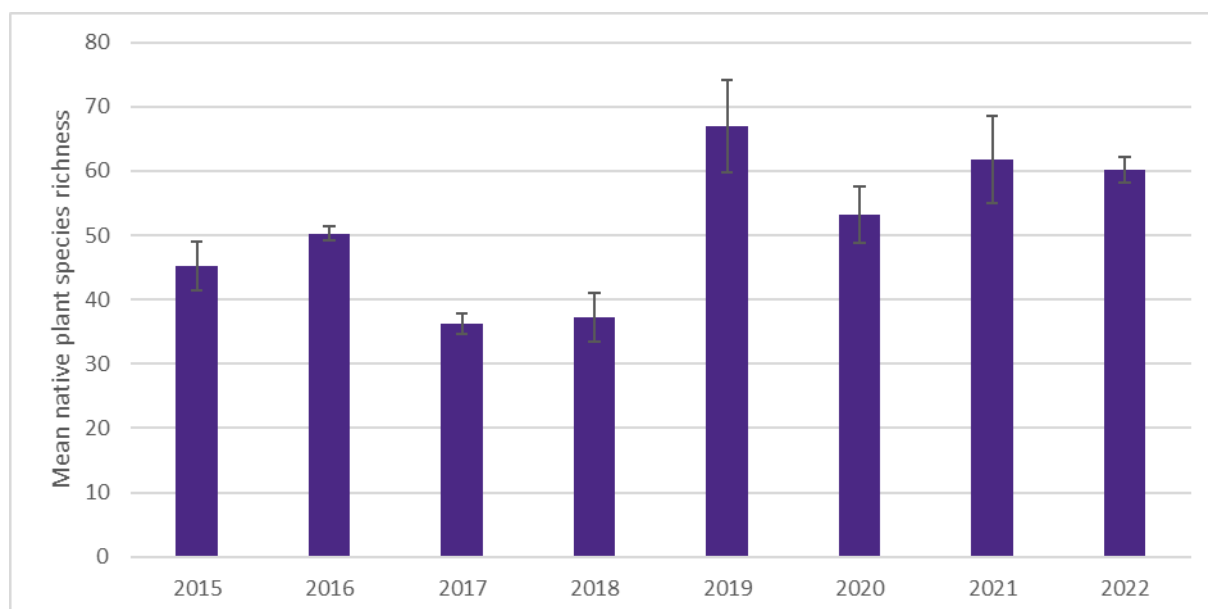
3.1.1 White Box – Yellow Box – Blakely's Red Gum Woodland

3.1.1.1 Native plant species richness

Four BAM plots in MU20 (PCT 703/3510) were surveyed in February 2022 (see **Figure 2-1**). **Graph 3-1** below shows native plant species richness in BAM plots across the years 2015 to 2022. Native plant species richness was highest in 2019.

A one-way ANOVA was performed to compare monitoring year and native plant species richness which revealed that there was a statistically significant difference in native plant species richness between at least two years ($F [7, 24] = 6.7411$; $p = 0.0002$).

A paired two-tailed t-test was performed to compare the 2022 mean native plant species richness to previous years. The mean native species richness in 2022 has not significantly changed since 2020, however has significantly increased since the 2015 to 2018 monitoring years ($p = 0.0091$; 0.0090 ; 0.0017 ; 0.0137). See **Appendix A** for full flora inventory and photo monitoring.



Graph 3-1: Histogram displaying mean native plant species richness between monitoring years

3.1.1.2 Vegetation integrity

BAM and vegetation integrity scores (VIS) were calculated across a four-year period for the four White Box - Yellow Box - Blakely's Red Gum Grassy Woodland BAM plots. **Table 3-1** provides a summary of these scores.

Table 3-1: BAM composition, structure, function and VI scores across 2019 – 2022

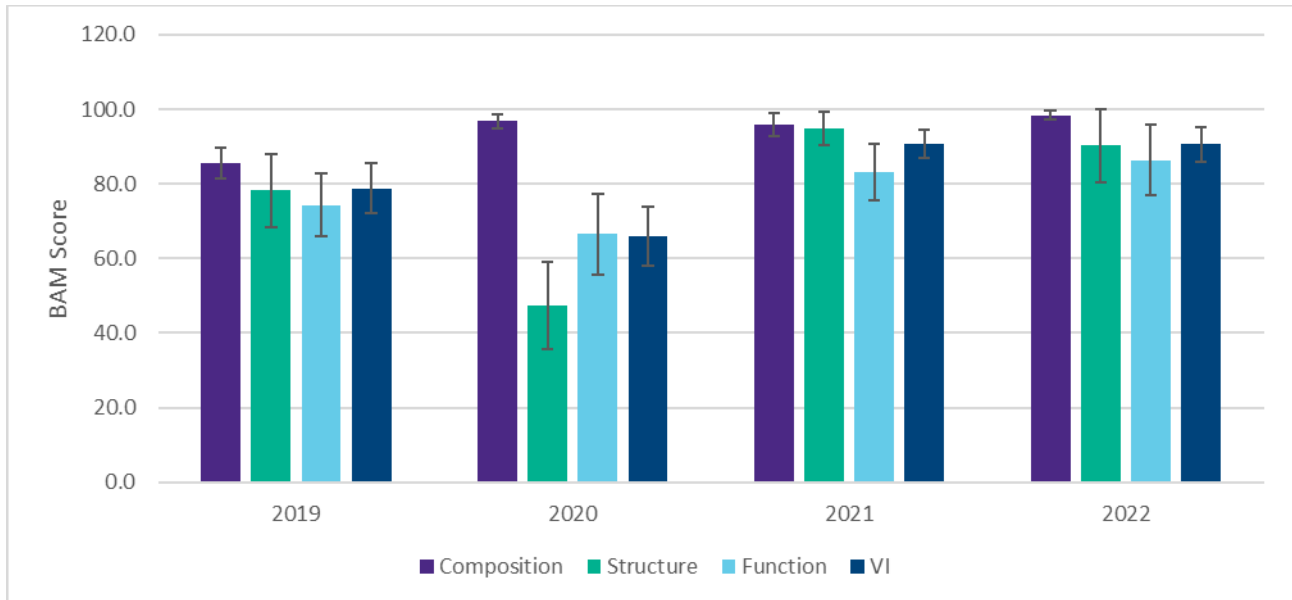
Year	Composition	Structure	Function	VI Score
2019	85.4	78.3	74.3	78.8
2020	96.8	47.3	66.5	65.9
2021	96.0	94.8	83.1	90.8
2022	98.4	90.2	86.4	90.6

Red = statistical decrease; Green = statistical increase

REPORT

Paired two-tailed t-tests were performed to compare the 2022 BAM scores to previous years (see **Graph 3-2**). The results are as follows:

- 2022 BAM scores did not significantly change since 2021;
- The 2022 composition score was significantly higher than the 2019 composition score ($p = 0.0372$);
- The 2022 structure score was significantly higher than the 2020 structure score ($p = 0.0149$); and
- The 2022 VI score was significantly higher than the 2020 VI score ($p = 0.0058$).



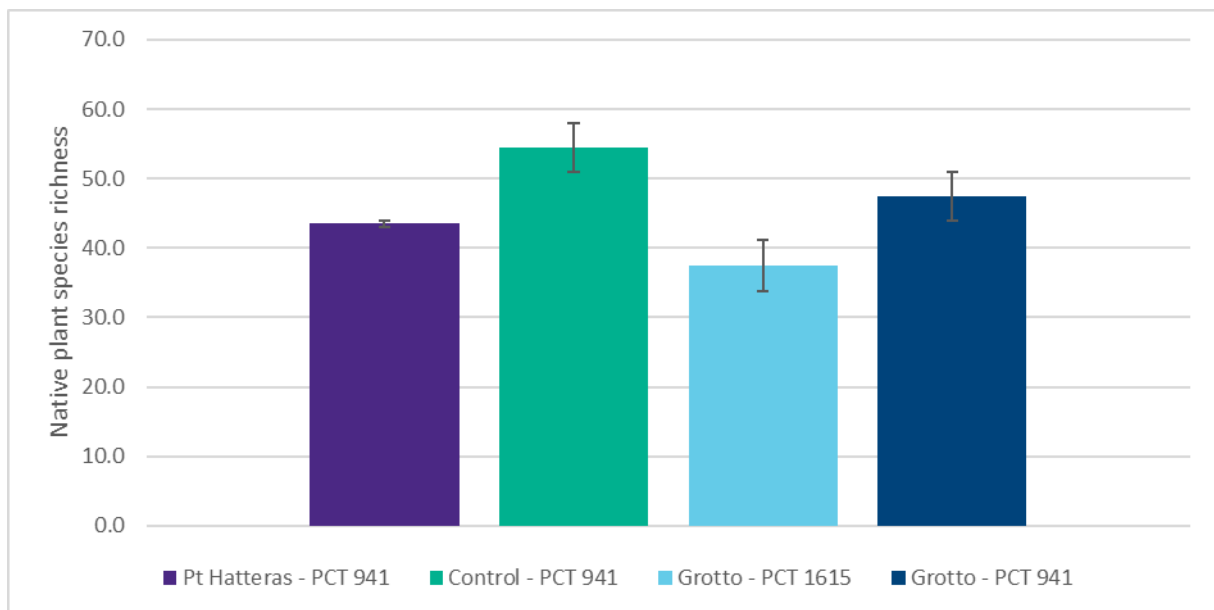
Graph 3-2: Histogram displaying mean BAM scores (composition, structure, function, VI) between monitoring years

3.1.2 Groundwater Dependent Ecosystems

Ten GDE plots were established in the 2022 monitoring period. Plots were located within both the Pt Hatteras BMP area, and within the Grotto to establish baseline data for the CLZ ML1814 BMP. See **Figure 2-1**.

3.1.2.1 Native plant species richness

Graph 3-3 below displays the 2022 native plant species richness within the GDE plots across monitoring locations. This data will be used for comparison in future monitoring periods. PCT 941 control plots display the highest species richness and generally PCT 941 has a higher diversity than PCT 1615. See **Appendix B** for the full flora inventory and photo monitoring.



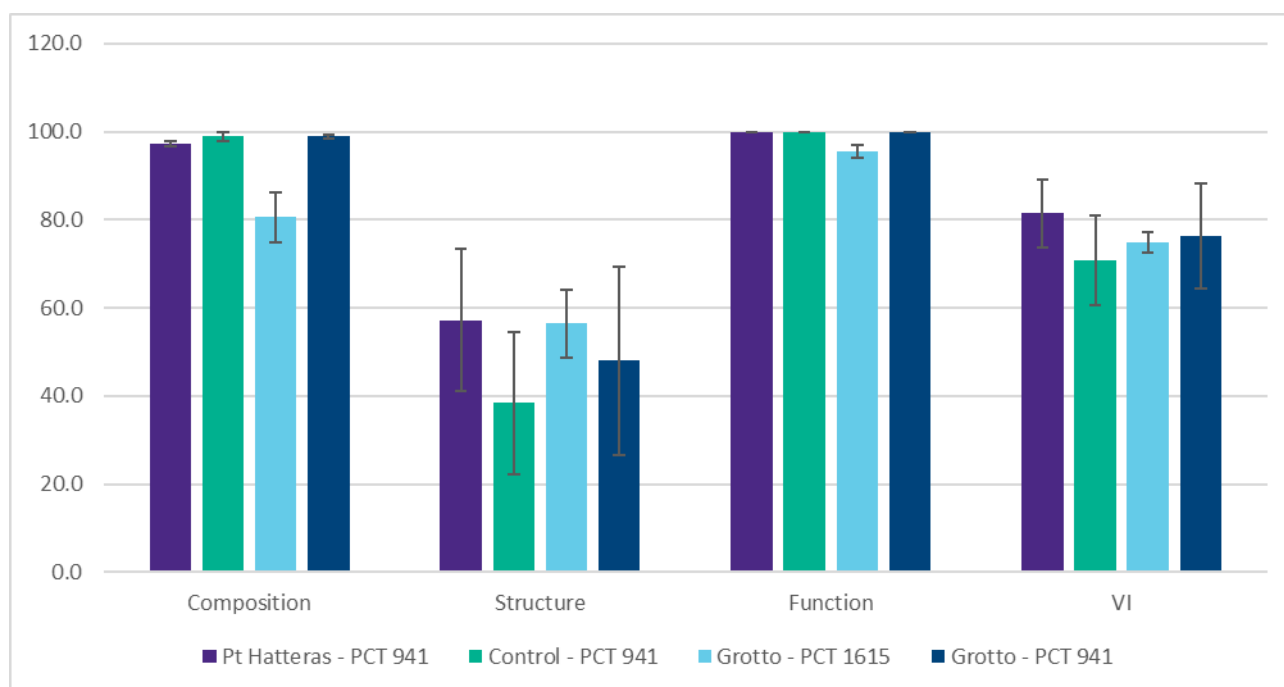
Graph 3-3: 2022 GDE plots – mean native plant species richness and SE of across monitoring location and PCT

3.1.2.2 Vegetation integrity

Table 3-2 and **Graph 3-4** displays the 2022 composition, structure, function and VI scores within the GDE plots across monitoring locations. This data will be used for comparison in future monitoring periods.

Table 3-2: 2022 GDE plots - mean BAM scores across monitoring locations

Location – PCT	Composition	Structure	Function	VI
Pt Hatteras – PCT 942	97.3	57.2	100.0	81.5
Control – PCT 941	98.9	38.4	100.0	70.9
Grotto – PCT 1615	80.6	56.4	95.5	74.9
Grotto – PCT 941	98.9	48.1	100.0	76.2



Graph 3-4: Histogram displaying mean BAM scores (composition, structure, function, VI) and SE across monitoring locations

3.1.2.3 Rapid aquatic assessment

Rapid aquatic assessment occurred along 50 m transects within the Grotto at five locations adjacent streams. **Table 3-3** provides a summary of the stream condition within the Grotto whilst **Table 3-4** provides a summary of the stream types. This data forms a part of the baseline condition of these monitoring locations.

Table 3-3 2022 stream condition

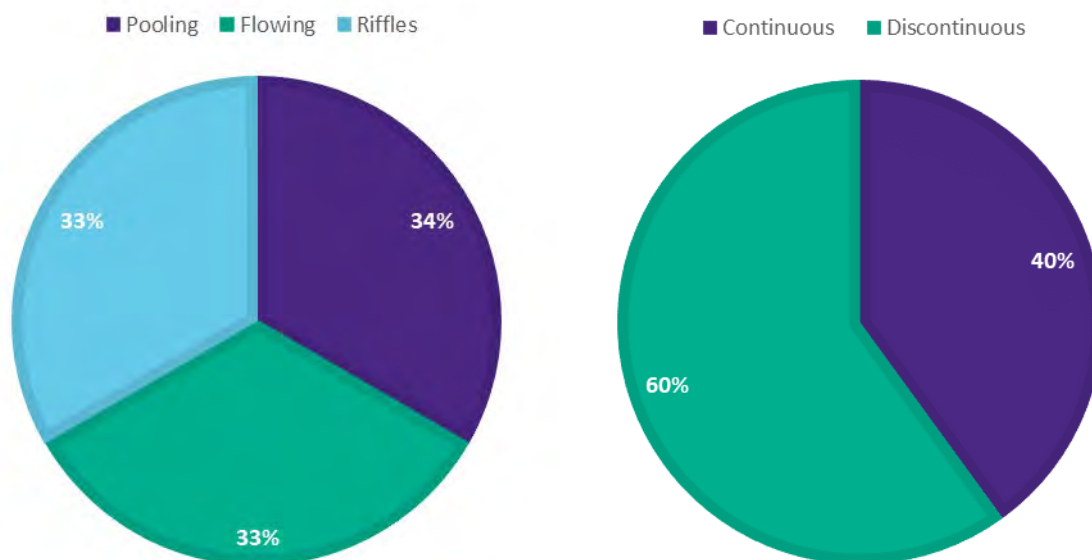
Plot name	Average flow width (m)	Max flow width (m)	Min flow width (m)	Average soil moisture $\pm 3\%$ VWC	Average Conductivity	Clarity/sediment load (0 poor – 5 clear)	Erosion (0 absent – 5 severe)
GDE BAM05	1.0	1.4	0.6	21.24	2.146	4	1
GDE BAM06	1.0	3.1	0.0	28.96	2.298	4	1
GDE BAM07	0.9	1.9	0.4	28.66	2.310	4	1
GDE BAM08	1.7	2.1	1.2	13.90	1.919	5	1
GDE BAM10	0.7	1.6	0.0	11.46	1.851	4	1

Table 3-4 2022 GDE stream type parameters

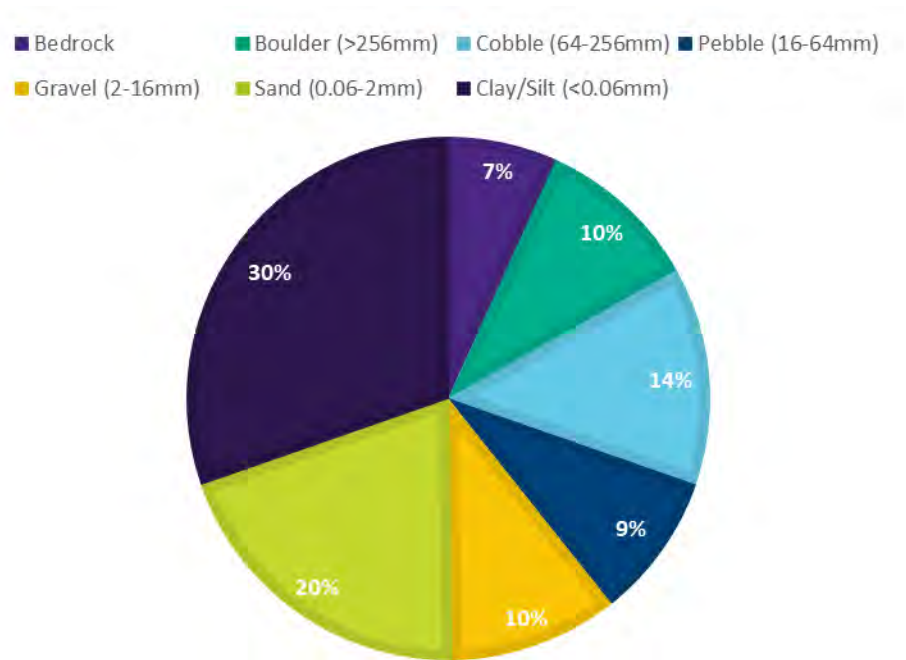
Parameter	Percent of streams sampled
Stream flow type	
Pooling	100%
Flowing	100%
Continuous	40%
Discontinuous	60%

Parameter	Percent of streams sampled
Riffles	100%
Aquatic vegetation type	
Submerged	50%
Floating	0%
Emergent	0%
Substrate type	
Bedrock	10%
Boulder (>256mm)	15%
Cobble (64-256mm)	20%
Pebble (16-64mm)	13%
Gravel (2-16mm)	16%
Sand (0.06-2mm)	30%
Clay/Silt (<0.06mm)	45%
Bank slope	
Flat <10°	0%
Low 10 – 30°	0%
Moderate 30 – 60°	25%
Steep 60 – 80°	75%
Vertical 80 – 90°	0%

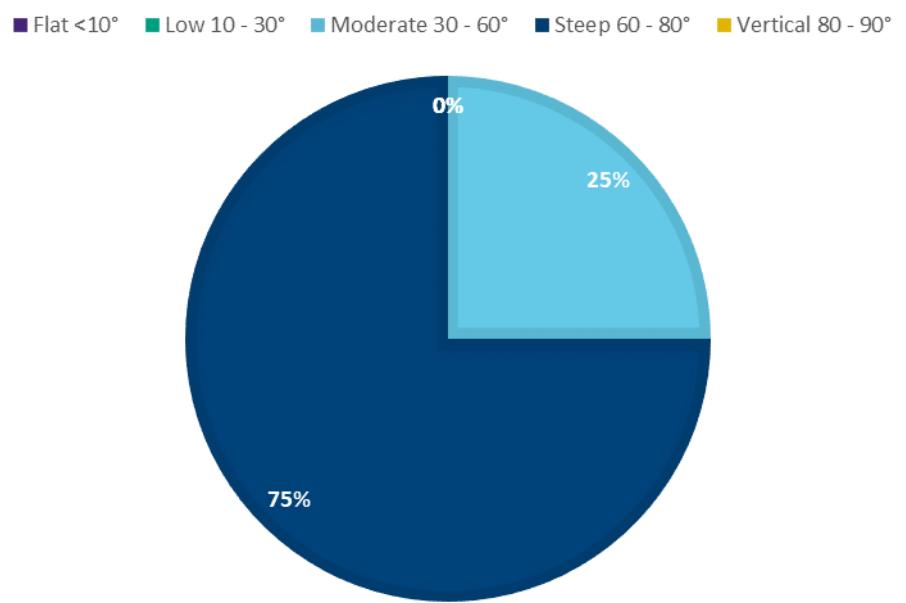
Streams typically all had areas that were pooling, flowing and riffles and more streams presented discontinuous flow (**Graph 3-5**). Aquatic vegetation was present at half the locations in the form of submerged vegetation. Substrate varied across all type, with sand and clay the most persistent substrate type (**Graph 3-6**). Bank slopes consisted of moderate to steep slopes, typically of the gully landscape position (**Graph 3-7**).



Graph 3-5: Stream flow type across sampled locations



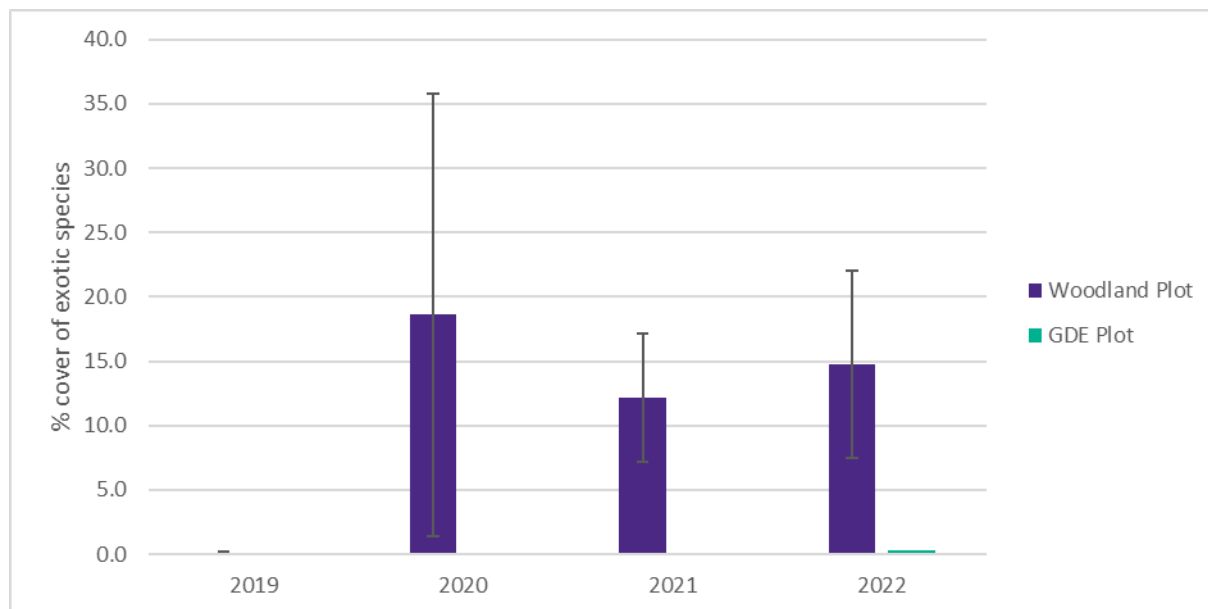
Graph 3-6: Substrate type across sampled locations



Graph 3-7: Bank slope type across sampled locations

3.1.3 Exotic species

Across the 14 BAM plots, a total of 26 exotic species were detected in the management area. This is six more than recorded within the 2021 monitoring period, however ten more monitoring locations were added in the 2022 monitoring period. In the 2022 monitoring period, there has been a reduction of exotic species cover within the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland BAM plots with an average of 7.2% cover. Within the GDE plots, exotic species cover is low with an average of 0.3% cover. See **Graph 3-8**.



Graph 3-8: Mean exotic species cover within White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and GDE BAM plots

Exotic species with a cover of 3% or greater is summarised in **Table 3-5**. Woodland plot 1 has the highest exotic species cover due to a high grass cover of *Phalaris aquatica* within the riparian area. All weed species require management requirements under the *Biosecurity Act 2015*.

Table 3-5: Occurrences of high exotic species cover in White Box – Yellow Box – Blakely's Red Gum Grassy Woodland plots

Quadrant	Exotic species with a cover of 3% or greater	Total % cover
BAM 1	<i>Phalaris aquatica</i>	30
BAM 2	<i>Conyza spp.</i>	11
BAM 4	<i>Senecio jacobaea</i>	9

3.2 Flora results

3.2.1 *Prostanthera stricta* (Mount Vincent Mint-bush)

Eighteen transects were completed across the 2022 monitoring program, including four transects which were established, and two transects that were re-established (see **Figure 2-2**). **Table 3-6** summarises the mean cover of *P. stricta* across transects at each monitoring location.

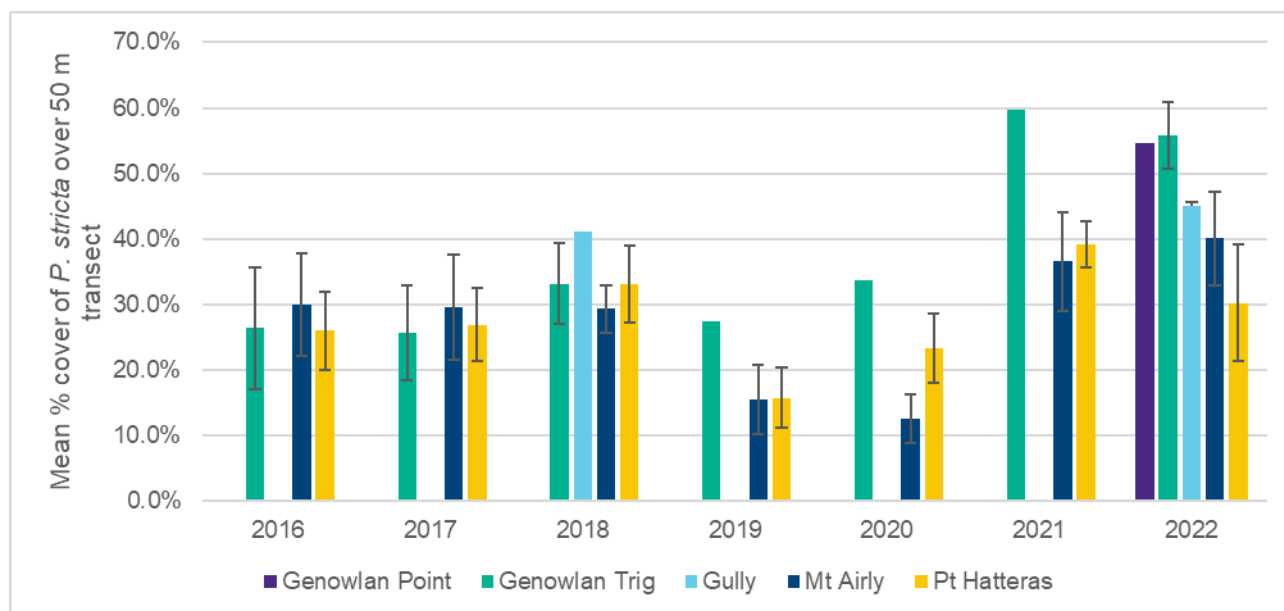
Table 3-6: Mean % cover of *P. stricta* across location and years (n = number of transects)

Location	Mean cover						
	Y2016	Y2017	Y2018	Y2019	Y2020	Y2021	Y2022
All transects	28.1% (n =10)	28.0% (n =10)	31.8% (n =14)	16.6% (n =12)	17.4% (n =11)	39.4% (n =11)	42.7% (n =15)
Genowlan Point							54.6%
Genowlan Trig	26.5%	25.8%	33.2%	27.4%	33.8%	59.8%	55.8%
Gully			41.1%				45.1%
Mt Airly	29.9%	29.6%	29.3%	15.6%	12.5%	36.6%	40.2%
Pt Hatteras	26.0%	26.9%	33.1%	15.8%	23.3%	39.2%	30.3%

Red = statistical decrease; Green = statistical increase

A one-way ANOVA was performed to compare monitoring year and % cover of *P. stricta* which revealed that there was a statistically significant difference in % cover of *P. stricta* between at least two years ($F(6, 76) = 5.4186$, $p = 0.0001$).

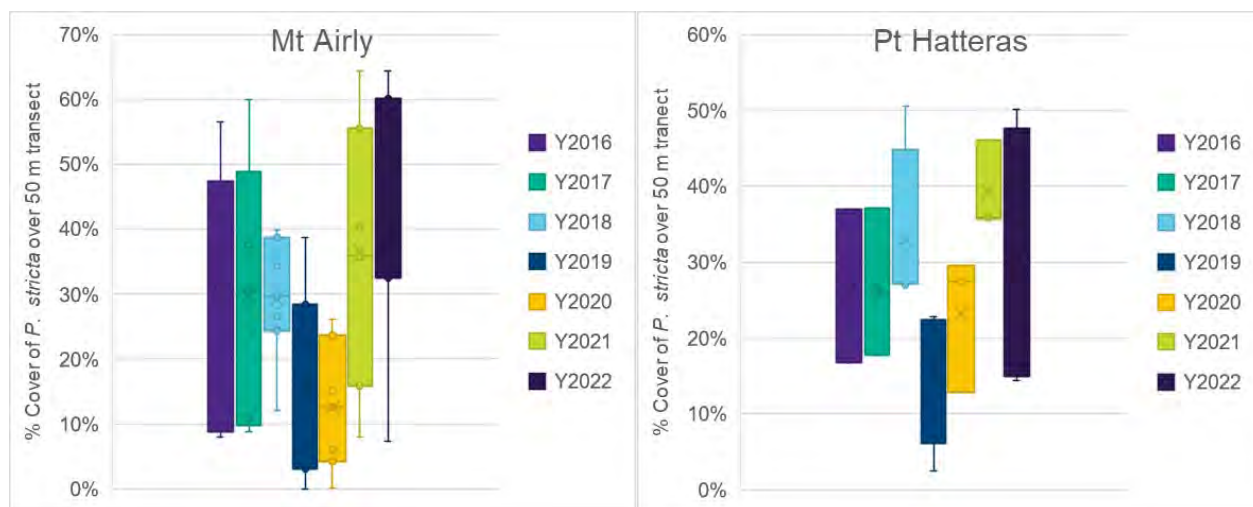
A two-tailed t-test was performed to compare the 2022 mean % cover of *P. stricta* to previous years. The mean % cover of *P. stricta* in 2022 has not significantly changed since 2021, however the mean % cover of *P. stricta* in 2022 has significantly increased since 2016, 2017, 2019 and 2020 ($p < 0.05$). See **Graph 3-9**.



Graph 3-9: Histogram displaying mean % cover of *P. stricta* and SE across monitoring locations and years. Note that transects at Genowlan Point have been established in 2022

Two-tailed t-test was performed to compare the 2022 % cover of *P. stricta* at Mt Airly, to previous years. The % cover of *P. stricta* has significantly increased in 2022, since 2018, 2019, and 2020 ($p = 0.0185$; 0.0002 ; 0.0002). The % cover of *P. stricta* at Pt Hatteras has not significantly changed. See **Error! Reference source not found.**

The statically significant increase in *P. stricta* cover over the past two years is likely linked to rainfall patterns (see **Section 2.6**) which were above the historical average for 9 months of the year (BOM 2021) and population recovery since the controlled burn across Mount Airly in 2018. It is to note that three new transects were established at Genowlan Point in 2022 and have been left out of the population analysis between years.



Graph 3-10 Graph 3 10: Box and whiskers plot displaying % cover of *P. stricta* across Mt Airly and Pt Hatteras BMP areas

3.2.2 *Eucalyptus cannonii* (Capertee Stringybark)

A total of 28 *E. cannonii* individuals were monitored (see **Table 6-1**), of which, ten were newly monitored at Pt Hatteras to establish the baseline data for MW13-16 BMP (see **Figure 2-2**). The condition as well as size class of *E. cannonii* trees were assessed as per the parameters in **Table 2-7** and were averaged depending on the monitoring location of the individuals. **Table 3-7** summarises these results. Photo monitoring is provided in **Appendix A**.

Table 3-7: Average *E. cannonii* condition classes across monitoring years

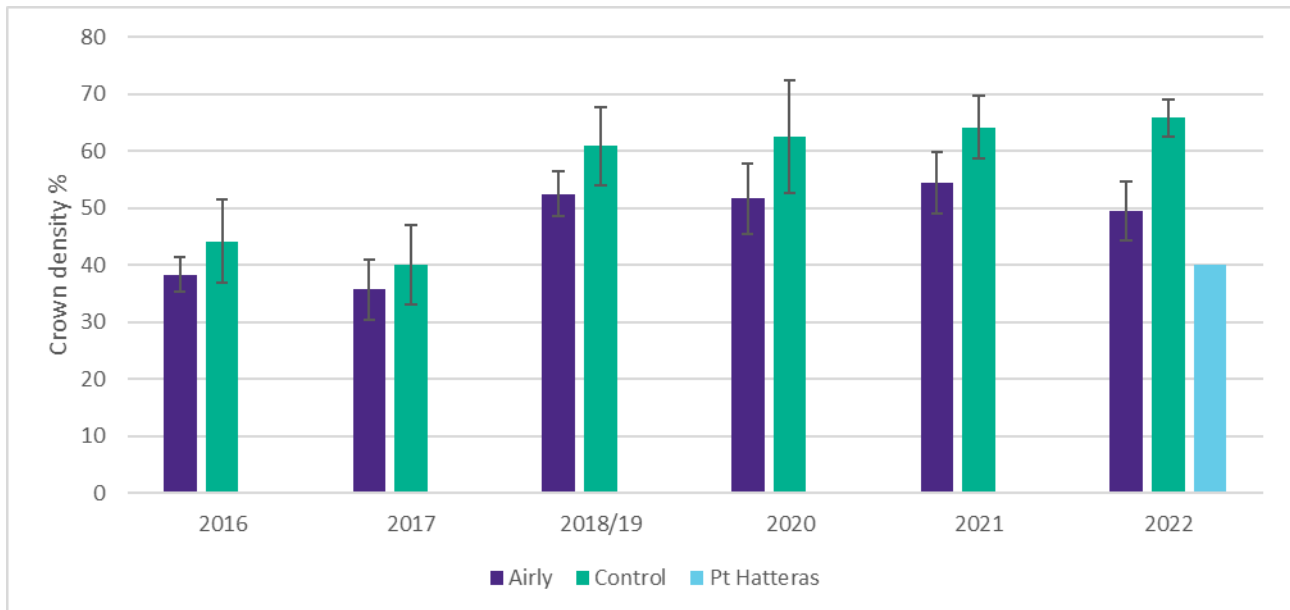
Location	2016	2017	2018/19	2020	2021	2022
Average crown density class						
Mt Airly	38	36	53	52	54	50
Control	44	40	61	63	64	66
Pt Hatteras						40
Average crown extent class						
Mt Airly	75	76	78	58	76	48
Control	73	73	85	69	69	58
Pt Hatteras						40

Red = statistical decrease since 2016/2017; Green = statistical increase since 2016/2017

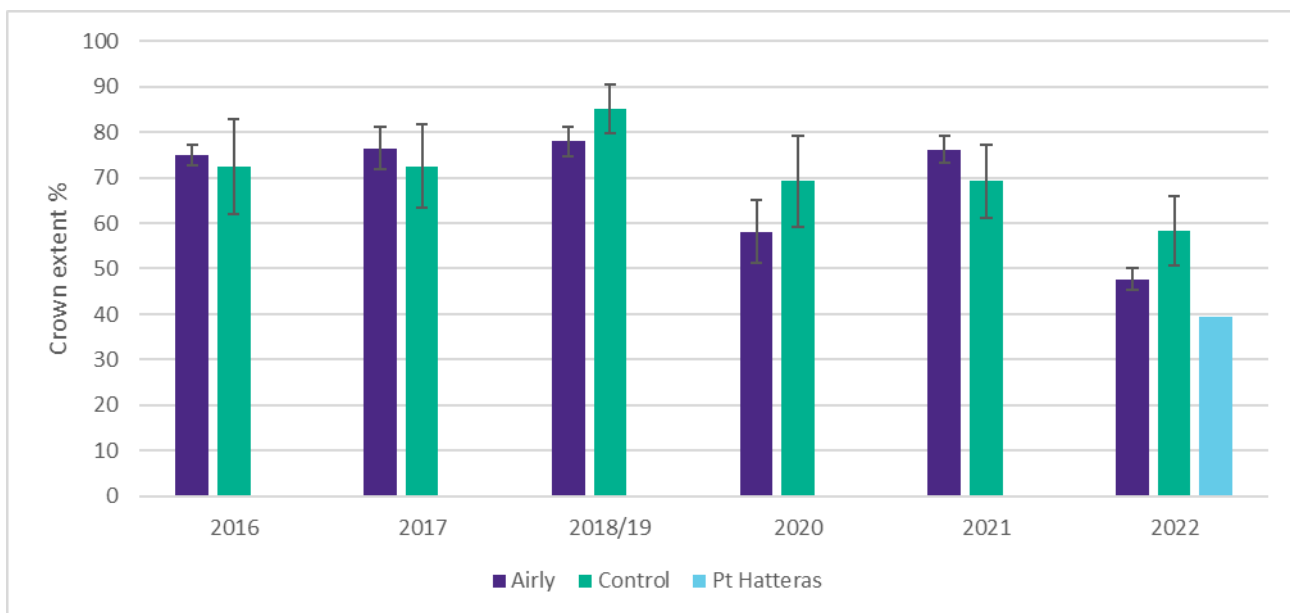
A two-tailed t-test was performed to compare the 2022 *E. cannonii* tree condition and size classes to previous years. Crown density has not significantly changed since 2016/2017 monitoring years (see **Graph 3-11**) at Mt Airly ($p > 0.05$). Within the control population crown density has significantly increased since 2016/2017 ($p = 0.0009$). The average crown extent within the Mt Airly population has significantly decreased since 2016/2017 ($p = 0.0000$) (see **Graph 3-12**). No significant crown extent changes have been observed in the control population. No significant variation in height or DBH has been observed across the populations.

Crown density increases may be correlated with higher than average rainfall over the past two years, and the transition into La Nina (see **Section 2.6**). It is unclear why crown extent has decreased and an investigation of photo monitoring display no apparent visual changes. Crown extent (i.e. the percentage of above ground biomass that forms the live tree canopy) may not be the most reliable indicator of tree health as it varies with tree age. For example, a young tree would partition more of its biomass to its leaves for photosynthesis and

growth, however a mature tree would allocate resources to trunk growth. Therefore as a tree ages, crown extent is likely to be proportionally less, when compared to the size of the tree. Therefore, crown density may be a more reliable indicator of tree health.



Graph 3-11: Histogram displaying average crown density % and SE across monitoring locations and years. Note that transects at Pt Hatteras have been established in 2022



Graph 3-12: Histogram displaying average crown extent % and SE across monitoring locations and years. Note that transects at Pt Hatteras have been established in 2022

3.3 Fauna results

3.3.1 Glossy black-cockatoos

The presence of Glossy black-cockatoos was confirmed through opportunistic sightings of individuals and the presence of *Allocasuarina* 'orts' at eight separate monitoring locations. Four additional plots were established in December 2022 within the Pt Hatteras, Genowlan Trig and Genowlan Point monitoring locations. See **Table 3-8** for a summary of the monitoring results.

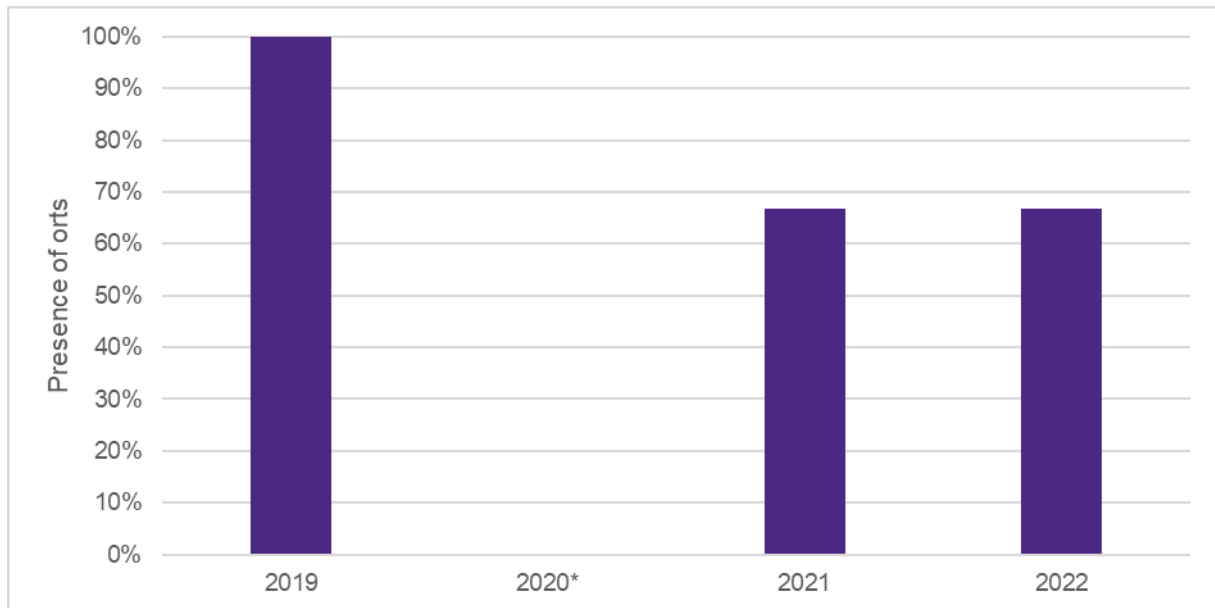
Table 3-8: 2022 Glossy black-cockatoo monitoring results

Location	Site Number	Total Canopy Cover (%)	Allocasuarina Canopy Cover (%)	Orts Present (P) or Absent (A)	Chewed Orts Ground Coverage (%)	Glossy black-cockatoo Presence (P) or Absence (A)
Airly	1	-	45	P	1	A
Airly	2	-	45	P	3	A
Airly	3	35	15	P	1	A
Airly	4	40	30	A	0	A
Airly	5	35	20	A	0	A
Airly	6	60	75	P	2	A
Pt Hatteras	7	70	55	P	1	A
Pt Hatteras	8	40	23	P	4	A
Genowlan Trig	9	45	22	P	4	A
Genowlan Point	10	50	20	P	3	A

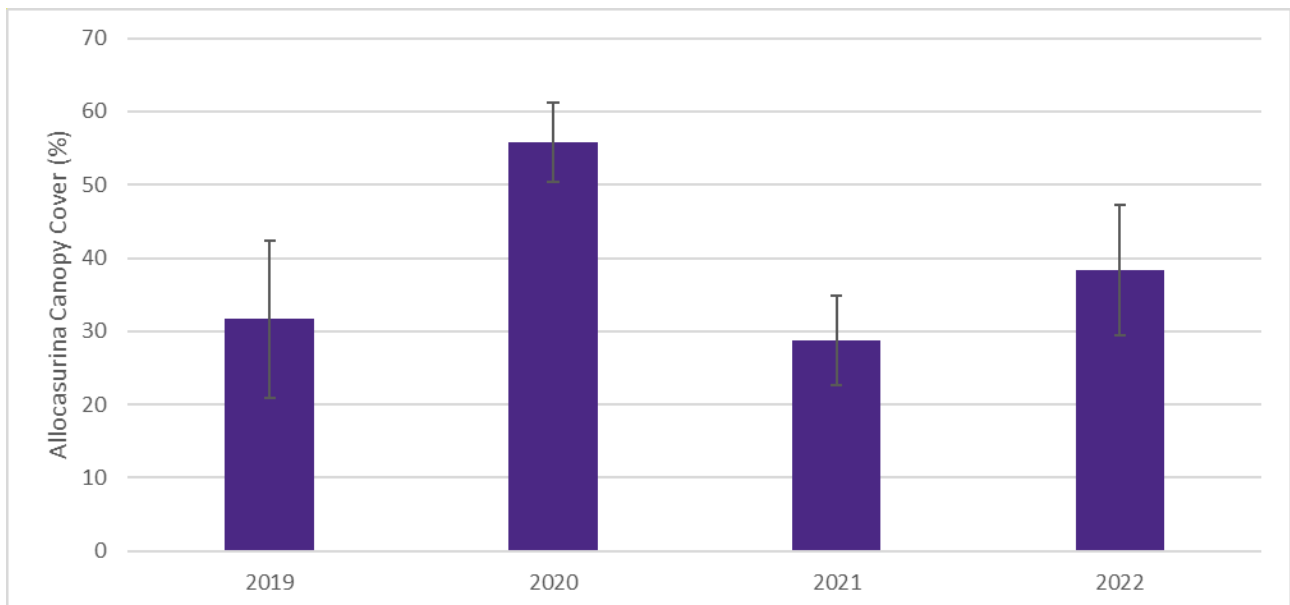
Note: - denotes missing data

No Glossy black-cockatoos were observed at the monitoring sites; however, Glossy black-cockatoo presence was confirmed by calls recorded by acoustic recordings (i.e., song meter) and opportunistic surveys.

Chewed orts were present 67% of the time which is comparable with 2021, however has reduced since 2019. Statistically, percent *Allocasuarina* canopy cover has not changed between 2022 and 2021 monitoring periods. Note, the four additional plots have not been included in this analysis. See **Graph 3-13**.



Graph 3-13: Histogram displaying presence of orts across all monitoring locations. *Note: no data collected in 2020



Graph 3-14: Histogram of mean *Allocasuarina* cover and SE across years

3.3.2 Forest owls

Three of the four forest owl roost locations were surveyed across Mt Airly. Site 2 remains inaccessible due to landslides. Searches were conducted for owl pellets and whitewash. Acoustic recordings, call playback and spotlighting confirmed the presence of a sooty owl (*Tyto tenebricosa*; BC Act: Vulnerable) at the base of Mt Airly (**Plate 3-1**).



Plate 3-1: Sooty Owl observed on Mt Airly during spotlighting

3.3.3 Woodland birds

A total of 64 bird species were detected during the 2022 monitoring period of which 41 were detected during the diurnal bird transects. The additional 23 bird species were detected through opportunistic sightings and camera trap observations. See **Appendix D** for the full fauna inventory.

Five of the recorded diurnal bird species are listed as threatened under the BC Act and two are listed under the EPBC Act. See **Table 3-9** for a summary of the threatened bird species recorded in the 2022 survey period.

Table 3-9: Threatened diurnal bird species recorded within the 2022 monitoring period

Common Name	Scientific Name	Observation Type and Method	Count	BC Act	EPBC Act
Diamond Firetail	<i>Stagonopleura guttata</i>	OW; Birding	1	Vulnerable	Not Listed
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	W; Birding	2	Vulnerable	Endangered
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	W; Songmeter	4	Vulnerable	Vulnerable
Sooty Owl	<i>Tyto tenebricosa</i>	W; Songmeter	1	Vulnerable	Not Listed
Speckled Warbler	<i>Chthonicola sagittata</i>	O; Camera trap	1	Vulnerable	Not Listed

O = Observed, W = Heard

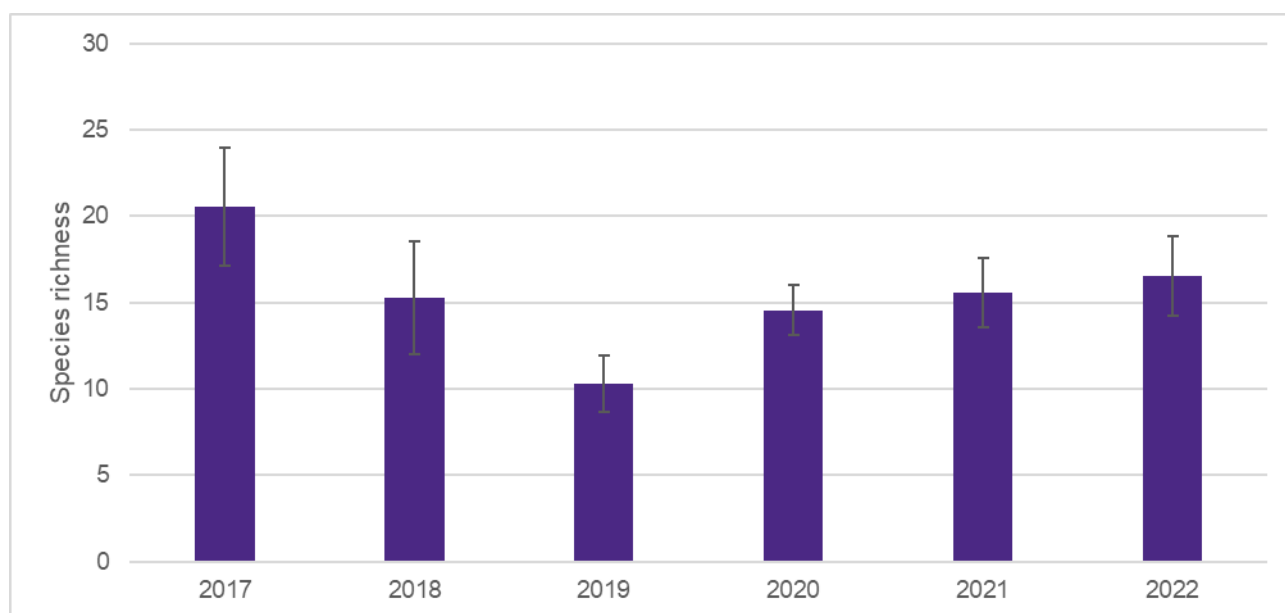


Plate 3-2: Speckled Warbler on camer R17

The Dusky Woodswallow (*Artamus cyanopterus*; BC Act: Vulnerable), Brown Treecreeper (*Climacteris picumnus victoriae*; BC Act: Vulnerable) and Scarlet Robin (*Petroica boodang*; BC Act: Vulnerable) were observed in 2021, however were not observed during this monitoring period. One cryptic threatened bird species, the Speckled Warbler (see Error! Reference source not found. and **Plate 3-2**) were observed on camera trap, a new observation within the management area.

The most common bird species was the Yellow-faced Honeyeater which was heard calling in five of the seven birding transects and observed in camera trap footage. Other common bird species noted across five or more birding transects include the Australian Raven (*Corvus coronoides*) and Laughing Kookaburra (*Dacelo novaeguineae*). Cryptic bird species such as the Bassian Thrush (*Zoothera lunulate*) was only detected by camera trap footage.

A two-tailed t-test was performed to compare the 2022 birding species richness across all transects to previous years. No significant changes were noted in bird species richness. Therefore it is deemed that the bird species richness across the management area is stable as shown in **Graph 3-14**.



Graph 3-15: Histogram of mean bird species richness and SE across years

3.3.4 Cave-dwelling microbats

A total of eight Anabat detectors were installed over four nights in February 2022 and eight Anabat detectors over four nights in December 2022. A total of 71,590 call sequences were recorded, of which 34,560 call sequences were able to be analysed (i.e. were not 'noise' files or bat calls of short length). Of the bat calls, 14,589 call sequences (42 %) were able to be confidently identified (those classified as either definite or probable identifications) to species level. Species recorded in the 2022 monitoring period, confidence level and their BC Act and EPBC Act status are summarised in **Table 3-10**.

Two of the three target microbat species were detected at a definite confidence level during both spring and summer surveys, being the Eastern Horseshoe-bat (*Rhinolophus megaphyllus*) and the Large-eared Pied-bat (*Chalinolobus dwyeri*; BC Act: Vulnerable; EPBC Act: Vulnerable). The Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*) was possibly detected at Anabat 4, 8, 11, and 12 (see **Figure 2-3**), however calls of the Southern Forest Bat (*Vespadelus regulus*) overlap in this region and it can't be distinguished reliably from bat calls. However, given the high number of calls, and location at a known bat roost, it is likely that the Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*) is roosting there.

One threatened microbat species, the Large-eared Pied Bat (*Chalinolobus dwyeri*; BC Act: Vulnerable; EPBC Act: Vulnerable) was confidently detected in the 2022 monitoring period. Two threatened microbat species, Large-footed Myotis (*Myotis macropus*; BC Act: Vulnerable) and Little Forest Bat (*Vespadelus troughtoni*; BC Act: Vulnerable) were possible detections in the 2022 monitoring period.

Due to the high number of calls of the Eastern Horseshoe Bat (*Rhinolophus megaphyllus*) during February, the adits (Anabats 11 and 8) are likely to be a maternity colony of this species. The complete bat call analysis is in **Appendix E**.

Table 3-10: Microbat species recorded in the 2022 monitoring period

Species Name	Common Name	Confidence	Anabat	BC Act	EPBC Act
<i>Austronomus australis</i>	White-striped Free-tailed Bat	Definite	4, 6, 11, 12	Not Listed	Not Listed
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Definite	4, 6, 11, 12	Vulnerable	Vulnerable
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	Definite	4, 6, 11, 12, 8	Not Listed	Not Listed
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	Definite	4, 6	Not Listed	Not Listed
<i>Ozimops ridei</i>	Ride's Free-tailed Bat	Definite	4, 6	Not Listed	Not Listed
<i>Ozimops planiceps</i>	Southern Free-tailed Bat	Definite	4, 6, 8	Not Listed	Not Listed

Species Name	Common Name	Confidence	Anabat	BC Act	EPBC Act
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe Bat	Definite	1, 11, 2, 3, 8	Not Listed	Not Listed
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	Definite		Not Listed	Not Listed
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Definite	4	Vulnerable	Not Listed
<i>Vespadelus darlingtoni</i>	Large Forest Bat	Definite	12, 4, 6	Not Listed	Not Listed
<i>Falsistrellus tasmaniensis</i>	Eastern Falsistrelle	Probable	11, 4, 6	Not Listed	Not Listed
<i>Myotis macropus</i>	Large-footed Myotis	Probable	11, 12, 4, 8	Vulnerable	Not Listed
<i>Nyctophilus geoffroyi</i>	Lesser long-eared Bat	Probable	11, 12, 4, 8	Not Listed	Not Listed
<i>Nyctophilus gouldi</i>	Gould's long-eared Bat	Probable	11, 12, 4, 8	Not Listed	Not Listed
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	Probable	11, 4, 6	Not Listed	Not Listed
<i>Vespadelus regulus</i>	Southern Forest Bat	Probable	3, 4, 6, 8, 11, 12	Not Listed	Not Listed
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	Probable	12, 4, 6, 8	Vulnerable	Not Listed
<i>Vespadelus vulturnus</i>	Little Forest Bat	Probable	12, 4, 6, 8	Not Listed	Not Listed

3.3.5 Vertebrate census

A total of 16 native vertebrate species (excluding birds and microbats) were detected during the 2022 monitoring period. This included:

- four frog species;
- nine mammal species; and
- three reptiles.

Of the 16 native vertebrate species (excluding birds and microbats), one is listed as Vulnerable under the BC Act. See **Table 3-11** for threatened fauna species recorded in the 2022 survey period. The Spotted-tailed Quoll (*Dasyurus maculatus*; BC Act: Vulnerable; EPBC Act: Endangered) has not been observed since 2012. See **Appendix D** for the full fauna inventory.

Table 3-11: Threatened fauna species (excluding birds and microbats) recorded during the 2022 survey period

Scientific Name	Common Name	Observation Type and Method	Count	BC Act	EPBC Act
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	O, Camera trap	2	Vulnerable	Not Listed

O = Observed, W = Heard

It is to note that Rosenberg's Goanna (*Varanus rosenbergi*) was observed at Pt Hatteras for the third year in a row. See **Plate 3-3**.



Plate 3-3: Rosenberg's Goanna (*Varanus rosenbergi*: BC Act: Vulnerable)

3.3.6 Feral species

Four feral fauna species were recorded during the 2022 monitoring period as summarised **Table 3-12**.

Table 3-12: Feral fauna species within the management area

Scientific Name	Common Name	Count	Method of Observation
Cat	<i>Felis catus</i>	2	Camera trap
European cattle	<i>Bos taurus</i>	1	Camera trap
Fox	<i>Vulpes vulpes</i>	6	Camera trap
Pig	<i>Sus scrofa</i>	2	Camera trap

The European Fox was the most common feral species being seen on six of the 12 camera traps. No feral dogs (*Canis lupus*) were recorded in the 2022 monitoring period, however, were present in the 2021 period. See **Appendix D** for the full fauna inventory.

Centennial Airly actively participate in feral species management strategies (Airly Cat Trapping Program, Local Land Services District Wild Dog Control, engaging third-party feral species control), and is an ongoing recommendation that is upheld by Centennial Airly.

4 COMPLIANCE

Table 4-1: Assessment of biodiversity related subsidence impact performance measures (Schedule 3 – condition 2 SSD-5581)

Biodiversity feature – Performance measure	Biodiversity monitoring	Location addressed in report	Relevant BMP	Comment	Compliance status for monitoring period
Gap and Genowlan Creeks The Grotto Threatened species, threatened populations, EECs and groundwater dependent ecosystems. - Negligible environmental consequences to water quality and to bed and bank stability - No greater environmental consequences than predicted in the EIS to water flows (including baseflow) Negligible subsidence impacts or environmental consequences	Groundwater Dependant Ecosystems (GDE)	Section 3.1.2	CLZ ML1814 BMP	- Ten GDE plots were established in the 2022 monitoring period. Plots were located within both the Pt Hatteras BMP area, and within the Grotto to establish baseline data to provide baseline condition for the CLZ ML1814 BMP. - GDE plots consist of photo monitoring BAM plots and a 50 m rapid aquatic assessment based on AUSRIVAS where suitable.	Repeatable and measurable monitoring methods established. Baseline data collected.
Threatened species, threatened populations, EECs and groundwater dependent ecosystems.	White Box – Yellow Box – Blakely's Red Gum Woodland	Section 3.1.1	- Western Region BMP - Mt Airly BMP	- The mean native species richness in 2022 has not significantly changed since 2020, however has significant increased since the 2015 to 2018 monitoring years. - Vegetation integrity scores have been calculated for year 2019 to 2022 in line with the BAM. 2022 structure and VI scores are higher than in 2020, however not at a level of significance.	Increase in species richness and BAM scores, therefore SSD-5581 compliance has been met

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Biodiversity feature – Performance measure	Biodiversity monitoring	Location addressed in report	Relevant BMP	Comment	Compliance status for monitoring period
Negligible environmental consequences	<i>Prostanthera stricta</i> (Mount Vincent Mint-bush)	Section 3.2.1	- Western Region BMP - Mt Airly BMP - ML1331 CLZ BMP - Pt Hatteras BMP - MW17-19 BMP	- Four additional monitoring transects were installed, and two were re-established to provide supplementary controls, and for Pt Hatteras and MW17-19 BMPs. - Transects were stratified into BMP locations to provide power for statistical analysis. - Across all transects, the % cover of <i>P. stricta</i> has significantly increased since 2020. - At Mt Airly, the % cover of <i>P. stricta</i> has significantly increased in 2022, since 2018, 2019, and 2020 which is likely linked to higher than average rainfall patterns and population recovery since the controlled burn across Mt Airly in 2018. - The % cover of <i>P. stricta</i> at Pt Hatteras has not significantly changed.	Increase in <i>P. stricta</i> cover, therefore SSD-5581 compliance has been met
	<i>Eucalyptus cannonii</i> (Capertee Stringybark)	Section 3.2.2	- Western Region BMP - Mt Airly BMP - Pt Hatteras BMP	- Ten additional <i>E. cannonii</i> trees are being monitoring across Pt Hatteras. - The average <i>E. cannonii</i> crown density has significantly increased since 2017 at both the Mt Airly and control populations. - The average crown extent within the Mt Airly population has significantly decreased since 2021. - No significant variation in height or DBH has been observed across any of the populations. - Crown extent may not be the most reliable indicator of tree health, as it varies significantly with tree age. Therefore crown density would be a more reliable indicator of tree health.	Whilst crown extent has significantly reduced between monitoring years, crown density is stable or increased since 2017. Therefore, <i>E. cannonii</i> tree health is stable across populations therefore SSD-5581 compliance has been met.
Threatened species, threatened populations, EECs and groundwater dependent ecosystems. Negligible environmental consequences	Glossy-black Cockatoos (<i>Calyptorhynchus lathami</i>)	Section 3.3.1	- Western Region BMP - Mt Airly BMP - ML1331 CLZ BMP - Pt Hatteras BMP	- Four additional plots were established in December 2022 within the Pt Hatteras, Genowlan Trig and Genowlan Point monitoring locations. - The presence of Glossy black-cockatoos was confirmed through, acoustic recording and opportunistic sightings of individuals and 'orts' were noted as present at eight separate monitoring locations.	Continued persistence of threatened bird species, therefore SSD-5581 compliance has been met.
	Large Forest Owls	Section 3.3.2		No roost sites displayed indirect evidence of use (i.e. white wash and pellets); however, a Sooty Owl (<i>Tyto tenebricosa</i>;	

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Biodiversity feature – Performance measure	Biodiversity monitoring	Location addressed in report	Relevant BMP	Comment	Compliance status for monitoring period
			- MW17-19 BMP - CLZ ML1814 BMP	BC Act: Vulnerable) was detected by means of song meter and spotlighting. Statistical analysis confirmed that bird species richness across the management area is stable.	
	Diurnal birds, including threatened and regionally significant woodland bird species	Section 3.3.3			
	Cave-dwelling microbats	Section 3.3.4		- Similarly to 2021, two of the three target microbat species were detected at a definite confidence level during both spring and summer surveys, being the Eastern Horseshoe-bat (<i>Rhinolophus megaphyllus</i>) and the Large-eared Pied-bat (<i>Chalinolobus dwyeri</i>; BC Act: Vulnerable; EPBC Act: Vulnerable). - The breeding colony of Eastern Horseshoe Bat continues to persist at the adit locations.	Persistence of roosting and breeding microbat species, therefore SSD-5581 compliance has been met.
	Vertebrate census/ other targeted fauna	Section 3.3.5		- Rosenberg's Goanna (<i>Varanus rosenbergi</i>) was observed at Pt Hatteras for the third year in a row. - Four feral fauna species were recorded on camera traps including European cattle on one occasion, Feral cats on two occasions, feral pigs on two occasions, and European foxes on six occasions. - No feral dogs were recorded during the 2022 monitoring period.	Persistence of threatened fauna species and relatively low pest species, therefore SSD-5581 compliance has been met
<i>Pultenaea</i> sp. Genowlan Point population and Genowlan Point Heathland community. No environmental consequences	<i>Pultenaea</i> sp. Genowlan Point population and Genowlan Point Heathland community	N/A	N/A	Monitored by NPWS	N/A

5 CONCLUSION

This annual monitoring addresses the biodiversity-related conditions of consent outlines in SSD-5581. Schedule 3, Condition 2 of the SD-5581 development consent specifies the following performance measures:

5. Gap and Genowlan Creeks: Negligible environmental consequences to water quality and to bed and bank stability; no greater environmental consequences than predicted in the EIS to water flows (including baseflow).
6. The Grotto: Negligible subsidence impacts or environmental consequences.
7. Threatened species, threatened populations, EECs and groundwater dependent ecosystems (with the exception of those listed below): Negligible environmental consequences.
8. *Pultenaea* sp. Genowlan Point population and Genowlan Point *Allocasurina nana* Heathland community: No environmental consequences.

This monitoring report comprises information pertaining to performance measure three and provides baseline biodiversity data for the performance measures one and two. Performance measure 4 is addressed in a separate monitoring report prepared by National Parks and Wildlife Services (NPWS).

The 2022 monitoring results have displayed that threatened species, threatened populations, EECs and groundwater dependent ecosystems are still persisting in the management area, with negligible environmental consequences. Further discussion is provided below.

5.1 Vegetation communities

The mean native species richness of the White Box – Yellow Box – Blakely's Red Gum Woodland CEEC plots has not significantly changed since 2020, however has significantly increased since the 2015 to 2018 monitoring years. VI scores have been calculated for year 2019 to 2022 in line with the BAM (State of NSW 2020) of which the 2022 structure and VI scores are significantly higher in comparison to 2020.

Ten GDE plots were established in the 2022 monitoring period to establish baseline condition for future Extraction Plan BMPs. GDE plots consist of photo monitoring BAM plots and a 50 m rapid aquatic assessment based on a modified form of the Australian River Assessment System (AUSRIVAS) methodology where suitable.

A total of 26 exotic species were detected in the management area. In the 2022 monitoring period, there has been a reduction of exotic species cover within the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland BAM plots. BAM plot 1 has the highest weed cover due to a high grass cover of *Phalaris aquatica* within the riparian area. GDE plots display a negligible weed species cover. All weed species require management under the *Biosecurity Act 2015*. In 2022 Centennial Airly conducted an extensive weed program on the Airly Pit Top and surrounding mine owned lands, including weed spraying works on property at the base of Mt Genowlan and weed control works in the Carinya Offset Area.

5.2 Flora

Percent cover of *P. stricta* across all transects in 2022 has significantly increased since 2020. At Mt Airly, the % cover of *P. stricta* has significantly increased in 2022, since 2018, 2019, and 2020 which is likely linked to higher than average rainfall patterns and population recovery since the controlled burn across Mount Airly in 2018. The % cover of *P. stricta* at Pt Hatteras has not significantly changed.

The following significant *E. cannonii* results were identified by the analysis:

- Crown density has not significantly changed since 2016/2017 monitoring years at the Mt Airly population.
- Crown density has significantly increased within the control population since 2016/2017.
- The average crown extent within the Mt Airly population has significantly decreased since 2021.
- No significant variation in height or DBH has been observed across the populations.

Crown density increases may be correlated with higher than average rainfall over the past two years, and the transition into La Nina. It is unclear why crown extent has decreased; however crown extent may not be the most reliable indicator of tree health as it varies with tree age. Generally, as a tree ages, crown extent is likely to be proportionally less, when compared to the size of the tree. Therefore, crown density may be a more reliable indicator of tree health.

5.3 Fauna

Continued monitoring of Glossy black-cockatoos has shown that this species persists on site, with evidence of feeding (chewed orts) and the presence of individuals recorded opportunistically and through songmeter recordings throughout the management area.

No roost sites displayed evidence of use (i.e. white wash and pellets) and Site 2 remains inaccessible due to landslides. However, a Sooty Owl (*Tyto tenebricosa*; BC Act: Vulnerable) was observed during spotlighting and recorded on songmeter.

Five of the 64 bird species recorded are listed as threatened under the BC Act which include Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable; EPBC Act: Endangered), Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable; EPBC Act: Vulnerable), Diamond Firetail (*Stagonopleura guttata*; BC Act: Vulnerable) and Speckled Warbler (*Chthonicola sagittata*; BC Act: Vulnerable). The speckled warbler is a new threatened bird species detected within the management area. No significant changes were noted in bird species richness, therefore it is deemed that the bird species richness across the management area is stable.

Two of the three target microbat species were detected at a definite confidence level during both spring and summer surveys, being the Eastern Horseshoe-bat (*Rhinolophus megaphyllus*) and the Large-eared Pied-bat (*Chalinolobus dwyeri*; BC Act: Vulnerable; EPBC Act: Vulnerable). Whilst not definite, it is likely that given the high number of calls, and location at a known bat roost, the Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*) is also roosting in the study area. The adits are likely to be the location of the Eastern Horseshoe Bat (*Rhinolophus megaphyllus*) maternity colony. Two other threatened microbat species were possibly detected within the study area which are Large-eared Pied Bat (*Chalinolobus dwyeri*; BC Act: Vulnerable; EPBC Act: Vulnerable) and the Eastern Horseshoe-bat (*Rhinolophus megaphyllus*; BC Act: Vulnerable; EPBC Act: Vulnerable). Of the 16 native vertebrate species (excluding birds and microbats) detected during the 2022 monitoring period, one is listed as threatened under the BC Act and/or EPBC Act. Rosenberg's Goanna (*Varanus rosenbergi*; BC Act: Vulnerable) was observed on a camera trap at Point Hatteras for the third year in a row.

Four feral fauna species were recorded on camera traps during the 2022 monitoring period including European Cattle on one occasion, feral cats on two occasions, feral pigs on two occasions, and European foxes on six occasions. Feral species activity has increased since last year, however no feral dogs were recorded this year. Centennial Airly actively participate in feral species management strategies (Airly Cat Trapping Program, Local Land Services District Wild Dog Control, engaging third-party feral species control). In 2022 Centennial Airly employed Apex Enviro Solutions to conduct pest control work across Airly Pit Top, Carinya Offset Area and Benrnina. This program resulted in the removal of 81 pigs, one fox and two cats. Pest control is an ongoing recommendation that is upheld by Centennial.

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Appendix A

2022 *Eucalyptus cannonii* monitoring photos

Table 6-1: Condition Assessment for *Eucalyptus cannonii*

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
1	35	40	-	22	80	No	No	No	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
2	70	40	-	18	36	No	No	No	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
4	25	40	-	21	65	no	no	no	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
5	70	80	-	20	90	no	no	yes	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
6	65	60	-	12	40	no	yes	no	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
7	70	80	-	17	60	no	no	no	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
8	45	60	-	23	82	no	no	no	
									

Photo Monitoring Point								
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence
9	40	40	-	23	80	no	no	yes
								

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
10	50	50	-	12	45	no	no	no	
11	70	40	-	18	27	no	yes	-	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
12	70	40	-	20	76	no	yes	no	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
13	65	55	-	20	54	no	no	yes	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
14	55	50	-	22	62	no	no	no	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
15	70	60	-	19	55	no	no	no	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
16	30	50	-	6	20	no	no	no	

Photo Monitoring Point								
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence
17	40	40	-	7	20	no	no	yes
								

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
18	70	50	-	8	35	no	no	no	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
22	65	50	1	15	32.5	no	no	yes	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
23	65	40	5	15	32	no	no	no	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
24	60	30	1	16	32.5	no	no	yes	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
25	20	60	2	11	26	no	no	yes	

Photo Monitoring Point								
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence
26	15	20	100	7	21.5	no	no	yes
								

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
27	25	30	30	10	20	no	no	yes	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
28	25	60	40	11	27	no	no	yes	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
29	25	30	85	9	24	no	no	yes	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
30	45	35	5	10	33.5	no	no	yes	

Photo Monitoring Point									
Tree ID	Crown density (%)	Crown extent (%)	Crown Epicormic Growth Extent (%)	Height (m)	DBH (cm)	Signs of Subsidence	Signs of erosion	Weed presence	
31	55	40	20	10	34	no	no	yes	

Appendix B

White Box - Yellow Box - Blakely's Red Gum Grassy Woodland Plots – species list and photos

Apx Table 1: White Box - Yellow Box - Blakely's Red Gum Grassy Woodland - Flora species list

Scientific Name	Exotic	Common Name	BAM 1 Cover	BAM 1 Abundance	BAM 2 Cover	BAM 2 Abundance	BAM 3 Cover	BAM 3 Abundance	BAM 4 Cover	BAM 4 Abundance
<i>Acacia dawsonii</i>		Poverty Wattle	0.3	6	1	1				
<i>Acacia dealbata</i>		Silver Wattle	0.8	15	1	2			0.1	2
<i>Acacia elongata</i>		Swamp Wattle					0.3	6		
<i>Acacia falciformis</i>		Broad-leaved Hickory					15	20		
<i>Acacia implexa</i>		Hickory Wattle							0.5	1
<i>Acacia longifolia</i> <i>subsp. longifolia</i>		Sydney Golden Wattle					0.5	2		
<i>Acacia obtusifolia</i>					0.1	6			0.5	2
<i>Acaena novae-zelandiae</i>		Bidgee-widgee	0.1	20	0.1	100			0.3	15
<i>Acrotriche rigida</i>					1	8			0.3	1
<i>Adiantum aethiopicum</i>		Common Maidenhair	1	60					0.3	9
<i>Amyema spp.</i>		Mistletoe					0.2	1		
<i>Anagallis arvensis</i>	*	Scarlet Pimpernel	0.1	5			0.1	5		
<i>Aristida ramosa</i>		Purple Wiregrass			0.1	30				
<i>Aristida vagans</i>		Threeawn Speargrass			1	75	0.4	30	0.4	20
<i>Asperula conferta</i>		Common Woodruff	0.1	20	0.1	8	0.1	12	0.2	15
<i>Billardiera scandens</i>		Hairy Apple Berry			0.1	8			0.1	1

REPORT

Scientific Name	Exotic	Common Name	BAM 1 Cover	BAM 1 Abundance	BAM 2 Cover	BAM 2 Abundance	BAM 3 Cover	BAM 3 Abundance	BAM 4 Cover	BAM 4 Abundance
<i>Bossiaea prostrata</i>							1	10		
<i>Brachyscome</i> spp.					0.1	2				
<i>Bromus</i> spp.					0.1	5				
<i>Brunoniella pumilio</i>		Dwarf Blue Trumpet			0.1	10				
<i>Bursaria spinosa</i>		Native Blackthorn			3	15	0.3	1	4	60
<i>Calotis cuneata</i>		Mountain Burr-Daisy							0.2	6
<i>Calotis cuneifolia</i>		Purple Burr-Daisy	0.1	10			2	30		
<i>Cassinia sifton</i>			0.3	8						
<i>Cassinia</i> spp.					0.1	15			0.3	15
<i>Cassinia uncata</i>		Sticky Cassinia	0.2	5			0.8	15		
<i>Centaurium erythraea</i> *		Common Centaury			1	75			0.2	20
<i>Cheilanthes sieberi</i>		Rock Fern	0.2	40	0.1	15	2	50	0.2	10
<i>Cirsium vulgare</i> *		Spear Thistle	0.2	30	2	20	0.2	10	2	75
<i>Clematis glycinoides</i>		Headache Vine			2	80			3	100
<i>Conyza</i> spp.	*		0.1	20	3	120	0.1	10	2	160
<i>Coronidium</i> spp.									0.3	30
<i>Correa reflexa</i>		Native Fuschia							0.4	10
<i>Cynoglossum australe</i>			0.3	30	5	30	0.1	4	0.2	20
<i>Dampiera</i> spp.					10	1000				
<i>Daucus glochidiatus</i>		Native Carrot							0.2	15
<i>Desmodium varians</i>		Slender Tick-trefoil	0.2	30	5	1000	0.8	50	2	1000
<i>Dianella caerulea</i>		Blue Flax-lily	0.1	2						
<i>Dianella revoluta</i>		Blueberry Lily	1	20	3	30	4	40	0.3	10
<i>Dichelachne inaequiglumis</i>			2	80						
<i>Dichelachne</i> spp.					1	20			0.3	30

REPORT

Scientific Name	Exotic	Common Name	BAM 1 Cover	BAM 1 Abundance	BAM 2 Cover	BAM 2 Abundance	BAM 3 Cover	BAM 3 Abundance	BAM 4 Cover	BAM 4 Abundance
<i>Dichondra repens</i>		Kidney Weed	0.3	80	5	700	2	100	2	1000
<i>Dipodium variegatum</i>									0.1	1
<i>Echinopogon caespitosus</i>		Bushy Hedgehog-grass	2	50	2	55	4	50	0.4	25
<i>Echinopogon ovatus</i>		Forest Hedgehog Grass			5	50	4	50	0.4	23
<i>Echium vulgare</i>	*	Viper's Bugloss	0.1	3						
<i>Eleocharis dietrichiana</i>			0.2	30						
<i>Entolasia marginata</i>		Bordered Panic					0.5	50		
<i>Eucalyptus blakelyi</i>		Blakely's Red Gum	1	1			15	3		
<i>Eucalyptus dalrympleana</i>		Mountain Gum	0.1	3			4	5		
<i>Eucalyptus macrorhyncha</i>		Red Stringybark	10	5			10	2	3	1
<i>Eucalyptus melliodora</i>		Yellow Box			10	5			25	12
<i>Eucalyptus moluccana</i>		Grey Box			18	7				
<i>Eucalyptus polyanthemus</i>		Red Box					15	4		
<i>Euchiton gymnocephalus</i>			0.1	10			0.5	50		
<i>Euchiton sphaericus</i>		Star Cudweed			1	40	1	60	1	80
<i>Euchiton spp.</i>			0.1	10						
<i>Exocarpos cupressiformis</i>		Cherry Ballart							0.3	1
<i>Fabaceae indeterminate</i>	*	Legumes					0.1	2		
<i>Galium gaudichaudii</i>		Rough Bedstraw	0.1	10			0.1	5		
<i>Galium leiocarpum</i>			0.2	50			0.5	40		

REPORT

Scientific Name	Exotic	Common Name	BAM 1 Cover	BAM 1 Abundance	BAM 2 Cover	BAM 2 Abundance	BAM 3 Cover	BAM 3 Abundance	BAM 4 Cover	BAM 4 Abundance
<i>Galium spp.</i>					10	1000			0.2	100
<i>Geranium solanderi</i>		Native Geranium	0.3	80	0.1	35	0.2	10	0.4	70
<i>Geranium spp.</i>					0.1	1				
<i>Glycine clandestina</i>		Twining glycine					0.4	60	1	350
<i>Glycine microphylla</i>		Small-leaf Glycine	0.2	30			0.2	10		
<i>Glycine spp.</i>					0.1	5				
<i>Gonocarpus longifolius</i>							0.1	5		
<i>Gonocarpus tetragynus</i>		Poverty Raspwort			5	800	0.8	30	0.5	60
<i>Goodenia hederacea</i>		Ivy Goodenia					1	50		
<i>Goodenia ovata</i>		Hop Goodenia			2	100				
<i>Grevillea acanthifolia</i>			0.1	1						
<i>Haloragis heterophylla</i>		Variable Raspwort	0.1	10			0.2	10		
<i>Hibbertia obtusifolia</i>		Hoary Guinea Flower					0.2	3		
<i>Holcus mollis</i>	*	Creeping Fog	0.3	30						
<i>Hydrocotyle laxiflora</i>		Stinking Pennywort	2	100	8	800	5	300	1	300
<i>Hypericum gramineum</i>		Small St John's Wort			0.1	1	2	50		
<i>Hypericum japonicum</i>			0.2	9	0.1	2			0.1	5
<i>Hypochaeris radicata</i>	*	Catsear	2	100	1	30	1	80	1	100
<i>Indigofera australis</i>		Australian Indigo			6	40			1	12
<i>Juncus planifolius</i>			0.1	5						
<i>Lepidosperma laterale</i>		Variable Sword-sedge			1	20	0.1	2	999	25
<i>Lepidosperma neesii</i>									0.4	12

REPORT

Scientific Name	Exotic	Common Name	BAM 1 Cover	BAM 1 Abundance	BAM 2 Cover	BAM 2 Abundance	BAM 3 Cover	BAM 3 Abundance	BAM 4 Cover	BAM 4 Abundance
<i>Leucopogon muticus</i>		Blunt Beard-heath					2	2		
<i>Lindsaea linearis</i>		Screw Fern	0.1	10					0.2	9
<i>Lomandra filiformis</i>		Wattle Matt-rush							0.1	2
<i>Lomandra glauca</i>		Pale Mat-rush	0.1	3			0.1	5		
<i>Lomandra longifolia</i>		Spiny-headed Mat-rush			6	50	7	40	25	110
<i>Lomandra multiflora</i>		Many-flowered Mat-rush	0.1	2						
<i>Melichrus urceolatus</i>		Urn Heath			0.1	1				
<i>Mentha spp.</i>					0.1	5			0.1	2
<i>Microlaena stipoides</i>		Weeping Grass	15	1000	1	40	30	1000	1	80
<i>Microtis spp.</i>			0.1	30			0.1	10		
<i>Modiola spp.</i>	*		0.1	30			0.1	3	0.4	120
<i>Monotoca scoparia</i>					0.1	5			0.1	1
<i>Monotoca spp.</i>			0.1	1						
<i>Myoporum montanum</i>		Western Boobialla			3	14			1	4
<i>Opercularia hispida</i>		Hairy Stinkweed					0.8	50		
<i>Opercularia spp.</i>									0.1	1
<i>Oxalis perennans</i>			0.2	30						
<i>Oxalis spp.</i>					0.1	1			0.2	2
<i>Paspalum dilatatum</i>	*	Paspalum	0.8	30						
<i>Pellaea nana</i>		Dwarf Sickle Fern	0.1	15						
<i>Pennisetum spp.</i>			0.2	20						
<i>Persoonia linearis</i>		Narrow-leaved Geebung			0.1	3				
<i>Phalaris aquatica</i>	*	Phalaris	30	1000						
<i>Phragmites australis</i>		Common Reed	0.1	5						

REPORT

Scientific Name	Exotic	Common Name	BAM 1 Cover	BAM 1 Abundance	BAM 2 Cover	BAM 2 Abundance	BAM 3 Cover	BAM 3 Abundance	BAM 4 Cover	BAM 4 Abundance
<i>Pimelea curviflora</i>		Rice Flower							0.1	2
<i>Plantago debilis</i>		Shade Plantain	0.8	80			0.1	5		
<i>Plantago gaudichaudii</i>		Narrow Plantain	0.1	5	8	500			1	115
<i>Plantago lanceolata</i>	*	Lamb's Tongues	0.5	50	2	115	0.3	20	0.4	35
<i>Poa labillardierei</i>		Tussock	1	60	10	30			5	90
<i>Poa sieberiana</i>		Snowgrass			3	50	0.2	10	0.7	25
<i>Prunella vulgaris</i>	*	Self-heal	0.1	8						
<i>Ranunculus inundatus</i>		River Buttercup	0.1	20						
<i>Rubus fruticosus</i>	*	Blackberry complex					0.1	4		
<i>Rubus parvifolius</i>		Native Raspberry			1	20	0.1	2	0.8	20
<i>Rumex spp.</i>		Dock			0.1	10				
<i>Rytidosperma caespitosum</i>		Ringed Wallaby Grass			8	70			0.6	40
<i>Rytidosperma fulvum</i>		Wallaby Grass					3	60		
<i>Rytidosperma pallidum</i>		Redanther Wallaby Grass; Silvertop Wallaby Grass	0.2	10	1	15	2	30		
<i>Rytidosperma racemosum</i>		Wallaby Grass					2	50		
<i>Schenkia australis</i>		Spike Centaury	0.1	6			2	50		
<i>Schoenus apogon</i>		Fluke Bogrush			0.1	25				
<i>Schoenus spp.</i>					0.1	15	0.2	20		
<i>Senecio diaschides</i>					0.1	2				
<i>Senecio jacobaea</i>	*	Ragwort	0.8	30	2	80	0.8	15	3	80
<i>Senecio quadridentatus</i>		Cotton Fireweed	0.2	15	0.1	3			0.5	40
<i>Senecio spp.</i>		Groundsel, Fireweed					0.1	3		
<i>Sigesbeckia orientalis</i>		Indian Weed			0.1	1			0.3	8

REPORT

Scientific Name	Exotic	Common Name	BAM 1 Cover	BAM 1 Abundance	BAM 2 Cover	BAM 2 Abundance	BAM 3 Cover	BAM 3 Abundance	BAM 4 Cover	BAM 4 Abundance
<i>Solanum nigrum</i>	*	Black-berry Nightshade					0.2	2	0.3	5
<i>Solanum prinophyllum</i>		Forest Nightshade			0.1	8			0.8	27
<i>Sonchus oleraceus</i>	*	Common Sowthistle	0.1	2						
<i>Sonchus spp.</i>		Sowthistle							0.5	45
<i>Sporobolus spp.</i>		Rat's Tail Couch					0.1	2		
<i>Stellaria pungens</i>		Prickly Starwort	0.5	60						
<i>Taraxacum officinale</i>	*	Dandelion							0.1	1
<i>Thelionema spp.</i>							0.1	5		
<i>Themeda australis</i>			0.2	20						
<i>Themeda triandra</i>					0.1	2			0.8	55
<i>Tricoryne elatior</i>		Yellow Autumn-lily	0.1	2						
<i>Tricoryne spp.</i>					0.1	5				
<i>Typha spp.</i>			0.2	5						
<i>Verbascum thapsus</i>	*	Great Mullein	0.1	2						
<i>Verbena bonariensis</i>	*	Purpletop	0.2	20						
<i>Vernonia cinerea</i>			0.1	4			0.1	12		
<i>Veronica plebeia</i>		Trailing Speedwell			1	75	0.2	15	0.3	24
<i>Veronica spp.</i>			0.1	1						
<i>Viola betonicifolia</i>		Native Violet			0.1	2				
<i>Vittadinia cuneata</i>			0.2	20	0.1	30	2	40	0.3	25
<i>Wahlenbergia communis</i>		Tufted Bluebell	1	100			0.6	50	0.2	10
<i>Wahlenbergia gracilis</i>		Sprawling Bluebell			2	350			0.3	15

Apx Table 2: White Box - Yellow Box - Blakely’s Red Gum Grassy Woodland plot photos

Plot ID	Photo
BAM 1	 Two photographs of Plot BAM 1. The left photo shows a grassy slope with trees and a white measuring pole. The right photo shows a similar scene with a white measuring pole.
BAM 2	 Two photographs of Plot BAM 2. The left photo shows a grassy woodland with trees and a white measuring pole. The right photo shows a similar scene with a white measuring pole.

REPORT

Plot ID

Photo

BAM 3



BAM 4



Appendix C

GDE Plots – species list and photos

REPORT

ApX Table 3: GDE - Flora species list

Scientific Name	Exotic	Common Name	1 Cover	1 Abundance	2 Cover	2 Abundance	3 Cover	3 Abundance	4 Cover	4 Abundance	5 Cover	5 Abundance	6 Cover	6 Abundance	7 Cover	7 Abundance	8 Cover	8 Abundance	9 Cover	9 Abundance	10 Cover	10 Abundance
<i>Acacia melanoxylon</i>		Blackwood	4	7	8	4	1	3														
<i>Acacia obtusifolia</i>			4	10	3	3	6	20	2	5	4	10	0.5	10	0.1	1		0.5	1			
<i>Acaena novae-zelandiae</i>		Bidgee-widgee			0.1	5	0.1	2	0.1	4										0.2	10	
<i>Acrotriche rigida</i>									0.2	1												
<i>Adiantum aethiopicum</i>		Common Maidenhair									0.3	30	0.3	20			0.5	100	0.2	20		
<i>Ajuga australis</i>		Austral Bugle		0.1	6	1	30										0.2	40	0.3	10		
<i>Allocasuarina littoralis</i>		Black She-Oak				0.5	1															
<i>Amperea xiphoclada</i>									0.3	20												
<i>Amyema spp.</i>		Mistletoe						0.1	2								0.1	1				
<i>Asplenium flabellifolium</i>		Necklace Fern							0.2	20									0.1	5		
<i>Asplenium flaccidum</i>		Weeping Spleenwort									0.1	2	0.1	10								
<i>Billardiera scandens</i>		Hairy Apple Berry	0.2	20		0.1	5	0.1	5				0.1	2								
<i>Blechnum cartilagineum</i>		Gristle Fern							15	50	0.1	4	40.5	310			25	75	8	30		
<i>Blechnum nudum</i>		Fishbone Water Fern											0.1	2								
<i>Brachychiton populneus</i>		Kurrajong	0.1	1																		
<i>Bursaria spinosa</i>		Native Blackthorn		7	20	6	20	1	5										0.2	2		
<i>Calochlaena dubia</i>		Rainbow Fern							25	100	4	20	60	500					2	20		
<i>Calotis hispidula</i>		Bogan Flea				0.1	20															

REPORT

Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Cassinia spp.</i>			0.1	2		0.1	2				0.1	2										
<i>Cassinia uncata</i>		Sticky Cassinia																		0.1	1	
<i>Centaurium spp.</i>	*				0.1	4											0.1	2				
<i>Cheilanthes sieberi</i>		Rock Fern	0.1	4	0.1	6	0.1	2		0.1	10											
<i>Cirsium vulgare</i>	*	Spear Thistle			0.1	6	0.1	3		0.1	1		0.1	1						0.1	3	
<i>Clematis aristata</i>		Old Man's Beard	7	50	8	60	2	30	2	50	0.1	5	0.1	5	2.1	65		0.2	30	0.5	20	
<i>Clematis glycinoides</i>		Headache Vine							0.2	10							2	50				
<i>Conyza bonariensis</i>	*	Flaxleaf Fleabane							0.1	2												
<i>Conyza spp.</i>	*		0.1	1	0.1	5	0.2	10			0.1	2	0.1	2								
<i>Coprosma quadrifida</i>		Prickly Currant Bush																	2	9		
<i>Coronidium spp.</i>									0.1	1												
<i>Correa reflexa</i>		Native Fuschia							0.1	2							0.1	2				
<i>Correa reflexa var. reflexa</i>		Native Fuschia					0.2	3														
<i>Crassula Sieberiana</i>		Australian Stonecrop										0.1	4									
<i>Cyathea australis</i>		Rough Treefern								1	4				22	30				1	2	
<i>Cynoglossum australe</i>								2	50													
<i>Cyperus spp.</i>										0.1	1	0.1	1									
<i>Dendrobium spp.</i>										1	20											
<i>Desmodium varians</i>		Slender Tick-trefoil	0.3	40	0.2	30	0.2	20									0.1	50				

REPORT

Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Dianella caerulea</i>		Blue Flax-lily												0.3	10							
<i>Dianella caerulea</i> var. <i>caerulea</i>								0.2	20		0.5	20										
<i>Dianella caerulea</i> var. <i>producta</i>			1	15	1	10	0.5	20	1	20	3	70	1	30	0.3	5		2	50	0.1	3	
<i>Dichelachne</i> spp.			7	60	1	10	10	100	1	40	0.5	20		0.1	3					0.1	7	
<i>Dichondra repens</i>		Kidney Weed	3	100	3	80	3	100	5	200				3	100		0.1	100	2	100		
<i>Doodia aspera</i>											0.5	50					0.2	40	0.5	20		
<i>Doodia</i> spp.														2	80							
<i>Echinopogon caespitosus</i>		Bushy Hedgehog-grass	0.1	4	1	30					0.1	10	1	40					0.2	30		
<i>Echinopogon ovatus</i>		Forest Hedgehog Grass						1	50								0.1	50	0.1	8		
<i>Echium plantagineum</i>	*	Patterson's Curse			0.1	1																
<i>Einadia hastata</i>		Berry Saltbush	0.1	2																		
<i>Elaeocarpus reticulatus</i>		Blueberry Ash				0.1	1			0.7	3	4	6	15.1	10		0.1	1	4	5		
<i>Entolasia marginata</i>		Bordered Panic	3	100	2	60		0.5	30		25	1000	2	90					0.1	10		
<i>Entolasia stricta</i>		Wiry Panic												0.2	10		0.1	30				
<i>Epacris microphylla</i>		Coral Heath								0.1	3											
<i>Epacris</i> spp.						0.1	1															
<i>Eucalyptus blaxlandii</i>		Blaxland's Stringybark									6	4										
<i>Eucalyptus cannonii</i>		Capertee Stringybark				15	3	7	2													

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Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance				
<i>Eucalyptus cypellocarpa</i>		Monkey Gum	25	10	50	11	10	3		25	5	15	4				25	4	10	1			35	5	10	3
<i>Eucalyptus fastigata</i>		Brown Barrel												25	4											
<i>Eucalyptus macrorhyncha</i>		Red Stringybark	2	3					3	1	15	2														
<i>Eucalyptus piperita</i>		Sydney Peppermint								25	8	3	2					15	3		15	5				
<i>Eucalyptus polyanthemos</i>		Red Box	2	2			15	7																		
<i>Eucalyptus punctata</i>		Grey Gum												0.5	1			3	1							
<i>Eucalyptus spp.</i>					0.1	1								0.1	1											
<i>Euchiton involucratus</i>		Star Cudweed			0.2	20	0.2	50																		
<i>Euchiton spp.</i>			0.1	3					0.1	5											0.1	10				
<i>Eustrephus latifolius</i>		Wombat Berry	0.1	10																						
<i>Gahnia spp.</i>										0.2	1															
<i>Galium gaudichaudii</i>		Rough Bedstraw									0.1	5		0.1	20			0.1	20							
<i>Galium leiocarpum</i>			0.1	20	4	10	0.3	40	1	100	0.4	50	0.1	10	0.5	50		1	400	0.1	20					
<i>Galium propinquum</i>		Maori Bedstraw												1	100					0.1	10					
<i>Galium spp.</i>									0.1	5																
<i>Geitonoplesium cymosum</i>		Scrambling Lily	1	40	0.2	20	0.1	3	0.1	2	0.1	2	0.3	10	0.5	40					0.1	10				
<i>Geranium homeanum</i>											0.1	10	0.1	5				0.1	20							
<i>Geranium solanderi</i>		Native Geranium	0.1	3	1	20	0.1	4						2	80											
<i>Geranium spp.</i>																		0.3	30	1	50					
<i>Glycine clandestina</i>		Twining glycine							0.3	30								0.2	50							

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Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Glycine microphylla</i>		Small-leaf Glycine					0.2	30														
<i>Glycine spp.</i>			0.1	10	0.1	3	0.1	30														
<i>Glycine tabacina</i>		Variable Glycine					0.1	20					0.1	30						0.2	40	
<i>Gonocarpus tetragynus</i>		Poverty Raspwort				0.3	30													0.1	20	
<i>Gonocarpus teucrioides</i>		Germander Raspwort	0.3	2		0.1	3			0.1	2	1	25	0.1	2			0.3	15	0.2	10	
<i>Goodenia bellidifolia</i>						0.1	3															
<i>Goodenia ovata</i>		Hop Goodenia	7	50																		
<i>Grevillea speciosa</i>		Red Spider Flower								0.1	2											
<i>Hardenbergia violacea</i>		False Sarsaparilla				0.1	3															
<i>Hedycarya angustifolia</i>		Native Mulberry									2	20										
<i>Helichrysum elatum</i>																				0.2	1	
<i>Hibbertia empetrifolia</i>																	1	10	0.3	6		
<i>Hibbertia obtusifolia</i>		Hoary Guinea Flower				0.1	2															
<i>Hibbertia spp.</i>			0.1	4																		
<i>Hydrocotyle laxiflora</i>		Stinking Pennywort		5	10	1	50	3	200		0.2	20	3.3	220			1	200	2	100		
<i>Hydrocotyle sibthorpioides</i>											0.2	40										
<i>Hypericum gramineum</i>		Small St John's Wort		0.1	10	0.1	10													0.1	3	
<i>Hypericum spp.</i>								0.1	1													
<i>Hypochaeris glabra</i>	*	Smooth Catsear						0.1	5													

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Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Hypochaeris radicata</i>	*	Catsear		0.1	6	0.1	3			0.1	2			0.1	2							
<i>Indigofera australis</i>		Australian Indigo	1	10	0.1	1	3	10		0.1	2		0.1	2	1	4		0.5	5		0.2	5
<i>Isolepis inundata</i>		Club-rush									4	200										
<i>Juncus spp.</i>										0.1	1											
<i>Lagenifera stipitata</i>		Blue Bottle-daisy		0.1	10	1	40		0.1	20		0.1	10	0.1	10		0.1	20		0.3	30	
<i>Lepidium spp.</i>			0.2	20	0.3	20	0.1	3														
<i>Lepidosperma laterale</i>		Variable Sword-sedge		0.1	1					0.2	3											
<i>Lepidosperma spp.</i>											0.4	15		0.2	10							
<i>Leptospermum morrisonii</i>									25	20							0.1	1		30	30	
<i>Leptospermum polygalifolium</i>		Tantoon									10	30		9	12							
<i>Leucopogon juniperinus</i>		Prickly Beard-heath												0.1	1							
<i>Leucopogon lanceolatus</i>									0.5	3				0.5	5		1	1		0.3	1	
<i>Lissanthe strigosa</i>		Peach Heath		0.2	5					0.1	1											
<i>Lomandra confertifolia</i>		Matrush				0.1	2				0.1	5										
<i>Lomandra longifolia</i>		Spiny-headed Mat-rush	4	30	10	20	20	90	4	30	1	6	2	15	4.2	20		4	100	3	30	
<i>Lomandra multiflora</i>		Many-flowered Mat-rush				0.2	10															
<i>Lomandra spp.</i>		Mat-rush								0.5	5											
<i>Marsdenia spp.</i>			0.1	1										0.1	2							

REPORT

Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Medicago spp.</i>	*			0.1	3																	
<i>Microlaena stipoides</i>		Weeping Grass	10	200	30	200	1	50	2	100	0.2	10	2	100	5	140		7	1000	30	300	
<i>Notodanthonia longifolia</i>		Long-leaved Wallaby Grass									0.1	3					0.1	10				
<i>Opercularia hispida</i>		Hairy Stinkweed	0.1	2			0.1	3	0.3	20												
<i>Oplismenus aemulus</i>			0.1	4				0.1	10					3	100		5	750	5	200		
<i>Oplismenus imbecillis</i>											0.1	10										
<i>Oxalis spp.</i>																	0.1	20				
<i>Pandorea pandorana</i>		Wonga Wonga Vine	0.1	3																		
<i>Panicum spp.</i>		Panicum																		4	80	
<i>Persoonia linearis</i>		Narrow-leaved Geebung	0.1	2			0.1	2	1	2	0.7	2	0.1	4	0.1	2						
<i>Phyllanthus hirtellus</i>		Thyme Spurge	0.2	15																		
<i>Pimelea latifolia</i> subsp. <i>hirsuta</i>			0.1	1													1	15	0.2	2		
<i>Plantago debilis</i>		Shade Plantain			0.1	2	1	30														
<i>Platysace lanceolata</i>		Shrubby Platysace									0.1	1										
<i>Poa sieberiana</i>		Snowgrass						0.2	10								1	20				
<i>Poa spp.</i>					1	10	2	40														
<i>Poaceae indeterminate</i>	*	Grasses, reeds and bamboos								0.1	10											
<i>Podolobium ilicifolium</i>		Prickly Shaggy Pea					0.2	3														

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<i>Polyscias sambucifolia</i>		Elderberry Panax									0.1	5		0.1	1							
<i>Pomaderris spp.</i>											25	30										
<i>Poranthera microphylla</i>		Small Poranthera			0.1	8	0.1	20		0.2	10		0.1	4		0.1	20					
<i>Prunella vulgaris</i>	*	Self-heal						0.1	5													
<i>Pteridium esculentum</i>		Bracken	3	60		1	10	999	999	1	10	3	20	1.1	22			2	30	3	20	
<i>Pyrrosia rupestris</i>		Rock Felt Fern									0.2	40										
<i>Rhytidosporum spp.</i>					0.2	20																
<i>Rosa rubiginosa</i>	*	Sweet Briar			0.1	1																
<i>Rubus fruticosus sp. agg.</i>	*	Blackberry complex			0.1	1																
<i>Rubus parvifolius</i>		Native Raspberry			0.1	2								0.7	30			0.1	3	0.1	8	
<i>Rytidosperma pallidum</i>		Redanther Wallaby Grass; Silvertop Wallaby Grass						0.2	5													
<i>Rytidosperma racemosum</i>		Wallaby Grass						0.1	5													
<i>Rytidosperma spp.</i>								0.5	20													
<i>Schoenus apogon</i>		Fluke Bogrush									0.1	15										
<i>Senecio diaschides</i>					0.1	10	0.1	4														
<i>Senecio jacobaea</i>	*	Ragwort			0.1	20	0.1	6		0.1	1											

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Senecio minimus							1	25			0.1	5											
Senecio quadridentatus		Cotton Fireweed			0.1	2	0.1	6															
Sigesbeckia orientalis		Indian Weed	1	30	1	30																	
Solanum aviculare		Kangaroo Apple			0.3	5																	
Solanum brownii		Violet Nightshade	0.5	8	0.2	20																	
Solanum nigrum	*	Black-berry Nightshade			0.1	3																	
Solanum prinophyllum		Forest Nightshade	0.1	10			0.1	3		0.1	5			0.1	5			0.1	20		0.1	3	
Solanum stelligerum		Devil's Needles						0.1	2														
Sonchus spp.		Sowthistle				0.1	1													0.1	1		
Stellaria pungens		Prickly Starwort				0.1	3							0.2	7			0.1	15				
Stylidium graminifolium		Grass Triggerplant								0.1	2												
Styphelia triflora		Pink Five-Corners				2	20	0.1	4	0.1	2												
Teucrium spp.																		1	50	0.1	8		
Thysanotus juncifolius						0.1	20																
Todea barbara		King Fern									0.4	5		1	6								
Urtica incisa		Stinging Nettle			0.1	3																	
Verbena bonariensis	*	Purpletop			0.1	2																	
Vernonia cinerea								0.1	5														
Veronica plebeia		Trailing Speedwell	0.2	20	0.1	10	0.1	3		0.1	5	0.1	1	0.1	5		0.1	8		0.1	50	0.1	7

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Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Viola hederacea</i>		Ivy-leaved Violet	15	300		9	200	25	800	0.2	20		5	300						20	300	
<i>Viola sieberana</i>											0.2	40	1	60			5		1000			
<i>Vittadinia cuneata</i>						0.1	5															
<i>Wahlenbergia communis</i>		Tufted Bluebell						0.2	50										0.1	10		
<i>Wahlenbergia gracilis</i>		Sprawling Bluebell	0.1	4	0.1	3																
<i>Wahlenbergia spp.</i>		Bluebell									0.1	2										
<i>Wahlenbergia stricta</i>		Tall Bluebell			0.1	20	0.2	30														
<i>Wilkiea spp.</i>															3	1			2	2		
<i>Xylomelum pyriforme</i>		Woody Pear							0.3	999												

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Apx Table 4: BAM plot photos

Plot ID	Photo
GDE BAM 1	
GDE BAM 2	

Plot ID Photo

GDE BAM 3



GDE BAM 4



Plot ID Photo

GDE BAM 5



GDE BAM 6



Plot ID	Photo
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GDE BAM 7	
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GDE BAM 8	
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Plot ID Photo

GDE BAM 9



GDE BAM 10



Appendix D

Fauna Species List

Class	Common Name	Scientific Name	Exotic	Count	Obs. Type	Method	BC Act	EPBC Act
Amphibia	Bleating Tree Frog	<i>Litoria dentata</i>			W	Songmeter	Not Listed	Not Listed
Amphibia	Common Eastern Froglet	<i>Crinia signifera</i>			W	Songmeter	Not Listed	Not Listed
Amphibia	Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>			W	Songmeter	Not Listed	Not Listed
Amphibia	Peron's Tree Frog	<i>Litoria peronii</i>			W	Songmeter	Not Listed	Not Listed
Birds	Australian King-Parrot	<i>Alisterus scapularis</i>			OW	Birding	Not Listed	Not Listed
Birds	Australian Magpie	<i>Cracticus tibicen</i>			OW	Birding	Not Listed	Not Listed
Birds	Australian Owlet-nightjar	<i>Aegotheles cristatus</i>			W	Songmeter	Not Listed	Not Listed
Birds	Australian Raven	<i>Corvus coronoides</i>			W	Birding	Not Listed	Not Listed
Birds	Bassian Thrush	<i>Zoothera lunulata</i>			O	Camera trap	Not Listed	Not Listed
Birds	Black-eared Cuckoo	<i>Chalcites osculans</i>			W	Birding	Not Listed	Not Listed
Birds	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>			W	Birding	Not Listed	Not Listed
Birds	Brown Thornbill	<i>Acanthiza pusilla</i>			OW	Birding	Not Listed	Not Listed
Birds	Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>			W	Songmeter	Not Listed	Not Listed
Birds	Chestnut-rumped heathwren	<i>Hylacola pyrrhopygia</i>			O	Camera trap	Not Listed	Not Listed
Birds	Crimson Rosella	<i>Platycercus elegans</i>			OW	Birding	Not Listed	Not Listed
Birds	Diamond Firetail	<i>Stagonopleura guttata</i>			OW	Birding	Vulnerable	Not Listed
Birds	Eastern Barn Owl	<i>Tyto javanica</i>			W	Songmeter	Not Listed	Not Listed
Birds	Eastern Whipbird	<i>Psophodes olivaceus</i>			O	Camera trap	Not Listed	Not Listed
Birds	Eastern Yellow Robin	<i>Eopsaltria australis</i>			W	Birding	Not Listed	Not Listed
Birds	Eastern/Pale-headed Rosella	<i>Platycercus adscitus adscitus x eximius</i>			W	Songmeter	Not Listed	Not Listed
Birds	Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>			W	Birding	Not Listed	Not Listed
Birds	Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>			W	Birding	Vulnerable	Endangered
Birds	Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>			W	Songmeter	Vulnerable	Vulnerable

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Birds	Golden Whistler	<i>Pachycephala pectoralis</i>	W	Birding	Not Listed	Not Listed
Birds	Grey Fantail	<i>Rhipidura albiscapa</i>	OW	Birding	Not Listed	Not Listed
Birds	Grey Shrike-thrush	<i>Colluricincla harmonica</i>	OW	Birding	Not Listed	Not Listed
Birds	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	W	Birding	Not Listed	Not Listed
Birds	Little Friarbird	<i>Philemon citreogularis</i>	W	Birding	Not Listed	Not Listed
Birds	Little Wattlebird	<i>Anthochaera chrysoptera</i>	W	Birding	Not Listed	Not Listed
Birds	Nankeen Kestrel	<i>Falco cenchroides</i>	O	Opportunistic	Not Listed	Not Listed
Birds	Noisy Friarbird	<i>Philemon corniculatus</i>	W	Birding	Not Listed	Not Listed
Birds	Olive-backed Oriole	<i>Oriolus sagittatus</i>	OW	Birding	Not Listed	Not Listed
Birds	Painted Button-quail	<i>Turnix varius</i>	OW	Birding	Not Listed	Not Listed
Birds	Peregrine Falcon	<i>Falco peregrinus</i>	W	Songmeter	Not Listed	Not Listed
Birds	Pied Butcherbird	<i>Cracticus nigrogularis</i>	O	Camera trap	Not Listed	Not Listed
Birds	Pied Currawong	<i>Strepera graculina</i>	W	Birding	Not Listed	Not Listed
Birds	Red Wattlebird	<i>Anthochaera carunculata</i>	W	Birding	Not Listed	Not Listed
Birds	Red-browed Finch	<i>Neochmia temporalis</i>	O	Birding	Not Listed	Not Listed
Birds	Restless Flycatcher	<i>Myiagra inquieta</i>	W	Birding	Not Listed	Not Listed
Birds	Rockwarbler	<i>Origma solitaria</i>	O	Camera trap	Not Listed	Not Listed
Birds	Rufous Fantail	<i>Rhipidura rufifrons</i>	O	Opportunistic	Not Listed	Not Listed
Birds	Rufous Whistler	<i>Pachycephala rufiventris</i>	W	Birding	Not Listed	Not Listed
Birds	Sacred Kingfisher	<i>Todiramphus sanctus</i>	O	Birding	Not Listed	Not Listed
Birds	Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>	O	Camera trap	Not Listed	Not Listed
Birds	Silvereye	<i>Zosterops lateralis</i>	W	Songmeter	Not Listed	Not Listed
Birds	Sooty Owl	<i>Tyto tenebricosa</i>	W	Songmeter	Vulnerable	Not Listed
Birds	Southern Boobook	<i>Ninox novaeseelandiae</i>	W	Songmeter	Not Listed	Not Listed
Birds	Speckled Warbler	<i>Chthonicola sagittata</i>	O	Camera trap	Vulnerable	Not Listed
Birds	Spotted Pardalote	<i>Pardalotus punctatus</i>	W	Birding	Not Listed	Not Listed
Birds	Spotted Quail-thrush	<i>Cinclosoma punctatum</i>	O	Camera trap	Not Listed	Not Listed

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Birds	Striated Pardalote	<i>Pardalotus striatus</i>		W	Birding	Not Listed	Not Listed
Birds	Striated Thornbill	<i>Acanthiza lineata</i>		OW	Birding	Not Listed	Not Listed
Birds	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>		W	Birding	Not Listed	Not Listed
Birds	Superb Fairy-wren	<i>Malurus cyaneus</i>		W	Birding	Not Listed	Not Listed
Birds	Superb Lyrebird	<i>Menura novaehollandiae</i>		W	Birding	Not Listed	Not Listed
Birds	Welcome Swallow	<i>Hirundo neoxena</i>		O	Opportunistic	Not Listed	Not Listed
Birds	White-browed Scrubwren	<i>Sericornis frontalis</i>		OW	Birding	Not Listed	Not Listed
Birds	White-eared Honeyeater	<i>Nesoptilotis leucotis</i>		W	Birding	Not Listed	Not Listed
Birds	White-throated Gerygone	<i>Gerygone olivacea</i>		W	Birding	Not Listed	Not Listed
Birds	White-throated Treecreeper	<i>Cormobates leucophaea</i>		OW	Birding	Not Listed	Not Listed
Birds	White-winged Chough	<i>Corcorax melanorhamphos</i>		O	Birding	Not Listed	Not Listed
Birds	Willie Wagtail	<i>Rhipidura leucophrys</i>		OW	Birding	Not Listed	Not Listed
Birds	Wonga Pigeon	<i>Leucosarcia melanoleuca</i>		O	Camera trap	Not Listed	Not Listed
Birds	Wonga Pigeon	<i>Leucosarcia picata</i>		W	Songmeter	Not Listed	Not Listed
Birds	Yellow Honeyeater	<i>Stomiopera flavus</i>		O	Camera trap	Not Listed	Not Listed
Birds	Yellow-faced Honeyeater	<i>Caligavis chrysops</i>		OW	Birding	Not Listed	Not Listed
Birds	Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>		W	Songmeter	Not Listed	Not Listed
Birds	Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>		W	Birding	Not Listed	Not Listed
Mammalia	Sugar Glider	<i>Petaurus breviceps</i>		W	Songmeter	Not Listed	Not Listed
Mammals	Cat	<i>Felis catus</i>	*	2	O	Camera trap	Not Listed
Mammals	Common Brushtail Possum	<i>Trichosurus vulpecula</i>		O	Camera trap	Not Listed	Not Listed
Mammals	Common Wombat	<i>Vombatus ursinus</i>		O	Camera trap	Not Listed	Not Listed
Mammals	Eastern Grey Kangaroo	<i>Macropus giganteus</i>		O	Opportunistic	Not Listed	Not Listed
Mammals	European cattle	<i>Bos taurus</i>	*	1	O	Camera trap	Not Listed
Mammals	Fox	<i>Vulpes vulpes</i>	*	6	O	Camera trap	Not Listed
Mammals	kangaroo / wallaby	<i>Macropus sp.</i>		O	Camera trap	Not Listed	Not Listed
Mammals	Pig	<i>Sus scrofa</i>	*	2	O	Camera trap	Not Listed

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Mammals	Red-necked Wallaby	<i>Macropus rufogriseus</i>	O	Camera trap	Not Listed	Not Listed
Mammals	Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	O	Camera trap	Not Listed	Not Listed
Mammals	Swamp Wallaby	<i>Wallabia bicolor</i>	O	Camera trap	Not Listed	Not Listed
Mammals	Unidentified Antechinus	<i>Antechinus sp.</i>	O	Camera trap	Not Listed	Not Listed
Microbat	Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Eastern Broad-nosed Bat	<i>Scotorepens orion</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Eastern Cave Bat	<i>Vespadelus troughtoni</i>	Q	Anabat	Vulnerab le	Not Listed
Microbat	Eastern Falsistrelle	<i>Falsistrellus tasmaniensis</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Eastern Horseshoe Bat	<i>Rhinolophus megaphyllus</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Gould's long-eared Bat	<i>Nyctophilus gouldi</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	Q	Anabat	Vulnerab le	Not Listed
Microbat	Large Forest Bat	<i>Vespadelus darlingtoni</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	Q	Anabat	Vulnerab le	Vulnerabl e
Microbat	Large-footed Myotis	<i>Myotis macropus</i>	Q	Anabat	Vulnerab le	Not Listed
Microbat	Lesser long-eared Bat	<i>Nyctophilus geoffroyi</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Little Forest Bat	<i>Vespadelus vulturnus</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Ride's Free-tailed Bat	<i>Ozimops ridei</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Southern Forest Bat	<i>Vespadelus regulus</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Southern Free-tailed Bat	<i>Ozimops planiceps</i>	Q	Anabat	Not Listed	Not Listed
Microbat	White-striped Free-tailed Bat	<i>Austronomus australis</i>	Q	Anabat	Not Listed	Not Listed
Microbat	Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>	Q	Anabat	Not Listed	Not Listed
Reptiles	Eastern Blue-tongue	<i>Tiliqua scincoides</i>	O	Camera trap	Not Listed	Not Listed
Reptiles	Lace Monitor	<i>Varanus varius</i>	O	Camera trap	Not Listed	Not Listed
Reptiles	Rosenberg's Goanna	<i>Varanus rosenbergi</i>	O	Camera trap	Vulnerab le	Not Listed

Appendix E Bat Call Analysis

APPENDIX 4 Aboriginal Cultural Heritage Management Plan for CLZ (ML1814)



Aboriginal Cultural Heritage Management Plan (CLZ (ML1814) ACHMP)

**Cliff Line Zone of First Workings
Extraction Plan (ML1814)**

Airly Mine (SSD_5581)

July 2024

DOCUMENT CONTROL / TITLE BLOCK

EXTRACTION PLAN DETAILS	Title:	Aboriginal Cultural Heritage Management Plan: Cliff Line Zone of First Workings Extraction Plan (ML1814)
	Applicant:	Centennial Airly Mine
	Revision No.:	CLZ (ML1814) ACHMP_Rev_3 ¹

REVISION

REVISION DETAILS	Revision No.	Details of Revision	Date Sent
	Rev_0	Draft for external consultation	1/12/2023
	Rev_1	Update to address recommendations from Heritage NSW	12/2/2024
	Rev_2	Update to address feedback from the RAPs	22/3/2024
	Rev_3	Minor amendments to address recommendations from consultation	25/07/2024

¹ An integrated Document Control Procedure is incorporated into Centennial Airly Mine's Safety Management System (SMS). Documents, data and records pertaining to this plan will be managed according to the ***Airly Mine Document and Data Control Management Plan (AIR-MP-1034)***.

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ABBREVIATIONS

BMP	Biodiversity Management Plan
CLZ	Cliff Line Zone of First Workings (approved mining zone under consent SSD_5581)
DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
DPE	NSW Department of Planning and Environment (now NSW Planning)
DPIE	NSW Department of Planning, Industry and Environment (now NSW Planning)
DOC	Depth of Cover
EP	Extraction Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environment Protection License
HHMP	Historic Heritage Management Plan
IEP	Independent Expert Panel (post-consent)
IRP	Independent Review Panel (pre-consent)
LCC	Lithgow City Council
LMP	Land Management Plan
MEP	Airly Mine Extension Project
ML	Mining Lease
MOD	Modification to Airly Mine's former Development Consent (DA162/91)
NPWS	NSW National Parks and Wildlife Service
NSW Planning	NSW Department of Planning, Housing and Infrastructure (formerly DPE)
NSW-RR	NSW Resources Regulator
OEH	NSW Office of Environment & Heritage
PPMZ	Panel & Pillar Mining Zone (approved mining zone under consent SSD_5581)
PSMP	Public Safety Management Plan
SCA	State Conservation Area
SSD	State Significant Development
SMP	Subsidence Monitoring Program
SMZ	Shallow Mining Zone (approved mining zone under consent SSD_5581)
TARP	Trigger Action Response Plan
WMP	Water Management Plan

1 INTRODUCTION

1.1 Background

Airly Mine is an existing underground coal mine located approximately 40 kilometres (km) northwest of Lithgow in New South Wales, 170km northwest of Sydney and 4 km to the northeast of Capertee, as illustrated on **Figure 1.1**. The mine is partly located within the Mugii Murum-ban State Conservation Area (SCA). Centennial Airly Pty Limited (Centennial Airly) is the operator of the mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited (Centennial).

Development Consent for the Airly Mine Extension Project (MEP) was approved on 15 December 2016 subject to the Conditions in Schedule 2 to 6 of State Significant Development 5581 (SSD_5581). The consent allows extraction of 1.8 million tonnes of run-of-mine (ROM) coal per calendar year for a period of 20 years, which is supplied to both domestic and international markets. As per commitments within the Environmental Impact Statement (EIS) for SSD_5581, Airly Mine is implementing a conservative approach to mining, with different mining methods applied in different areas of the mining lease called Mining Zones².

The *Cliff Line Zone of First Workings (ML1814) (CLZ (ML1814)) Extraction Plan* as detailed in the *CLZ (ML1814) Extraction Plan Main Report (the EP Main Report)* and the supporting component plans, continues the conservative approach to mining being implemented by Airly Mine, with the proposed first workings under this Extraction Plan specifically designed to provide long term stable and effectively non-subsiding pillars to protect the surface such that there is no adverse impact. Mine design and implementation is a key element of subsidence impact avoidance and management. The *Extraction Plan Area (EP Area)* is further defined in **Section 1.3**.

The *EP Main Report* and the supporting component plans have been developed using a risk-based approach and in accordance with:

- Relevant requirements listed under *Condition 7 in Schedule 3* of SSD_5581;
- *Extraction Plan Guideline*, NSW Department of Planning and Environment 2022;
- *Managing Risks of Subsidence Guideline*, NSW Department of Industry, Resources Regulator (NSWRR), 2017; and
- *Consultation with all relevant key stakeholders* (potentially affected by subsidence) and the Independent Expert Panel (IEP) established by NSW Department of Planning, Housing and Infrastructure (NSW Planning) for the project.

An Extraction Plan is required to be developed and approved prior to undertaking any first workings within the Cliff Line Zone and Zone of First Workings, including the development of this *Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) (CLZ (ML1814) ACHMP)*.

² Airly Mine has five (5) mining zones approved under development consent SSD_5581 as shown in Figure 2 in Appendix 3 of SSD_5581. These zones provide design criteria for different mining methods based on the differing levels of environmental sensitivity of surface features and depth of cover across the Airly mining leases. Section 8 of the Airly Mine EIS (2014) provides further details on the definitions of each of these approved mining zones if required.

1.2 Purpose and Scope

The purpose of this **CLZ (ML1814) ACHMP** is to meet the requirements under *Condition 7(i)(vi) in Schedule 3* of SSD_5581 and associated relevant guidelines, leases and licenses, including outlining the monitoring and management measures to be implemented to address any potential impacts to heritage sites (**Section 3.2**) during first workings within the EP Area (**Section 1.3**).

A directly related *Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP)* (Appendix 6 of the EP Main Report) has also been specifically developed for the Extraction Plan to address the project performance measures prescribed by consent SSD_5581, supported by a *Master Trigger Action Response Plan for CLZ (ML1814) (CLZ (ML1814) TARP)* (Appendix 7 of the EP Main Report), including adaptive management measures if required. It is noted, management and monitoring required under the existing Western Region ACHMP are required in addition to the management and monitoring within this CLZ (ML1814) ACHMP.

1.3 Extraction Plan Area

The Extraction Plan Area (EP Area) is illustrated on **Figure 1.2** and is defined as:

- The *Cliff Line Zone of First Workings* within ML1814;
- Includes all proposed first workings within the EP Area;
- First workings incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features;
- No secondary extraction is permitted or proposed within the EP Area;
- No surface impacts have been predicted for first workings; and
- The EP Area is wholly located within the Mugii Murum-ban State Conservation Area (SCA) with no private land ownership.

1.4 Relevant Features

The features identified within the EP Area, and which are subject to this *CLZ (ML1814) ACHMP*, as illustrated on **Figure 1.2**, are summarised below and detailed in the following sections:

- **Section 1.4.1**– known Aboriginal Heritage Site (AHIMS 45-1-0167)

1.4.1 Aboriginal Heritage Site (AHIMS 45-1-0167) Details

There is one known Aboriginal site recorded on the AHIMS database within the Cliff Line Zone ML 1814 site. The Western Region ACHMP (RPS 2021) includes an assessment of the cultural and scientific significance of sites. The ACHMP classifies that site within this area is a Rockshelter with Deposit (AHIMS 45-1-0167). It is assessed as having extremely high cultural significance, high local scientific significance, and high regional scientific significance.

The AHIMS site card for 45-1-0167 was lodged on the 17th of February 1992 (Appendix 2). It records the site as:

Genowlan Creek 1 – Shelter with Archaeological Deposit

Location: The shelter is situated on the eastern side of a steeply inclined valley with cliffline on both sides. It is about 500 metres upstream of a junction of Genowlan Creek. Vegetation in the valley is dominated by tree ferns, bracken and tall eucalypts. Above a vehicle track, the shelter is about 30 metres from the Creek above a 30% gradient.

Description: Facing southwest, this is a large shelter, the main body of the overhang being 41 metres long more than six metres deep and six metres high. The floor is fairly level and most of it is dry. The deposit consists of pale grey and yellow sandy soil with some roof fall. Behind an area of roof fall the deposit appears potentially deep. Part of the drip line is covered in bracken and ferns. Six artefacts were recorded at the northwestern end of the shelter where the deposit appeared to be of restricted depth overlying, rockfall. Here as well as behind the roof fall deposit is <10cm deep.

1.4.2 Context of Aboriginal Heritage Site (AHIMS 45-1-0167)

A search of the Aboriginal Heritage Information Management System database was undertaken for this document (25/6/2023, Appendix 2). It shows that there 24 Aboriginal heritage sites in the overall Airly Mine area (Table 1.1). This is the same number of Aboriginal sites as per the Western Region Aboriginal Cultural Heritage Management Plan.

The assessment of scientific significance includes the consideration rarity. The rarity of an Aboriginal site increases if there are less of that site type or site feature in the local area. Rarity is also a factor in the assessment of cultural significance. As there has been no change in the numbers of sites, the rarity of AHIMS 45-1-0167 remains the same and thus has the same significance ranking as per the Western Region Aboriginal Cultural Heritage Management Plan (Table 1.2).

Table 1.1: Airly AHIMS Sites Summary

Predictions	Count	Percent
Artefact Scatter	14	58.33%
Isolated Find	3	12.50%
Artefact Scatter + Rockshelter	2	8.33%
Rockshelter + PAD	2	8.33%
Art Site	1	4.17%
Surface Artefact(s)	1	4.17%
Scarred Tree	1	4.17%
Total	24	100.00%

Table 1.2: Significance of AHIMS 45-1-0167 over time

AHIMS	Site Type	Western Region ACHMP			This ACHMP		
		Cultural	Scientific (Local scale)	Scientific (Regional scale)	Cultural	Scientific (Local scale)	Scientific (Regional scale)
45-1-0167	Rockshelter + PAD	Extremely High	High	High	No change, significance remains extremely high	No change, significance remains high	No change, significance remains high

Figure 1.1: Locality Plan

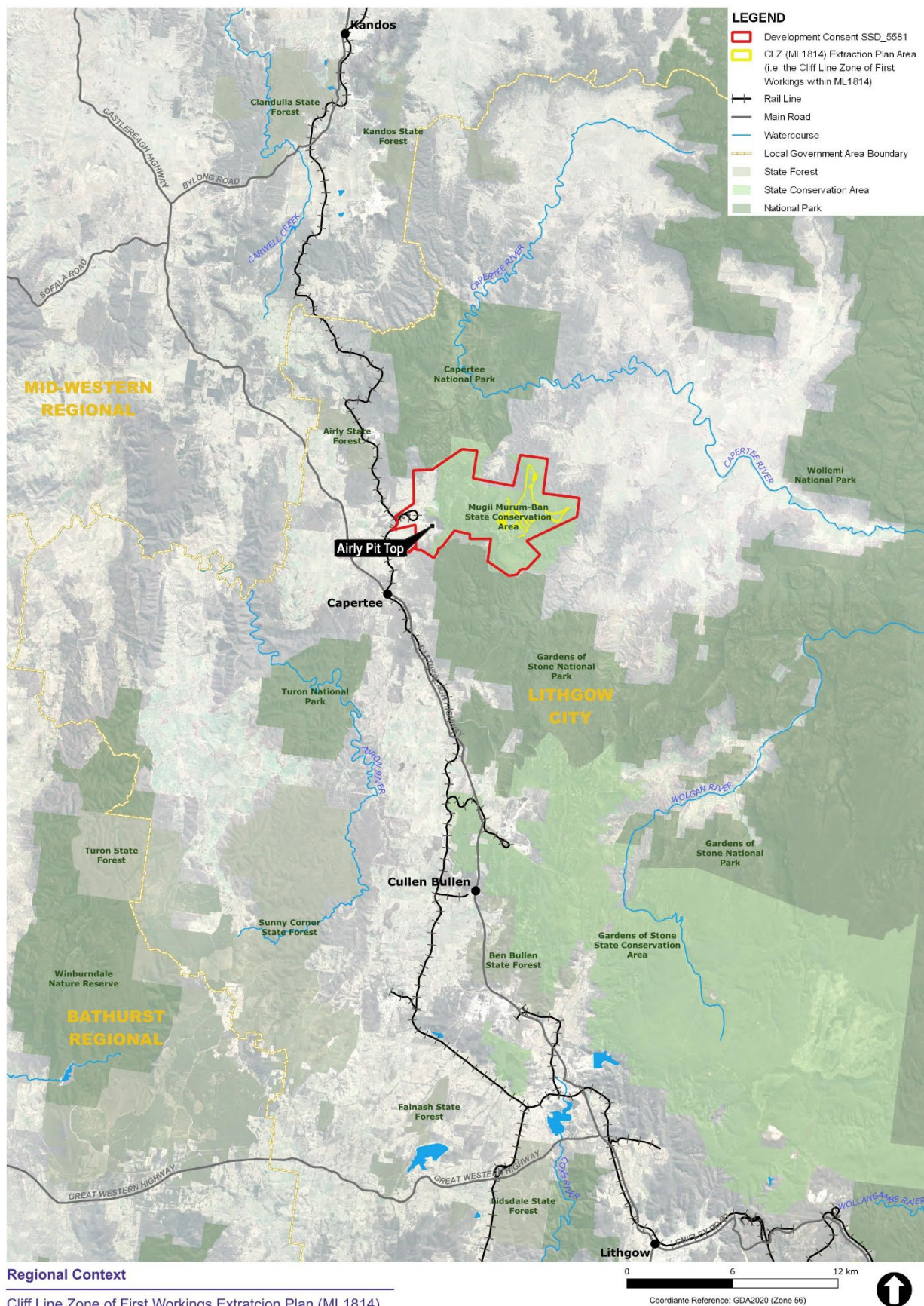
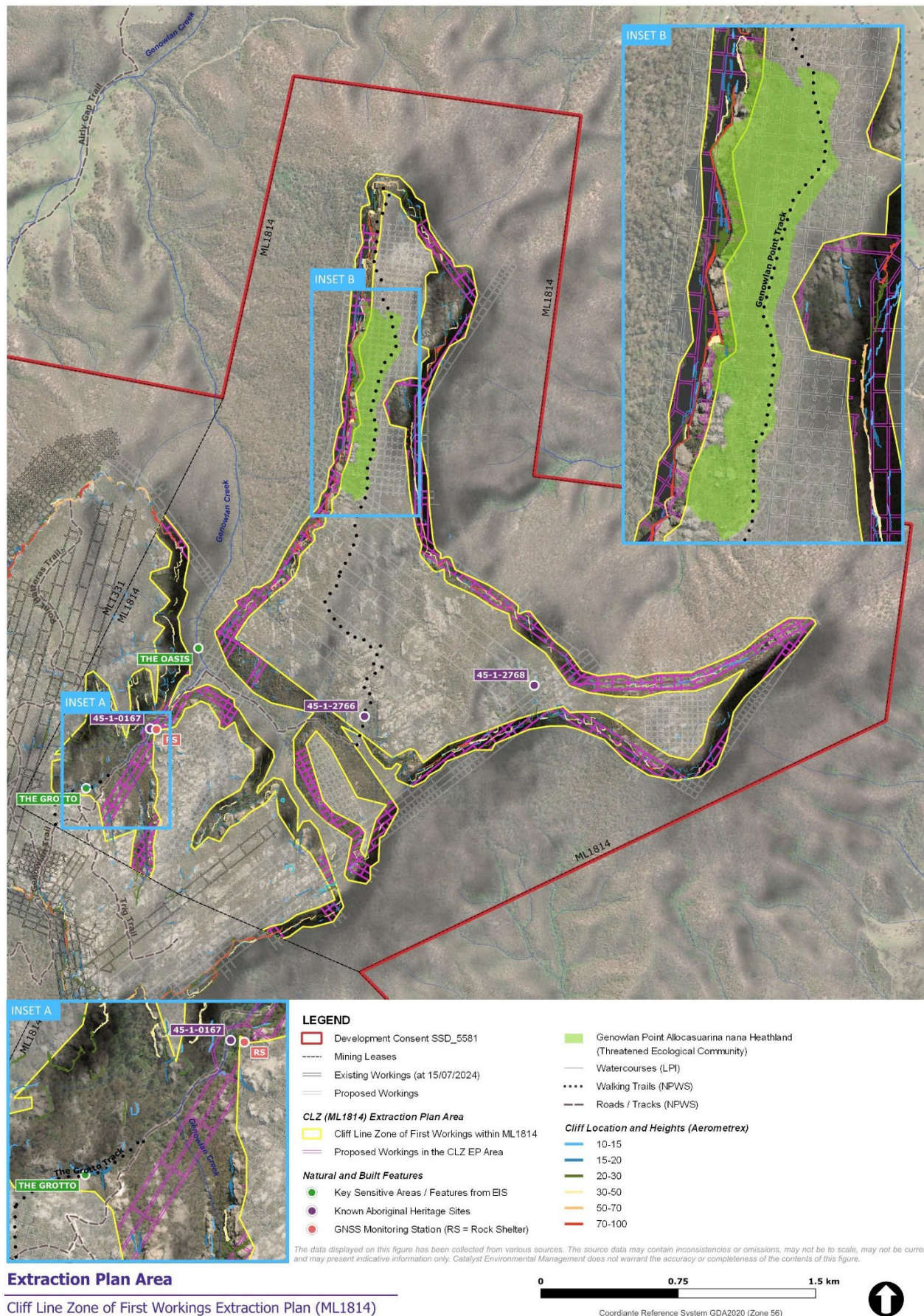


Figure 1.2: Extraction Plan Area (EP Area) and Relevant Features within the EP Area



1.5 Structure of the CLZ (ML1814) ACHMP

The main text sections of this CLZ (ML1814) ACHMP include:

- Section 1** Provides an introduction, purpose, scope, extraction plan area, relevant heritage features / sites and document structure.
- Section 2** Provides the statutory regulatory requirements, risk identification and consultation.
- Section 3** Provides the predicted subsidence impacts assessment and subsidence performance indicators to be used to assess against the relevant subsidence performance measures for heritage.
- Section 4** Outlines the monitoring and management measures in place for the key features in the EP Area.
- Section 5** Summarises the management, mitigation, remediation and reporting measures for this CLZ (ML1814) ACHMP, including relevant performance measures and indicators, contingency response, adaptive management, reporting and auditing.
- Section 6** Provides an outline of the plan administration and roles and responsibilities for this CLZ (ML1814) ACHMP.
- Section 7** Provides a historical review of references leading to the development of this CLZ (ML1814) ACHMP.

1.6 Authorship and Technical Specialist Endorsement

The heritage components of this report were authored by Tessa Boer-Mah, Principal Heritage Consultant at Heritage Now.

2 PLAN DEVELOPMENT AND CONSULTATION

2.1 Statutory Requirements

Centennial Airly conducts its operations in accordance with:

- The conditions of the Development Consent (SSD_5581);
- Relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL No. 12374) and Mining Leases (i.e. ML 1331 and ML 1814); and
- other relevant State and Commonwealth environmental, planning, mining, safety, and natural resource legislation and guidelines.

Centennial Airly maintains a register of relevant environmental legislative and regulatory requirements in a compliance database.

The relevant statutory requirements applicable to the *CLZ (ML1814) Extraction Plan* and this supporting CLZ (ML1814) ACHMP are presented in the EP Main Report (*refer Section 2.1 and Attachment B*).

This CLZ (ML1814) ACHMP is a component of the EP Main Report and has been prepared specifically to address Condition 7 in Schedule 3 of SSD_5581 which states:

(7) Prior to carrying out any first workings within the Cliff Line Zone and Zone of First Workings (refer to Figure 2 in Appendix 3) or second workings, the Applicant must prepare an Extraction Plan for the relevant workings to the satisfaction of the Secretary. Each Extraction Plan must:

(i)...include a:

(vi) Heritage Management Plan which has been prepared in consultation with Heritage Division and relevant Aboriginal stakeholders, to manage the potential environmental consequences of the proposed workings on Aboriginal and historic heritage and includes all requirements under condition 19 of Schedule 4;

This **CLZ (ML1814) ACHMP** has been developed in accordance with Condition 2 in Schedule 6 of SSD_5581 (management plan requirements). **Table 2.1** details where these conditions have been addressed.

Table 2.1: Heritage Management Plan Requirements

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section Addressed
The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: a) Detailed baseline data; b) A description of: • The relevant statutory requirements (including any relevant approval, licence or lease conditions); • Any relevant limits or performance measures/criteria; • The specific performance indicators or triggers that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures. c) A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria.	Section 4.2 EP Main Report (Section 2.1, Attachment B) Section 5.1 Section 5.4, CLZ (ML1814) TARP Sections 2.1, 5.1, 5.4

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section Addressed
d) A program to monitor and report on the: - Impacts an environmental performance of the development; - Effectiveness of any management measures (see c) above);	Section 4 Sections 5.4, 5.7
e) A contingency plan to manage any unpredicted impacts and consequences	Section 5.5
f) A program to investigate and implement ways to improve the environmental performance of the development over time	Section 5
g) A protocol for managing and reporting any: - Incidents; - Complaints; - Non-compliances with statutory requirements; and - Exceedances of the impact assessment criteria and/or performance criteria; and	Section 5.6
h) A protocol for periodic review of the plan.	Section 6.1

2.2 Specialist Assessments

This CLZ (ML1814) ACHMP has been informed by a Baseline Historic Heritage Assessment (RPS, 2022a) and Baseline Aboriginal Cultural Heritage Assessment (RPS, 2022b) developed for the EP Area with the purpose of reviewing the relevant heritage information to identify heritage items within the region and informing the development of the Heritage Management Plan for the Extraction Plan.

SCT were engaged to prepare and provide a subsidence prediction and impact assessment report, on the likely impacts of these predicted levels of subsidence on the natural and built features that exist within the EP Area. The Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) provided the subsidence predictions and impact assessment for the Extraction Plan. An addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b) was prepared to review the earlier pillar geometry assessment (SCT, 2023a) for an increased roadway height of 3.2m. The subsidence predictions and impact assessment is further discussed below in **Section 3.2** of this CLZ (ML1814) ACHMP.

2.3 Risk Identification and Assessment

Centennial Airly has undertaken a dedicated ***Subsidence and Environmental Risk Assessment*** (Stature RA Number: 1001330039³) directly in support of this Extraction Plan which provide a risk framework basis for development of the component management plans.

The CLZ (ML1814) Extraction Plan risk assessment was completed on the 20 June 2023 with key staff from the Airly Mine including the Mine Manager, Statutory Mine Surveyor, Technical Services / Compliance Manager and Environment and Community Superintendent, as well as key EP Project Team members for Heritage, Ecology and the Lead Consultant for the Extraction Plan. The landholder was also represented by a member from the NPWS. The Heritage representative was Tessa Boer-Mah Principal Heritage Consultant at Heritage Now (Appendix 1).

³ Centennial Airly has adopted the Stature Risk Assessment Program which sets out a consequences table and risk ranking matrix for managing identified risks consistent with AS/NZS ISO 31000:2009.

Risks were identified and assessed through the review of known surface and sub-surface features within the EP Area. The risk assessment also specifically assessed key heads of consideration required by the Managing Risks of Subsidence Guideline (NSW RR, 2017).

A risk ranking (low, moderate, significant, high or extreme) was assigned to each risk/hazard in consideration of the Maximum Reasonable Consequence (MRC) for the given controls. There were 34 potential risks scenarios assessed during the Risk Assessment; 1 significant, 7 moderate, 23 low and 3 were assessed as not applicable.

The risk assessment determined that the **risk of impact for heritage features / sites** (noting the extensive controls identified) was **moderate** including aspects associated with cliffs and pagodas within the EP Area.

A copy of the risk assessment is included in the EP Main Report (refer Attachment C). Additional details regarding the management and monitoring of subsidence related impacts within the EP Area have been detailed in **Section 4** and **Section 5**.

2.4 Consultation

Condition 7(i)(vi) in Schedule 3 of SSD_5581 requires the preparation of this **CLZ (ML1814) ACHMP** in consultation with key relevant stakeholders as detailed below:

- Heritage NSW part of the Environment and Heritage Group within the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) and
- relevant Aboriginal stakeholders.

The outcomes of consultation undertaken for the project is provided in the EP Main Report (refer Attachment D), including copies of relevant correspondence such as project presentations delivered by the mine to key stakeholders and relevant formal correspondence received from key stakeholders.

Stakeholder feedback provided has been reviewed and addressed as necessary as part of the development and review of this Extraction Plan and key component plans.

2.4.1 Ongoing Consultation

To ensure ongoing consultation with the registered Aboriginal parties, Centennial established an Aboriginal Heritage Committee for the western region in May 2015. The Aboriginal Heritage Committee includes representatives from the various registered Aboriginal parties. The Aboriginal Heritage Committee meets twice a year with the primary purpose to discuss matters relating to Aboriginal cultural heritage including, but not limited to a review of any heritage related works carried out over the previous 6 months and any works proposed over the coming 6 months (including field surveys and site recording). Minutes of the meeting are recorded and distributed to members. An agenda will be distributed to members of the committee prior to meetings taking place, ensuring that the members of the committee will have input into the meeting's agenda. The committee will also discuss the Aboriginal heritage matters relating to any offset areas associated with the various operations. The meetings will be attended by representatives from each of Centennial's western operations.⁴

Aboriginal feedback on this report has been incorporated with photogrammetry being added to the baseline recording phase as per request from an Aboriginal stakeholder group.⁵

⁴ For further details refer to Section 5 of the [Western Region Aboriginal Cultural Heritage Management Plan](#)

⁵ Applicable consultation records are provided in *Attachment D – Stakeholder Consultation* of this CLZ (ML1814) Extraction Plan.

3 SUBSIDENCE ASSESSMENT

3.1 Mine Planning and Design

The proposed first workings within the CLZ (ML1814) consist mainly of (or parts of) 3 or 5 roadway main headings which provide access to future mining areas. First workings incorporate mine development of roadways / headings and cut throughs to form long term stable pillars.

Mine design is the primary control utilised at Airly Mine for subsidence impact avoidance. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement.

3.2 Subsidence Predictions

Condition 7(g) in Schedule 3 of SSD_5581 and the Extraction Plan Guidelines (DPE, 2022) requires revised predictions of potential subsidence effects, subsidence impacts and environmental consequences to be presented within the Extraction Plan for the EP Area, including any relevant information obtained since the EIS and consent, in consultation with the Independent Expert Panel (IEP).

Subsidence predictions for this Extraction Plan were assessed by SCT (2023a; 2023b) and are presented in full as *Attachment E – Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b)*.⁶

The maximum predicted subsidence for the EP Area are consistent with the EIS Predictions as shown in **Table 3.1**. The predictions included assessment of the subsidence effects measured in the current first workings at Airly Mine, including a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331).

Table 3.1: Maximum Subsidence Predictions with Comparison to Previous Predictions

Predictions	Pillar Stability	Max Subsidence	Max Tilt (mm/m)	Max Strain	
				Tensile (mm/m)	Compressive (mm/m)
This CLZ EP (ML1814) Predictions SCT (2023a; 2023b)	Long Term Stable with minimal subsidence	≤37mm	≤0.61	≤0.18	≤0.25
EIS Predictions Golder (2014b)	Long Term Stable	65mm	0.6-1.1	0.2-0.3	0.2-0.5
Current CLZ EP (ML1331) Predictions Golder (2017)	Long Term Stable, negligible settlement, effectively non-subsiding	<53mm Worst Case (long term flooded and additional pillar loading) Short to medium term <30mm and typical <20m	0.4-0.9	0.1-0.3	0.1-0.3

The predicted subsidence is not expected to cause adverse impacts on the relevant features covered under this CLZ (ML1814) ACHMP.

⁶ A detailed review of the revised subsidence predictions is provided in the *EP Main Report (refer Section 3.2)*

4 MONITORING PROGRAM

The general heritage monitoring program was outlined in the Western Region Aboriginal Cultural Heritage Management Plan. This monitoring program has been adapted to meet the specific requirements of AHIMS 45-1-0167 (**Table 4.1**) and also adopts a more thorough monitoring method using continuous occupation GNSS (Global Navigation Satellite System) and lidar (**Section 4.1.2** and **Section 4.1.3**).

4.1 Heritage Features Monitoring Program

4.1.1 Aboriginal Heritage Site (AHIMS 45-1-0167)

One Aboriginal Heritage Site (AHIMS 45-1-0167) is located within the EP Area, in the vicinity of The Grotto above the 500 Panel Area. Potential subsidence related impacts to AHIMS 45-1-0167 will be managed in accordance with the Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) (**Table 4.1**).

SCT (2023) stated that, subsidence effects, impacts and consequences are consistent with the EIS and CLZ (ML1331) EP which expects minimal surface impacts. Hence, as the predicted levels of subsidence are similar to those provided in the 2014 EIS, i.e., the maximum predicted subsidence (from first workings in the cliff line zone) is less than 65 mm with no surface cracking, and the assessed levels of potential impact for the Aboriginal Heritage Site, are similar to those based on the EIS Layout.

The following monitoring will be implemented to monitor for the presence/absence of potential subsidence related impacts or change to Aboriginal Heritage Site (AHIMS 45-1-0167):

- Continuous occupation GNSS monitoring undertaken in accordance with **Section 4.1.2**;
- LiDAR undertaken in accordance with **Section 4.1.3**;
- Three phase monitoring undertaken in accordance with the Western Region Aboriginal Cultural Heritage Management Plan; including:
 - **Phase 1:** Baseline archival recording including a detailed plan of the site, archival-quality photographic records and a record of the surface conditions of the site including photogrammetry (prior to site being undermined);
 - **Phase 2:** Post mining initial condition (immediately after undermining); and
 - **Phase 3:** Post mining secondary condition (approximately 8 months after undermining)
 - Representatives of the Registered Aboriginal Parties will be invited to participate in all three phases of the monitoring process for Aboriginal cultural heritage sites.
- Results of monitoring will be reported to the Aboriginal Heritage Committee undertaken in accordance with **Section 2.4.1**; and
- If ground conditions have stabilised and no changes to sites condition are observed, then no further monitoring will be required.

Table 4.1: Heritage Features Subsidence Monitoring Program Summary

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
Heritage				
Aboriginal Heritage Site (AHIMS 45-1-0167)	<i>500 Panel Area:</i> Aboriginal Heritage Site (AHIMS 45-1-0167) located in the vicinity of The Grotto above the 500 Panel Area	Archival recording including a detailed plan of the site, archival-quality photographic records and a record of the surface conditions of the site including photogrammetry (3 phase monitoring including pre and post monitoring) GNSS Monitoring Station providing continuous near real time point data (raw data set at 10 second intervals), $\pm 5\text{mm}$ rolling 7-day average	Presence/absence of mine-induced damage or change to features	Phase 1: Baseline recording (prior to site being undermined) - GNSS installed prior to commencement During Mining: - GNSS continuous throughout first workings in the active panel area Phase 2: Post mining initial condition (immediately after undermining) - GNSS stations will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of development in the active panel area Phase 3: Post mining secondary condition (approximately 8 months after undermining) - If ground conditions have stabilised and no changes to sites condition are observed, then no further monitoring will be required

4.1.2 Airly Mine GNSS Monitoring Stations

Airly Mine has an extensive network of existing (and proposed) GNSS units, also known as Continually Operating Reference Stations (CORS), including several at targeted locations within the EP Area.

The GNSS units use the Global Navigation Satellite System (GNSS) and record X, Y, Z spatial position readings. The stations provide near real time continuous monitoring, recording readings at 10 second intervals (raw data), and calculating statistical 24hr (daily) averages and rolling 7-day averages at $\pm 5\text{mm}$ accuracy. The GNSS units are co-located with photogrammetry geo-reference markers and the data collected will also be used to provide continually operating reference points for the LiDAR surveys.

The continuous and near real time data are envisaged to provide the mine with suitably fast and accurate data to monitor and respond to ground movements, particularly if abnormal subsidence is measured in this EP Area.

The GNSS units are primarily used to monitor and provide notifications to Airly Mine for secondary extraction approved by other Extraction Plans, including monitoring within an Extended / Far Field Monitoring Area which incorporates areas within the EP Area.

The following provides the purpose and some context of the GNSS monitoring stations relevant to this Extraction Plan:

- Continuous occupation monitoring of vertical and horizontal movements, including for baseline, at key locations / surface features, including
 - Monitor movements at or toward key sensitive features and areas (i.e., large cliffs and incised gorges primarily on the western side of the EP Area)
 - Monitor movements at or toward Aboriginal Heritage Site (AHIMS 45-1-0167)
 - Public access areas (i.e., The Grotto walking trail)
- Co-located with photogrammetry geo-reference markers to provide continually operating reference points for LiDAR

The GNSS units are intended to be deployed continuously at proposed locations throughout the duration of mining within the EP Area (and for secondary extraction approved by other Extraction Plans) and will remain in-situ until data demonstrates subsidence has stabilised following the completion of mining (potentially up to a maximum of 12 months post mining, but noting that monitoring will continue until movement stabilises). Once data has demonstrated subsidence has stabilised following the completion of mining, Airly Mine may seek to re-deploy appropriate units closer to current or future mining areas. Notwithstanding, any potential relocation of individual GNSS units as mining advances would be undertaken in consultation with the IEP, and NSWRR and NPWS prior to doing so.

Raw subsidence monitoring data from the GNSS units will be provided to NPWS on a quarterly (3 monthly) basis.

4.1.2.1 Baseline

Existing GNSS units within the EP Area, GM10, GM11 and GM 12, were installed in September 2021.

The installation of additional proposed GNSS units, including site RS associated with monitoring of Aboriginal Heritage Site (AHIMS 45-1-0167), is subject to receiving approval from NPWS. The GNSS units will be installed prior to commencement of first workings in the EP Area and will collect baseline data through to the commencement of first workings.

4.1.3 LiDAR

High resolution (40pts per square meter) LiDAR will be used for vertical subsidence monitoring. The system identifies ground points and then revisits these each monitoring event ('epochs').

Routine LiDAR surveys are undertaken at approximately six-monthly intervals. The LiDAR surveys are part of a whole of mine monitoring program and cover previously approved EP Areas (and future EP Areas). Monitoring within the EP Area will be consistent with schedules of previously approved Extraction Plans.

Differential subsidence is measured between each epoch comparing thousands of data points and is georeferenced to the GNSS monitoring network. The system is capable of detecting 50mm subsidence movements at very high confidence level for each epoch.

The point measurement distribution provides a monitoring grid of similar density to conventional subsidence survey lines, but with the advantage of extensive coverage over the entire EP Area. This distribution of monitoring points provides a mine-wide subsidence profile of suitable accuracy to complement the integrated subsidence monitoring network (particularly the much higher accuracy GNSS units). Theoretically a subsidence line, and subsidence profile, could be placed anywhere within the EP Area using the data from stereo vertical photogrammetry.

Aerial survey includes consideration of:

- Condition of natural rock structures, including rock falls (natural or otherwise) or significant cracking, including percentage of cliff face area affected,
- Presence/absence of significant damage or change to general land surface of the SCA (topography, soil cover, vegetation cover, etc.); and
- Subsidence that exceeds consent limits (within the 50mm accuracy).

Methodology:

- Fixed wing aircraft to capture LiDAR
- LiDAR resolution will nominally be 40 points per square meter
- Ground control from survey targets co-located with the GNSS monitoring stations
- Ground control is measured on imagery.
- Once satisfactory results obtained in the software (Aero3D) - triangulation imagery is available for stereo measurement derivation of height points that are used for differential subsidence monitoring.
- By using the same flight plan from epoch to epoch the same georeferenced positioning locations are used to perform direct comparisons at the same locations.
- A spatially accurate point cloud is developed as a primary product, from which a Digital Elevation Model (DEM) is generated and subsequently analysed.

Further detailed analysis and/or targeted visual ground inspection will be undertaken if issues are identified from aerial work as per triggers detailed in the *CLZ (ML1814) Master TARP*.

4.1.3.1 Baseline

LiDAR baseline for the EP Area was flown in December 2022 and June 2023, ongoing surveys will be undertaken at approximately six-month intervals increasing the baseline data set through to commencement.

4.2 Baseline Monitoring

Baseline monitoring of heritage features / sites within the EP Area will be obtained by using a combination of the following methods:

- The installation of a GNSS monitoring station prior to commencement of development workings with baseline continuous data from installation through to commencement of first workings in the CLZ within ML1814 in the vicinity of AHIMS 45-1-0167.7
 - GNSS installed prior to commencement
 - GNSS continuous throughout first workings in the active panel area
 - GNSS stations will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of development in the active panel area
- The monitoring is to be undertaken in accordance with the three phase monitoring program as set out in the Western Region Aboriginal Cultural Heritage Management Plan, noting that during mining monitoring will also take place:
 - **Phase 1: Baseline recording** (prior to site being undermined)
 - **Phase 2: Post mining initial condition** (immediately after undermining)
 - **Phase 3: Post mining secondary condition** (approximately 8 months after undermining)
- If ground conditions have stabilised and no changes to sites condition are observed, then no further monitoring will be required

Further details including methodologies, locations, parameters, frequencies and duration of monitoring is provided in the *CLZ (ML1814) SMP* (Appendix 6 of the EP Main Report).

⁷ Installation of this monitoring equipment is subject to an REF amendment and subsequent approval from NPWS.

5 MANAGEMENT, MITIGATION, REMEDIATION AND REPORTING MEASURES

5.1 Performance Measures and Indicators

The approved subsidence impact performance measures are specified under Condition 2 in Schedule 3 of SSD_5581. The performance measures relating to potential subsidence impacts (as they relate to this CLZ (ML1814) ACHMP) are outlined in **Table 5.1**⁸.

Table 5.1: Relevant Subsidence Impact Performance Measures for Heritage Sites

Heritage Sites	Performance Measure	Performance Indicator	Applicability to this EP Area
Aboriginal heritage site AHIMS 45-1-0167	Negligible environmental consequences	Presence/absence of mine-induced damage or change to features	Applicable
No Non-Aboriginal heritage sites identified	Negligible environmental consequences. Wherever depth of cover is < 30 m, no second workings to occur within a setback distance defined by half the depth of cover from site 3 and site 24, measured horizontally in the seam	Presence/absence of mine-induced damage or change to features	Not Applicable (no Non-Aboriginal heritage sites identified within the EP Area)

Additional internal performance measures set by Centennial Airly for the mine design (to be monitored by the underground components of the Subsidence Monitoring Program) are and have been reflected within the CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

To establish compliance with the performance measures, Airly Mine has developed a monitoring program with several integrated components detailed in the CLZ (ML1814) SMP (Appendix 6 of the EP Main Report) (see **Section 4**) and an associated CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

These documents establish appropriate monitoring elements, parameters, and associated trigger levels to demonstrate that the environmental performance satisfies the criteria in Section 5.1 of the EP Main Report.

Table 5.2 contains the performance indicators which have been established for key monitoring aspects with allocated trigger values to define the following key performance scenarios within the CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

⁸ extracts from Table 1, under Condition 2 in Schedule 3 of SSD_5581

Table 5.2: Performance Indicators & TARP Risk Management Scenarios

Performance Indicator	General Description	Action / Response
Level 1: Condition Green	Operations within predictions, and within approved impacts.	Continued operations and monitoring as normal.
Level 2: Condition Amber	Operations within approved impacts but potentially exceed / exceed predictions.	Review and investigation processes are engaged, with adaptive management as required.
Level 3: Condition Red	Operations exceed approved impact. <i>The approved Performance Measures (criteria thresholds) of Development Consent (and any other relevant approvals) are listed in Condition Red.</i>	Adaptive Management measures are fully engaged as per the TARP and relevant sections of the Extraction Plan and the SMP.

5.2 Management and Mitigation Measures

As described in **Section 3.2**, the predicted subsidence levels in the EP Area are minimal and well below levels expected to cause damage or any adverse impacts on the natural features.

The CLZ (ML1814) risk assessment (**Section 2.2**) determined that the risk of impact for heritage features / sites was **moderate**. There are two main management aspects of this CLZ (ML1814) ACHMP, including:

- Mine design to avoid impacts (**Sections 3.1 and 3.2**);
 - The primary management strategy being implemented is impact avoidance through the implementation of a conservative mine design. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement, and
- Monitoring and management measures (**Sections 4.1 and 4.2**).
 - Monitoring to ensure the mine design is strictly implemented as designed through underground mining controls and monitoring of key landscape features for change (particularly cliffs and pagodas) will be undertaken to confirm that the mine design measures to prevent impact are adequate and remain within consent.

Airly mine has committed to the following monitoring and management measures, as they related to heritage in the EP Area, including:

- Develop an Integrated Subsidence Monitoring Program that will provide data for trend analysis, that will inform adaptive management if required (**Section 5.2** (for further details refer to Section 4 of the EP Main Report and CLZ (ML1814) SMP (Appendix 6);
- Develop an Aboriginal Cultural Heritage Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on heritage sites.

It is expected with the above controls in place, the subsidence performance measures for heritage sites will be achieved.

Notwithstanding this, appropriate responses have been conservatively developed for unexpected/higher than predicted subsidence within a **Master Trigger Action Response Plan (TARP)** developed for the Extraction Plan and this CLZ (ML1814) ACHMP.

5.2.1 Identification of Previously Unknown Aboriginal Cultural Heritage Sites (including skeletal remains)

In accordance with Section 6.7 in the Western Region Aboriginal Cultural Heritage Management Plan if, during the course of mining or development works, cultural heritage sites not previously identified are uncovered, onsite works will stop immediately in the vicinity of the site and the area will be cordoned off as appropriate with high-visibility flagging tape. The onsite personnel will inform the nominated Centennial Environmental Co-ordinator responsible about the whereabouts of the site, the condition of the site (i.e. any harm caused to the site as a result of mining or development works) in addition to any other relevant information. The Centennial Environmental Co-ordinator will then contact Heritage NSW, NSW Planning and representatives of the local Aboriginal community about the incident and/or newly identified site in addition to any required monitoring or management strategies to be instigated.

If any skeletal remains are identified all work will halt in the immediate area to prevent any further harm to the remains. Centennial will contact the NSW Police immediately. No action is to be undertaken until police provide written notification to Centennial. If the skeletal remains are identified as Aboriginal, Centennial will contact Heritage NSW, NSW Planning and representatives of the local Aboriginal community. No works will continue until Heritage NSW provides written notification to Centennial about the action plan for the management of the skeletal remains and formulated management plan if required.

5.3 Remediation and Rehabilitation Measures

Due to the minimal subsidence expected the need to implement remediation/rehabilitation measures for potential impacts are considered unlikely. However, if remediation is required, Airly Mine will undertake remediation in accordance with:

- Conditions 7a)-7c) in Schedule 6 of SSD_5581, noting the requirement to submit a report to NSW Planning describing remediation options and any preferred remediation measures or other course of action;
- Any relevant actions prescribed in the CLZ (ML1814) TARP developed for the Extraction Plan;
- The current Rehabilitation Management Plan; and
- In consultation with key stakeholders including any affected land holders and relevant government agencies.

A Response Strategy will be adopted if a significant impact is detected as a result of mining activities within the Extraction Plan area.

In the event of subsidence impacts to AHIMS site 45-1-0167, the development of rehabilitation and remediation measures will be undertaken in consultation with the Registered Aboriginal Parties and Heritage NSW.

5.4 Trigger Action Response Plan

A detailed CLZ (ML1814) TARP (Appendix 7 of the EP Main Report) has been developed for the Extraction Plan to reflect the commitments of this CLZ (ML1814) ACHMP and other related aspects. Whilst impacts are not

predicted nor expected, the *CLZ (ML1814) TARP* provides a process of tiered and/or escalating trigger levels for contingency measures should subsidence and impacts be greater than predicted/approved. The *CLZ (ML1814) TARP* applies only to the EP Area (separate TARPs apply to other established EP Areas in various approved mining zones).

Given the mine has been designed specifically to avoid impacts, the *CLZ (ML1814) TARP* includes detailed measures for Underground Mining Controls to ensure that the mining geometry is formed as per the approved design specifications that determine the predicted subsidence movements and impacts.

The *CLZ (ML1814) TARP* includes detailed performance indicators for heritage management. The contingency plan where a performance indicator has been exceeded is outlined in the TARP. A trigger will result in additional investigations to determine if the exceedance is related to non-mining-factors or is a consequence of mining activity. The response to these exceedances will follow the TARP. Management / corrective actions can be implemented where required to remedy these non-conformities and report accordingly.

5.5 Adaptive Management and Contingency Planning

An Adaptive Management Framework provides for flexible decision making, adjusted to consider uncertainties as management outcomes are understood. The adaptive management approach at Airly Mine is detailed in the EP Main Report (*refer Section 5.2*).

In summary, adaptive management at Airly Mine involves monitoring and evaluation against performance measures and associated indicators in the *CLZ (ML1814) TARP* established for the extraction plan and supporting management plans. Where performance indicators indicate increasing levels of risk (i.e., where relevant thresholds of conditions green, amber or red are being exceeded), escalating adaptive management measures are engaged in accordance with the *CLZ (ML1814) TARP*. The process has been successfully implemented in existing Extraction Plan areas at Airly Mine and has been updated to reflect EIS commitments and consent requirements for the Airly Mine Extension Project, including specific performance measures.

5.6 Incidents, Complaints, Exceedances and Non-Compliances

Incidents, complaints, exceedances and non-compliances are managed accordance with the requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, relevant legislation and regulations, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). Additionally, high potential incident notifications for unexpected subsidence events in relation to the safety of other persons under WHS legislation has also been included. A detailed review of the notification requirements relevant to the Extraction Plan, including this *CLZ (ML1814) ACHMP*, is provided in the EP Main Report (*refer Section 5.7.1*), including requirements for:

- Incident or non-compliance reporting in accordance with:
 - Condition 9 (Incident Reporting) in Schedule 6 of SSD_5581.
 - EPBC 2013/7076 Condition 1, or as triggered by the TARP (reporting incidents under Management Plans as per Condition 2(g) in Schedule 6 of SSD_5581).
 - EPL12374 condition R2
 - WHS Regulation (Mines and Petroleum Sites, 2022) Section 124 - Duty to notify regulator of certain incidents
 - Section 6 of the Guidelines for Managing Risks of Subsidence (WHS (Mines and Petroleum Sites), February 2017

- Managing complaints.

Incidents, complaints, exceedances and non-compliances will be managed in accordance with the requirements detailed in the EP Main Report (*refer Section 5.6*).

5.7 Reporting and Auditing

5.7.1 Reporting

Reporting is undertaken in accordance with the requirements of specific requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). A detailed review of the reporting and notification requirements relevant to the Extraction Plan, including this CLZ (ML1814) ACHMP, is provided in the EP Main Report (*refer Section 5.7.1*, including requirements for:

- Regular reporting of impacts and environmental monitoring results in accordance with Condition 10 in Schedule 6 of SSD_5581;
- Annual reporting required in accordance with Condition 11 in Schedule 6 of SSD_5581 and separately under EPBC 2013 / 7076;

Reporting and notifications will be undertaken in accordance with the requirements detailed in the EP Main Report (*refer Section 5.7.1*).

5.7.2 Periodic Auditing

Comprehensive Independent Environmental Audits of the entire approved development under development consent SSD_5581 are undertaken within 1 year of commencement and every 3 years thereafter (unless directed otherwise) in accordance with Conditions 12 and 13 in Schedule 6 of SSD_5581.

Auditing of any rehabilitation undertaken for the mine (including for subsidence if triggered) is undertaken in accordance with the Rehabilitation Management Plan under Condition 27 in Schedule 4 of SSD_5581.

Additionally, in accordance with section 20(c) of the WHSMP Regulation (2022), auditing will be undertaken in accordance with the Airly Mine Safety Management System (SMS), against the performance standards for measuring the effectiveness of all aspects of the SMS, including the methods, frequency and results of the audit process. The audit should also consider the following matters:

- (1) competency of the auditor,
- (2) the person responsible for ensuring the audit is conducted, and
- (3) the person responsible for implementing the results of the audit.

6 PLAN ADMINISTRATION AND RESPONSIBILITIES

6.1 Review

In accordance with the requirements under Condition 3 in Schedule 6 of SSD_5581, as a minimum Centennial Airly will review this Plan within three months of the following:

- a) Submission of an incident report;
- b) Submission of an Annual Review (required 31 March annually);
- c) Submission of an Independent Environmental Audit; or
- d) Any modification to the conditions of SSD_5581.

Where this leads to revisions of the document, within four (4) weeks of the review the revised document must be submitted to NSW Planning for the approval of the Secretary. Continual improvement shall be achieved through monitoring, internal and external communication with stakeholders, implementation of corrective and preventative actions and through monitoring progress against the objectives included in the environmental management plans. The reporting framework (refer **Section 5.7**) will document the effectiveness of this document (and the related Extraction Plan) through comparison of the predicted negligible impacts of subsidence against actual outcomes.

Each variation to this Plan will be identified in the Document Control Table at the beginning of this document.

Additionally, to maintain consistency with existing management plans and previous Extraction Plans at the mine, this CLZ (ML1814) ACHMP will also be reviewed in the event that the following occur:

- Stakeholders raise issues that necessitate a review;
- There are other changes to management requirements (e.g. changes to other related approvals besides consent, such as Mining Lease and/or EPL conditions);
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan;
- Monitoring or audit processes demonstrate that a review is warranted;
- Where otherwise triggered by the CLZ (ML1814) TARP;
- Where triggered by (or for) review of other related management plans (if applicable); or
- Every three (3) years as a minimum (where not already triggered above).

Any amendments to the CLZ (ML1814) ACHMP will be undertaken in accordance with Consent/relevant approvals and in consultation with key relevant stakeholders where required. Following any significant changes, a copy of the amended CLZ (ML1814) ACHMP will be forwarded to all relevant stakeholders.

In addition to planning development consent requirements, Airly Mine must review and as necessary revise the risk control measures implemented for subsidence in accordance with section 20 of the *WHSMP Regulation (2022)*. Any review triggered by WHS Legislation Requirements will be addressed via the process identified in the EP Main Report (*refer Section 5.5*) and the CLZ (ML1814) PSMP (Appendix 5 of the EP Main Report).

6.2 Key Responsibilities

The responsibility for implementation, monitoring and review of the CLZ (ML1814) ACHMP lies with the Superintendent Environment and Community. The ultimate responsibility for the implementation of the CLZ (ML1814) ACHMP lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for this CLZ (ML1814) ACHMP are outlined in **Table 6.1**.

Table 6.1: Key Personnel and Accountabilities

Position	Responsibility
Mine Manager	- Ensuring that sufficient resources are available to implement and execute the requirements of this Plan; and - Reporting triggers/non-conformances to external stakeholders.
Technical Services Manager	- Coordinate underground inspections and subsidence monitoring program associated with this CLZ (ML1814) ACHMP; - Coordinate implementation of the mine design and CLZ (ML1814) TARP. - Reporting triggers/non-conformances internally to the mine manager as appropriate. - Reporting to NSW Planning and NSW RR of subsidence and pillar system performance upon completion of specified monitoring intervals.
Production Manager	- Implement mine design - Establish and maintain underground monitoring and inspections program; - Auditing as required
Mine Surveyor	- Survey as built initial development pillars - Establish and maintain subsidence monitoring program; - Internal reporting as required. - Mark up centre lines for driveage in pillars - Produce final mining plan for first workings to be carried out in consultation with the Technical Services Manager.
Superintendent Environment and Community	Implementation, monitoring and review of this plan, including: - The carrying out of targeted inspections; - The installation and maintenance of signage where required; - Reporting triggers/non-conformances internally to the Mine Manager as appropriate; - Consulting with land owners, landholders and managers regarding any land management issues arising from subsidence within the EP Area. This includes (but may not be limited to) NPWS, Office of Crown Lands and private landowners within the EP Area (if and as applicable); - Reviewing this CLZ (ML1814) ACHMP, including consultation during the review process with relevant stakeholders; - Coordinating any remediation work as required; - Inspecting targeted accessible areas susceptible to tensile and compressive strains and potential cracking as required (e.g. accessible tracks and trails); and - Co-ordinating the generation and submission of formal reporting requirements outlined in this Plan.

7 REFERENCES

- Golder (2014a). *Airly Mine Extension Project Environmental Impact Statement*, Golder Associates, April 2014
- Golder (2014b). *Subsidence Predictions and Impact Assessment (SIA) for Airly Mine (127621105-003-R-Rev0)*, Golder Associates, January 2014
- Golder (2014c). *Subsidence Impact Assessment on the Cliff Lines and Associated Landforms for Airly Mine. Report Number (127621105-001-RRevA)*
- Golder (2017). *The Adequacy of Coal Pillars Planned for the Cliff Line Zone in ML1331, Airly Mine. Project No. 127621105-313-R-Rev1.*
- MSEC (2015). *MSEC749 Peer Review of Airly Mine Subsidence Predictions and Assessments - letter 150318.*
- MSEC (2024). *MSEC1447 Subsidence Predictions and Impact Assessments for the Natural and Built Features over and near the proposed 500 Mains and HB1 and HB2 Herringbone First Workings in support of the Extraction Plan Application.*
- Independent Review Panel (2016). *Report of the Independent Review Panel Established to Report on Accuracy and Reliability Of Mine Subsidence Impacts On Sensitive Features Across The Airly Mine Extension Application Area*
- Office of Environment & Heritage (2015). *Mugii Murum-ban State Conservation Area Draft Plan of Management*, NSW National Parks and Wildlife Service
- SCT (2023a). *Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (Airly 5535_Rev 3)*
- SCT (2023b). *Cliff Line Zone Pillar Design Review for an Increased Extraction Height (Airly 5702)*, dated 16 November 2023
- SCT (2024a). *High level subsidence, conductivity and connectivity review for The Grotto and The Oasis at Airly Mine (Airly 5650, Rev 4)*, dated July 2024
- SCT (2024b). *Airly Mine Overburden Subsidence and Conductivity Review for The Grotto and The Oasis – Q2 2024 (Airly 5796, Rev 2)*, dated July 2024
- RPS (2022a). *Airly Extraction Plan for the Cliff Line Zone ML1814 and CLZ (ML1814) Extraction Plan Area Historical Heritage Management Plan Update & Phase 1 Baseline Historical Heritage Assessment (Report No. PR152234-1)*
- RPS (2022b). *Desktop review of ML 1814 area and CLZ (ML1814) EP Area for Aboriginal Cultural Heritage (Report No. AU213005571)*
- RPS (2023). *Baseline Biodiversity Report CLZ (ML1814) EP Area and CLZ (ML1814) EP Area (Report No. 152229)*

APPENDIX 1: DPE (now NSW Planning) Endorsement

Ms Jacqueline Cooke
Compliance Manager
Centennial Coal Company Limited

Via: NSW Major Projects portal
20/09/2023

Subject: Endorsement of Heritage Specialist - Cliff Line Zone First Workings Extraction Plan

Dear Ms Cooke,

I refer to your request dated 13 September 2023 for the Planning Secretary's endorsement of Tessa Boer-Mah as a suitably qualified and experienced person to prepare the Extraction Plan Heritage Management Plan for the Cliff Line Zone First Workings Extraction Plan required under Schedule 3, Condition 7 of SSD-5581. I note that Ms Boer-Mah would replace the previously endorsed Heritage Specialist, Susan Kennedy (RPS).

The Department has reviewed the nomination and information you have provided and is satisfied that Tessa Boer-Mah is suitably qualified and experienced. Accordingly, I can advise that the Planning Secretary endorses the appointment of Tessa Boer-Mah of Heritage Now as Technical Specialist – Heritage Management Plan for the Cliff Line Zone First Workings Extraction Plan at Airly Mine (SSD-5581) in place of Susan Kennedy (RPS).

If you wish to discuss the matter further, please contact Emily Pemberton on 02 8275 1783.

Yours sincerely

A handwritten signature in black ink, appearing to read "J. Evans".

Director
Energy and Resource Assessments

As nominee of the Planning Secretary

APPENDIX 2: Site Card for AHIMS 45-1-0167 AND AHIMS RECENT SEARCH



National Parks and Wildlife Service

BOX N189, GROSVENOR STREET POST OFFICE, SYDNEY, NSW 2000. TEL (02) 237 6500

Standard Site Recording Form



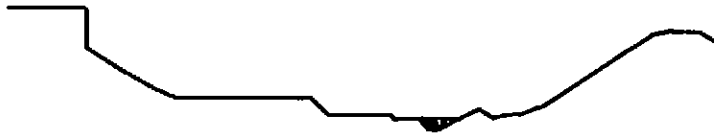
45-1-0167

MAP NAME	EDITION	SCALE	REFERENCE	HEAD OFFICE USE ONLY:
SYDNEY		1:250,000		NWPS site no: 45-1-167
GLEN ALICE		1:250,000	2/25360 63/32640	Site types: ① File nos: Date 17/2/92
Filed by: S.D.				
Site name: GENOWLAN CREEK 1		Locality/property name: "AIRLY MOUNTAIN"		Owner/Manager:
Local post office: CAPEERTEE				Address:
NPWS District: BLUE MOUNTAINS		Region: CENTRAL		
Reason for investigation (give R.O. instruction no. where applicable): EIS UNDERGROUND MINING - AIRLY AUTHORIZATION 232				
Portion no:		Other land category:		Plan/sketch/section of site attached? Yes/No
Parish: MORUNDUREY		County: ROXBURGH		How many?
Air photo refs. (for stereo pair)				Photos taken? Yes/No
				How many attached?
How to get to the site (refer to permanent features, give best approach to site eg. from above, below, along cliff. (Draw diagram on separate sheet.) FROM CAPEERTEE TAKE GLEN DAVIS ROAD EAST TURN LEFT ^{AFTER} 6.5 km TO "AIRLY MOUNTAIN" TAKE STEEP TRACK UP SLARP (HARD RALLY), RIGHT AT TOP THEN LEFT TOWARDS POINT HATTERAS. SITE ON GENOWLAN CR, EAST SIDE - VERY LARGE & UNMISTAKABLE, 20M ABOVE VEHICLE TRACK.				
Other sites in locality? Yes/No.		Site Types Include:		
Are sites in NPWS Register? Yes/No.		Unregistered sites — plans for future recording? Yes/No.		
Have artefacts been removed from site? Yes/No/don't know. When?		Deposited where?		
By whom?				
Is site important to local Aborigines? Yes/No/don't know.				
Give contact(s) name(s) + address(es)		JOHN BURG WINDRADYNE LOCAL ABORIGINAL LAND COUNCIL 125 WILLIAM ST BATHURST		
Contacted for this recording? Yes/No.				
(Attach additional information separately) If not, why not?				
Verbal/written reference sources (including full title of accompanying report). AIRLY AUTHORIZATION (A232) NEAR CAPEERTEE, NSW ADDITIONAL ARCHAEOLOGICAL SURVEY FOR ABORIGINAL SITES. N. GRAYSHAW 1991 C-2193				
Checklist: surface visibility, damage/disturbance/ threat to site	Condition of site: DEPOSIT APPEARS UNDISTURBED. ROCK CRACKED AND PROBABLY VULNERABLE TO SUBSIDENCE.			
Recommendations for management & protection (attach separate sheet if necessary): TEST EXCAVATION IF TO BE MINED UNDER.				
Site recorded by: H. GRAYSHAW M. DALLAS S. BURG		Date: 12/6/91		
Address/institution: 51 THOMPSON ST DRUMMOYNE 2047				

SITE POSITION & ENVIRONMENT

OFFICE USE ONLY: NPWS site no: 45-1-167

1. Land form a. beach/hill slope/ridge top, etc: **HILL SLOPE** b. site aspect: **W** c. slope: **30%**
- d. mark on diagram provided or on your own sketch the position of the site: e. Describe briefly:



- f. Local rock type: **NARRABEEN SANDSTONE** g. Land use/effect:

2. Distance from drinking water: **30m** Source: **GENOWLAN CREEK**

3. Resource Zone associated with site (estuarine, riverine, forest etc): **MOUNTAIN TEMPERATE RF FEATURES**

4. Vegetation: **TREE FERNS BRACKEN TALL EUCALYPTS**

5. Edible plants noted:

6. Faunal resources (include shellfish):

7. Other exploitable resources (river pebbles, ochre, etc):

Site type:

**SHELTER
WITH
ARCHAEOLOGICAL
DEPOSIT**

DESCRIPTION OF SITE & CONTENTS.

Note state of preservation of site & contents. Do NOT dig, disturb, damage site or contents.

Genowlan Creek 1 Shelter with Archaeological Deposit

Map Ref: Glen Alice 1:25,000 2/25360 63/32640

Location: The shelter is situated on the eastern side of a steeply inclined valley with cliffline on both sides. It is about 500m upstream of a junction of Genowlan Creek. Vegetation in the valley is dominated by tree ferns, bracken and tall eucalypts. Above a vehicle track, the shelter is about 30m from the creek above a 30% gradient.

Description: Facing south west, this is a large shelter the main body of the overhang being 41m long, more than 6m deep and 6m high. The floor is fairly level and most of it is dry. The deposit consists of pale grey and yellow sandy soil with some roof fall. Behind an area of roof fall the deposit appears potentially deep. Part of the dripline is covered in bracken and ferns.

Six artefacts were recorded at the north western end of the shelter where the deposit appeared to be of restricted depth, overlying rockfall. Here as well as behind the roof fall deposit is <10cm deep.

No art was observed within the shelter, although there was some graffiti dating to 23/3/1975. Other evidence of European occupation included an aluminium can and a recent fireplace.

The rear wall of the shelter contains a number of cracks which suggest that mining induced subsidence would cause significantly more rockfall and probably partial collapse.

Recorded artefacts:

1. Quartz bipolar core 23x20x13mm, 30% cortex
2. Quartz flake [21]x13x8mm, focal platform, distal end missing, 35% cortex, R/U 1 lateral
3. Quartz flaked piece 11x10x4mm
4. Quartz flake [12]x12x4mm, distal end missing
5. Grey chert flaked piece 18x13x4mm
6. Brownish chert flake 25x19x3mm, focal platform.

Quartz pebbles were observed in a nearby creek.

indicate north, show scale.

Attach annotated photos (stereo where useful) showing scale, particularly for art sites.

CHECKLIST TO HELP:
length, width, depth,
height of site, shelter,
deposit, structure,
element eg. tree scar,
grooves in rock.

DEPOSIT: colour,
texture, estimated
depth, stratigraphy,
contents-shell, bone,
stone, charcoal, density
& distribution of these,
stone types, artefact
types.

ART: area of surface
decorated, motifs,
colours, wet, dry
pigment, technique of
engraving, no. of
figures, sizes,
patination.

BURIALS: number &
condition of bone,
position, age, sex,
associated artefacts.

TREES: number, alive,
dead, likely age, scar
shape, position, size,
patterns, axe marks,
regrowth.

QUARRIES: rock type,
debris, recognisable
artefacts, percentage
quarried.

OTHER SITES EG.
structures (fish traps,
stone arrangements,
bora rings, mia mias),
mythological sites, rock
holes, engraved groove
channels, contact sites
(missions massacres
cemeteries) as
appropriate

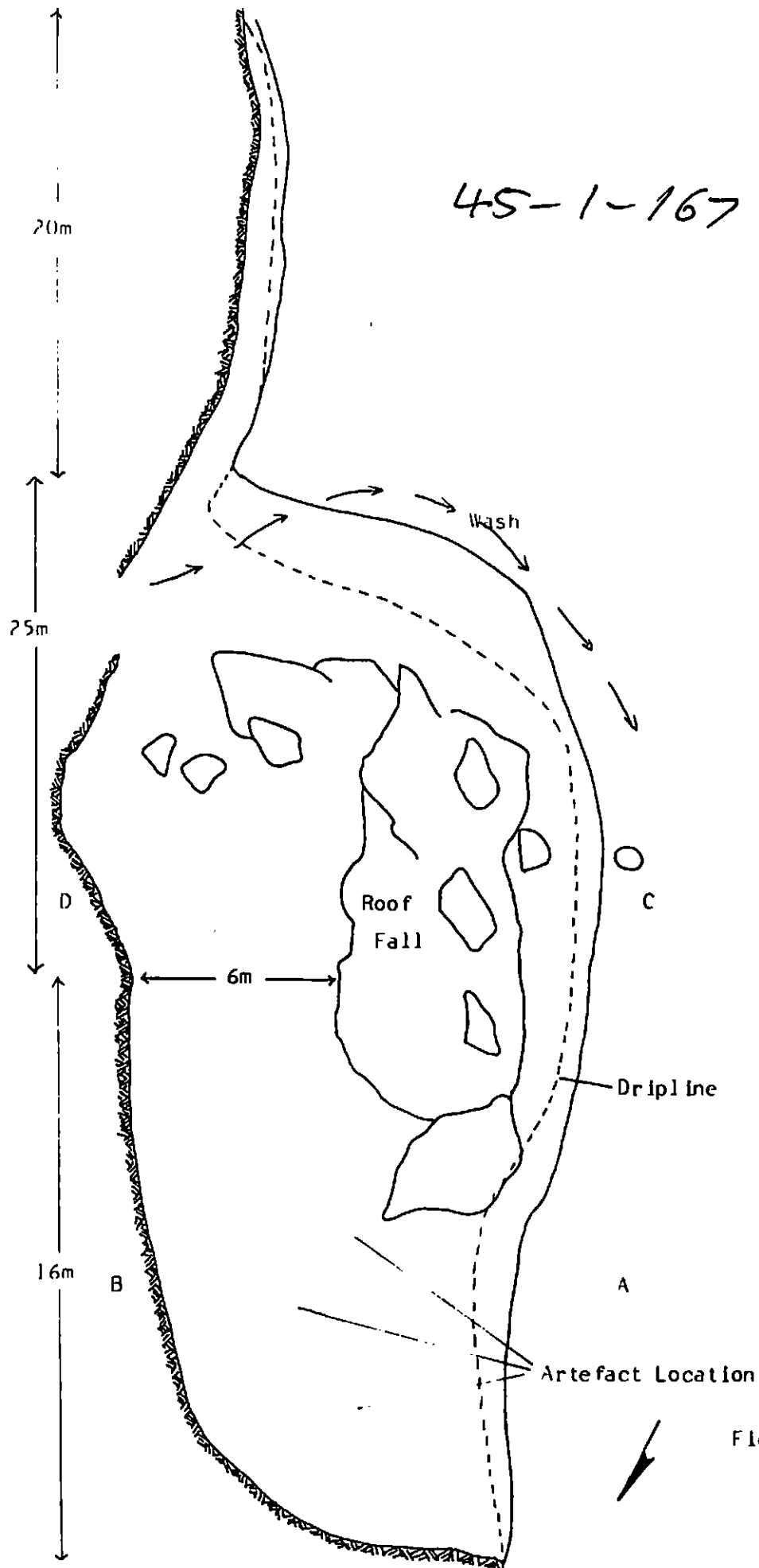


Fig 5: Genowian Creek
Sketch Plan

45-1-167

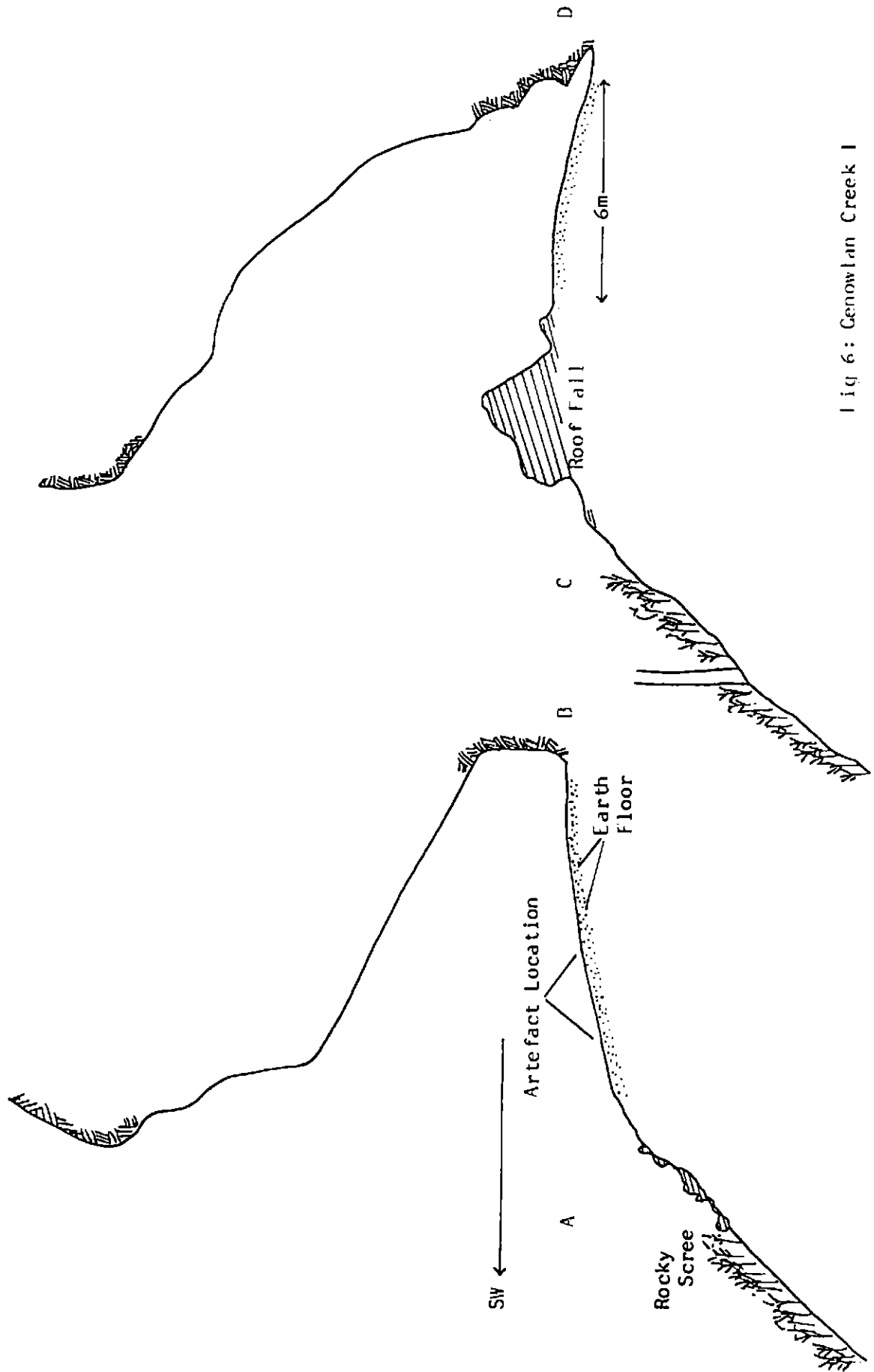
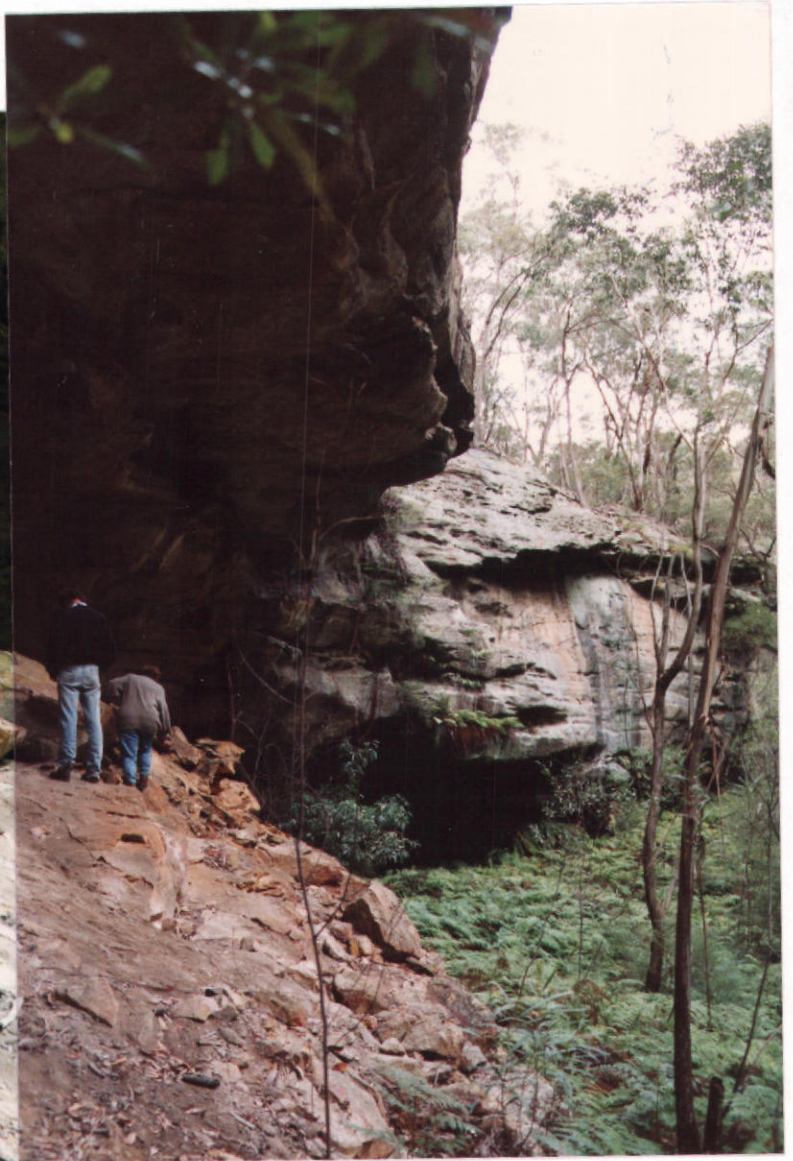


Fig 6: Genowlan Creek I
Cross Sections

48-1-167



SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-1-2745	RPS AY 019	GDA	56	220430	6334585	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-2585	CSR 3	AGD	56	230420	6322501	Open site	Valid	Aboriginal Resource and Gathering : 13		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>	1829	
45-1-0080	Morenmore Shelter	AGD	56	223600	6318000	Closed site	Valid	Artefact : -	Shelter with Deposit	343
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-2675	BBN IF1	AGD	56	226898	6317032	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
44-3-0179	94MStr84	GDA	55	776208	6329272	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-2685	Flitton Valley 3	GDA	56	240043	6341715	Open site	Valid	Artefact : 3		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-0127	Airly Mountain	AGD	56	224060	6331080	Open site	Valid	Artefact : -	Open Camp Site	1947
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-0042	Little Capertee Creek;	AGD	56	242240	6326020	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-2544	Carinya (C-ST-1);Hillcroft;	AGD	56	220840	6332250	Open site	Destroyed	Modified Tree (Carved or Scarred) : -	Scarred Tree	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
37-4-0012	Chimney Stack;	AGD	56	234485	6346988	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-0118	Baal Bone 1;	AGD	56	227000	6318420	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-2679	BBN OS3	AGD	56	228069	6317312	Open site	Valid	Artefact : 4		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
44-3-0028	Capertee	AGD	55	775492	6333617	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	1298,4795
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-2742	RPS AY 023	GDA	56	223226	6332207	Open site	Valid	Artefact : 1, Habitation Structure : 1		
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-1-0167	Genowlan Creek 1	AGD	56	225360	6332640	Closed site	Valid	Artefact : -	Shelter with Deposit	2193
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-1-2732	Limestone Gully	GDA	56	222113	6339816	Open site	Valid	Artefact : 1		
	Contact	Recorders	Miss.Sharon Riley					Permits		
45-1-2766	RPS-AY-007	GDA	56	226583	6332980	Open site	Valid	Art (Pigment or Engraved) : -, Habitation Structure : -		
	Contact	Recorders	Mrs.Tessa Boer-Mah					Permits		
45-1-2686	Flitton Valley 4	GDA	56	240050	6341710	Open site	Valid	Artefact : 2		
	Contact	Recorders	Mr.John Shipp					Permits		
45-1-2833	Newnes 4	GDA	56	242457	6326252	Open site	Valid	Artefact : -		
	Contact	Recorders	Mrs.Angela Besant,Insite Heritage Pty Ltd					Permits		
45-1-2772	RPS-AY-013	GDA	56	221240	6334987	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Philippa Sokol					Permits		
45-1-0038	Newnes;Point Nicholson;Red Rocks;	AGD	56	238820	6327250	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Val Attenbrow					Permits		
45-1-0036	Mt Harvey;Little Capertee;	AGD	56	238870	6325790	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Val Attenbrow					Permits		
44-3-0274	Diggings 1	GDA	55	775385	6324281	Open site	Valid	Artefact : -		
	Contact	Recorders	Mrs.Angela Besant,Insite Heritage Pty Ltd					Permits		
45-1-2678	BBN OS2	AGD	56	228875	6317699	Open site	Valid	Artefact : 13		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo					Permits		
45-1-0097	Gardiners Hill;Baal Bone Creek;Ben Bullen State Forest;	AGD	56	229700	6316600	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	I Brown					Permits		
45-1-2777	RPS-AY-018	GDA	56	220300	6334516	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Philippa Sokol					Permits		
45-1-2776	RPS-AY-017	GDA	56	220322	6334755	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Miss.Philippa Sokol					Permits		
45-1-0030	Capertee State Forest;	AGD	56	224650	6326650	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	Contact	Recorders	Unknown Author					Permits		
45-1-2763	RPS-AY-004	GDA	56	222036	6332723	Open site	Valid	Artefact : -		
	Contact	Recorders	RPS AAP Consulting Pty Ltd - Hamilton,Mr.David White					Permits		
44-3-0044	Running Stream Kadisha	AGD	55	773950	6334700	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	1097,1298
	Contact	Recorders	Mr.Allan Lance					Permits		

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : HN675-A

Client Service ID : 794537

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-1-2684	Restriction applied. Please contact ahims@environment.nsw.gov.au. Contact					Open site	Valid			
		Recorders	Mr.John Shipp					Permits		
45-1-2748	RPS AY 022 Contact	GDA	56	224061	6332976	Open site	Valid	Artefact : 1		
		Recorders	RPS AAP Consulting Pty Ltd - Echuca Victoria					Permits		
45-1-2747	RPS AY 021 Contact	GDA	56	224223	6332733	Open site	Valid	Artefact : 1		
		Recorders	RPS AAP Consulting Pty Ltd - Hamilton,RPS AAP Consulting Pty Ltd - Echuca Victor					Permits		
45-1-2726	Airstrip Area (a) Contact	GDA	56	223999	6343558	Open site	Valid	Artefact : 1		
		Recorders	Miss.Sharon Riley					Permits		
45-1-2744	RPS-AY-025 Contact	GDA	56	224485	6331436	Open site	Valid	Artefact : 1		
		Recorders	RPS AAP Consulting Pty Ltd - Echuca Victoria,RPS AAP Consulting Pty Ltd - Pitt Str					Permits		
45-1-2767	RPS-AY-008 Contact	GDA	56	221169	6333899	Open site	Valid	Artefact : -		
		Recorders	Miss.Philippa Sokol					Permits		
45-1-2584	CSR 01 Contact	AGD	56	230870	6322684	Open site	Valid	Artefact : 22		
		Recorders	Mr.Wayne Robert					Permits	1829	
45-1-2682	BBN OS5 Contact	AGD	56	229047	6317959	Open site	Valid	Artefact : 4		
		Recorders	OzArk Environmental and Heritage Management - Dubbo					Permits		
44-3-0056	Capertee; Contact	AGD	55	778043	6328484	Open site	Valid	Modified Tree (Carved or Scarred) : -, Ceremonial Ring (Stone or Earth) : -	Bora/Ceremonial,C arved Tree	65
		Recorders	Unknown Author					Permits		
45-1-2761	RPS-AY-002 Contact	GDA	56	221871	6332330	Open site	Valid	Habitation Structure : -, Potential Archaeological Deposit (PAD) : -		
		Recorders	RPS AAP Consulting Pty Ltd - Hamilton,Ms.Cheng-Yen Loo					Permits		
45-1-2746	RPS AY 020 Contact	GDA	56	221936	6332676	Open site	Valid	Artefact : 1		
		Recorders	RPS AAP Consulting Pty Ltd - Echuca Victoria					Permits		
45-1-2733	Deadmans Creek Contact	GDA	56	222480	6341170	Open site	Valid	Artefact : 1		
		Recorders	Miss.Sharon Riley					Permits		
45-1-2736	Capertee River - oak Creek Contact	GDA	56	223513	6340296	Open site	Valid	Artefact : 1		
		Recorders	Miss.Sharon Riley					Permits		
45-1-0168	Dog Trap Creek; Contact	AGD	56	226000	6329950	Open site	Valid	Artefact : -	Open Camp Site	2193
		Recorders	Helen Brayshaw,Mary Dallas Consulting Archaeologists (MDCA),John Bugg					Permits		
44-3-0147	CHC-ST1 (Capertee) Contact	GDA	55	777705	6329080	Open site	Deleted	Modified Tree (Carved or Scarred) : 1		99921
		Recorders	Doctor.Jodie Benton					Permits		

Report generated by AHIMS Web Service on 25/06/2023 for Trishia Palconit for the following area at Datum :GDA, Zone : 56, Eastings : 210531.0 - 242531.0, Northings : 6316586.0 - 6348586.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 100

This information is not guaranteed to be free from error omission. Heritage NSW and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-1-0119	Baal Bone 2;	AGD	56	226880	6317680	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>		Helen Brayshaw,Ms.Laila Haglund				<u>Permits</u>		
36-6-0033	The Chimney;Mt Ilford Rd;	AGD	55	772770	6346262	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	1097
	<u>Contact</u>	<u>Recorders</u>		J Johnson				<u>Permits</u>		
44-3-0029	Capertee.	AGD	55	778043	6328484	Closed site	Valid	Artefact : -, Art (Pigment or Engraved) : -	Shelter with Art,Shelter with Deposit	1298
	<u>Contact</u>	<u>Recorders</u>		Unknown Author				<u>Permits</u>		
45-1-2770	RPS-AY-011	GDA	56	220443	6331341	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>		Miss.Philippa Sokol				<u>Permits</u>		
45-1-2771	RPS-AY-12	GDA	56	220695	6331352	Open site	Valid	Art (Pigment or Engraved) : -		
	<u>Contact</u>	<u>Recorders</u>		Miss.Philippa Sokol				<u>Permits</u>		
45-1-0098	Glow Worm Tunnel 1;Wollemi N.P;	AGD	56	240300	6316500	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>		Ian Brown				<u>Permits</u>		
45-1-2730	Capertee River Area (a)	GDA	56	222771	6341085	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>		Miss.Sharon Riley				<u>Permits</u>		
45-1-2727	Airstrip Area (b)	GDA	56	224318	6343149	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>		Miss.Sharon Riley				<u>Permits</u>		
45-1-2735	Wallaby Creek 1	GDA	56	225879	6343485	Open site	Valid	Aboriginal Resource and Gathering : 1, Art (Pigment or Engraved) : 1, Artefact : 1, Grinding Groove : 1, Hearth : 1, Potential Archaeological Deposit (PAD) : 1		
	<u>Contact</u>	<u>Recorders</u>		Miss.Sharon Riley				<u>Permits</u>		
37-4-0008	Chimney Stack;	AGD	56	232394	6346308	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>		Unknown Author				<u>Permits</u>		
45-1-2768	RPS-AY-009	GDA	56	227550	6333120	Open site	Valid	Artefact : -, Habitation Structure : -, Potential Archaeological Deposit (PAD) : -		
	<u>Contact</u>	<u>Recorders</u>		Ms.Karyn Virgin				<u>Permits</u>		
45-1-2596	Wolgan Valley - AMBS03	AGD	56	238081	6316876	Open site	Valid	Artefact : 2		

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
	Contact T Russell	Recorders						Permits		
36-6-0014	The Chimney;"Reloha";	AGD	55	772510	6346570	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	213
	Contact	Recorders						Permits		
44-3-0219	94M Str80 - Relocation	GDA	55	776451	6328202	Open site	Valid	Artefact : -		
	Contact	Recorders						Permits		
44-3-0149	Airly 1	GDA	56	219208	6330113	Open site	Valid	Artefact : 3		
	Contact	Recorders						Permits		
45-1-2680	BBN 0S4	AGD	56	228620	6317297	Open site	Valid	Artefact : 3		
	Contact	Recorders						Permits		
45-1-2595	Wolgan Valley - AMBS04	AGD	56	237916	6316615	Open site	Valid	Artefact : 2		
	Contact T Russell	Recorders						Permits		
45-1-0031	Umbiella Creek;Glen Alice;	AGD	56	239650	6340330	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders						Permits		
45-1-2731	Oaky Creek Area 1	GDA	56	222867	6339317	Open site	Valid	Artefact : 1		
	Contact	Recorders						Permits		
45-1-0092	Newnes 2;	AGD	56	242210	6326100	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders						Permits		
45-1-2676	BBN IF2	AGD	56	227468	6317040	Open site	Valid	Artefact : 1		
	Contact	Recorders						Permits		
44-3-0275	WSF 02	GDA	55	775869	6321758	Open site	Valid	Artefact : -		
	Contact	Recorders						Permits		
45-1-2594	Wolgan Valley - AMBS02	AGD	56	238593	6317089	Open site	Valid	Artefact : 6		
	Contact T Russell	Recorders						Permits		
45-1-2764	RPS-AY-005	GDA	56	224324	6331334	Open site	Valid	Artefact : -		
	Contact	Recorders						Permits		
45-1-0099	Mt Iris;Wollemi N.P.	AGD	56	242400	6335200	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	Recorders						Permits		
45-1-2773	RPS-AY-014	GDA	56	221211	6335509	Open site	Valid	Artefact : -		
	Contact	Recorders						Permits		
45-1-0039	Newnes;Point Nicholson;	AGD	56	238975	6327402	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders						Permits		
45-1-0252	AC-OC-1;"Airly";	AGD	56	220110	6331040	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders						Permits		

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-1-2760	RPS-AY-001	GDA	56	220621	6333652	Open site	Valid	Artefact : -		
	Contact	Recorders	RPS AAP Consulting Pty Ltd - Hamilton,Mr.David White					Permits		
45-1-2577	Fish River 3	AGD	56	240363	6329979	Open site	Valid	Artefact : 1		98339
	Contact	Recorders	Doctor.Susan (left ahms) McIntyre-Tamwoy					Permits	1582,2247	
45-1-2729	Capertee River (ATFT)	GDA	56	223063	6342099	Open site	Valid	Artefact : 1		
	Contact	Recorders	Miss.Sharon Riley					Permits		
45-1-2734	Capertee River (rvr crossing)	GDA	56	223109	6342117	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	Contact	Recorders	Miss.Sharon Riley					Permits		
45-1-2743	RPS AY 024	GDA	56	223701	6332733	Open site	Valid	Artefact : 1		
	Contact	Recorders	RPS AAP Consulting Pty Ltd - Hamilton,RPS AAP Consulting Pty Ltd - Echuca Victor					Permits		
45-1-0082	Newnes 1;	AGD	56	242150	6325860	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Ann Jelinek					Permits		
45-1-0037	Mt Harvey;Little Capertee;	AGD	56	238122	6324184	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Val Attenbrow					Permits		
45-1-2683	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact	Recorders	Mr.John Shipp					Permits		
45-1-2688	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	Contact	Recorders	Mr.John Shipp					Permits		
45-1-2765	RPS-AY-006	GDA	56	224170	6333583	Open site	Valid	Artefact : -		
	Contact	Recorders	RPS AAP Consulting Pty Ltd - Hamilton,Mr.David White					Permits		
45-1-2769	RPS-AY-010	GDA	56	220789	6331017	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Philippa Sokol					Permits		
45-1-2774	RPS-AY-015	GDA	56	221061	6335600	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Philippa Sokol					Permits		
45-1-2576	Fish River 2	AGD	56	231262	6323547	Open site	Valid	Artefact : 1		98339
	Contact	Recorders	Doctor.Susan (left ahms) McIntyre-Tamwoy					Permits	1582	
45-1-2681	BBN SAL1	AGD	56	228172	6317372	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo					Permits		
45-1-2677	BBN OS1	AGD	56	228935	6317854	Open site	Valid	Artefact : 4		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo					Permits		
45-1-2775	RPS-AY-016	GDA	56	220360	6334698	Open site	Valid	Artefact : -		
	Contact	Recorders	Miss.Philippa Sokol					Permits		
45-1-2762	RPS-AY-003	GDA	56	221930	6332867	Open site	Valid	Artefact : -		

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : HN675-A

Client Service ID : 794537

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
	<u>Contact</u>	<u>Recorders</u>	RPS AAP Consulting Pty Ltd - Hamilton,Mr.David White					<u>Permits</u>		
45-1-2737	Restriction applied. Please contact ahims@environment.nsw.gov.au.					Open site	Valid			
	<u>Contact</u>	<u>Recorders</u>	Miss.Sharon Riley					<u>Permits</u>		
45-1-2738	Yard Paddoc	GDA	56	222629	6342252	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	<u>Contact</u>	<u>Recorders</u>	Miss.Sharon Riley					<u>Permits</u>		
44-3-0085	Jack Halls Creek;Kadisha;Sofala;	AGD	55	773950	6334700	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	1097,102202
	<u>Contact</u>	<u>Recorders</u>	Mr.Noel Webster,Mr.Allan Lance					<u>Permits</u>		
45-1-2728	Airstrip Area (c)	GDA	56	224836	6343228	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	Miss.Sharon Riley					<u>Permits</u>		
45-1-0120	Baal Bone 3;	AGD	56	227510	6316940	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	Helen Brayshaw,Ms.Laila Haglund					<u>Permits</u>		
36-6-0017	The Chimney;Reloha;	AGD	55	772510	6346570	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>	R French					<u>Permits</u>		
44-3-0178	94M Str80	GDA	55	776470	6328209	Open site	Destroyed	Artefact : -		104296
	<u>Contact</u>	<u>Recorders</u>	Mrs.Angela Besant,Insite Heritage Pty Ltd,OzArk Environmental and Heritage Man:					<u>Permits</u>	4130	
45-1-2687	Flitton Valley 5	GDA	56	240055	6341564	Open site	Valid	Artefact : 6		
	<u>Contact</u>	<u>Recorders</u>	Mr.John Shipp					<u>Permits</u>		
45-1-2586	CSR 2	AGD	56	230790	6322874	Open site	Valid	Artefact : 7		
	<u>Contact</u>	<u>Recorders</u>	Mr.Wayne Robert					<u>Permits</u>	1829	
45-1-2575	Fish River 1	AGD	56	231108	6322938	Open site	Valid	Artefact : -		98339
	<u>Contact</u>	<u>Recorders</u>	Doctor.Susan (left ahms) McIntyre-Tamwoy					<u>Permits</u>	1582	

** Site Status

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 25/06/2023 for Trishia Palconit for the following area at Datum :GDA, Zone : 56, Eastings : 210531.0 - 242531.0, Northings : 6316586.0 - 6348586.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 100

This information is not guaranteed to be free from error omission. Heritage NSW and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

APPENDIX 5Public Safety Management Plan for CLZ (ML1814)



Public Safety Management Plan (CLZ (ML1814) PSMP)

**Cliff Line Zone of First Workings
Extraction Plan (ML1814)**

Airly Mine (SSD_5581)

July 2024

A decorative graphic in the bottom right corner consisting of overlapping curved shapes in shades of teal, blue, and purple.

DOCUMENT CONTROL / TITLE BLOCK

EXTRACTION PLAN DETAILS	Title:	Public Safety Management Plan: Cliff Line Zone of First Workings Extraction Plan (ML1814)
	Applicant:	Centennial Airly Mine
	Revision No.:	CLZ (ML1814) PSMP_Rev_2 ¹

REVISION

REVISION DETAILS	Revision No.	Details of Revision	Date Sent
	Rev_0	Draft for external consultation	1/12/2023
	Rev_1	Update to address recommendations from consultation	22/03/2024
	Rev_2	Minor amendments to address recommendations from consultation	25/07/2024

¹ An integrated Document Control Procedure is incorporated into Centennial Airly Mine's Safety Management System (SMS). Documents, data and records pertaining to this plan will be managed according to the ***Airly Mine Document and Data Control Management Plan (AIR-MP-1034)***.

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ABBREVIATIONS

BCD	Biodiversity Conservation Division (now BCS)
BCS	Biodiversity, Conservation and Science group within the NSW DCCEEW
BMP	Biodiversity Management Plan
CLZ	Cliff Line Zone of First Workings (approved mining zone under consent SSD_5581)
DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
DPE	NSW Department of Planning and Environment (now NSW Planning)
DPIE	NSW Department of Planning, Industry and Environment (now NSW Planning)
DOC	Depth of Cover
EP	Extraction Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environment Protection License
HHMP	Historic Heritage Management Plan
IEP	Independent Expert Panel (post-consent)
IRP	Independent Review Panel (pre-consent)
LCC	Lithgow City Council
LMP	Land Management Plan
MEP	Airly Mine Extension Project
ML	Mining Lease
MOD	Modification to Airly Mine's former Development Consent (DA162/91)
NSW Planning	NSW Department of Planning, Housing and Infrastructure (formerly DPE)
NPWS	NSW National Parks and Wildlife Service
NSW-RR	NSW Resources Regulator
OEH	NSW Office of Environment & Heritage
PPMZ	Panel & Pillar Mining Zone (approved mining zone under consent SSD_5581)
PSMP	Public Safety Management Plan
SCA	State Conservation Area
SSD	State Significant Development
SMP	Subsidence Monitoring Program
SMZ	Shallow Mining Zone (approved mining zone under consent SSD_5581)
TARP	Trigger Action Response Plan
WMP	Water Management Plan

1 INTRODUCTION

1.1 Background

Airly Mine is an existing underground coal mine located approximately 40 kilometres (km) northwest of Lithgow in New South Wales, 170km northwest of Sydney and 4 km to the northeast of Capertee, as illustrated on **Figure 1-1**. The mine is partly located within the Mugii Murum-ban State Conservation Area (SCA). Centennial Airly Pty Limited (Centennial Airly) is the operator of the mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited (Centennial).

Development Consent for the Airly Mine Extension Project (MEP) was approved on 15 December 2016 subject to the Conditions in Schedule 2 to 6 of State Significant Development 5581 (SSD_5581). The consent allows extraction of 1.8 million tonnes of run-of-mine (ROM) coal per calendar year for a period of 20 years, which is supplied to both domestic and international markets. As per commitments within the Environmental Impact Statement (EIS) for SSD_5581, Airly Mine is implementing a conservative approach to mining, with different mining methods applied in different areas of the mining lease called Mining Zones².

The *Cliff Line Zone of First Workings (ML1814) (CLZ (ML1814)) Extraction Plan* as detailed in the *CLZ (ML1814) Extraction Plan Main Report (the EP Main Report)* and the supporting component plans, continues the conservative approach to mining being implemented by Airly Mine, with the proposed first workings under this Extraction Plan specifically designed to provide long term stable and effectively non-subsiding pillars to protect the surface such that there is no adverse impact. Mine design and implementation is a key element of subsidence impact avoidance and management. The *Extraction Plan Area (EP Area)* is further defined in **Section 1.3**.

The *EP Main Report* and the supporting component plans have been developed using a risk-based approach and in accordance with:

- Relevant requirements listed under *Condition 7 in Schedule 3* of SSD_5581;
- *Extraction Plan Guideline*, NSW Department of Planning and Environment 2022;
- *Managing Risks of Subsidence Guideline*, NSW Department of Industry, Resources Regulator (NSWRR), 2017; and
- *Consultation with all relevant key stakeholders* (potentially affected by subsidence) and the Independent Expert Panel (IEP) established by NSW Department of Planning, Housing and Infrastructure (NSW Planning) for the project.

An Extraction Plan is required to be developed and approved prior to undertaking any first workings within the Cliff Line Zone and Zone of First Workings, including the development of this *Public Safety Management Plan for CLZ (ML1814) (CLZ (ML1814) PSMP)*.

² Airly Mine has five (5) mining zones approved under development consent SSD_5581 as shown in Figure 2 in Appendix 3 of SSD_5581. These zones provide design criteria for different mining methods based on the differing levels of environmental sensitivity of surface features and depth of cover across the Airly mining leases. Section 8 of the Airly Mine EIS (2014) provides further details on the definitions of each of these approved mining zones if required.

1.2 Purpose and Scope

The purpose of this **CLZ (ML1814) PSMP** is to meet the requirements under *Condition 7(i)(vii) in Schedule 3* of SSD_5581 and associated relevant guidelines, leases and licenses, including outlining the monitoring and management measures to be implemented to address any potential impacts to public safety (**Section 3.2**) during first workings within the EP Area (**Section 1.3**).

A directly related *Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP)* (Appendix 6 of the EP Main Report) has also been specifically developed for the Extraction Plan to address the project performance measures prescribed by consent SSD_5581, supported by a *Master Trigger Action Response Plan for CLZ (ML1814) (CLZ (ML1814) TARP)* (Appendix 7 of the EP Main Report), including adaptive management measures if required.

1.3 Extraction Plan Area

The Extraction Plan Area (EP Area) is illustrated on **Figure 1-2** and is defined as:

- The *Cliff Line Zone of First Workings* within ML1814;
- Includes all proposed first workings within the EP Area;
- First workings incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features;
- No secondary extraction is permitted or proposed within the EP Area;
- No surface impacts have been predicted for first workings; and
- The EP Area is wholly located within the Mugii Murum-ban SCA with no private land ownership.

1.4 Relevant Features

The features identified within the EP Area, and which are subject to this *CLZ (ML1814) PSMP*, as illustrated on **Figure 1-2**, are summarised below and detailed in the following sections:

- **Section 1.4.1** – Public Use of Mugii Murum-ban SCA area
- **Section 1.4.2** – Public Access/Primary Thoroughfares
- **Section 1.4.3** – Unsealed roads and tracks

Public safety is primarily managed under this *CLZ (ML1814) PSMP*, however the *Land Management Plan for CLZ (ML1814) (CLZ (ML1814) LMP)* is also relevant due to the landscape features which were identified as directly related, potential risk to public safety (particularly cliffs).

1.4.1 Public Use of Mugii Murum-ban SCA area

The Mugii Murum-ban SCA provides opportunities for self-reliant recreation including four-wheel driving, nature study and heritage tourism (e.g. ruins of the New Hartley Oil Shale Mine), picnicking, unsupported camping (no facilities), mountain biking, bushwalking and birdwatching. Basic ‘bush-camping’ (no built facilities, including toilets) can also be undertaken within the SCA. It is noted, horse-riding and motorcycling (dirt bikes) are not permitted in the SCA:

The SCA is a moderately popular destination for four-wheel driving and attracts club and private outings. Many of the existing four-wheel drive routes have tight turns, steep slopes, ruts, and steps and require a high level of proficiency and vehicle capacity. Many trips are undertaken by registered clubs and include overnight

camping. This use will continue to be allowed under the draft Plan of Management (POM) for the SCA (OEH, 2015), subject to the planned controlled vehicle access system which will ensure safety during wet weather and prevent damage to park roads and trails (OEH 2015).

Prior to gazettal in 2011(as modified in 2016), the area now encompassing Mugii Murum-ban SCA had no formal visitation management and therefore there are minimal visitor facilities. Information on park visitation is limited, but the SCA Draft Plan of Management (POM) (OEH 2015) suggests up to 200 four-wheel drive vehicles may enter the park each year. Whilst periods of more intense use occurs (e.g. seasonal influence, group/4WD club use) on average across the year this represents approximately 4 cars a week.³

Mugii Murum-ban SCA is not currently a popular destination for adventure recreation activities such as abseiling and rock climbing (POM, 2015), and given opportunities for such in several nearby parks and the relative difficulty in accessing cliff faces within the SCA means its use for adventure recreation is likely to remain minimal (POM, 2015). Adventure activities also have the potential to damage fragile rock formations, particularly pagodas, therefore management of adventure activities will focus on protecting natural features (POM, 2015).

Section 3.7(g) of the POM states that the SCA is also not currently a common destination for commercial tour operators, however, the park has some potential for small-scale, sustainable, self-reliant commercial recreational opportunities (the surrounding Capertee Valley is recognised for tourism and the natural and cultural heritage of the area, including within the SCA, provides a significant contribution to the local tourism market). As with other recreational activities within the SCA, commercial tourism is managed in a regional context, considering opportunities that exist elsewhere in the greater Blue Mountains region. Interest in commercial recreation within the park is anticipated to be low due to the relative ease of access to other nearby locations offering similar recreational activities opportunities (POM, 2015). All commercial activities within the SCA (and all NPWS parks) require an operating licence with conditions that aim to minimise potential adverse impacts.

1.4.2 Public Access/Primary Thoroughfares

Due to the rugged nature of the Mugii Murum-ban SCA public access is primarily via SCA management trails. The main public entry point over the EP Area is via Genowlan Trail, which is located off Glen Davis Road. Genowlan Trail is an unsealed four wheel drive, dry-weather, gravel road in reasonable condition. In practice, it is understood that maintenance of the road is typically undertaken by the mine and NSW National Parks and Wildlife Service as part of management of the SCA. Genowlan Trail is planned to be gated to control access under the POM (OEH 2015).

All other access to the SCA is on foot and designated walking tracks in the SCA are limited. Therefore access is very limited and difficult beyond the trails mentioned above. Whilst the entire EP area is theoretically accessible, in reality access is difficult and very few individuals venture beyond the formed tracks and trails.

1.4.3 Unsealed Roads and Tracks

Unsealed roads and tracks are located within the EP Area. These roads/tracks are only accessible by 4WD vehicles. It is noted that no sealed roads are located within the EP Area. It is unlikely that the unsealed road and track surfaces over the EP Area will be adversely impacted by the proposed first workings, as there is expected to be only very low levels of subsidence which should not cause physical impacts (i.e. surface cracking).

³ See Section 3.7 of the Draft Plan of Management (OEH 2015) for further details on park uses and constraints.

Figure 1-1: Locality Plan

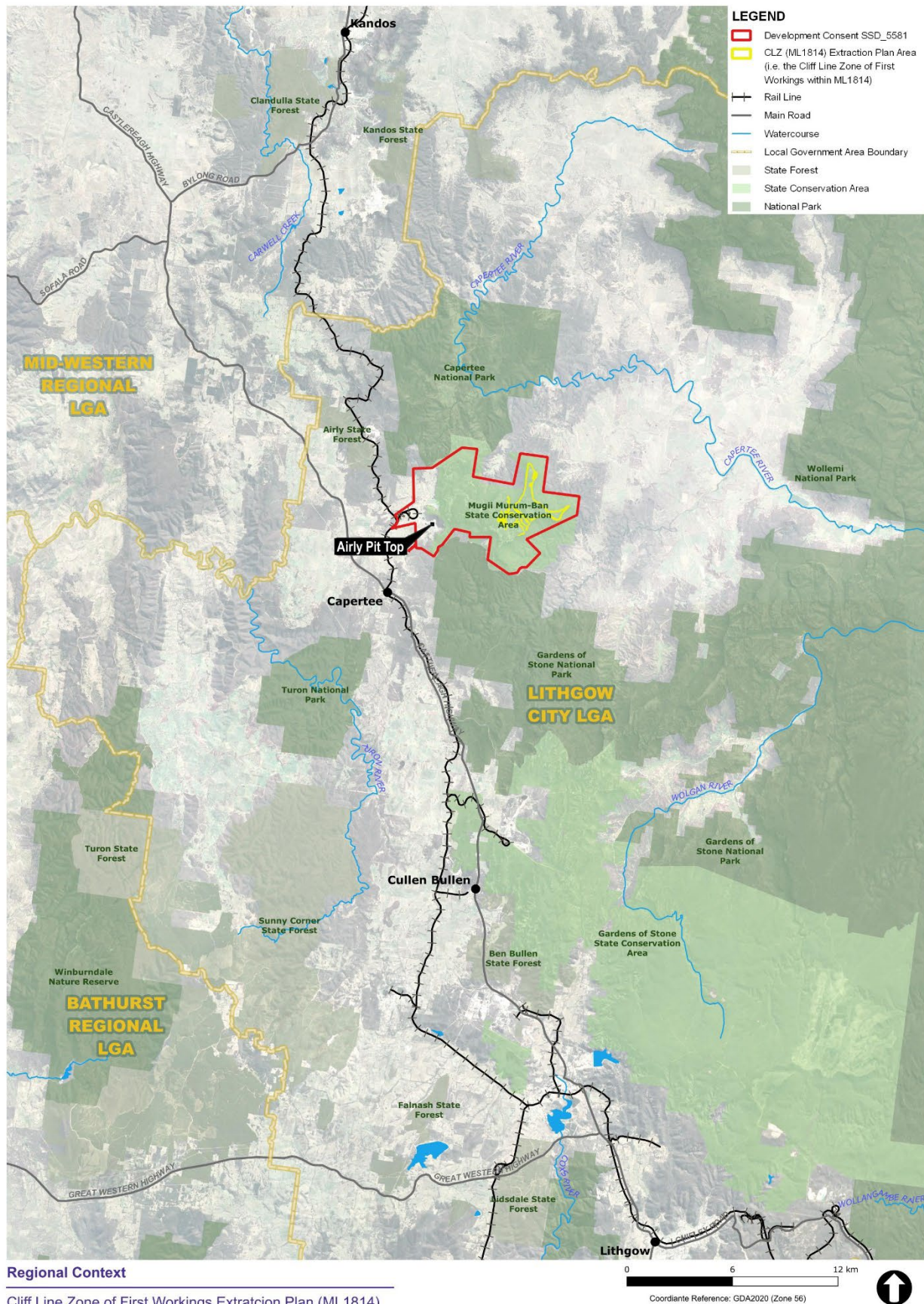


Figure 1-2: Extraction Plan Area (EP Area) and Relevant Features within the EP Area

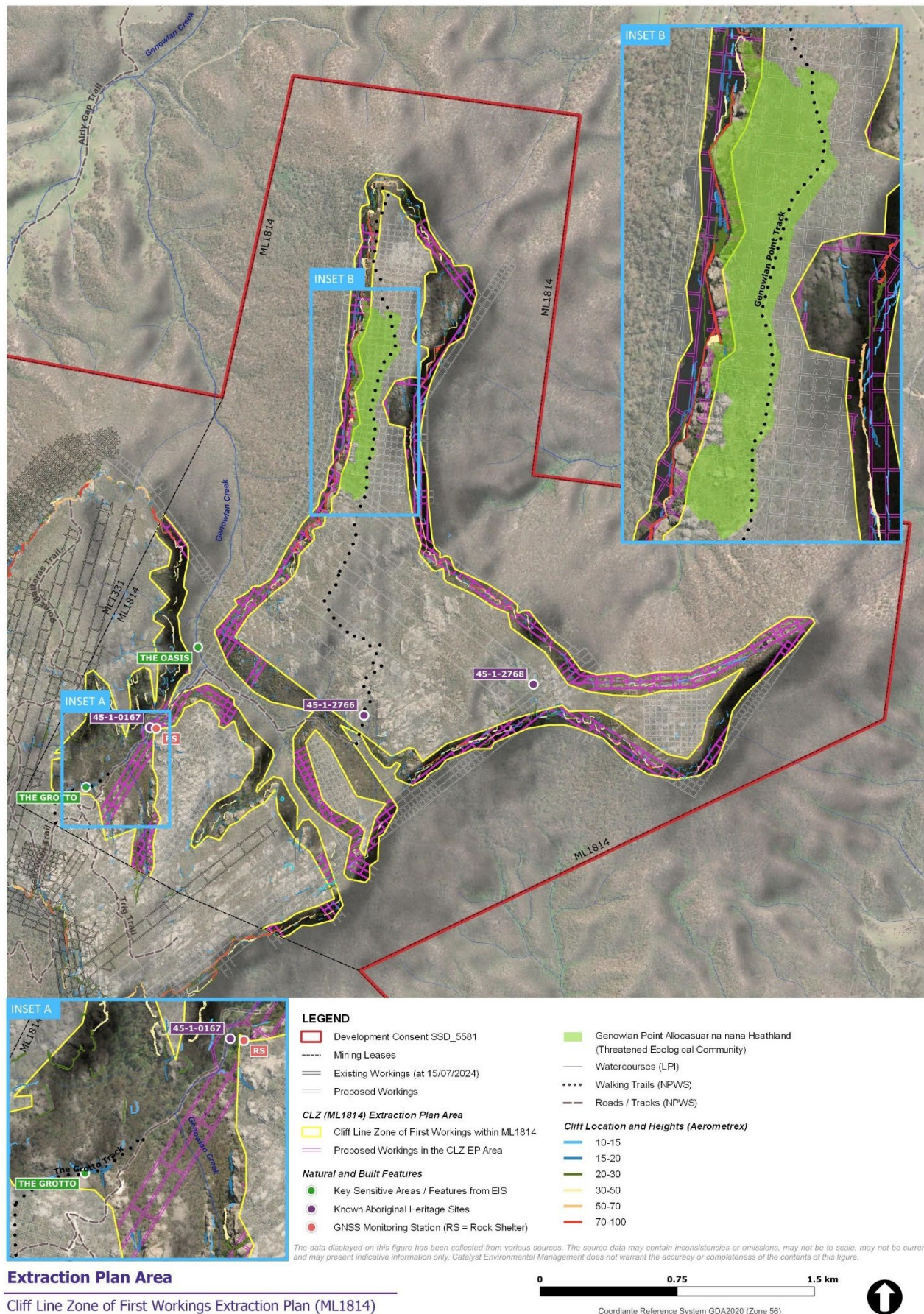
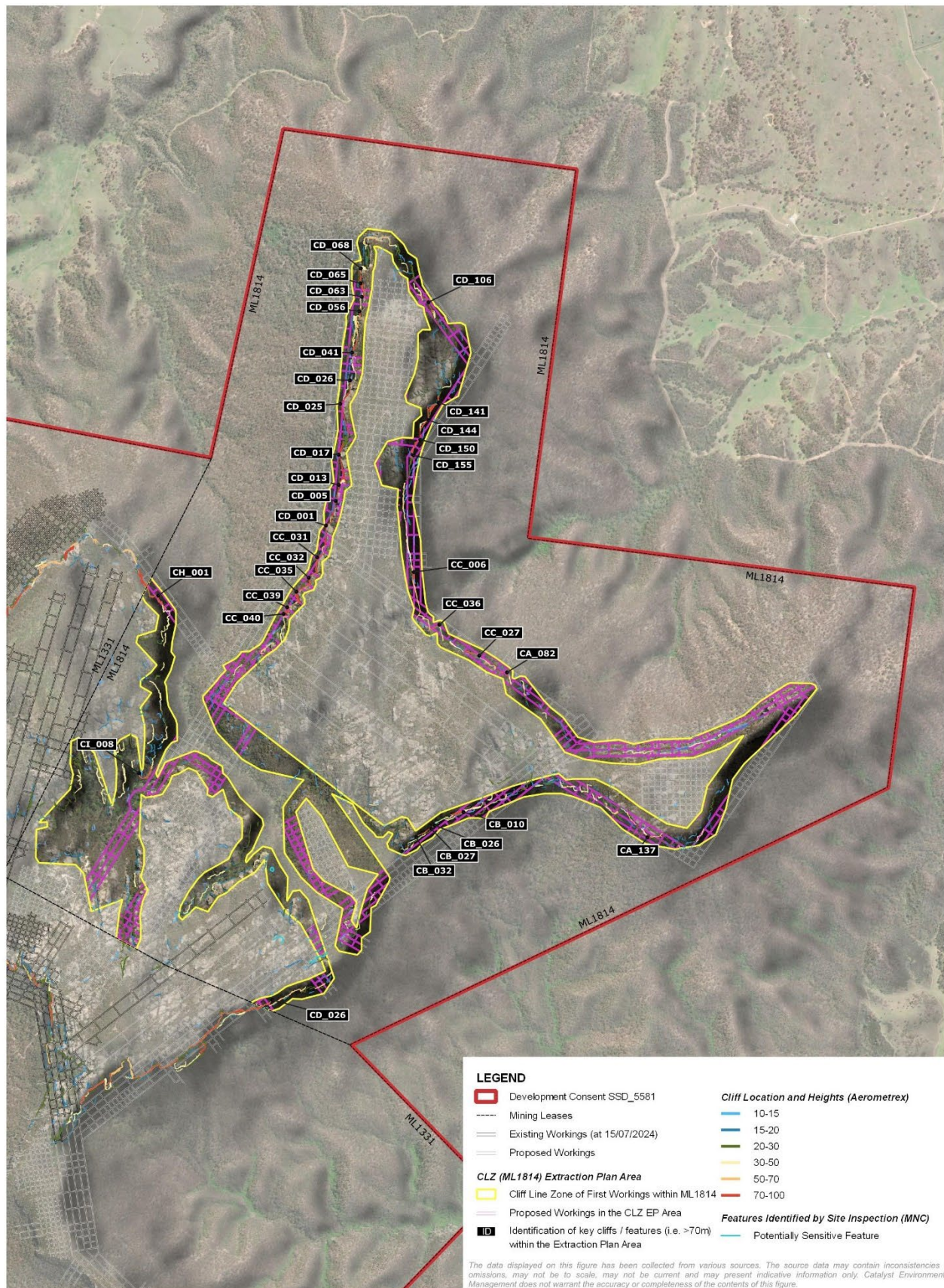


Figure 1-3: Key Cliffs / Features in the EP Area



Key Cliffs / Features

Cliff Line Zone of First Workings Extraction Plan (ML1814)

0 0.75 1.5 km

Coordinate Reference System GDA2020 (Zone 56)



1.5 Structure of the CLZ (ML1814) PSMP

The main text sections of this CLZ (ML1814) PSMP include:

- Section 1** Provides an introduction, purpose, scope, extraction plan area, relevant features to land and document structure.
- Section 2** Provides the statutory regulatory requirements, risk identification and consultation.
- Section 3** Provides the predicted subsidence impacts assessment and subsidence performance indicators to be used to assess against the relevant subsidence performance measures for land.
- Section 4** Outlines the monitoring and management measures in place for the key features in the EP Area.
- Section 5** Summarises the management, mitigation, remediation and reporting measures for this CLZ (ML1814) PSMP, including relevant performance measures and indicators, contingency response, adaptive management, reporting and auditing.
- Section 6** Provides an outline of the plan administration and roles and responsibilities for this CLZ (ML1814) PSMP.
- Section 7** Provides a historical review of references leading to the development of this CLZ (ML1814) PSMP.

2 PLAN DEVELOPMENT AND CONSULTATION

2.1 Statutory Requirements

Centennial Airly conducts its operations in accordance with:

- The conditions of the Development Consent (SSD_5581);
- Relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL No. 12374) and Mining Leases (i.e. ML 1331 and ML 1814); and
- other relevant State and Commonwealth environmental, planning, mining, safety, and natural resource legislation and guidelines.

Centennial Airly maintains a register of relevant environmental legislative and regulatory requirements in a compliance database.

The relevant statutory requirements applicable to the *CLZ (ML1814) Extraction Plan* and this supporting CLZ (ML1814) PSMP are presented in the EP Main Report (*refer Section 2.1 and Attachment B*).

This *CLZ (ML1814) PSMP* is a component of the EP Main Report and has been prepared specifically to address Condition 7 in Schedule 3 of SSD_5581 which states:

(7) Prior to carrying out any first workings within the Cliff Line Zone and Zone of First Workings (refer to Figure 2 in Appendix 3) or second workings, the Applicant must prepare an Extraction Plan for the relevant workings to the satisfaction of the Secretary. Each Extraction Plan must:

(i)...include a:

(vii) Public Safety Management Plan which has been prepared in consultation with the IEP, Resources Regulator and BCD to ensure public safety and manage access on the site;

This ***CLZ (ML1814) PSMP*** has been developed in accordance with Condition 2 in Schedule 6 of SSD_5581 (management plan requirements). **Table 2.1** details where these conditions have been addressed.

Table 2.1: Public Safety Management Plan Requirements

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section Addressed
The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:	
a) Detailed baseline data;	Section 1.4, 4.2
b) A description of:	
• The relevant statutory requirements (including any relevant approval, licence or lease conditions);	EP Main Report (Section 2.1, Attachment B)
• Any relevant limits or performance measures/criteria;	Section 5.1
• The specific performance indicators or triggers that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures.	Section 5.4, CLZ (ML1814) TARP
c) A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria.	Sections 2.1, 5.1, 5.4
d) A program to monitor and report on the:	
• Impacts an environmental performance of the development;	Section 4

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section Addressed
Effectiveness of any management measures (see c) above);	Sections 5.4, 5.7
e) A contingency plan to manage any unpredicted impacts and consequences	Section 5.5
f) A program to investigate and implement ways to improve the environmental performance of the development over time	Section 5
g) A protocol for managing and reporting any: - Incidents; - Complaints; - Non-compliances with statutory requirements; and - Exceedances of the impact assessment criteria and/or performance criteria; and	Section 5.6
h) A protocol for periodic review of the plan.	Section 6.1

2.1.1 Work, Health and Safety Laws (subsidence related)

Airly Mine operates in accordance with its Safety Management System which integrates plans, policies and procedures that enables a systematic approach to establishing and maintaining effective systems to manage health and safety consistent with WHS laws and relevant standards.

WHS laws⁴ have been considered for the Extraction Plan principally within the context of subsidence related risks to public safety, including to public infrastructure and in reference to Managing Risks of Subsidence Guideline (NSW RR, 2017).

An outline of key relevant WHS requirements is provided in the sections below.⁵

Potential Risks to the Safety of Others

WHS requirements considered for the Extraction Plan principally are within the context of subsidence related risks to public safety, including to private property and public infrastructure, include:

- Section 19 of the *Work Health and Safety Act 2011* (WHS Act)
..all persons conducting a business or undertaking, including mine operators, must ensure, so far as is reasonably practicable,..... that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.
- Under section 14(1) of the WHS (Mines and Petroleum) Regulation (2022) (*WHSMP Regulation*),
..all persons conducting a business or undertaking at a mine, including the mine operator, must manage risks to health and safety associated with mining operations at the mine in accordance with Part 3.1 of the Work Health and Safety Regulation 2011 (WHS Regulation).

Subsidence as a Principal Hazard

First workings (as proposed within this Extraction Plan) is not considered a *principal hazard* under the above WHS legislation definition, and subsequently a formal PHMP is not required. This *CLZ (ML1814) PSMP* is intended to manage potential risks from subsidence, particularly within the context of the “safety of others”.

⁴ WHS laws include the Work Health and Safety Act 2011 (WHS Act), Work Health and Safety Regulation 2017 (WHS Regulation), Work Health and Safety (Mines and Petroleum Sites) Act 2013 (WHSMP Act), and the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 (WHSMP Regulation)

⁵ See Section 2.1.2 in the EP Main Report for further details of the subsidence related WHS requirements

Assessment for High Risk Activity

The proposed mining within the EP Area does not meet the definition of High Risk Activities (HRA) under relevant WHS.

Guidelines for Managing Risks of Subsidence (WHS Legislation)

This CLZ (ML1814) PSMP (and the Extraction Plan Main Report) has been prepared in accordance with the *Managing Risks of Subsidence Guideline* (NSW RR, 2017) which provides practical guidance of key recommended factors to be considered in the management of subsidence risks to ‘other persons’ (including for Principal Hazard Management Plans) as well as High Risk Activity components.⁶

These have been specifically included in the *Subsidence and Environmental Risk Assessment* undertaken for the Extraction Plan⁷, supported by specific technical assessments of these aspects in supporting specialist reports such as those in *Attachment E – Pillar Geometry Assessment for Cliff Line Zone Extraction Plan* (SCT, 2023a) and the addendum *Cliff Line Zone Pillar Design Review for an Increased Extraction Height* (SCT, 2023b).

2.2 Specialist Assessments

This CLZ (ML1814) PSMP has been informed by cliff identification assessments undertaken by Aerometrex (2021; 2022) and Michael Nicholson Consulting Pty Ltd (MNC) (2023a; 2023b).

The purpose of the cliff identification assessments was to identify and map the locations of cliffs and other sensitive surface features which can then be used as the basis to minimise risk of surface impacts through appropriate mine layout design to reduce subsidence at sensitive high cliffs and escarpments located on the external parts of the Mount Airly and Genowlan Mountain mesas.

Extensive aerial photogrammetry and cliff identification work was undertaken by Aerometrex (2021; 2022). MNC was then engaged to undertake site inspections (“ground truthing”) of the cliffs that were identified as being located within the CLZ at Genowlan Creek Valley – Grotto to Oasis (MNC, 2023a) and Central Genowlan – Genowlan Point (MNC, 2023b).

The relevant features within the EP Area, including the key cliffs and features identified by these reports, are illustrated on **Figure 1-3**.

SCT were engaged to prepare and provide a subsidence prediction and impact assessment report, on the likely impacts of these predicted levels of subsidence on the natural and built features that exist within the EP Area. The *Pillar Geometry Assessment for Cliff Line Zone Extraction Plan* (SCT, 2023a) provided the subsidence predictions and impact assessment for the Extraction Plan. An addendum *Cliff Line Zone Pillar Design Review for an Increased Extraction Height* (SCT, 2023b) was prepared to review the earlier pillar geometry assessment (SCT, 2023a) for an increased roadway height of 3.2m.

The subsidence predictions and impact assessment is discussed in **Section 3.2**.

⁶ See *Attachment B – Relevant Legal and Other Requirements* for key recommended factors to be considered in accordance with the NSWRR guidelines for the management of subsidence risks to ‘other persons’ (including for Principal Hazard Management Plans as well as HRA components of the guidelines) and where they have been considered for the CLZ (ML1814) PSMP (and the Extraction Plan Main Report).

⁷ See Section 2.3 Risk Assessment and *Attachment C – Subsidence and Environmental Risk Assessment*

2.3 Risk Identification and Assessment

Centennial Airly has undertaken a dedicated ***Subsidence and Environmental Risk Assessment*** (Stature RA Number: 1001330039⁸) directly in support of this Extraction Plan which provide a risk framework basis for development of the component management plans.

The *CLZ (ML1814) Extraction Plan* risk assessment was completed on the 20 June 2023 with key staff from the Airly Mine including the Mine Manager, Statutory Mine Surveyor, Technical Services / Compliance Manager and Environment and Community Superintendent, as well as key EP Project Team members for Heritage, Ecology and the Lead Consultant for the Extraction Plan. The landholder was also represented by a member from the NPWS.

Risks were identified and assessed through the review of known surface and sub-surface features within the EP Area. The risk assessment also specifically assessed key heads of consideration required by the Managing Risks of Subsidence Guideline (NSW RR, 2017).

A risk ranking (low, moderate, significant, high or extreme) was assigned to each risk/hazard in consideration of the Maximum Reasonable Consequence (MRC) for the given controls. There were 34 potential risks scenarios assessed during the Risk Assessment; 1 significant, 7 moderate, 23 low and 3 were assessed as not applicable.

The risk assessment determined that the **risk of impact for public safety** (noting the extensive controls identified) was **low to moderate** including aspects associated with cliffs and pagodas within the EP Area.

A copy of the risk assessment is included in the EP Main Report (refer Attachment C). Additional details regarding the management and monitoring of subsidence related impacts within the EP Area have been detailed in **Section 4** and **Section 5**.

2.4 Consultation

Condition 7(i)(vii) in Schedule 3 of SSD_5581 requires the preparation of this ***CLZ (ML1814) PSMP*** in consultation with key relevant stakeholders as detailed below:

- IEP;
- Resources Regulator; and
- Biodiversity, Conservation and Science (BCS) group within the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The outcomes of consultation undertaken for the project is provided in the EP Main Report (refer Attachment D), including copies of relevant correspondence such as project presentations delivered by the mine to key stakeholders and relevant formal correspondence received from key stakeholders.

Stakeholder feedback provided has been reviewed and addressed as necessary as part of the development and review of this Extraction Plan and key component plans.

⁸ Centennial Airly has adopted the Stature Risk Assessment Program which sets out a consequences table and risk ranking matrix for managing identified risks consistent with AS/NZS ISO 31000:2009.

3 SUBSIDENCE ASSESSMENT

3.1 Mine Planning and Design

The proposed first workings within the CLZ (ML1814) consist mainly of (or parts of) 3 or 5 roadway main headings which provide access to future mining areas. First workings incorporate mine development of roadways / headings and cut throughs to form long term stable pillars.

Mine design is the primary control utilised at Airly Mine for subsidence impact avoidance. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement.

3.2 Subsidence Predictions

Condition 7(g) in Schedule 3 of SSD_5581 and the Extraction Plan Guidelines (DPE, 2022) requires revised predictions of potential subsidence effects, subsidence impacts and environmental consequences to be presented within the Extraction Plan for the EP Area, including any relevant information obtained since the EIS and consent, in consultation with the Independent Expert Panel (IEP).

Subsidence predictions for this Extraction Plan were assessed by SCT (2023a; 2023b) and are presented in full as *Attachment E – Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b)*.⁹

The maximum predicted subsidence for the EP Area are consistent with the EIS Predictions as shown in **Table 3.1**. The predictions included assessment of the subsidence effects measured in the current first workings at Airly Mine, including a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331).

Table 3.1: Maximum Subsidence Predictions with Comparison to Previous Predictions

Predictions	Pillar Stability	Max Subsidence	Max Tilt (mm/m)	Max Strain	
				Tensile (mm/m)	Compressive (mm/m)
This CLZ EP (ML1814) Predictions SCT (2023a; 2023b)	Long Term Stable with minimal subsidence	≤37mm	≤0.61	≤0.18	≤0.25
EIS Predictions Golder (2014b)	Long Term Stable	65mm	0.6-1.1	0.2-0.3	0.2-0.5
Current CLZ EP (ML1331) Predictions Golder (2017)	Long Term Stable, negligible settlement, effectively non-subsiding	<53mm Worst Case (long term flooded and additional pillar loading) Short to medium term <30mm and typical <20mm	0.4-0.9	0.1-0.3	0.1-0.3

The predicted subsidence is not expected to cause adverse impacts on the relevant features covered under this CLZ (ML1814) PSMP.

⁹ A detailed review of the revised subsidence predictions is provided in the *EP Main Report (refer Section 3.2)*

4 MONITORING PROGRAM

4.1 Public Safety Monitoring Program

Subsidence monitoring considerations for public safety are focused on the key sensitive features of cliffs, minor cliffs and pagodas.

The proposed monitoring program and strategy is developed in consultation with key stakeholders including (but not limited to) the IEP, BCS, NSW Resources Regulator and NPWS, and is detailed within the dedicated *CLZ (ML1814) SMP* (Appendix 6 of the EP Main Report) for the EP Area. The proposed Integrated Subsidence Monitoring Program within the Subsidence Monitoring Program includes:

- **Underground Mining Control** - routine survey of workings and inspections by mining officials to ensure mining is strictly implemented as designed (primary control utilised at Airly Mine for subsidence impact avoidance);
- **Monitoring ground movement** and surface subsidence impacts via Global Navigation Satellite System (GNSS) Monitoring Stations / Continually Operating Reference Station (CORS) – Long occupation real time point data base stations;
- **Remote monitoring of the Surface Environment** via LiDAR (40 points per square meter) – for monitoring of vertical subsidence over the EP Area relative to baseline and Performance Measures;
- **Trigger-based Targeted Surface Inspections** where required (where safely and readily accessible, such as where 4WD trails traverse or are close to the EP Area, and where otherwise triggered by the *CLZ (ML1814) TARP*); and
- **Data Analysis** data analysis and reporting will monitor specifically for change and target:
 - Any areas detected for significant change by remote monitoring results (including pre and post mining areas), triggering further detailed analysis under the *CLZ (ML1814) TARP*, including a process for determining natural or mining-induced rock fall.
 - The process for this detection is detailed further in the *CLZ (ML1814) SMP* and *CLZ (ML1814) TARP* respectively. Data for natural rock falls in areas yet to be mined will also provide additional data to the baseline data set.

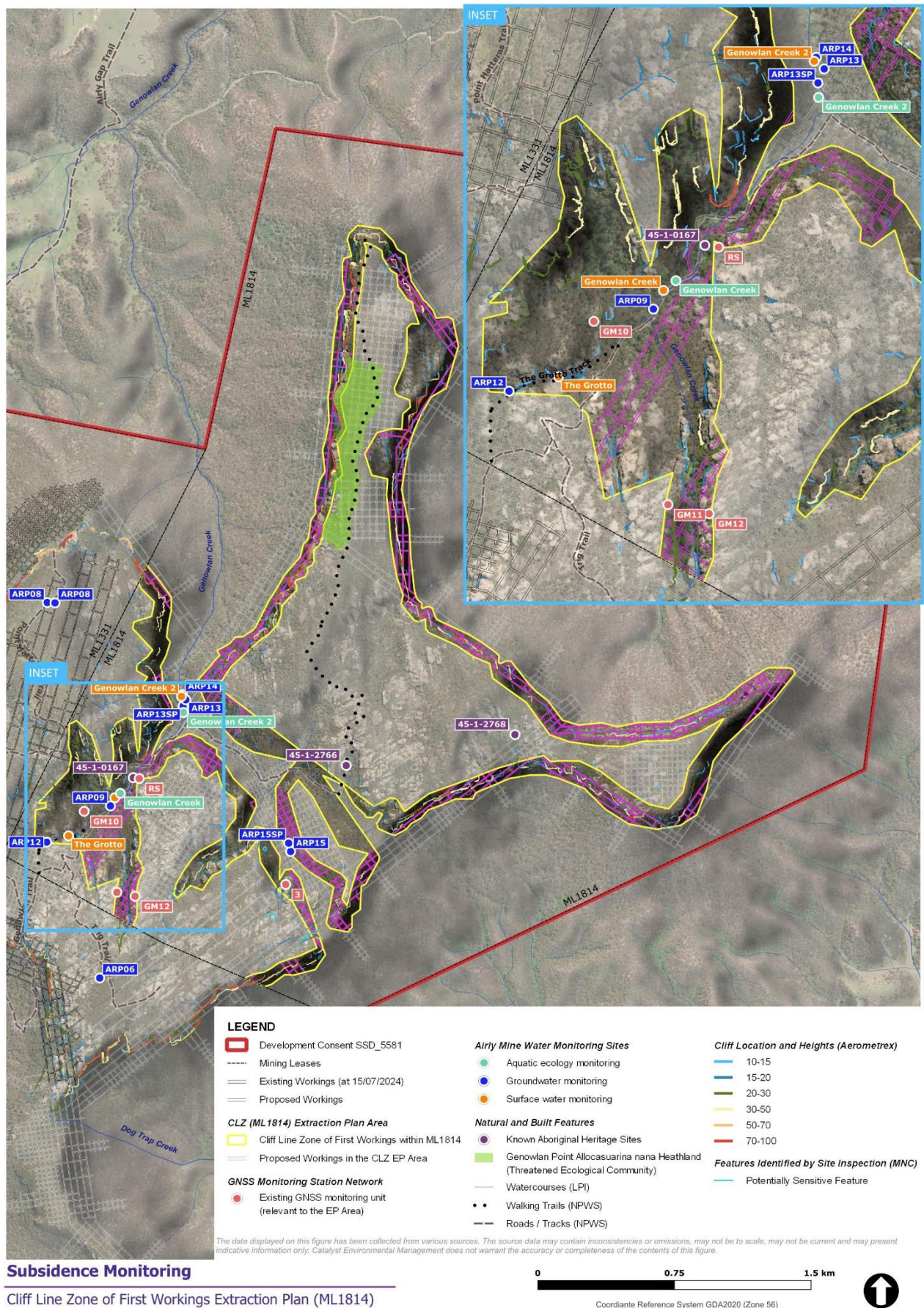
Airly Mine will implement the monitoring program applicable to public safety as specified in **Table 4.1**¹⁰ and shown on **Figure 4-1** to monitor the development of possible subsidence related environmental impacts. A contingency plan has been developed as a component of this *CLZ (ML1814) PSMP* to outline management measures that will be implemented if predicted environmental consequences are exceeded (**Section 5.1**).

¹⁰ reproduced from the original within the *Subsidence Monitoring Program for CLZ (ML1814)*, refer to the *CLZ (ML1814) SMP* for full details.

Table 4.1: Public Safety Subsidence Monitoring Program Summary

Monitoring Component / Feature (Management Plan)	Purpose/Parameter	Monitoring Method	Frequency & Duration
Cliffs, Minor Cliffs & Pagodas	Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking) Various Parameters relevant to each method	LiDAR	At least two (2) remote aerial monitoring surveys will be undertaken prior to first workings under this Extraction Plan, and ongoing surveys will be undertaken at approximately six-month intervals. At least one survey will be undertaken following completion of first workings under this Extraction Plan. No further detailed analysis after post mining survey has indicated negligible impacts (in the undermined area).
		Targeted GNSS Monitoring Stations	Installed prior to commencement, continuous data from installation, throughout first workings under this Extraction Plan and will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of first workings under this Extraction Plan.
		Targeted visual surface inspections	Only if triggered as per CLZ (ML1814) TARP triggers
General Land Surface (excl. cliffs and pagodas)	Evidence of subsidence impacts compared to baseline records	LiDAR	At least two (2) remote aerial monitoring surveys will be undertaken prior to first workings under this Extraction Plan, and ongoing surveys will be undertaken at approximately six-month intervals. At least one survey will be undertaken following completion of first workings under this Extraction Plan. No further detailed analysis after post mining survey has indicated negligible impacts (in the undermined area).
		Targeted GNSS Monitoring Stations	Installed prior to commencement, continuous data from installation, throughout first workings under this Extraction Plan and will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of first workings under this Extraction Plan.
		Targeted visual surface inspections	Only if triggered as per CLZ (ML1814) TARP triggers
Walking and 4WD tracks	Evidence of subsidence impacts compared to baseline records	LiDAR	At least two (2) remote aerial monitoring surveys will be undertaken prior to first workings under this Extraction Plan, and ongoing surveys will be undertaken at approximately six-month intervals. At least one survey will be undertaken following completion of first workings under this Extraction Plan. No further detailed analysis after post mining survey has indicated negligible impacts (in the undermined area).
		Targeted visual surface inspections	Only if triggered as per CLZ (ML1814) TARP triggers

Figure 4-1: Subsidence Monitoring



4.2 Baseline Monitoring

Baseline monitoring of natural features as they relate to public safety within the EP Area has commenced and will be obtained by using a combination of the following methods:

- **Landscape Features** (including cliffs and pagodas) using both monitoring ground movement and remote monitoring methods as described (**Section 4.1**) with the EP Area;
 - The installation of the GNSS network is scheduled for completion prior to commencement of development workings with baseline continuous data from installation through to commencement of first workings in the CLZ within ML1814.¹¹
 - LiDAR baseline flown in December 2022 and June 2023; an additional survey will be flown prior to first workings in the CLZ within ML1814.
 - High resolution stereo vertical and 3D oblique photogrammetry baseline flown in May 2020, November 2020, May 2021, May 2022 and December 2022.¹²

Further details including methodologies, locations, parameters, frequencies and duration of monitoring is provided in the *CLZ (ML1814) SMP* (Appendix 6 of the EP Main Report).

¹¹ Installation of this monitoring equipment is subject to an REF amendment and subsequent approval from NPWS.

¹² Note, stereo vertical and 3D oblique photogrammetry has been replaced by routine LiDAR survey, however the baseline photogrammetry data may be used for data analysis or comparison against future LiDAR surveys if required.

5 MANAGEMENT, MITIGATION, REMEDIATION AND REPORTING MEASURES

5.1 Performance Measures and Indicators

The approved subsidence impact performance measures are specified under Condition 2 in Schedule 3 of SSD_5581. The performance measures relating to potential subsidence impacts (as they relate to this CLZ (ML1814) PSMP) are outlined in **Table 5.1**¹³.

Table 5.1: Relevant Subsidence Impact Performance Measures for Public Safety

Public Safety	Performance Measure	Performance Indicator	Applicability to this EP Area
Public Safety	Negligible additional risk, in consultation with the Resources Regulator and BCS	Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking) Various Parameters relevant to each method	Applicable

Additional internal performance measures set by Centennial Airly for the mine design (to be monitored by the underground components of the Subsidence Monitoring Program) are and have been reflected within the CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

To establish compliance with the performance measures, Airly Mine has developed a monitoring program with several integrated components detailed in the CLZ (ML1814) SMP (Appendix 6 of the EP Main Report) (see **Section 4**) and an associated CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

These documents establish appropriate monitoring elements, parameters, and associated trigger levels to demonstrate that the environmental performance satisfies the criteria in Section 5.1 of the EP Main Report.

Table 5.2 contains the performance indicators which have been established for key monitoring aspects with allocated trigger values to define the following key performance scenarios within the CLZ (ML1814) TARP (Appendix 7 of the EP Main Report).

Table 5.2: Performance Indicators & TARP Risk Management Scenarios

Performance Indicator	General Description	Action / Response
Level 1: Condition Green	Operations within predictions, and within approved impacts.	Continued operations and monitoring as normal.
Level 2: Condition Amber	Operations within approved impacts but potentially exceed / exceed predictions.	Review and investigation processes are engaged, with adaptive management as required.
Level 3: Condition Red	Operations exceed approved impact. <i>The approved Performance Measures (criteria thresholds) of Development Consent (and any other relevant approvals) are listed in Condition Red.</i>	Adaptive Management measures are fully engaged as per the TARP and relevant sections of the Extraction Plan and the SMP.

¹³ extracts from Table 1, under Condition 2 in Schedule 3 of SSD_5581

5.2 Management and Mitigation Measures

As described in **Section 3.2**, the predicted subsidence levels in the EP Area are minimal and well below levels expected to cause damage or any adverse impacts on the natural features.

The CLZ (ML1814) risk assessment (**Section 2.2**) determined that the risk of impact for public safety was **low to moderate**. There are two main management aspects of this CLZ (ML1814) PSMP, including:

- Mine design to avoid impacts (**Sections 3.1 and 3.2**);
 - The primary management strategy being implemented is impact avoidance through the implementation of a conservative mine design. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement, and
- Monitoring and management measures (**Sections 4.1 and 4.2**).
 - Monitoring to ensure the mine design is strictly implemented as designed through underground mining controls and monitoring of key landscape features for change (particularly cliffs and pagodas) will be undertaken to confirm that the mine design measures to prevent impact are adequate and remain within consent.

The EP Area is located in rugged, largely inaccessible, terrain within the Mugii Murum-ban SCA which offers opportunities for self-reliant recreation including four-wheel driving, nature study, camping, mountain biking, bushwalking and birdwatching.

The overall management of Mugii Murum-ban SCA is the responsibility of the NPWS. In consultation with the NPWS, IEP, BCS and NSW Resources Regulator, Airly mine has committed to the following monitoring and management measures, as they related to land in the EP Area, including:

- Develop an Integrated Subsidence Monitoring Program that will provide data for trend analysis, that will inform adaptive management if required (**Section 5.2** (for further details refer to Section 4 of the EP Main Report and CLZ (ML1814) SMP (Appendix 6);

It is expected with the above controls in place, the subsidence performance measures for public safety will be achieved. Notwithstanding this, appropriate responses have been conservatively developed for unexpected/higher than predicted subsidence within a **Master Trigger Action Response Plan (TARP)** developed for the Extraction Plan and this CLZ (ML1814) PSMP.

5.3 Remediation and Rehabilitation Measures

Due to the minimal subsidence expected the need to implement remediation/rehabilitation measures for potential impacts are considered unlikely. However, if remediation is required, Airly Mine will undertake remediation in accordance with:

- Conditions 7a)-7c) in Schedule 6 of SSD_5581, noting the requirement to submit a report to NSW Planning describing remediation options and any preferred remediation measures or other course of action;
- Any relevant actions prescribed in the CLZ (ML1814) TARP developed for the Extraction Plan;
- The current Rehabilitation Management Plan; and
- In consultation with key stakeholders including any affected land holders and relevant government

agencies.

A Response Strategy will be adopted if a significant impact is detected as a result of mining activities within the Extraction Plan area.

5.4 Trigger Action Response Plan

A detailed *CLZ (ML1814) TARP* (Appendix 7 of the EP Main Report) has been developed for the Extraction Plan to reflect the commitments of this CLZ (ML1814) PSMP and other related aspects. Whilst impacts are not predicted nor expected, the *CLZ (ML1814) TARP* provides a process of tiered and/or escalating trigger levels for contingency measures should subsidence and impacts be greater than predicted/approved. The *CLZ (ML1814) TARP* applies only to the EP Area (separate TARPs apply to other established EP Areas in various approved mining zones).

Given the mine has been designed specifically to avoid impacts, the *CLZ (ML1814) TARP* includes detailed measures for Underground Mining Controls to ensure that the mining geometry is formed as per the approved design specifications that determine the predicted subsidence movements and impacts.

The *CLZ (ML1814) TARP* includes detailed performance indicators for public safety management. The contingency plan where a performance indicator has been exceeded is outlined in the TARP. A trigger will result in additional investigations to determine if the exceedance is related to non-mining-factors or is a consequence of mining activity. The response to these exceedances will follow the TARP. Management / corrective actions can be implemented where required to remedy these non-conformities and report accordingly.

5.5 Adaptive Management and Contingency Planning

An Adaptive Management Framework provides for flexible decision making, adjusted to consider uncertainties as management outcomes are understood. The adaptive management approach at Airly Mine is detailed in the EP Main Report (*refer Section 5.2*).

In summary, adaptive management at Airly Mine involves monitoring and evaluation against performance measures and associated indicators in the *CLZ (ML1814) TARP* established for the extraction plan and supporting management plans. Where performance indicators indicate increasing levels of risk (i.e., where relevant thresholds of conditions green, amber or red are being exceeded), escalating adaptive management measures are engaged in accordance with the *CLZ (ML1814) TARP*. The process has been successfully implemented in existing Extraction Plan areas at Airly Mine and has been updated to reflect EIS commitments and consent requirements for the Airly Mine Extension Project, including specific performance measures.

5.6 Incidents, Complaints, Exceedances and Non-Compliances

Incidents, complaints, exceedances and non-compliances are managed accordance with the requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, relevant legislation and regulations, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). Additionally, high potential incident notifications for unexpected subsidence events in relation to the safety of other persons under WHS legislation has also been included. A detailed review of the notification requirements relevant to the Extraction Plan, including this *CLZ (ML1814) PSMP*, is provided in the EP Main Report (*refer Section 5.7.1*), including requirements for:

- Incident or non-compliance reporting in accordance with:
 - Condition 9 (Incident Reporting) in Schedule 6 of SSD_5581.

- EPBC 2013/7076 Condition 1, or as triggered by the TARP (reporting incidents under Management Plans as per Condition 2(g) in Schedule 6 of SSD_5581).
- EPL12374 condition R2
- WHS Regulation (Mines and Petroleum Sites, 2022) Section 124 - Duty to notify regulator of certain incidents
- Section 6 of the Guidelines for Managing Risks of Subsidence (WHS (Mines and Petroleum Sites), February 2017
- Managing complaints.

Incidents, complaints, exceedances and non-compliances will be managed in accordance with the requirements detailed in the EP Main Report (*refer Section 5.6*).

5.7 Reporting and Auditing

5.7.1 Reporting

Reporting is undertaken in accordance with the requirements of specific requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). A detailed review of the reporting and notification requirements relevant to the Extraction Plan, including this CLZ (ML1814) PSMP, is provided in the EP Main Report (*refer Section 5.7.1*, including requirements for:

- Regular reporting of impacts and environmental monitoring results in accordance with Condition 10 in Schedule 6 of SSD_5581;
- Annual reporting required in accordance with Condition 11 in Schedule 6 of SSD_5581 and separately under EPBC 2013 / 7076;

Reporting and notifications will be undertaken in accordance with the requirements detailed in the EP Main Report (*refer Section 5.7.1*).

5.7.2 Periodic Auditing

Comprehensive Independent Environmental Audits of the entire approved development under development consent SSD_5581 are undertaken within 1 year of commencement and every 3 years thereafter (unless directed otherwise) in accordance with Conditions 12 and 13 in Schedule 6 of SSD_5581.

Auditing of any rehabilitation undertaken for the mine (including for subsidence if triggered) is undertaken in accordance with the Rehabilitation Management Plan under Condition 27 in Schedule 4 of SSD_5581.

Additionally, in accordance with section 20(c) of the WHSMP Regulation (2022), auditing will be undertaken in accordance with the Airly Mine Safety Management System (SMS), against the performance standards for measuring the effectiveness of all aspects of the SMS, including the methods, frequency and results of the audit process. The audit should also consider the following matters:

- (1) competency of the auditor,
- (2) the person responsible for ensuring the audit is conducted, and
- (3) the person responsible for implementing the results of the audit.

6 PLAN ADMINISTRATION AND RESPONSIBILITIES

6.1 Review

In accordance with the requirements under Condition 3 in Schedule 6 of SSD_5581, as a minimum Centennial Airly will review this Plan within three months of the following:

- a) Submission of an incident report;
- b) Submission of an Annual Review (required 31 March annually);
- c) Submission of an Independent Environmental Audit; or
- d) Any modification to the conditions of SSD_5581.

Where this leads to revisions of the document, within four (4) weeks of the review the revised document must be submitted to NSW Planning for the approval of the Secretary. Continual improvement shall be achieved through monitoring, internal and external communication with stakeholders, implementation of corrective and preventative actions and through monitoring progress against the objectives included in the environmental management plans. The reporting framework (refer **Section 5.7**) will document the effectiveness of this document (and the related Extraction Plan) through comparison of the predicted negligible impacts of subsidence against actual outcomes.

Each variation to this Plan will be identified in the Document Control Table at the beginning of this document.

Additionally, to maintain consistency with existing management plans and previous Extraction Plans at the mine, this CLZ (ML1814) PSMP will also be reviewed in the event that the following occur:

- Stakeholders raise issues that necessitate a review;
- There are other changes to management requirements (e.g. changes to other related approvals besides consent, such as Mining Lease and/or EPL conditions);
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan;
- Monitoring or audit processes demonstrate that a review is warranted;
- Where otherwise triggered by the CLZ (ML1814) TARP;
- Where triggered by (or for) review of other related management plans (if applicable); or
- Every three (3) years as a minimum (where not already triggered above).

Any amendments to the CLZ (ML1814) PSMP will be undertaken in accordance with Consent/relevant approvals and in consultation with key relevant stakeholders where required. Following any significant changes, a copy of the amended CLZ (ML1814) PSMP will be forwarded to all relevant stakeholders.

In addition to planning development consent requirements, Airly Mine must review and as necessary revise the risk control measures implemented for subsidence in accordance with section 20 of the *WHSMP Regulation (2022)*. Any review triggered by WHS Legislation Requirements will be addressed via the process identified in the EP Main Report (refer *Section 5.5*) and the CLZ (ML1814) PSMP (this document).

6.2 Key Responsibilities

The responsibility for implementation, monitoring and review of the CLZ (ML1814) PSMP lies with the Superintendent Environment and Community. The ultimate responsibility for the implementation of the CLZ (ML1814) PSMP lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for this CLZ (ML1814) PSMP are outlined in **Table 6.1**.

Table 6.1: Key Personnel and Accountabilities

Position	Responsibility
Mine Manager	- Ensuring that sufficient resources are available to implement and execute the requirements of this Plan; and - Reporting triggers/non-conformances to external stakeholders.
Technical Services Manager	- Coordinate underground inspections and subsidence monitoring program associated with this CLZ (ML1814) PSMP; - Coordinate implementation of the mine design and CLZ (ML1814) TARP. - Reporting triggers/non-conformances internally to the mine manager as appropriate. - Reporting to NSW Planning and NSW RR of subsidence and pillar system performance upon completion of specified monitoring intervals.
Production Manager	- Implement mine design - Establish and maintain underground monitoring and inspections program; - Auditing as required
Mine Surveyor	- Survey as built initial development pillars - Establish and maintain subsidence monitoring program; - Internal reporting as required. - Mark up centre lines for driveage in pillars - Produce final mining plan for first workings to be carried out in consultation with the Technical Services Manager.
Superintendent Environment and Community	Implementation, monitoring and review of this plan, including: - The carrying out of targeted inspections; - The installation and maintenance of signage where required; - Reporting triggers/non-conformances internally to the Mine Manager as appropriate; - Consulting with land owners, landholders and managers regarding any land management issues arising from subsidence within the EP Area. This includes (but may not be limited to) NPWS, Office of Crown Lands and private landowners within the EP Area (if and as applicable); - Reviewing this CLZ (ML1814) PSMP, including consultation during the review process with relevant stakeholders; - Coordinating any remediation work as required; - Inspecting targeted accessible areas susceptible to tensile and compressive strains and potential cracking as required (e.g. accessible tracks and trails); and - Co-ordinating the generation and submission of formal reporting requirements outlined in this Plan.

7 REFERENCES

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- RPS (2022b). *Desktop review of ML 1814 area and CLZ (ML1814) EP Area for Aboriginal Cultural Heritage (Report No. AU213005571)*
- RPS (2023). *Baseline Biodiversity Report CLZ (ML1814) EP Area and CLZ (ML1814) EP Area (Report No. 152229)*

APPENDIX 6 Subsidence Monitoring Program for CLZ (ML1814)



Subsidence Monitoring Program (CLZ (ML1814) SMP)

**Cliff Line Zone of First Workings
Extraction Plan (ML1814)**

Airly Mine (SSD_5581)

July 2024

DOCUMENT CONTROL / TITLE BLOCK

EXTRACTION PLAN DETAILS	Title:	Subsidence Monitoring Program: Cliff Line Zone of First Workings Extraction Plan (ML1814)
	Applicant:	Centennial Airly Mine
	Revision No.:	CLZ (ML1814) SMP_Rev_2 ¹

REVISION

REVISION DETAILS	Revision No.	Details of Revision	Date Sent
	Rev_0	Draft for external consultation	1/12/2023
	Rev_1	Update to address recommendations from consultation	22/03/2024
	Rev_2	Minor amendments to address recommendations from consultation	25/07/2024

¹ An integrated Document Control Procedure is incorporated into Centennial Airly Mine's Safety Management System (SMS). Documents, data and records pertaining to this plan will be managed according to ***Airly Mine Document and Data Control Management Plan (AIR-MP-1034)***.

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APPLICATION (MSEC, 2024)

ABBREVIATIONS

BCD	Biodiversity Conservation Division (now BCS)
BCS	Biodiversity, Conservation and Science group within the NSW DCCEEW
BMP	Biodiversity Management Plan
CLZ	Cliff Line Zone of First Workings (approved Mining Zone of consent SSD_5581)
DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
DPE	NSW Department of Planning and Environment (now NSW Planning)
DOC	Depth of Cover
EP	Extraction Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environment Protection Licence
HHMP	Historic Heritage Management Plan
LiDAR	Light Detection And Ranging
LMP	Land Management Plan
MEP	Airly Mine Extension Project
ML	Mining Lease
MODx	Airly DA162/91 Modifications (e.g. MOD3, MOD, MOD5)
Mtpa	Million tonnes per annum
NPWS	NSW National Parks and Wildlife Service
NSW Planning	NSW Department of Planning, Housing and Infrastructure (formerly DPE)
OEH	NSW Office of Environment & Heritage
PSE	Principal Subsidence Engineer
PSMP	Public Safety Management Plan
SCA	State Conservation Area
SMP	Subsidence Monitoring Program
TARP	Trigger Action Response Plan

1 INTRODUCTION

1.1 Background

Airly Mine is an existing underground coal mine located approximately 40 kilometres (km) northwest of Lithgow in New South Wales, 170km northwest of Sydney and 4 km to the northeast of Capertee, as illustrated on **Figure 1.1**. The mine is partly located within the Mugii Murum-ban State Conservation Area (SCA). Centennial Airly Pty Limited (**Centennial Airly**) is the operator of the mine and is a wholly owned subsidiary of Centennial Coal Company Pty Limited (**Centennial**).

Development Consent for the Airly Mine Extension Project (**MEP**) was approved on 15 December 2016 subject to the Conditions in Schedule 2 to 6 of State Significant Development 5581 (**SSD_5581**). The consent allows extraction of 1.8 million tonnes of run-of-mine (**ROM**) coal per calendar year for a period of 20 years, which is supplied to both domestic and international markets. As per commitments within the Environmental Impact Statement (EIS) for SSD_5581, Airly Mine is implementing a conservative and staged approach to mining, with different mining methods applied in different areas of the mining lease called Mining Zones².

The *Cliff Line Zone of First Workings (ML1814) (CLZ (ML1814)) Extraction Plan* as detailed in the *CLZ (ML1814) Extraction Plan Main Report (the EP Main Report)* and the supporting component plans, continues the conservative approach to mining being implemented by Airly Mine, with the proposed first workings under this Extraction Plan specifically designed to provide long term stable and effectively non-subsiding pillars to protect the surface such that there is no adverse impact. Mine design and implementation is a key element of subsidence impact avoidance and management. The *Extraction Plan Area (EP Area)* is further defined in **Section 1.3**.

The *EP Main Report* and the supporting component plans have been developed using a risk-based approach and in accordance with:

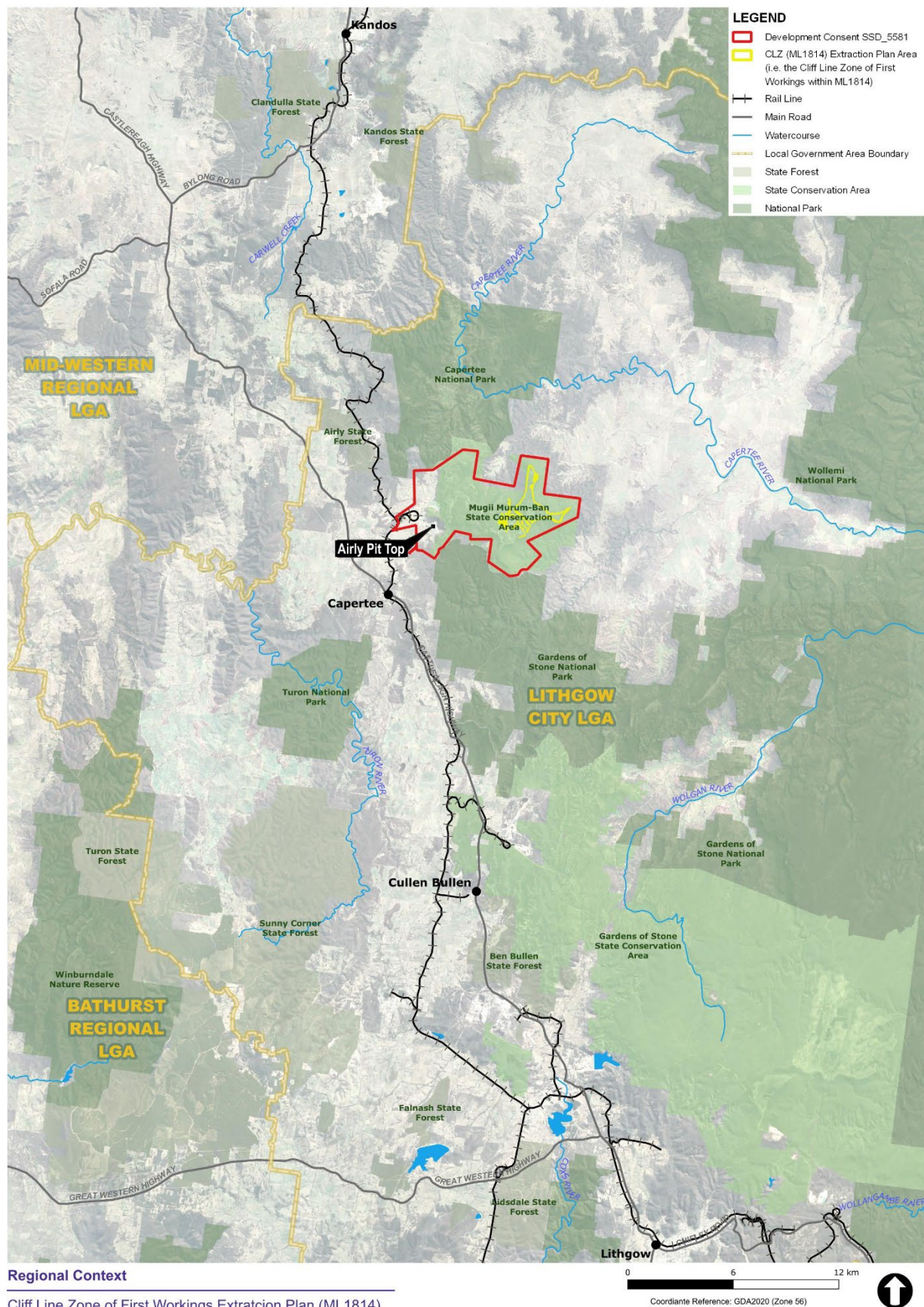
- Relevant requirements listed under *Condition 7 in Schedule 3* of SSD_5581;
- *Extraction Plan Guideline*, NSW Department of Planning and Environment 2022;
- *Managing Risks of Subsidence Guideline*, NSW Department of Industry, Resources Regulator (**NSWRR**), 2017; and
- *Consultation with all relevant key stakeholders* (potentially affected by subsidence) and the Independent Expert Panel (**IEP**) established by NSW Department of Planning, Housing and Infrastructure (**NSW Planning**) for the project.

An Extraction Plan is required to be developed and approved prior to undertaking any first workings within the Cliff Line Zone and Zone of First Workings, including the development of this ***Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP)***.

The design of this subsidence monitoring program is the progressive result of extensive and ongoing stakeholder consultation, risk assessments and feedback since the Airly MEP EIS (pre-2014) and continuing throughout previously approved Extraction Plans through to the present, including with the IEP, Groups of the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) – National Parks & Wildlife Service (**NPWS**) and Biodiversity, Conservation and Science (**BCS**), NSW Planning and NSWRR.

² Airly Mine has five (5) mining zones approved under development consent SSD_5581 as shown in Figure 2 in Appendix 3 of SSD_5581. These zones provide design criteria for different mining methods based on the differing levels of environmental sensitivity of surface features and depth of cover across the Airly mining leases. Section 8 of the Airly Mine EIS (2014) provides further details on the definitions of each of these approved mining zones if required.

Figure 1.1: Locality Plan



1.2 Purpose & Scope

The purpose of this CLZ (ML1814) SMP is to meet the requirements under Condition 7(i)(i) in Schedule 3 of SSD_5581 and associated relevant guidelines, leases and licenses, is to outline the monitoring and management measures to be implemented to address any potential impacts (**Section 3.2**) during first workings within the EP Area (**Section 1.3**).

This CLZ (ML1814) SMP is supported by a *Master Trigger Action Response Plan for CLZ (ML1814) (CLZ (ML1814) TARP)* (Appendix 7 of the EP Main Report), including adaptive management measures if required.

1.3 Extraction Plan Area

The Extraction Plan Area (EP Area), as illustrated on **Figure 1.2**, is defined as:

- The *Cliff Line Zone of First Workings* within ML1814;
- Includes all proposed first workings within the EP Area;
- First workings incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features;
- No secondary extraction is permitted or proposed within the EP Area;
- No surface impacts have been predicted for first workings; and
- The EP Area is wholly located within the Mugii Murum-ban SCA with no private land ownership.

1.4 Relevant Features

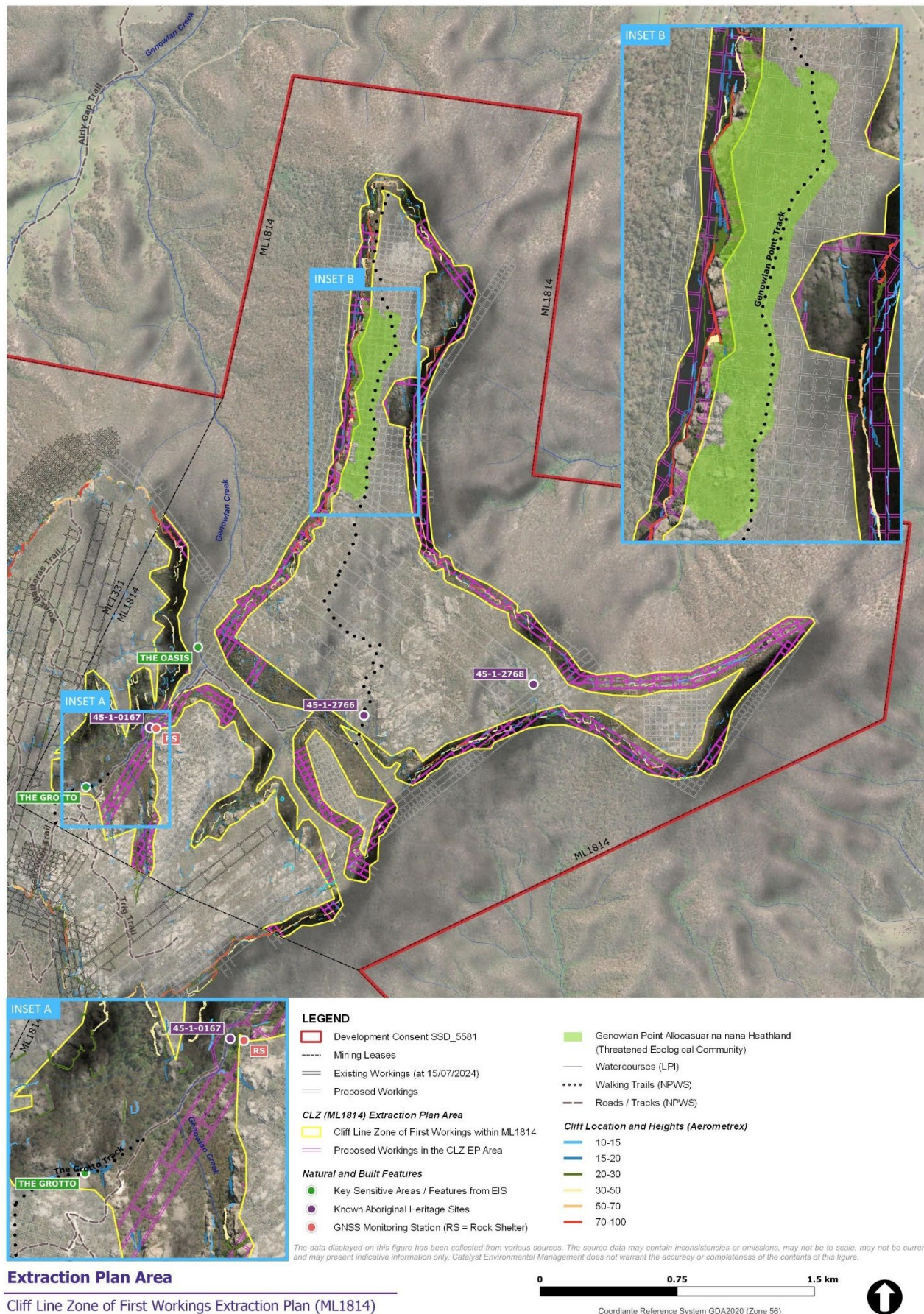
The natural and built features identified within the EP Area, as illustrated on **Figure 1.2**, include:

- | | |
|--|--|
| • Surface Water | • Threatened Flora & Fauna |
| • Groundwater | • Potential Endangered Ecological Communities (EEC) and Groundwater Dependent Ecosystems (GDE) (including facultative) |
| • Aquatic ecology | • Public Safety / Safety of 'others' associated with potential for subsidence. |
| • Cliffs, Minor Cliffs and Pagodas | • Publicly accessible sections of the EP Area within Mugii Murum-ban State Conservation Area including tracks and trails and general SCA surface area. |
| • Mugii Murum-ban SCA General Surface Area, including steep slopes and rock outcrops | |
| • The deeply incised canyons/gorge including an area known as the Grotto | |
| • Tracks and Trails, Fences & Gates | |
| • Habitat | |

The natural and built features relevant to the CLZ (ML1814) Extraction Plan are identified in the checklist provided in the *EP Main Report*.³

³ refer Attachment A – Identification of Natural and Built Features Checklist

Figure 1.2: Extraction Plan Area (EP Area) and Relevant Features within the EP Area



1.5 Structure of the CLZ (ML1814) SMP

This *CLZ (ML1814) SMP* provides details of the monitoring and management strategies and methodologies of the current program which has been designed to address the key risks identified by the ongoing risk assessment and stakeholder consultation process.

The main text sections of this *CLZ (ML1814) SMP* include:

- Section 1** Provides an introduction, purpose, scope, extraction plan area, relevant features and document structure.
- Section 2** Provides the statutory regulatory requirements, risk identification and consultation.
- Section 3** Provides the predicted subsidence impacts assessment and subsidence performance indicators to be used to assess against the relevant subsidence performance measures.
- Section 4** Outlines the monitoring and management measures in place for the key features in the EP Area.
- Section 5** Summarises the management, mitigation, remediation and reporting measures for the CLZ (ML1814) Extraction Plan, including relevant performance measures and indicators, contingency response, adaptive management, reporting and auditing.
- Section 6** Provides an outline of the plan administration and roles and responsibilities for this CLZ (ML1814) SMP.
- Section 7** Provides a historical review of references leading to the development of this CLZ (ML1814) SMP.

1.6 Related Management and Monitoring Plans

Table 1-1 provides a summary of the natural and built features within the EP Area along with the related sub-management plan that the respective features are managed through. The scope of management plans for the Extraction Plan was developed in consultation with NSW Planning.

Related monitoring programs detailed in these documents have been outlined in **Section 4** and are summarised in **Table 4-1** (*Subsidence Movements and Effects Monitoring Program Summary*) and **Table 4-2** (*Natural and Built Features Monitoring Program Summary*).

Table 1-1: Relevant Features within the EP Area and Related Management Plans

Key Features Managed and Monitored	Section	Sub-management Plan
Surface Water (quality, flow and stream stability, erosion & sediment control)	4.3.1	Airly Mine Water Management Plan (WMP) (<i>whole of site/consent area</i>) – refer Appendix 1
Groundwater (including downstream alluvial and facultative ecosystems)	4.3.2	
Monitoring of aquatic ecology	4.3.3	
Cliffs, Minor Cliffs and Pagodas	4.3.4	Land Management Plan for CLZ (ML1814) (CLZ (ML1814) LMP) – refer Appendix 2
Mugii Murum-ban SCA General Surface Area, including steep slopes and rock outcrops	4.3.5	
The deeply incised canyons/gorge including the Grotto	4.3.6	
Tracks and Trails, Fences & Gates	4.3.6	
Habitat Threatened flora and fauna Endangered Ecological Communities (EEC) Groundwater Dependent Ecosystems (GDE) Aquatic ecosystems	4.3.7	Biodiversity Management Plan for CLZ (ML1814) (CLZ (ML1814) BMP) – refer Appendix 3
Aboriginal heritage site (AHMIS 45-1-0167)	4.3.8	Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) (CLZ (ML1814) ACHMP) – refer Appendix 4
Public Safety / Safety of ‘others’ associated with <i>potential</i> for subsidence. Publicly accessible sections of the EP Area within Mugii Murum-ban State Conservation Area including tracks and trails and general SCA surface area.	CLZ (ML1814) PSMP	Public Safety Management Plan for CLZ (ML1814) (CLZ (ML1814) PSMP) – refer Appendix 5
Details the monitoring program for the EP Area for all Key Features Includes baseline monitoring, as well as during and post mining requirements	4	Subsidence Monitoring Program for CLZ (ML1814) (CLZ (ML1814) SMP) – <i>this document</i>

2 PLAN DEVELOPMENT AND CONSULTATION

2.1 Statutory Requirements

2.1.1 Development Consent and Statement of Commitments

Centennial Airly conducts its operations in accordance with:

- The conditions of the Development Consent (SSD_5581);
- Relevant licences and permits, including conditions attached to the Environment Protection Licence (EPL No. 12374) and Mining Leases (i.e. ML 1331 and ML 1814); and
- other relevant State and Commonwealth environmental, planning, mining, safety, and natural resource legislation and guidelines.

Centennial Airly maintains a register of relevant environmental legislative and regulatory requirements in a compliance database. The relevant statutory requirements applicable to the *CLZ (ML1814) Extraction Plan* and this supporting *CLZ (ML1814) SMP* are presented in the EP Main Report.⁴

This *CLZ (ML1814) SMP* is a component of the EP Main Report and has been prepared specifically to address Condition 7(i)(i) of Schedule 3 which states:

(7) Prior to carrying out any first workings within the Cliff Line Zone and Zone of First Workings (refer to Figure 2 in Appendix 3) or second workings, the Applicant must prepare an Extraction Plan for the relevant workings to the satisfaction of the Secretary. Each Extraction Plan must:

(i)...include a:

(i) Subsidence Monitoring Program which has been prepared in consultation with the IEP, Resources Regulator and BCD, to:

- *monitor the subsidence effects and subsidence effects of the development;*
- *develop effective remote monitoring techniques for the development;*
- *monitor pillar loads underground to develop an understanding of the loading conditions on pillars in the vicinity of cliff lines, pagodas and steep slopes;*
- *provide data to assist with the management of risks associated with subsidence;*
- *validate the subsidence predictions;*
- *analyse the relationship between the predicted and resulting subsidence effects and predicted and resulting impacts under the plan and any ensuing environmental consequences; and*
- *inform the contingency plan and adaptive management process;*

This *CLZ (ML1814) SMP* has been developed in accordance with Condition 2 in Schedule 6 of SSD_5581 (management plan requirements). **Table 2-1** details where these conditions have been addressed.

⁴ refer Section 2.1 and Attachment B – Relevant Legal and Other Requirements

Table 2-1: Development Consent SSD_5581 Management Plan Requirements

Schedule 6, Condition 2 (Management Plan Requirements) SSD_5581	Section
The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: a) Detailed baseline data; b) A description of: • The relevant statutory requirements (including any relevant approval, licence or lease conditions); • Any relevant limits or performance measures/criteria; • The specific performance indicators or triggers that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures. c) A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria. d) A program to monitor and report on the: • Impacts an environmental performance of the development; • Effectiveness of any management measures (see c) above); e) A contingency plan to manage any unpredicted impacts and consequences f) A program to investigate and implement ways to improve the environmental performance of the development over time g) A protocol for managing and reporting any: • Incidents; • Complaints; • Non-compliances with statutory requirements; and • Exceedances of the impact assessment criteria and/or performance criteria; and h) A protocol for periodic review of the plan.	Section 4.2 and 4.3 EP Main Report (Section 2.1, Attachment B) Section 5.1 EP Main Report (Section 5.1), CLZ (ML1814) Master TARP Section 4 and related management plans Section 4 Section 5.4 Section 5.4, 5.5 and 5.6 Section 5.5 Section 6.1

2.1.2 WHS (Mines and Petroleum) Legislation

The NSW *Work Health and Safety (Mines and Petroleum Sites) Regulation 2022* (WHSMP Regulation) under the NSW Work Health and Safety Act (2011) requires the mine operator of an underground coal mine to ensure that:

- Monitoring of subsidence is conducted, including monitoring of its effects on relevant surface and subsurface features (Section 70(2)(b); and
- All subsidence monitoring data is provided to the regulator in the manner and form and at the times required by the regulator (Section 70(2) (d)).

Table 2-2 lists recommended factors to be considered in the development of subsidence monitoring programs in accordance with the *Managing Risks of Subsidence Guideline*, NSW Department of Industry, Resources Regulator (NSWRR), 2017.⁵

⁵ Table 2.2 is a summary of aspects specifically related to subsidence monitoring.

Table 2-2: Recommended factors in development of Subsidence Monitoring Programs

Referenced Section	Requirement	Section
Primary Duty of Care (s1.2, s2.1)	Under Section 19 of the Work Health and Safety Act 2011 (WHS Act) all persons conducting a business or undertaking (PCBUs), including mine operators, must ensure, so far as is reasonably practicable,..... that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.	CLZ (ML1814) PSMP Section 2.2 Attachment C
Managing Risks of Subsidence (Overview) (s2.1)	Under section 70(1) of the WHSMP Regulation (2022), the operator of an underground coal mine must..... manage risks to health and safety associated with subsidence at the mine. Section 70(2) sets out specific requirements in relation to subsidence. <i>Note: Section 3 of the Guidelines provides further details for risk identification, assessment and management for principal hazards which are described further in the PSMP (refer for full details if required).</i>	CLZ (ML1814) PSMP Section 2.2 Attachment C
Objectives of Subsidence Monitoring (s2.9.1.1)	In undertaking subsidence monitoring, the mine operator should determine how the monitoring data is to be captured, recorded, communicated and, importantly, acted upon, for the purpose of:	Section 4
	(1) ensuring that the mine operator has a current and correct understanding of the hazards of subsidence	Section 2.2
	(2) ensuring that the risk control measures are maintained so that they remain effective,	Section 4, 6.2
	(3) avoiding unplanned events.	Section 5.3
	(4) detecting early warnings of changes from the results of risk assessments to facilitate corrective or proactive management actions or the commencement of emergency procedures,	Section 4, 5.3, CLZ (ML1814) Master TARP
	(5) identifying emerging new risks of subsidence, and	Section 4, 5.3
	(6) informing the continual improvement and change management.	Section 5.6.2
Scope of Subsidence Monitoring (s2.9.1.2)	The scope of subsidence monitoring must include:	
	(1) Monitoring of subsidence	Section 4
	(2) Monitoring of the effects of subsidence on relevant surface or subsurface features	Section 4
	(3) Monitoring the risk control measures to ensure they remain effective	Section 4
Design, implementation and maintenance of Subsidence Monitoring (s2.9.1.3)	When designing, implementing and maintaining a subsidence monitoring program, the mine operator of an underground coal mine should:	
	(1) address the objective and scope of the subsidence monitoring program (refer to sections 2.9.1.1 and 2.9.1.2 above)	This document
	(2) consider the outcomes of subsidence hazard identification, investigation and analysis (refer to section 2.3.4 above). In particular, the subsidence monitoring program should be designed and implemented to assist with: (a) the verification of the risk assessments previously conducted, (b) the verification of the assumptions used during the investigations, analyses or risk assessments previously conducted; (c) the management of uncertainty and abnormal subsidence,	Section 2.2, 4, Attachment C
	(3) consider the results of stakeholder consultation	Attachment D
	(4) ensure that the monitoring activities are carried out by a competent person	Section 6.2
	The subsidence monitoring program should specify:	
	(1) the individual monitoring activities of the subsidence monitoring program,	Section 4
	(2) the information to be captured from each of the individual monitoring activities	Section 4

Referenced Section	Requirement	Section
	(3) the locations and area where each of the individual monitoring activities will be undertaken, in particular, the layout and/or locations of instrumentation, monitoring points and inspections,	Section 4
	(4) the timing, frequency and duration of monitoring activities and reporting	Section 4
	(5) the monitoring methods, technologies, industry standards and codes of practice that apply when undertaking the monitoring activities	Section 4
	(6) the measures and procedures for quality assurance	Section 4
	(7) the measures and procedures for detecting emerging new risks or early warnings of changes from the results of risk assessments	Section 4, 5.3, CLZ (ML1814) Master TARP
	(8) the measures and procedures for recording and reporting monitoring results to the regulator and stakeholders	Section 5.6.1
	(9) the measures and procedures for rectifying any disturbances to or malfunctions of the implemented monitoring device in a timely manner so that the subsidence monitoring program remains effective	Section 4, 5.3, CLZ (ML1814) Master TARP
	(10) a set of criteria, which if satisfied, enables a competent person to vary the implemented subsidence monitoring program (e.g. timing, frequency or duration of subsidence monitoring or reporting)	Section 2.2, 4, 5.1
	(11) any necessary “redundancies”, that is, different monitoring technologies or procedures that are to be used to monitor the same subsidence hazard. “Redundancies” should be considered where the subsidence hazard may have potentially severe health and safety consequences	Section 2.2, 4
	(12) Relevant details of a proposed subsidence monitoring program should be demonstrated on a graphical plan (i.e. Plan 7) that is part of the HRA notification (refer to the NSW Department of Industry WHS guideline “Notifying the regulator of a high risk activity”).	Refer HRA Application
Baseline Subsidence Data (s2.9.1.4)	Prior to the development of subsidence, the mine operator should complete:	
	(1) the design and implementation of the subsidence monitoring program in accordance with section 2.9.1.3 above	This document
	(2) the collection of base-line subsidence data in accordance with the subsidence monitoring program	Section 4
Review (s2.9.2)	The mine operator must ensure that any interpretation of subsidence information (e.g. reviewing the risk control measures for subsidence) is carried out only by a competent person	Section 6.2
	The mine operator must review and as necessary revise the risk control measures implemented for subsidence in accordance with section 15 of the WHSMP Regulation	Section 6.1
	In undertaking the reviews, the stakeholders must, so far as is reasonably practicable, be consulted and the following questions should be addressed” (1) have all subsidence hazards been identified? (2) is the mine operator’s understanding of subsidence hazards still current and correct? (3) have the implemented risk control measures been working effectively? (4) are the risks of subsidence being adequately managed? (5) have there been any early warnings of changes from the results of risk assessments, which warrant corrective or proactive management actions or the commencement of emergency procedures? (6) have any incidents of subsidence occurred and what is the learning from the investigations of these incidents? (7) should the implemented risk control measures be revised according to the results of subsidence monitoring and review?	Section 6.1

2.2 Risk-based development of Monitoring Strategy

Centennial Airly has undertaken a dedicated ***Subsidence and Environmental Risk Assessment*** (*Stature RA Number: 1001330039⁶*) directly in support of this Extraction Plan which provide a risk framework basis for development of the component management plans.

The CLZ (ML1814) Extraction Plan risk assessment was completed on the 20 June 2023 with key staff from the Airly Mine including the Mine Manager, Statutory Mine Surveyor, Technical Services / Compliance Manager and Environment and Community Superintendent, as well as key EP Project Team members for Heritage, Ecology and the Lead Consultant for the Extraction Plan. The landholder was also represented by a member from the NPWS.

Risks were identified and assessed through the review of known surface and sub-surface features within the EP Area. The risk assessment also specifically assessed key heads of consideration required by the Managing Risks of Subsidence Guideline (NSW RR, 2017).

A risk ranking (low, moderate, significant, high or extreme) was assigned to each risk/hazard in consideration of the Maximum Reasonable Consequence (MRC) for the given controls. The risk assessment determined that the risk of impact for the relevant features within the EP Area (noting the extensive controls identified) was **Low to Significant** including aspects associated with cliffs and pagodas. There were 34 potential risks scenarios assessed during the Risk Assessment; 1 significant, 7 moderate, 23 low and 3 were assessed as not applicable.

A copy of the risk assessment is included in the EP Main Report (refer Attachment C). Additional details regarding the management and monitoring of subsidence related impacts to land within the EP Area have been detailed in **Section 4** and **Section 5**.

2.3 Consultation

Condition 7(i)(i) in Schedule 3 of SSD_5581 requires the preparation of this ***CLZ (ML1814) SMP*** in consultation with key relevant stakeholders as detailed below:

- IEP;
- NSW Resources Regulator; and
- Biodiversity, Conservation and Science (BCS) group within the NSW DCCEEW.

The outcomes of consultation undertaken for the project is provided in the EP Main Report (refer Attachment D), including copies of relevant correspondence such as project presentations delivered by the mine to key stakeholders and relevant formal correspondence received from key stakeholders.

Stakeholder feedback provided has been reviewed and addressed as necessary as part of the development and review of this Extraction Plan and key component plans.

⁶ Centennial Airly has adopted the Stature Risk Assessment Program which was developed to ensure consistency in all risk assessments across the Centennial operations. The Stature Risk Assessment Program sets out a consequences table and risk ranking matrix for managing identified risks consistent with AS/NZS ISO 31000:2009.

3 SUBSIDENCE ASSESSMENT

3.1 Mine Planning and Design

The proposed first workings within the CLZ (ML1814) consist mainly of (or parts of) main headings which provide access to future mining areas. First workings incorporate mine development of roadways and cut throughs to form long term stable pillars.

Mine design is the primary control utilised at Airly Mine for subsidence impact avoidance. The final pillars are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement.

Typical layouts for first workings within the CLZ (ML1814) EP Area will include the following:

- A mining height of 3.2m
- Maximum roadway (bord) width of 5.5m
- Maximum void width of <10m
- Minimum first workings on 35m x 35m pillar centres, *noting minimum pillar size increases for DOC 260m or greater*
- Pillar width to height ratio of >8.0
- Pillar system Factor of Safety (FOS) >2.11 for protection of key surface features (failure probability of > 1 in 1 million)
- DOC within the EP Area ranges from ~90-320m
- Long term stable pillars, and low levels of subsidence, are proposed to protect sensitive areas, including:
 - The Grotto and the Oasis
 - Known Aboriginal Heritage Site (AHIMS 45-1-0167)
 - Large cliffs associated with Genowlan Point, and the
 - Threatened flora species and threatened ecological community including the *Pultenaea* sp. Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland

3.2 Subsidence Predictions

Condition 7(g) in Schedule 3 of SSD_5581 and the Extraction Plan Guidelines (DPE, 2022) requires revised predictions of potential subsidence effects, subsidence impacts and environmental consequences to be presented within the Extraction Plan for the EP Area, including any relevant information obtained since the EIS and consent, in consultation with the Independent Expert Panel (IEP).

Subsidence predictions for this Extraction Plan were assessed by SCT (2023a; 2023b) and are presented in full as *Attachment E – Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a) and the addendum Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b)*.⁷

The maximum predicted subsidence for the EP Area are consistent with the EIS Predictions as shown in **Table 3-1**. The predictions included assessment of the subsidence effects measured in the current first workings at Airly Mine, including a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331).

Table 3-1: Maximum Subsidence Predictions with Comparison to Previous Predictions

Predictions	Pillar Stability	Max Subsidence	Max Tilt (mm/m)	Max Strain	
				Tensile (mm/m)	Compressive (mm/m)
This CLZ EP (ML1814) Predictions SCT (2023a; 2023b)	Long Term Stable with minimal subsidence	≤37mm	≤0.61	≤0.18	≤0.25
EIS Predictions Golder (2014b)	Long Term Stable	65mm	0.6-1.1	0.2-0.3	0.2-0.5
Current CLZ EP (ML1331) Predictions Golder (2017)	Long Term Stable, negligible settlement, effectively non-subsiding	<53mm Worst Case (long term flooded and additional pillar loading) Short to medium term <30mm and typical <20m	0.4-0.9	0.1-0.3	0.1-0.3

The predicted subsidence is not expected to cause adverse impacts on the relevant features covered under this CLZ (ML1814) SMP.

⁷ A detailed review of the revised subsidence predictions is provided in the *EP Main Report (refer Section 3.2)*

4 SUBSIDENCE MONITORING AND MANAGEMENT

4.1 Monitoring Strategy and Program Summary

4.1.1 Monitoring Strategy

The proposed monitoring strategy for the EP Area reflects several important considerations. An integrated approach to monitoring and inspections has been developed as a continuation of previously approved methodologies for existing Extraction Plans, to address the following:

- Demonstrate mining is undertaken as per the approved designs (as the basis of impact avoidance predictions);
- Provide information to demonstrate statutory performance criteria and obligations are satisfied, as detailed in **Section 5.1**;
- Target monitoring of potential changes/impact to key sensitive surface features within the EP Area (primarily cliffs, minor cliffs and pagodas);
- Recognises that the predicted subsidence levels are minimal and well below levels expected to cause damage.
- Validate the mine design and provide ongoing basis for future monitoring systems and staged Extraction Plans for other approved mining zones within the lease;
- Address stakeholder requirements to minimise environmental impact of monitoring in the SCA, recognising environmental sensitivity and accessibility. This includes limiting clearing and disturbance from general access requirements by personnel wherever possible;
- Where triggers are exceeded, provide data to demonstrate the effectiveness of adaptive management strategies; and
- Provide appropriate information required to assess against triggers within the Master TARP, including data for trend analysis to inform adaptive management (refer **Section 5.1 and 5.4**).

Given the above considerations (noting surface access restrictions), an integrated system of underground monitoring, detailed aerial remote monitoring and targeted and triggered surface monitoring has been developed for the current EP, using escalating triggers and levels of investigation where required in accordance with the *CLZ (ML1814) Master TARP*.

4.1.2 Integrated Subsidence Monitoring Program

The proposed monitoring program and strategy for the EP Area is developed in consultation with key stakeholders including (but not limited to) the IEP, BCS, NSW Resources Regulator and NPWS. The proposed *Integrated Subsidence Monitoring Program* includes:

- **Underground Mining Control** routine survey of workings and inspections by mining officials to ensure mining is strictly implemented as designed (primary control utilised at Airly Mine for subsidence impact avoidance);
- **Monitoring ground movement** and surface subsidence impacts via Global Navigation Satellite System (GNSS) Monitoring Stations / Continually Operating Reference Station (CORS) – Long occupation real time point data base stations;
- **Remote monitoring of the Surface Environment** via LiDAR (40 points per square meter) for monitoring of vertical subsidence over the EP Area relative to baseline and Performance Measures;

- **Trigger-based Targeted Surface Inspections** where required (where safely and readily accessible, such as where 4WD trails traverse or are close to the EP Area, and where otherwise triggered by the CLZ (ML1814) TARP); and
- **Data Analysis** data analysis and reporting will monitor specifically for change and target:
 - Any areas detected for significant change by remote monitoring results (including pre and post mining areas), triggering further detailed analysis under the CLZ (ML1814) TARP, including a process for determining natural or mining-induced rock fall.
 - The process for this detection is detailed further in the CLZ (ML1814) SMP and CLZ (ML1814) TARP respectively. Data for natural rock falls in areas yet to be mined will also provide additional data to the baseline data set.

4.1.3 Monitoring Program Summary

The monitoring program to monitor the development of possible subsidence related environmental impacts is detailed in **Section 4.2 and 4.3** and summarised in **Table 4-1** (*Subsidence Movements and Effects Monitoring Program Summary*) and **Table 4-2** (*Natural and Built Features Monitoring Program Summary*).

A contingency plan has been developed as a component of this CLZ (ML1814) SMP to outline management measures that will be implemented if predicted outcomes are exceeded (**Section 5.1**).

Table 4-1: Subsidence Movements and Effects Monitoring Program Summary

Type	Location	Purpose	Monitoring Methods / Standards and Accuracy	Parameter	Frequency and Duration
Underground Mine Control	Active Panel Area - Active Panel - Completed first workings during panel development - Planned final pillars after mining	Confirm that formation of underground workings for development is implemented as per approved designs.	- Conventional underground survey of chain pillar / workings as completed in the active panel. - Visual Inspection - Overlay of ‘as built’ pillars (as surveyed) against designed pillars of mine plan by Mine Surveyor to confirm appropriate final chain pillar sizes and panel system FOS has been achieved.	- Roadway width - Roadway height - Max void width - Final chain pillar area, - Final width to height ratio, - Final Pillar System FOS as formed - Presence & depth of rib spalling - Presence of geological structure in final pillars - Off line driveage	<u>During Mining:</u> - Inspections weekly in active working areas during first workings, undertaken by mining official. - Survey of pillars updated weekly by mine surveyor <u>Post Mining:</u> - Weekly visual inspection in developed area by mining official in accessible parts of the mine. - Final inspection at 3 months. - Accessible pillars in the cliff zone inspected during any adjacent second workings outside the cliff zone once during extraction.
Airly Mine GNSS Monitoring Stations	Targeted Locations within the EP Area Parts of the existing and proposed Airly Mine GNSS Monitoring Station network located in the Extraction Plan Area (associated with monitoring for other Extraction Plans), including one proposed targeted GNSS Monitoring Station on the cliff face above known heritage site (AHIMS 45-1-0167)	- Monitor vertical and horizontal movements to ensure within modelled predictions. - Continuous occupation monitoring, including for baseline, at key locations / surface features (e.g. large cliffs, public access areas, known heritage site (AHIMS 45-1-0167)) - Provide continually operating reference points for LiDAR	Continuous near real time point data (raw data set at 10 second intervals) - Global Navigation Satellite System (GNSS) Stations <+/-5mm rolling 7-day average - Co-located with photogrammetry/LiDAR geo-reference markers	- Vertical subsidence (mm) - Horizontal displacement (mm)	<u>Baseline:</u> Installed prior to commencement, providing continuous data from installation through to commencement <u>During mining:</u> Continuous throughout first workings in the active panel area <u>Post Mining:</u> GNSS stations will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of development in the active panel area
LiDAR	Entire EP Area Including pre-mining baseline areas and post mining areas	- Differential subsidence measure between each monitoring event (‘epochs’) across large areas. - Reporting of observed subsidence between each epoch – heat map and cross sections are available. - Ability to assess thousands of points and potentially provide whole of area monitoring.	- High Resolution LiDAR georeferenced to GNSS monitoring stations. 40pts per square meter - Capable of detecting 50mm subsidence movements at very high confidence levels. Smaller movements can also be detected at lower confidence levels.	Vertical subsidence movements monitoring of ‘broad-area’ (typically >50mm at high confidence levels) relative to previous monitoring events (‘epochs’).	<u>Baseline:</u> At least two surveys undertaken to date (December 2022 and June 2023), ongoing surveys will be undertaken at approximately six-month intervals increasing the baseline data set through to commencement. <u>During mining:</u> Ongoing surveys will be undertaken at approximately six-month intervals <u>Post Mining:</u> At least one survey will be undertaken following completion of first workings under this Extraction Plan. No further detailed analysis after post mining survey has indicated negligible impacts (in the undermined area).
Targeted Surface Inspection	Active Panel Area If issues are identified from monitoring as per Master TARP triggers.	Complementary monitoring supporting	Visual inspection of relevant area/location where safely accessible.	Presence/absence of mine-induced damage or change to features (e.g. rock falls or surface cracking)	Triggered targeted visual ground inspection will be undertaken if issues are identified from subsidence monitoring program as per Master TARP triggers

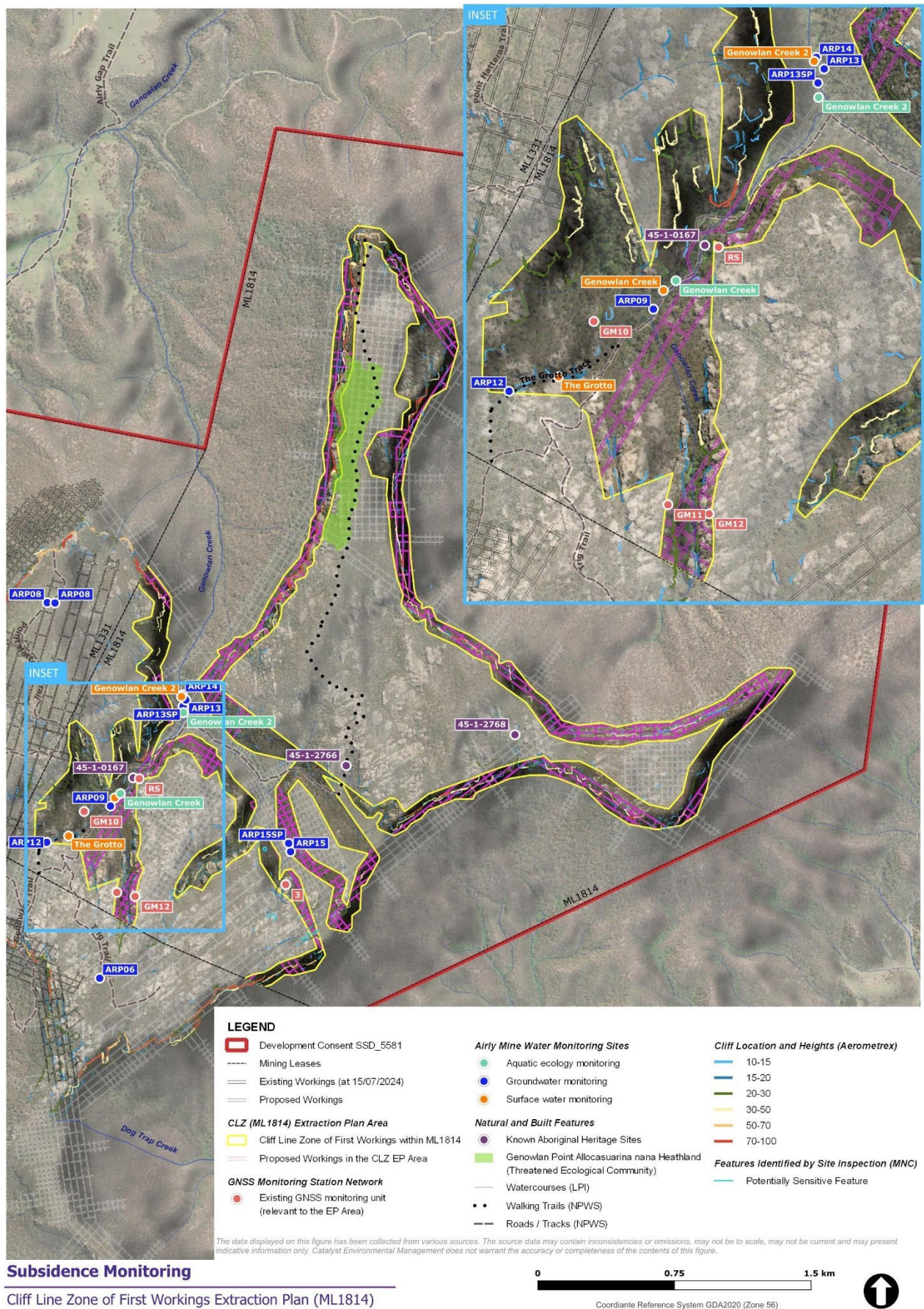
Table 4-2: Natural and Built Features Monitoring Program Summary

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
Land				
Cliffs, Minor Cliffs & Pagodas.	<i>Entire EP Area</i> - LiDAR for entire EP Area (including pre-mining baseline areas and post mining areas) - Reporting by exception (significant change)	- LiDAR (40pts/m²) - Trigger-based targeted visual inspection (including photos as required)	Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking). Various Parameters relevant to each method.	<u>Baseline:</u> At least two prior to extraction. <u>During mining (secondary extraction):</u> Approximately six-monthly surveys during mining for change relative to baseline and Performance Measures. <u>Post Mining:</u> No further detailed analysis once post mining survey has indicated negligible impacts (in the undermined area). Six monthly surveys continue with a focus on the next active mining area. <i>Trigger-based targeted visual ground inspection will be undertaken if issues are identified from aerial / underground monitoring as per CLZ (ML1814) Master TARP triggers (Appendix 7 of the EP Main Report).</i>
General Land Surface (excl. cliffs and pagodas)	<i>Entire EP Area</i> - Baseline – Entire EP Area - Routine Survey data for entire EP Area (including pre-mining areas and post mining areas) - Reporting by exception (significant change)	As above	Presence/absence of damage or change to land surface (including topography, sinkholes, rock features, soil cover, vegetation cover, etc.)	<u>Baseline:</u> At least two prior to extraction. <u>During mining (secondary extraction):</u> Approximately six-monthly surveys during mining for change relative to baseline and Performance Measures. <u>Post Mining:</u> No further detailed analysis once post mining survey has indicated negligible impacts (in the undermined area). Six monthly surveys continue with a focus on the next active mining area. <i>Trigger-based targeted visual ground inspection will be undertaken if issues are identified from aerial / underground monitoring as per CLZ (ML1814) Master TARP triggers (Appendix 7 of the EP Main Report).</i>
SCA Management Trails	<i>Entire EP Area</i> Sections traversing extraction plan area during undermining of any marked trail/track where the trail or track is within half depth of cover from the workings.	Trigger-based targeted visual inspection (including photos as required)	Surface cracking and drainage change. (Note: sections of cliffs and pagodas that are visible during surface inspections would also be assessed for any observed rock fall to support aerial monitoring of those aspects).	<i>Trigger-based targeted visual ground inspection will be undertaken if issues are identified from aerial / underground monitoring as per CLZ (ML1814) Master TARP triggers (Appendix 7 of the EP Main Report).</i>
Heritage				
Aboriginal Heritage Site (AHIMS 45-1-0167)	<i>500 Panel Area:</i> Aboriginal Heritage Site (AHIMS 45-1-0167) located in the vicinity of The Grotto above the 500 Panel Area	Archival recording including a detailed plan of the site, archival-quality photographic records and a record of the surface conditions of the site (3 phase monitoring including pre and post monitoring) GNSS Monitoring Station providing continuous near real time point data (raw data set at 10 second intervals), <+/- 5mm rolling 7-day average	Presence/absence of mine-induced damage or change to features	<u>Baseline:</u> - GNSS installed prior to commencement - Phase 1: Baseline recording (prior to site being undermined) <u>During Mining:</u> - GNSS continuous throughout first workings in the active panel area <u>Post-Mining:</u> - GNSS stations will remain in-situ until consistent results are obtained demonstrating completion of major subsidence movement (i.e. within survey error) following completion of development in the active panel area - Phase 2: Post mining initial condition (immediately after undermining) - Phase 3: Post mining secondary condition (approximately 8 months after undermining) - If ground conditions have stabilised and no changes to sites condition are observed, then no further monitoring will be required
Note: The monitoring outlined below presents site-wide monitoring undertaken for ‘whole-of-mine’ environmental management plans required separately to the Extraction Plan, but which may assist in assessing for potential unexpected impacts (e.g. downstream watercourses). As live EMS documents, refer each management plan for full and current details.				
Surface Water				
Gap Creek Genowlan Creek Airly Creek <i>including discharge monitoring and onsite locations (Airly Mine surface operations area)</i> <i>(see Site Water Management Plan (s4.2, 4.3))</i>	- Gap Creek Water Quality & Flow Monitoring Station - Genowlan Creek Flow Monitoring Station - Genowlan Creek 2 Water Quality & Flow Station - The Grotto Water Quality Monitoring Station - Airly Creek Water Quality Monitoring Station - Airly Creek Upstream Water Quality Monitoring Station 5 onsite dams.	- Flow monitoring - Water Quality Monitoring - Water quality in onsite dams as per s4.2 of WMP) - Visual Inspection of mine water dams	- Volumetric Flow - Water Quality (WQ) -monthly screening suite and annual full ANZECC suite. See WMP for parameter details - Water quality suites for onsite dams as per s4.2 of WMP (including EPL requirements) - Visual inspection of mine dams	- Continuous flow monitoring at Gap, Genowlan Creek and Genowlan Creek 2 site (data logged). - Monthly routine WQ screening samples during mining. - Annually- Full WQ sampling suite on Gap Creek, the Grotto, Genowlan Creek 2. - Weekly inspections of mine water dams and event based (20mm in 24hrs). Monthly and annual sampling of onsite dams as per s4.2 of WMP. - Refer site WMP for details including completion of monitoring.
Groundwater				
Groundwater Bores, Village Spring - Flow monitoring of seepage	- Vibrating wire piezometer (VWPs) and standpipe monitoring bore network across ML1331, monitoring various strata as per WMP. - Village spring seepage from old shale mine workings	All VWPs and standpipe bores continuously logged for piezometric head and groundwater levels. Groundwater Quality Monitoring as detailed in s4.4.2 of the WMP.	Water Level (mAHD)	Continuous monitoring of piezometric head and groundwater levels.

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
Transfers from Underground Workings <i>(refer Site Water Management Plan (s4.4))</i>	Underground workings	- Village spring seepage flow by logged pressure transducer. - In-line flow metering of underground transfers	- Water quality (monthly screening suite, annual ANZECC suite as per WMP). - Seepage flow volume - Transfer flow volume - Refer WMP for parameter details (s4.4).	- Monthly routine groundwater quality (screening suite) during mining (refer s4.4 of WMP for details). - Annually- Full groundwater quality suite (see s4.4 of WMP). - Continuous monitoring of Village Spring seepage. - Daily monitoring of underground transfers to surface dirty water dam (109ML dam). - Refer site WMP for details including completion of monitoring.
Aquatic Ecology and Stream Health				
Aquatic Ecology <i>(Note: see also Groundwater above for stygofauna)</i>	<u>Reference site:</u> Airly Creek Upstream. Dog Trap Creek will be used as a surrogate should Airly Creek upstream be dry in any sampling event. <u>Baseline sites:</u> - Torban Creek. - Dog Trap Creek. - Gap Creek. - Genowlan Creek. - Genowlan Creek 2. Baseline monitoring to cease following the spring 2017. <u>Impact site:</u> Airly Creek. Refer Figure 4-4 of the WMP.	- Sampling, sorting and identification of macroinvertebrates, associated with pool edge habitat in accordance with the Australian Rivers Assessment System (AUSRIVAS) protocols (Turak et al. 2004). - Assessment of the condition of the aquatic habitat using modified NSW AUSRIVAS field sheets. - Measurement of DO, EC, pH, temperature and turbidity just below the surface of the water column and at depth where sufficient water is available. - Collection of surface water and sediment grab samples for water and sediment quality analysis.	- Species presence/absence - Habitat condition - DO, EC, pH, temperature and turbidity - Sediment quality - selected parameters.	Typically biannually in spring and autumn when monitoring. Refer site WMP for details including completion of monitoring.
Stream Health	<u>Third order</u> stream sections within the site boundary for Gap Creek, Genowlan Creek, Torban Creek. (downstream of current EP Area)	Visual monitoring of watercourses by suitably qualified professionals to identify any instabilities that may form as a result of mining operations.	- Change in stream bed or bank conditions. - Incision or head cut development. - Surface cracking. - Ponding (particularly 'out of channel' ponding). - Step changes in bed profile. - Notable/indicative changes in stream vegetation.	Typically every two years, or where subsidence survey monitoring indicates greater than predicted subsidence. Refer site WMP for full details including completion of monitoring.
Biodiversity				
<i>Prostanthera stricta</i>	Representative sample of known locations of <i>Prostanthera stricta</i> across the Airly Development Consent Area and EP Area. Additional monitoring sites to be re-established at the commencement of the CLZ (ML1814) BMP. Previous <i>P. stricta</i> data collected at these sites from 2012 to 2014 by UQ, no data has previously been collected at the new <i>E. cannonii</i> sites.	Point intercept method and floristic density plots	- Density/Percent cover - Vegetation condition	Annually in Spring and Summer
<i>Eucalyptus cannonii</i>	Representative sample of known locations of <i>Prostanthera stricta</i> across the Airly Development Consent Area and EP Area.	Tree condition, crown extent, growth changes and associated species assessment.	Condition, crown extent, growth changes and associated species.	Annually in Spring and Summer
Capertee Rough-barked Apple – Redgum – Yellow Box Grassy Woodland (MU 20) EEC <i>Note: No EEC is located within current EP Area</i>	Permanently established plots in PCT 703 within the Airly Development Consent Area	BAM Plot survey to assess vegetation condition (DPIE 2020d)	- Composition based on number native plant species within a 20 x 20m plot for each growth form group. - Structure is assessment of foliage cover for each growth form group. - Stratum & layer in which each species occurs - Growth form for each recorded species. - Species name & estimate of the crown cover for each species - Abundance- estimate of the number of individuals or shoots of a species within the plot.	Annually in Spring and Summer
Facultative GDEs	Permanently established plots in PCT 1088 within the Airly Development Consent Area	BAM Plot survey to assess vegetation condition (DPIE 2020d)	Vegetation condition	Annually in Spring and Summer
Weed species	Permanently established plots across the Airly Development Consent Area and EP Area	Point intercept method and floristic density plots	- Density/Percent cover - Vegetation condition	Annually in Spring and Summer

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
Glossy-black Cockatoos	Areas of She-oak (<i>Casuarina</i> and <i>Allocasuarina</i> sp., but specifically <i>Allocasuarina littoralis</i>) across the Airly Development Consent Area and EP Area Two additional Glossy-black Cockatoo monitoring sites introduced into the EP Area.	Percent cover of <i>Allocasuarina</i> species and the presence and quantity of orts was recorded.	Species presence /absence /abundance/ distribution	Annually in Summer
Large Forest Owls	Valleys and other areas of potential habitat within the Airly Development Consent Area in conjunction with Koala census.	Targeted call-playback/spotlighting Stationary Song Meters to determine presence	Species presence /absence /abundance/ distribution	Annually in Spring and Summer
Diurnal Birds	Across the Airly Development Consent Area	30 minute surveys across permanent transects	Species presence /absence /abundance/ distribution	Annually in Spring and Summer
Microbats	Foraging and roosting sites and flyways within the Airly Development Consent Area	Anabat units to detect presence of microbat species	Species presence /absence /abundance/ distribution	Annually in Summer
Vertebrate Census	Gully habitats and rock habitats within the Airly Development Consent area and EP Area in conjunction with the reptile census.	Baited stationary infrared cameras to determine presence and count	Species presence /absence /abundance/ distribution	Annually in Summer
Koala sites (in conjunction with the Large Forest Owl sites)	Valleys and other areas of potential habitat within the Airly Development Consent Area in conjunction with Large Forest Owl census.	Stationary Song Meters to determine presence	Species presence /absence /abundance/ distribution	Annually in Summer
Gliders - Greater Glider and Squirrel Glider	Valleys and other areas of potential habitat within the Airly Development Consent Area in conjunction with Large Forest Owl census.	Targeted call-playback/spotlighting	Species presence /absence /abundance/ distribution	Annually in Summer

Figure 4.1: Subsidence Monitoring



4.2 Subsidence Movements and Effects Monitoring

4.2.1 Underground Survey, Inspections and Mine Control

The mine design has been specifically developed in response to the sensitive surface environment to avoid significant impact. Underground mining control aims to monitor and confirm that formation of underground workings for development and extraction is implemented as per the minimum design specifications that determine the predicted subsidence movements and impacts.⁸

Pillar and Roadway Size, Condition and Formation (in the EP Area)

Pillars are required to meet the performance measures. The underground survey, inspections and mine control monitoring will include:

- **Ensuring the mine layout is in accordance with design parameters** - the Airly Technical Services Manager will record and issue designs for minimum pillar dimensions conforming to the required mine design performance measures as part of the Authority to Mine process prior to commencement of panel development workings which are then to be implemented by development crews. including final pillar dimensions, roadway widths and mining heights.
- **Routine pillar inspections and implementation audits** by a mining official during mining and for appropriate period in accessible areas thereafter.
- **Conventional survey of pillars** updated weekly in active panel during development, with final survey once final pillars formed, to provide accurate “as-built” survey of pillar and roadway dimensions, overlaid against the mine design for confirmation mine design performance measures are met.⁹

Underground visual inspections and conventional survey data for as-built workings will be compared to mine design requirements for:

- Pillar size (by survey)
- Roadway position/location (online/offline driveage)
- Roadway width / height
- Pillar condition / floor heave / roof condition

Any non-conformances will be managed in accordance with detailed measures in the CLZ (ML1814) Master TARP for the underground mining controls to ensure that appropriate responses are taken if the mining geometry is not formed as per the approved design.

Baseline

The mine layout has been developed in accordance with the mine design parameters which have been designed and assessed to be consistent with the predictions in the EIS.¹⁰ This process is undertaken in consultation with the IEP and has included assessment of the subsidence effects measured in the current first workings at Airly Mine, including a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP (ML1331).

⁸ see the EP Main Report, Section 3.1.1 (proposed mining geometry and parameters) and Section 5.1.1 (performance measures for mine design and underground mining control).

⁹ Conventional survey is undertaken by the mine surveyor in accordance with AIR-ST-9001 Panel Design Standard.

¹⁰ For further details of the mine design parameters and subsidence predictions and assessment refer to the EP Main Report, in particular Section 3.1 (mine design and planning), Section 5.1.1 (performance measures in mine design and underground mining control) and Section 3.2 (subsidence predictions).

4.2.2 Airly Mine GNSS Monitoring Stations

Airly Mine has an extensive network of existing (and proposed) GNSS units, also known as Continually Operating Reference Stations (CORS), including several at targeted locations within the EP Area.

The GNSS units use the Global Navigation Satellite System (GNSS) and record X, Y, Z spatial position readings. The stations provide near real time continuous monitoring, recording readings at 10 second intervals (raw data), and calculating statistical 24hr (daily) averages and rolling 7-day averages at ± 5 mm accuracy. The GNSS units are co-located with photogrammetry geo-reference markers and the data collected will also be used to provide continually operating reference points for the LiDAR surveys.

The continuous and near real time data are envisaged to provide the mine with suitably fast and accurate data to monitor and respond to ground movements, particularly if abnormal subsidence is measured in this EP Area.

The GNSS units are primarily used to monitor and provide notifications to Airly Mine for secondary extraction approved by other Extraction Plans, including monitoring within an Extended / Far Field Monitoring Area which incorporates areas within the EP Area.

The following provides the purpose and some context of the GNSS monitoring stations relevant to this Extraction Plan:

- Continuous occupation monitoring of vertical and horizontal movements, including for baseline, at key locations / surface features, including
 - Monitor movements at or toward key sensitive features and areas (i.e., large cliffs and incised gorges primarily on the western side of the EP Area)
 - Monitor movements at or toward Aboriginal Heritage Site (AHIMS 45-1-0167)
 - Public access areas (i.e., The Grotto walking trail)
- Co-located with photogrammetry geo-reference markers to provide continually operating reference points for LiDAR

The GNSS units are intended to be deployed continuously at proposed locations throughout the duration of mining within the EP Area (and for secondary extraction approved by other Extraction Plans) and will remain in-situ until data demonstrates subsidence has stabilised following the completion of mining (potentially up to a maximum of 12 months post mining, but noting that monitoring will continue until movement stabilises). Once data has demonstrated subsidence has stabilised following the completion of mining, Airly Mine may seek to re-deploy appropriate units closer to current or future mining areas. Notwithstanding, any potential relocation of individual GNSS units as mining advances would be undertaken in consultation with the IEP, and NSWRR and NPWS prior to doing so.

Raw subsidence monitoring data from the GNSS units will be provided to NPWS on a quarterly (3 monthly) basis.

Baseline

Existing GNSS units within the EP Area, GM10, GM11 and GM 12, were installed in September 2021.

The installation of additional proposed GNSS units, including site RS associated with monitoring of Aboriginal Heritage Site (AHIMS 45-1-0167), is subject to receiving approval from NPWS. The GNSS units will be installed prior to commencement of first workings in the EP Area and will collect baseline data through to the commencement of first workings.

4.2.3 LiDAR

High resolution (40pts per square meter) LiDAR will be used for vertical subsidence monitoring. The system identifies ground points and then revisits these each monitoring event ('epochs').

Routine LiDAR surveys are undertaken at approximately six-monthly intervals. The LiDAR surveys are part of a whole of mine monitoring program and cover previously approved EP Areas (and future EP Areas). Monitoring within the EP Area will be consistent with schedules of previously approved Extraction Plans.

Differential subsidence is measured between each epoch comparing thousands of data points and is georeferenced to the GNSS monitoring network. The system is capable of detecting 50mm subsidence movements at very high confidence level for each epoch.

The point measurement distribution provides a monitoring grid of similar density to conventional subsidence survey lines¹¹, but with the advantage of extensive coverage over the entire EP Area. This distribution of monitoring points provides a mine-wide subsidence profile of suitable accuracy to complement the integrated subsidence monitoring network (particularly the much higher accuracy GNSS units). Theoretically a subsidence line, and subsidence profile, could be placed anywhere within the EP Area using the data from stereo vertical photogrammetry.

Aerial survey includes consideration of:

- Condition of natural rock structures, including rock falls (natural or otherwise) or significant cracking, including percentage of cliff face area affected,
- Presence/absence of significant damage or change to general land surface of the SCA (topography, soil cover, vegetation cover, etc.); and
- Subsidence that exceeds consent limits (within the 50mm accuracy).

Methodology:

- Fixed wing aircraft to capture LiDAR
- LiDAR resolution will nominally be 40 points per square meter
- Ground control from survey targets co-located with the GNSS monitoring stations
- Ground control is measured on imagery.
- Once satisfactory results obtained in the software (Aero3D) - triangulation imagery is available for stereo measurement derivation of height points that are used for differential subsidence monitoring.
- By using the same flight plan from epoch to epoch the same georeferenced positioning locations are used to perform direct comparisons at the same locations.
- A spatially accurate point cloud is developed as a primary product, from which a Digital Elevation Model (DEM) is generated and subsequently analysed.

Further detailed analysis and/or targeted visual ground inspection will be undertaken if issues are identified from aerial work as per triggers detailed in the *CLZ (ML1814) Master TARP*.

Baseline

LiDAR baseline for the EP Area was flown in December 2022 and June 2023, ongoing surveys will be undertaken at approximately six-month intervals increasing the baseline data set through to commencement.

4.2.4 Trigger based, Targeted Surface Inspection

Trigger-based, targeted surface inspections will also be undertaken where required under the CLZ (ML1814) Master TARP and where safely and readily accessible (such as where 4WD trails traverse or are close to the EP Area).

Inspections will be guided wherever possible by related information provided by the integrated monitoring system, including underground and remote/aerial monitoring systems to identify and target key areas required for surface inspection.

Additionally, opportunistic observations will be undertaken by mine personnel during other routine monitoring visits within the EP Area (i.e., for conventional survey or other environmental monitoring).

4.3 Natural and Built Features Monitoring

4.3.1 Surface Water

Potential surface water impacts from Airly Mine will be managed in accordance with the Airly Mine Water Management Plan (Airly Mine WMP) (GHD 2024) developed in accordance with Condition 13 in Schedule 4 of SSD_5581. SCT (2023) stated that, subsidence effects, impacts and consequences are consistent with the EIS and CLZ (ML1331) EP which expects minimal surface impacts. SCT (2023) assessed there is a moderate potential risk of downward flow through the fracture network and lineaments resulting in a reduction in head level of creek alluvials.

The surface water monitoring framework outlined in the Airly Mine WMP¹², includes:

- Continuous flow monitoring at Gap, Genowlan Creek and Genowlan Creek 2 site (data logged).
- Monthly routine water quality screening samples during mining.
- Annually- full water quality sampling suite on Gap Creek, the Grotto, Genowlan Creek 2.
- Routine (weekly) and event based (20mm in 24hrs) inspections of mine water dams.
- Monthly and annual sampling of onsite dams.

Drainage lines located within the EP Area and surface water monitoring locations are illustrated on **Figure 4.1**. Monitoring sites and types are summarised below in **Table 4-3**.

Table 4-3: Surface water monitoring sites

Creek System	Monitoring Location	Monitoring type
Airly Creek	Airly Creek Upstream	• Water quality • Aquatic Ecology
	Airly Creek	• Aquatic Ecology
	Dog Trap Creek	• Aquatic Ecology
Gap-Genowlan Creek	Gap Creek	• Water quality • Flow • Aquatic Ecology
	The Grotto	• Water quality
	Genowlan Creek	• Flow • Aquatic Ecology

¹² Refer to the Airly Mine WMP (Appendix 1 of the EP Main Report) for details including completion of monitoring

Creek System	Monitoring Location	Monitoring type
	Genowlan Creek 2	- Water quality - Aquatic Ecology
Torbane-Oaky Creek	Torbane Creek	Aquatic Ecology

Flows at the Genowlan Creek monitoring sites (located within the EP Area) have been recorded since February 2013. An additional flow monitoring gauge at the Genowlan Creek 2 site was installed in mid-2017. Flows at Genowlan Creek are primarily rainfall-dependent, exhibiting a marked peak after successive daily rainfall events exceeding 30 mm.

Water quality data has been collected at surface water storages on site and Airly Creek since 2010. Baseline water quality monitoring of Gap Creek and Genowlan Creek began in 2012.

Appendix D of the current Airly Mine WMP presents the baseline surface water quality data for selected parameters monitored at surface water storages on site and Airly Creek, Gap Creek and Genowlan Creek.

Monitoring locations for surface water, groundwater, stream stability and aquatic ecology are shown on Figures 4-1, 4-2, 4-3 and 4-4 of the Airly Mine WMP respectively.

4.3.2 Groundwater

Potential groundwater impacts from Airly Mine will be managed in accordance with the Airly Mine Water Management Plan (Airly Mine WMP) (GHD 2024) developed in accordance with Condition 13 in Schedule 4 of SSD_5581. The predicted levels of subsidence for the extraction plan are similar to those provided in the 2014 EIS, i.e., the maximum predicted subsidence (from first workings in the cliff line zone) is less than 65 mm with no surface cracking, and the assessed levels of potential impact for groundwater, are similar to those based on the EIS Layout.

The groundwater monitoring framework outlined in the Airly Mine WMP¹³, includes:

- Continuous monitoring of piezometric head and groundwater levels.
- Monthly routine groundwater quality (screening suite) during mining.
- Annually- Full groundwater quality suite.
- Continuous monitoring of Village Spring seepage.
- Daily monitoring of underground transfers to surface dirty water dam (109ML dam).

A groundwater monitoring network of vibrating wire piezometers (VWP's) and Standpipes has been progressively installed since 2012 (i.e. many key sites have in excess of two years baseline monitoring data) to monitor various targeted strata (including alluvium downstream of the EP Area) and is detailed within the Airly Mine WMP.

All VWPs and standpipe monitoring bores are continuously logged for piezometric head and groundwater levels. Groundwater quality in standpipe monitoring bores is monitored monthly for selected parameters. Sufficient baseline groundwater monitoring data is held for the proposed workings within the EP Area.

Monitoring locations for surface water, groundwater, stream stability and aquatic ecology are shown on Figures 4-1, 4-2, 4-3 and 4-4 of the Airly Mine WMP respectively.

¹³ Refer to the Airly Mine WMP (Appendix 1 of the EP Main Report) for details including completion of monitoring

4.3.3 Aquatic Ecology & Stream Health

Aquatic ecology and stream health monitoring is undertaken in accordance with the Airly Mine Water Management Plan (GHD 2024), which has been developed in consultation with key agencies including but not limited to the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW), NSW Environment Protection Authority (EPA) and DPE Water (the Water Group within NSW Planning).

Monitoring requirements outlined by GHD (2024) are summarised in the Monitoring Summary Table presented in **Table 4-2**. Monitoring locations are shown on Figure 4-4 of the Airly Mine WMP (*Appendix 1 of the EP Main Report*). Further detail of the aquatic ecology monitoring methodology and regional sampling extent is also provided in the Airly Mine WMP and the Western Region Biodiversity Management Plan, as also referenced in the CLZ (ML1814) BMP.

Geomorphic condition and watercourse stability

Watercourse stability monitoring is undertaken on third order streams within the broader development consent boundary (subject to access requirements), every two years. Watercourse stability monitoring will also be undertaken in areas where subsidence survey monitoring indicates greater than predicted subsidence. Visual monitoring of watercourses is carried out by suitably qualified professionals to identify any instabilities that may form as a result of mining operations. The results of the watercourse stability monitoring program will be compared to baseline data collected.

The visual inspection of watercourses will identify if any of the following potential subsidence impacts occur within the creek lines or immediate catchment flow paths:

- Change in stream bed or bank conditions.
- Incision or head cut development.
- Surface cracking.
- Ponding (particularly 'out of channel' ponding).
- Step changes in bed profile.
- Notable/indicative changes in stream vegetation.

A baseline assessment of geomorphology at Airly Mine was undertaken for the Airly Mine Extension Project (GHD 2014e). Watercourse stability monitoring was last undertaken in 2018 (GHD 2018a).

Geomorphic condition in Torbane and Airly Creeks was mostly moderate, though poor condition reaches were identified associated with active headcuts. Geomorphic condition in Gap, Genowlan and Dog Trap Creeks was good, with the exception of an upstream section of Gap Creek where land clearing has resulted in the channelisation of a narrow valley of fine-grained sediments. Apart from that poor condition reach, Gap, Genowlan and Dog Trap Creeks are characterised by confined, bedrock controlled valley settings, which are geomorphologically stable and subject to only slow rates of change.

The potential impacts of subsidence on these creeks would most likely be observable in areas of bedrock outcropping in the substrate, where any cracks would be evident during inspections.

Aquatic Ecology

Aquatic ecology monitoring at Airly Mine has been undertaken within Gap Creek, Genowlan Creek, Airly Creek, Torbane Creek and Dog Trap Creek since 2013. The monitoring methodology includes:

- Sampling, sorting and identification of macroinvertebrates collected from edge habitat in accordance with the Australian Rivers Assessment System (AUSRIVAS) protocols (Turak et al. 2004).
- Assessment of the condition of the aquatic habitat using modified NSW AUSRIVAS field sheets and riparian, channel and environmental (RCE) inventory (Peterson 1992).

- Measurement of DO, EC, pH, temperature and turbidity just below the surface of the water column and at depth where sufficient water is available.
- Collection of surface water and sediment grab samples for water and sediment quality analysis.

Overall, the aquatic habitat in Genowlan Creek was determined to be in the best condition (GHD 2017). The combination of low nutrient and metal concentrations and diverse habitat availability at the site supports a diverse macroinvertebrate community which is largely sensitive to pollution. The macroinvertebrate community in Gap Creek also contains pollution sensitive taxa and there is little disturbance related to human activities at the site, although water scarcity is a limiting constraint.

Airly Creek, Torbane Creek and Dog Trap Creek were more highly disturbed by grazing and agricultural land use compared to the Gap Creek and Genowlan Creek catchments. It is likely that these sites receive groundwater baseflow from the Shoalhaven Group, which is an early Permian marine formation in which groundwater has an elevated EC in the order of 4000 $\mu\text{S}/\text{cm}$. Monitoring sites in these catchments were dominated by pollution dominant taxa. The similarity of the macroinvertebrate communities in the Airly Creek sites upstream and downstream of the surface facilities area indicated that there was no impairment of the community at the downstream site associated with overland flows of discharges from Airly Mine.

4.3.4 Cliffs, Minor Cliffs and Pagodas

Potential subsidence related impacts to the sensitive rock features (i.e., cliffs, minor cliffs and pagodas) will be managed in accordance with the Land Management Plan for CLZ (ML1814).

SCT (2023) stated that, subsidence effects, impacts and consequences are consistent with the EIS and CLZ (ML1331) EP which expects minimal surface impacts. However, it has been noted previously that because natural rock falls have been reported to occur regularly¹⁴, it is not possible to guarantee that there would be no rock falls reported during the period of mining. However, if it was to occur, there should only be occasional falls of small slabs of rock and, because of the very low levels of subsidence being predicted at the identified cliffs and rock features, there should be little chance of exceedance of these development approval conditions for cliffs.

Hence, as the predicted levels of subsidence are similar to those provided in the 2014 EIS, i.e., the maximum predicted subsidence (from first workings in the cliff line zone) is less than 65 mm with no surface cracking, and the assessed levels of potential impact for the cliffs, are similar to those based on the EIS Layout.

The following monitoring will be implemented to monitor for the presence/absence of potential subsidence related impacts or change to features (significant rock falls and surface cracking):

- Continuous occupation GNSS monitoring undertaken in accordance with **Section 4.2.2**;
- LiDAR undertaken in accordance with **Section 4.2.3**;
- Trigger-based targeted visual inspection in relevant areas if issues are identified from integrated monitoring network as per triggers within the CLZ (ML1814) Master TARP undertaken in accordance with **Section 4.2.4**.

Baseline monitoring of landscape features within the EP Area has commenced and will be obtained by using a combination of methods as follows:

¹⁴ available aerial imagery of cliff lines dating back to 1982 was reviewed using time-lapse software and indicated eight (8) significant natural rock fall events within a 32 year period (indicating approximately once every four years on average). Smaller isolated falls occur more frequently but are generally not noticeable at any great distance.

- Cliff identification and location mapping (Aerometrex, 2021; 2022) – detailed mapping of landscape features was undertaken by Aerometrex in accordance with definitions of cliffs, minor cliffs, pagodas and steep slopes provided in Development Consent SSD_5581.
- Ground inspection (MNC, 2023a; 2023b) – Centennial Airly asked Michael Nicholson Consulting Pty Ltd (MNC) to undertake further site inspections (“ground truthing”) of the cliffs that are located within the EP Area to supplement the extensive aerial photogrammetry and cliff identification work that was undertaken previously Aerometrex. The site inspections confirmed the photographic analysis that was undertaken by Aerometrex and advised there were no features that would be particularly sensitivity to subsidence movements.
- LiDAR (December 2022 and June 2023) – Detailed baseline prior to commencement of first workings georeferenced with existing GNSS monitoring network (where available).
- Continuous occupation GNSS monitoring – strategically located GNSS stations within the EP Area will begin collecting near-real time 3D position data prior to the commencement of first workings at <+/- 5mm accuracy, including dedicated stations monitoring cliffs.
- Additional pre-Mining High Resolution Stereo Vertical Photogrammetry and High-Definition Oblique 3D Photogrammetry has also been complete (May 2020, November 2020, May 2022 and December 2022) and is available for data analysis and comparison with the above ongoing monitoring if required.

4.3.5 General Land Surface – Mugii Murum-ban State Conservation Area

The majority of the land overlying the EP Area is located within the Mugii Murum-ban SCA and is largely inaccessible or very hard to access by virtue of its location (e.g. beneath cliff lines or adjacent steep slopes), rugged topography, moderate to thick vegetation cover and significant rock outcrops dominated by Genowlan Mountain. No adverse impact has been predicted to the surface throughout the SCA within the EP Area.

The following monitoring will be implemented to monitor for the presence/absence of potential subsidence related impacts or change to features (significant rock falls and surface cracking):

- Continuous occupation GNSS monitoring undertaken in accordance with **Section 4.2.2**;
- LiDAR undertaken in accordance with **Section 4.2.3**;
- Triggered targeted visual ground inspection in relevant areas if issues are identified from integrated monitoring network as per triggers within the CLZ (ML1814) Master TARP undertaken in accordance with **Section 4.2.4**.

These methods are deemed appropriate given then predictions of no impact. These methods are considered sufficient to pick up any (unpredicted) significant impacts.

4.3.6 SCA Management Four-wheel Drive and Walking Trails

The EP Area contains unsealed 4WD tracks open to the public via Genowlan Trail, off Glen Davis Road through private property owned by Centennial, which is open to the public. There is a proposal by NPWS for a locked access gate up on Genowlan Mountain in the northeast where the Trig Trail meets the Genowlan Point Track.

Formal walking tracks recognised in the SCA draft Plan of Management (Sep 2015) are also located within the EP Area, as well as off-trail walking access available throughout the majority of the SCA (including beyond the EP Area).

Targeted inspections of trails within the EP Area will be undertaken if/where triggered by the Master TARP.

4.3.7 Biodiversity

Subsidence related impacts to biodiversity will be managed in accordance with the Biodiversity Management Plan for CLZ (ML1814).

The Biodiversity Management Plan prepared for the EP Area (CLZ (ML1814) BMP) identified the following:

- Vegetation communities - that predominately consists of heath communities and open forests typical of ridgetops. The EP Area contains eight plant community types (PCTs) dominant in PCT 3865, 3686 and 3695.
- Groundwater Dependent Ecosystems - no high priority GDEs have been identified within the EP Area however, two facultative ecosystems may occur within the gullies on the edges of the EP area.
- One threatened flora species is known to occur within this EP area being *Prostanthera stricta* (Mount Vincent Mint Bush).
- One threatened fauna species is persistent within the EP area. The Glossy Black-Cockatoo (*Calyptrorhynchus lathamii*), frequents the area feeding on abundant stands of *Allocasuarina* species.
- Other mobile threatened fauna species particularly woodland birds, microbats, reptiles and arboreal mammals would utilise the habitat features within the area. Key habitat features include:
 - First order creeks;
 - Sandstone habitats;
 - Flowering and fruiting plants;
 - *Allocasuarina* species; and
 - Koala feed trees.

Considering the low impacts predicted no impact has been predicted to biodiversity of the EP Area, including threatened flora and fauna and facultative Groundwater Dependent Ecosystems.

A broadscale Biodiversity Monitoring Program is currently being undertaken at Airly Mine within the Development Consent Area (SSD_5581) as per the Western Region Biodiversity Management Plan (RPS 2017a) required by Condition 15 in Schedule 4 of SSD_5581. The broader monitoring program within the Mining Lease Area includes the current EP Area (CLZ (ML1814)). The monitoring program commenced in 2012 by the University of Queensland (UQ) and was further developed and refined in 2015 by RPS whereby it has been carried out annually by RPS to present.

The current Biodiversity Monitoring Program has been reviewed and updated within the context for the current EP Area (CLZ (ML1814)) taking into consideration previous monitoring results and recommendations, and recent findings of the Baseline Assessment. This allows for the wealth of information obtained from previous monitoring efforts to be integrated into the baseline data and design.

4.3.8 Aboriginal Heritage Site (AHIMS 45-1-0167)

One Aboriginal Heritage Site (AHIMS 45-1-0167) is located within the EP Area, in the vicinity of The Grotto above the 500 Panel Area. Potential subsidence related impacts to AHIMS 45-1-0167 will be managed in accordance with the Aboriginal Cultural Heritage Management Plan for CLZ (ML1814).

SCT (2023) stated that, subsidence effects, impacts and consequences are consistent with the EIS and CLZ (ML1331) EP which expects minimal surface impacts. Hence, as the predicted levels of subsidence are similar to those provided in the 2014 EIS, i.e., the maximum predicted subsidence (from first workings in the cliff line

zone) is less than 65 mm with no surface cracking, and the assessed levels of potential impact for the Aboriginal Heritage Site, are similar to those based on the EIS Layout.

The following monitoring will be implemented to monitor for the presence/absence of potential subsidence related impacts or change to Aboriginal Heritage Site (AHIMS 45-1-0167):

- Continuous occupation GNSS monitoring undertaken in accordance with **Section 4.2.2**;
- LiDAR undertaken in accordance with **Section 4.2.3**;
- Three phase monitoring undertaken in accordance with the Western Region Aboriginal Cultural Heritage Management Plan; including:
 - Phase 1: Baseline archival recording including a detailed plan of the site, archival-quality photographic records and a record of the surface conditions of the site (prior to site being undermined);
 - Phase 2: Post mining initial condition (immediately after undermining); and
 - Phase 3: Post mining secondary condition (approximately 8 months after undermining).
 - Representatives of the Registered Aboriginal Parties will be invited to participate in all three phases of the monitoring process for Aboriginal cultural heritage sites.
- Results of monitoring will be reported to the Aboriginal Heritage Committee undertaken in accordance with the Aboriginal Cultural Heritage Management Plan for CLZ (ML1814); and
- If ground conditions have stabilised and no changes to sites condition are observed, then no further monitoring will be required.

5 MANAGEMENT, MITIGATION, REMEDIATION AND REPORTING MEASURES

5.1 Performance Measures and Indicators

The approved subsidence impact performance measures are specified under Condition 2 in Schedule 3 of SSD_5581. These are detailed in *Section 5.1 of the EP Main Report*, including additional internal performance measures set by Centennial Airly for the mine design (to be monitored by the underground components of the Subsidence Monitoring Program).

To establish compliance with the performance measures, Airly Mine has developed a monitoring program with several integrated components (*this CLZ (ML1814) SMP*) and an associated *CLZ (ML1814) Master TARP (Appendix 7 of the EP Main Report)*. These documents establish appropriate monitoring elements, parameters and associated trigger levels to demonstrate that the environmental performance satisfies the criteria in *Section 5.1 of the EP Main Report*.

Table 5-1 contains the performance indicators which have been established for key monitoring aspects with allocated trigger values to define the following key performance scenarios within the CLZ (ML1814) TARP.

Table 5-1: Performance Indicators & TARP Risk Management Scenarios

Performance Indicator	General Description	Action / Response
Level 1: Condition Green	Operations within predictions, and within approved impacts.	Continued operations and monitoring as normal.
Level 2: Condition Amber	Operations within approved impacts but potentially exceed / exceed predictions.	Review and investigation processes are engaged, with adaptive management as required.
Level 3: Condition Red	Operations exceed approved impact. <i>The approved Performance Measures (criteria thresholds) of Development Consent (and any other relevant approvals) are listed in Condition Red.</i>	Adaptive Management measures are fully engaged as per the TARP and relevant sections of the Extraction Plan and the SMP.

5.2 Remediation and Rehabilitation Measures

Due to the minimal subsidence expected the need to implement remediation/rehabilitation measures for potential impacts are considered unlikely. However, in the event that remediation is required, Airly Mine will undertake remediation in accordance with:

- Conditions 7a)-7c) in Schedule 6 of SSD_5581, noting in particular the requirement to submit a report to NSW Planning describing remediation options and any preferred remediation measures or other course of action;
- Any relevant actions prescribed in the *CLZ (ML1814) Master TARP* developed for this Extraction Plan (or other relevant plans of management);
- The current Rehabilitation Management Plan; and
- In consultation with key stakeholders including any affected land holders and relevant government agencies.

A Response Strategy will be adopted if a significant impact is detected as a result of mining activities within the Extraction Plan area.

5.3 Trigger Action Response Plan

A detailed CLZ (ML1814) TARP (Appendix 7 of the EP Main Report) has been developed for the Extraction Plan to reflect the commitments of this CLZ (ML1814) SMP and other related aspects. Whilst impacts are not predicted nor expected, the CLZ (ML1814) TARP provides a process of tiered and/or escalating trigger levels for contingency measures should subsidence and impacts be greater than predicted/approved. The CLZ (ML1814) TARP applies only to the EP Area (separate TARPs apply to other established EP Areas in various approved mining zones).

Given the mine has been designed specifically to avoid impacts, the CLZ (ML1814) TARP includes detailed measures for Underground Mining Controls to ensure that the mining geometry is formed as per the approved design specifications that determine the predicted subsidence movements and impacts.

The CLZ (ML1814) TARP includes detailed performance indicators for land management. The contingency plan where a performance indicator has been exceeded is outlined in the TARP. A trigger will result in additional investigations to determine if the exceedance is related to non-mining-factors or is a consequence of mining activity. The response to these exceedances will follow the TARP. Management / corrective actions can be implemented where required to remedy these non-conformities and report accordingly.

5.4 Adaptive Management and Contingency Plan

An Adaptive Management Framework provides for flexible decision making, adjusted to consider uncertainties as management outcomes are understood. The adaptive management approach at Airly Mine is detailed in the EP Main Report (*refer Section 5.5*).

In summary, adaptive management at Airly Mine involves monitoring and evaluation against performance measures and associated indicators in the CLZ (ML1814) TARP established for the extraction plan and supporting management plans. Where performance indicators indicate increasing levels of risk (i.e., where relevant thresholds of conditions green, amber or red are being exceeded), escalating adaptive management measures are engaged in accordance with the CLZ (ML1814) TARP. The process has been successfully implemented in existing Extraction Plan areas at Airly Mine and has been updated to reflect EIS commitments and consent requirements for the Airly Mine Extension Project, including specific performance measures.

5.5 Incidents, Complaints, Exceedances and Non-Compliances

Incidents, complaints, exceedances and non-compliances are managed in accordance with the requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/.7076, relevant legislation and regulations, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022).

Incidents, complaints, exceedances and non-compliances will be managed in accordance with the requirements detailed in the EP Main Report (*refer Section 5.6*).

5.6 Reporting and Auditing

5.6.1 Reporting

Reporting is undertaken in accordance with the requirements of specific requirements of relevant approvals and licences including SSD_5581, EPL12374 and EPBC 2013/7076, and generally in accordance with the *Extraction Plan Guideline* (DPE, 2022). A detailed review of the reporting and notification requirements relevant to the Extraction Plan, including this CLZ (ML1814) SMP, is provided in the EP Main Report. Reporting will be undertaken in accordance with the requirements detailed in the EP Main Report (*refer Section 5.7.1*).

5.6.2 Periodic Auditing

Comprehensive Independent Environmental Audits of the entire approved development under development consent SSD_5581 are undertaken within 1 year of commencement and every 3 years thereafter (unless directed otherwise) in accordance with Conditions 12 and 13 in Schedule 6 of SSD_5581.

Auditing of any rehabilitation undertaken for the mine (including for subsidence if triggered) is undertaken in accordance with the Rehabilitation Management Plan under Condition 27 in Schedule 4 of SSD_5581.

Additionally, in accordance with section 20(c) of the WHSMP Regulation (2022), auditing will be undertaken in accordance with the Airly Mine Safety Management System (SMS), against the performance standards for measuring the effectiveness of all aspects of the SMS, including the methods, frequency and results of the audit process. The audit should also consider the following matters:

- (1) competency of the auditor,
- (2) the person responsible for ensuring the audit is conducted, and
- (3) the person responsible for implementing the results of the audit.

6 PLAN ADMINISTRATION AND RESPONSIBILITIES

6.1 Review

In accordance with the requirements under Condition 3 in Schedule 6 of Development Consent SSD_5581, as a minimum Centennial Airly will review this Plan within three months of the following:

- a) Submission of an incident report;
- b) Submission of an Annual Review (required 31 March annually);
- c) Submission of an Independent Environmental Audit; or
- d) Any modification to the conditions of SSD_5581.

Where this leads to revisions of the document, within four (4) weeks of the review the revised document must be submitted to NSW Planning for the approval of the Secretary. Continual improvement shall be achieved through monitoring, internal and external communication with stakeholders, implementation of corrective and preventative actions and through monitoring progress against the objectives included in the environmental management plans. The reporting framework (refer **Section 5.5**) will document the effectiveness of this document (and the related Extraction Plan) through comparison of the predicted negligible impacts of subsidence against actual outcomes.

Each variation to this Plan will be identified in the Document Control Table at the beginning of this document.

Additionally, to maintain consistency with existing management plans and previous Extraction Plans at the mine, this CLZ (ML1814) SMP will also be reviewed in the event that the following occur:

- Stakeholders raise issues that necessitate a review;
- There are other changes to management requirements (e.g. changes to other related approvals besides consent, such as Mining Lease and/or EPL conditions);
- Where unpredicted impacts or consequences have required implementation of contingency actions under this plan;
- Monitoring or audit processes demonstrate that a review is warranted;
- Where otherwise triggered by the CLZ (ML1814) TARP;
- Where triggered by (or for) review of other related management plans (if applicable); or
- Every three (3) years as a minimum (where not already triggered above).

Any amendments to the CLZ (ML1814) SMP will be undertaken in accordance with Consent/relevant approvals and in consultation with key relevant stakeholders where required. Following any significant changes, a copy of the amended CLZ (ML1814) SMP will be forwarded to all relevant stakeholders.

In addition to planning development consent requirements, Airly Mine must review and as necessary revise the risk control measures implemented for subsidence in accordance with section 15 of the *WHSMP Regulation (2022)*. Any review triggered by WHS Legislation Requirements will be addressed via the process identified in the EP Main Report (refer *Section 5.5*) and the CLZ (ML1814) PSMP (Appendix 5 of the EP Main Report).

6.2 Key Responsibilities

The responsibility for implementation, monitoring and review of the CLZ (ML1814) SMP lies with the Technical Services Manager. The ultimate responsibility for the implementation of the CLZ (ML1814) SMP lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for this CLZ (ML1814) SMP are outlined in **Table 6-1**.

Table 6-1: Key Personnel and Accountabilities

Position	Responsibility
Mine Manager	- Ensuring that sufficient resources are available to implement and execute the requirements of this Plan - Reporting triggers/non-conformances to external stakeholders
Technical Services Manager	- Coordinate underground inspections and subsidence monitoring program - Coordinate implementation of the mine design and Master TARP - Reporting triggers/non-conformances internally to the mine manager as appropriate - Reporting to NSW Planning and NSWRR of subsidence and pillar system performance upon completion of specified monitoring intervals - Coordinating any remediation work as required - Inspecting targeted accessible areas susceptible to tensile and compressive strains and potential cracking as required (e.g. accessible tracks and trails) - Providing raw subsidence monitoring data from the GNSS units for the CLZ (ML1814) extraction area to NPWS on a quarterly (3 monthly) basis - Co-ordinating the generation and submission of formal reporting requirements outlined in this Plan - Reviewing this management plan
Production Manager	- Implement mine design - Establish and maintain underground monitoring and inspections program - Auditing as required
Mine Surveyor	- Survey as built initial development pillars - Establish and maintain subsidence monitoring program - Internal reporting as required - Mark up centre lines for driveage in pillars - Produce final mining plan for extraction workings to be carried out in consultation with the Technical Services Manager - Survey and reporting of pillars following development
Superintendent Environment and Community	Implementation, monitoring and review of this plan, including: - The carrying out of targeted inspections - The installation and maintenance of signage where required - Reporting triggers/non-conformances internally to the Mine Manager as appropriate - Consulting with land owners, landholders and managers regarding any land management issues arising from subsidence within the EP Area. This includes (but may not be limited to) NPWS, Office of Crown Lands and private landowners within the EP Area (if and as applicable) - Consultation during the review process with relevant stakeholders and distributing this management plan

7 REFERENCES

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- RPS (2022a). *Airly Extraction Plan for the Cliff Line Zone ML1814 and MW17-19 Extraction Plan Area Historical Heritage Management Plan Update & Phase 1 Baseline Historical Heritage Assessment (Report No. PR152234-1)*
- RPS (2022b). *Desktop review of ML 1814 area and MW17-19 EP Area for Aboriginal Cultural Heritage (Report No. AU213005571)*
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**APPENDIX 7 Master Trigger Action Response Plan for CLZ (ML1814) (CLZ (ML1814)
Master TARP)**

Aspect	Performance Criterion e.g., Consent Criteria / EIS Commitments	Condition Green (Operations within Predictions & Approved Impacts)	Condition Amber (Operations within Approved Impact Performance Measures but potentially exceeding predictions/designs)	Condition Red (Operations Exceed Approved Impact Performance Measures)
		<i>Continue Operations/Monitoring as Normal</i>	<i>Review Processes & Adaptive Management as Required</i>	<i>Adaptive Management Process Fully Engaged</i>
Underground Mining Control: First Workings (development) width / height / pillar size	First Workings beneath any feature requiring no or negligible¹ environmental consequences (and all first workings within the cliff line zone) required to be long term stable and non-subsiding. Design Parameters to achieve predicted subsidence as per Table 8.5 of the EIS <i>Note: Exceedance of approved mine design parameters may not automatically cause a surface impact or environmental consequence / non-compliance with the performance measures of SSD_5581. Subsequently, appropriate responses to check if such impacts have occurred are additionally triggered elsewhere below for all relevant aspects.</i>	TRIGGERS: - Underground mine survey and inspections confirms dimensions as mined are within compliant specifications, including: - Extraction height $\leq 3.2\text{m}$ average across panel - Maximum roadway width $\leq 5.5\text{m}$ average across panel - Minimum pillar system Factor of Safety (FOS) >2.11 - Minimum pillar size is $35\text{m} \times 35\text{m}$ (centres), <i>noting minimum pillar size increases for DOC $>260\text{m}$</i> - Pillar width/height (W/H) ratio ≥ 8.0 average across panel - Rib spall $<400\text{mm}$ on both ribs additional after rib support - Pillar conditions show no significant signs of deterioration/spalling during weekly statutory inspections - Depth of Cover (DOC) above first workings is $>90\text{m}$ and $<320\text{m}$, <i>noting minimum pillar size increases for DOC $>260\text{m}$</i> - Isolated change in pillar size required due to avoidance of geological structure encountered or other operation constraints, minimum pillar size for isolated cases is greater than 1/10th Depth of Cover² or greater than 10m, with geotechnical assessment undertaken confirming pillar system remains long-term stable - Minimum Pillar Size for isolated cases is $<1/10\text{th}$ depth of cover, with High Risk Activity notification undertaken as per WHS legislation and notification to IEP / DPE undertaken with confirmation pillar system remains long-term stable	TRIGGERS: - Underground mine survey and inspections confirms minor variations in dimensions as mined compared to compliant specifications, including: - Extraction height $>3.2\text{m}$ in isolated areas outside of geological structure zones - Isolated change in roadway width >5.5 - Offline driveage $>2\text{m}$ - Isolated non-compliance with condition green for FOS, W/H ratio, maximum or minimum DOC, and/or final pillar size - Minimum W/H ratio for isolated case pillars <4 - Rib spall $400\text{-}500\text{mm}$ on both ribs additional after rib support - Pillar condition deterioration/increased spalling observed	TRIGGERS: - Underground mine survey and inspections confirms significant variation (i.e. greater on average across panel as mined) in dimensions as mined compared to approved minimum design parameters and /or statutory design requirements², including: - Extraction height $>3.2\text{m}$ average across panel - Maximum roadway width $>5.5\text{m}$ on average across panel - Minimum pillar system FOS <2.11 average across the panel - Final pillar W/H ratio <8.0 average across panel (without further controls implemented) - Minimum W/H for isolated case pillars <3.6 (i.e. smaller than 10m) - Rib spall $>500\text{mm}$ on both ribs additional after rib support - Minimum Pillar Size for isolated cases is $<1/10\text{th}$ depth of cover or 10m, without High Risk Activity notification required under WHS legislation (with further controls required) and/or notification to IEP / DPE undertaken with confirmation pillar system is long-term stable - Depth of Cover (DOC) above first workings is $<90\text{m}$ or $>320\text{m}$, <i>noting minimum pillar size increases for DOC $>260\text{m}$</i>
		ACTIONS & RESPONSES: - No response required when above parameters are met - Designs assessed and confirmed by Independent Expert Panel as long term stable and effectively non-subsiding - Continue Subsidence Monitoring Program to ensure impacts are as designed	ACTIONS & RESPONSES: - Refer to and implement <i>Strata Management Plan</i> as required for additional roof support and/or rib support - Review mining processes (including Panel Design Standard), confirm and implement any changes as required - Review and improve training and communication with mining crews - Retraining of development where required - Minor incident internal investigation process if offline driveage has occurred (where minor and non-reportable to Resource Regulator) - Review and upgrade operational control and communication systems - Review subsidence predictions where appropriate - Review current subsidence monitoring results against the criteria of the related TARP aspects, including Cliffs and Pagodas for compliance	ACTIONS & RESPONSES: In addition to all actions and responses as per Condition Amber, Airly Mine will: - Notify and consult with relevant stakeholders as per requirements specified within the Extraction Plan/SMP/PSMP, Development Consent and related approvals - Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur - Cease mining operations in relevant areas if appropriate

Aspect	Performance Criterion e.g., Consent Criteria / EIS Commitments	Condition Green (Operations within Predictions & Approved Impacts)	Condition Amber (Operations within Approved Impact Performance Measures but potentially exceeding predictions/designs)	Condition Red (Operations Exceed Approved Impact Performance Measures)
		<i>Continue Operations/Monitoring as Normal</i>	<i>Review Processes & Adaptive Management as Required</i>	<i>Adaptive Management Process Fully Engaged</i>
Cliffs and Pagodas	Cliffs and pagodas within 26.5 degrees of any Airly mine workings in the EP Area, other than pagodas affected by the New Hartley Shale Mine Potential Interaction Zone: <i>No greater subsidence Impacts or environmental consequences than predicted in the EIS: (i.e., Occasional rock falls, displacement or dislodgment of boulders or slabs of less than 30 m³, or fracturing occurs, that do not impact Aboriginal heritage, EECs, or public safety, that in total, do not impact more than 2% of the total area of such cliffs or pagodas)</i> Minor Cliffs and Steep Slopes: <i>No greater subsidence impacts or environmental consequences than predicted in the MEP EIS. (i.e. negligible¹ impact, no surface cracking, collapse of features or slope failure for CLZ of First Workings).</i> <i>(Table 8.3 and Table 10.60 of EIS)</i>	TRIGGERS: - Subsidence monitoring (underground) remains compliant within condition green triggers for Underground Mining Control - Subsidence monitoring (surface, aerial monitoring) does not identify any mining induced impacts (e.g. no rock fall, cracking) from first workings within the EP Area, including: - No damage to pagoda/beehive formations - No damage to cliff and minor cliff faces	TRIGGERS: Level A: Surface impacts are not yet observed but monitoring indicates potential to occur: - Subsidence monitoring (underground, surface, aerial monitoring) indicates potential for surface impact requiring further investigation, including Condition Amber triggered for Underground Mining Control - Subsidence monitoring indicates potential for development of subsidence which may result in a failure of ground (<i>High Potential Incidents</i> as per section 124(5m) of the WHSMP Regulations 2022) Level B: Surface impacts are observed: - Impact observed but yet to be confirmed if mining induced or natural rock fall - The following mining-induced impacts occur but are within approved impacts of development consent SSD_5581 (i.e. still below Condition Red): <i>Occasional rock falls, displacement or dislodgment of boulders or slabs of less than 30 m³, or fracturing occurs, that do not impact Aboriginal heritage, EECs, or public safety, that in total, do not impact more than 2% of the total area of cliffs (excluding minor cliffs) or pagodas within 26.5 degrees of any Airly mine workings in the EP Area.</i> - Any of the following events occurs that would have been a dangerous incident if a person were reasonably in the vicinity at the time when the event occurred (<i>High Potential Incidents</i> as per section 124(5a) of the WHSMP Regulations 2022): <i>a failure of ground, or of slope stability control measures</i> <i>rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations due to subsidence.</i>	TRIGGERS: - Subsidence monitoring identifies that there are mining induced surface impacts exceeding the Performance Measures approved by Development Consent SSD_5581 and/or which cause or threaten material harm to the environment or safety of persons on the surface over the mining area. These are summarised as follows: Impacts Exceeding Approved Performance Measures of (as per Table 1, Sch3 SSD_5581): Cliffs (major cliffs) and pagodas: Non-occasional rock falls, displacement or dislodgment of boulders or slabs of greater than 30 m³, or fracturing occurs, that do impact Aboriginal heritage, EECs or public safety, that in total do impact more than 2% of the total area of cliffs (excluding minor cliffs) or pagodas within 26.5 degrees of any Airly mine workings in the EP Area. Minor Cliffs and Steep Slopes: Greater subsidence impacts or environmental consequences than predicted in the MEP EIS. (i.e. exceed negligible³ impact, e.g. fracturing or collapse of steep slopes) Other Relevant Impacts: - Failure of ground/slope stability control measures occurs (Including landslips) - Mining-induced instability of cliffs, steep slopes occurs - Development of surface cracking or deformations which present potential risk to the public/others (i.e., where trip hazards / step formation occurs or where there is potential for instability of a rock formation).

Aspect	Performance Criterion e.g., Consent Criteria / EIS Commitments	Condition Green (Operations within Predictions & Approved Impacts)	Condition Amber (Operations within Approved Impact Performance Measures but potentially exceeding predictions/designs)	Condition Red (Operations Exceed Approved Impact Performance Measures)
		<i>Continue Operations/Monitoring as Normal</i>	<i>Review Processes & Adaptive Management as Required</i>	<i>Adaptive Management Process Fully Engaged</i>
Cliffs and Pagodas (Continued)		ACTIONS & RESPONSES: - No response required. - Continue Subsidence Monitoring Program.	ACTIONS & RESPONSES: In addition to Condition Amber action/responses for Underground Mining Control, Airly Mine will: Level A: Surface impacts are not observed but monitoring indicates their potential to occur: - Assess the public safety risk and likelihood for mine-induced surface impacts and record assessment - If no public safety risk identified and/or mine-induced surface impacts are considered unlikely, continue Subsidence Monitoring Program - If public safety risk identified and/or mine-induced surface impacts are considered likely - Further notify NPWS and key stakeholders and consider additional warning signs / closure of access in affected areas - Further notify Resource Regulator under relevant WHS laws (i.e., for high potential incidents) - Implement Adaptive Management process in mine design, including consideration of the following potential actions where applicable: - Avoid mining under sensitive surface features - Change mine dimensions to ensure total extracted voids and pillar sizes are within appropriate limits - Increase the size of protection zones by commencing or stopping mine workings further away from sensitive features than planned - Review and undertake appropriate additional monitoring - Undertake targeted surface visual inspection over area possibly impacted and if surface impacts are observed refer Level B responses Level B: Surface impacts are observed: In addition to Level A action/responses above, Airly Mine will review available data or undertake targeted surface investigations to confirm if the impact is mining-induced or related to natural surface movements or activation of a natural feature: - If confirmed as not a mine-induced impact, continue Subsidence Monitoring Program and notify NPWS and key stakeholders - If mine-induced impact is confirmed: - Notify and consult with relevant stakeholders as per requirements specified within the Extraction Plan, Development Consent and related approvals - Compare the impacts to relevant approved performance measure thresholds (refer condition red trigger levels), if above thresholds, refer Condition Red responses	ACTIONS & RESPONSES: In addition to all actions and responses as per Condition Amber, Airly Mine will: - Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur. - Undertake targeted surface inspections (by suitably qualified personnel) if safely and readily accessible (or aerial if otherwise) where potential impact necessitates further assessment is <u>required to quantify impacts</u>, as determined in consultation with key stakeholders (OEH, NPWS, DPE and the NSW RR). - Where fracturing has occurred and potential for instability is noted, undertake specialist geotechnical assessment to confirm level of residual instability, potential safety risks and recommended courses of action (with direction from PIS³, DPE, NPWS/BCD). - Cease mining operations in relevant areas where appropriate (with direction from PIS³ and DPE). - Consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action. - Implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary. - Written reporting to relevant agencies as per Development Consent/relevant approvals as detailed in Extraction Plan.

Aspect	Performance Criterion e.g., Consent Criteria / EIS Commitments	Condition Green (Operations within Predictions & Approved Impacts)	Condition Amber (Operations within Approved Impact Performance Measures but potentially exceeding predictions/designs)	Condition Red (Operations Exceed Approved Impact Performance Measures)
		<i>Continue Operations/Monitoring as Normal</i>	<i>Review Processes & Adaptive Management as Required</i>	<i>Adaptive Management Process Fully Engaged</i>
Unsealed Access Roads and Tracks and General Land Surface (MMBSCA Management 4WD Trails and walking tracks; steep slopes and native vegetation cover)	Steep slopes and all other land not covered by a performance measure above No greater subsidence impacts or environmental consequences than predicted in the EIS Other built features Use should be maintained wherever practicable in consultation with BCD Damage must be fully repairable and must be fully repaired	TRIGGERS: - Scheduled monitoring (surface inspections of the MMBSCA Management Trails) does not identify any mining induced impacts, such as: - Visible cracking/fracturing (soil, trails, rock, etc) - Change in grade/heaving/buckling - Increased ponding - Subsidence monitoring (underground) remains compliant within condition green triggers for Underground Mining Control	TRIGGERS: Scheduled monitoring (surface inspections) of MMBSCA Management Trails does not identify any mining induced impacts (refer examples in Condition Green); however, underground monitoring or aerial monitoring systems trigger further investigation/surface inspection See also Cliffs and Pagodas and Underground Mining Control elements above for related triggers/responses that require further investigation to confirm any <i>potential</i> surface impacts	TRIGGERS: - Scheduled monitoring (surface inspections of MMBSCA Management Trails) identifies the development of mining induced surface cracking/fracturing or deformation. - Mining-induced changes in grade, heaving or buckling, increased ponding or other significant damage to MMBSCA management trails are observed during monitoring. - Any of the following events occurs that would have been a dangerous incident if a person were reasonably in the vicinity at the time when the event occurred (High Potential Incidents as per CI 124(5a) of the WHSMP Regulations 2022): - a failure of ground, or of slope stability control measures - rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations due to subsidence.
		ACTIONS & RESPONSES: - No response required when above parameters are met - Continue Subsidence Monitoring Program	ACTIONS & RESPONSES: - Airly Environment and Community Superintendent (or delegate) to undertake targeted surface inspection of accessible access roads and trails in relevant area to confirm if any impact at surface - Notify landowner i.e., NPWS If no impacts observed, continue Subsidence Monitoring Program If impact observed, refer Condition Red responses	ACTIONS & RESPONSES: Review available data or undertake targeted surface investigations to confirm if the impact is mining-induced or related to natural surface movements or activation of a natural feature: - If confirmed related to natural surface movements or activation of a natural feature, continue Subsidence Monitoring Program - If confirmed mining induced impacts, Airly Mine will: - Notify and consult with relevant stakeholders as per requirements specified within the Extraction Plan/SMP/PSMP, Development Consent and related approvals - Assess public safety risk. Consider erecting warning signs/warning tape or restricting access in immediate area - Notify Resource Regulator under relevant WHS laws (i.e. for high potential incidents) - Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur - Implement Adaptive Management process as described within the Extraction Plan - Cease secondary extraction in that area if appropriate (with direction from PIS³ and DPE) - Investigate remedial options in consultation with relevant stakeholders (incl. NPWS and DPE). Implement suitable remedial option once agreed

Aspect	Performance Criterion e.g., Consent Criteria / EIS Commitments	Condition Green (Operations within Predictions & Approved Impacts)	Condition Amber (Operations within Approved Impact Performance Measures but potentially exceeding predictions/designs)	Condition Red (Operations Exceed Approved Impact Performance Measures)
		<i>Continue Operations/Monitoring as Normal</i>	<i>Review Processes & Adaptive Management as Required</i>	<i>Adaptive Management Process Fully Engaged</i>
Biodiversity and Sensitive Vegetation: EEC / GDE, Threatened Species, Habitat, Aquatic Ecology	Negligible ¹ Environmental Consequences to terrestrial threatened species, threatened populations, EECs and GDE's. No significant adverse Impact predicted in the EIS.	TRIGGERS: - Mining induced impacts to key elements are not identified by subsidence monitoring as per Subsidence Monitoring Program or routine environmental monitoring undertaken as part of separate site EMPs (including surface and groundwater, biodiversity) - Subsidence monitoring (underground) remains compliant within condition green triggers for Underground Mining Control	TRIGGERS: - Subsidence monitoring program (underground/surface/aerial) identifies potential for impact at surface in the vicinity of sensitive vegetation / habitat area(s); and/or - Potential Impacts to key elements are identified (but not yet confirmed if mining induced) by routine environmental monitoring (including surface flow gauging, water quality, related groundwater levels and routine biodiversity monitoring); and/or - Amber Level triggers for surface water/groundwater (including alluvium) are triggered in the site Water Management Plan (Appendix D), indicating potential for Biodiversity impact requiring further monitoring/assessment	TRIGGERS: Mining induced impacts (beyond levels approved by consent / compared to baseline are identified by: - Subsidence monitoring program (underground/surface/aerial); and/or - by investigations and actions arising from Condition Amber; and/or - environmental monitoring (including flow gauging, water quality and Biodiversity) - Red Level triggers for surface water/groundwater (incl. Biodiversity) are triggered in the Airly Mine Water Management Plan (Appendix D)
		ACTIONS & RESPONSES: - No response required when above parameters are met - Continue subsidence monitoring - Continue biodiversity monitoring	ACTIONS & RESPONSES: - Review and confirm monitoring data, cross check Biodiversity monitoring data against other related environmental data and integrated subsidence monitoring and underground monitoring data - Analysis such as Analysis of Variance (ANOVA) would be performed to determine if the change meets a significance threshold. This analysis would be performed as part of a trigger investigation. An interim level of significance is benchmarked at 5% or p=0.05 - Notify NPWS/OEH/BCD and relevant stakeholders of current findings and proposed approach for investigation - Implement responses as per relevant Amber Level trigger/responses above (where triggered) for surface water/groundwater elements in the Water Management Plan - Where review of underground monitoring and/or Biodiversity monitoring data indicates potential for mining-induced impact, or there is insufficient data to quantify the above, undertake targeted monitoring inspection over the relevant surface area to confirm and quantify the scale/extent/nature of potential surface impacts - Undertake further investigations as appropriate with the aim of identifying the cause of the issue. Assess need for any increase to monitoring frequency or additional monitoring where relevant - Continue monitoring program	ACTIONS & RESPONSES: - Undertake incident notifications immediately where material harm to the environment is threatened or caused, in accordance with Reporting and Notifications section of this management plan - Implement Adaptive Management process as noted above and detailed within the Extraction Plan - Take all necessary steps to ensure that the exceedance ceases and does not recur (including ceasing workings in relevant areas where appropriate while incident investigated) - Targeted field inspection by Environment and Community Superintendent (or delegate) with invitation to relevant stakeholders - Monitor impact - Investigate exceedance of subsidence prediction model - Explore all remediation options and submit a report to DPE outlining them - Implement remediation measures to the satisfaction of the secretary - Review of mining design / predictions against mine design criteria - Identify and implement possible changes to mine design (to make more conservative) in consultation with relevant stakeholders, if necessary (e.g. undertake review of Extraction Plan) - Written reporting as per Consent / relevant approvals
Surface water and Groundwater	-	-		
		<i>Refer dedicated TARP within the Airly Mine Water Management Plan (Airly Mine WMP) – Appendix 1 (TARPs)</i>		

Aspect	Performance Criterion e.g., Consent Criteria / EIS Commitments	Condition Green (Operations within Predictions & Approved Impacts)	Condition Amber (Operations within Approved Impact Performance Measures but potentially exceeding predictions/designs)	Condition Red (Operations Exceed Approved Impact Performance Measures)
		<i>Continue Operations/Monitoring as Normal</i>	<i>Review Processes & Adaptive Management as Required</i>	<i>Adaptive Management Process Fully Engaged</i>
Aboriginal and Cultural Heritage Sites	Negligible ¹ Environmental Consequences (Table 1, Condition 2 Schedule 3)	TRIGGERS: - Subsidence monitoring program (underground, surface, aerial monitoring as per SMP) is within predictions, no mining induced impact and/or underground instability issues - No mining induced impact compared to pre-mining baseline inspection	TRIGGERS: - Subsidence monitoring program (underground, surface, aerial monitoring as per SMP), indicates no mining induced impact compared to pre-mining baseline assessments - Subsidence monitoring detects a significant rock fall has occurred (natural or otherwise) within vicinity of known heritage site	TRIGGERS: Mining induced impacts (beyond levels approved by consent / compared to baseline are identified by: - Subsidence monitoring program (underground/surface/aerial); and/or - by investigations and actions arising from Condition Amber
		ACTIONS & RESPONSES: - No response required when above parameters are met - Continue subsidence monitoring - Continue management of heritage sites in accordance with CLZ (ML1814) ACHMP	ACTIONS & RESPONSES: - Confirm if mining induced rock fall has occurred as per related triggers/responses that require further investigation to confirm any <i>potential</i> surface impacts (see also <i>Cliffs and Pagodas</i>) - Undertake ‘Phase 2’ monitoring and management of relevant heritage sites as described within the CLZ (ML1814) ACHMP - Where applicable, investigate underground instability areas for potential subsidence expression at the surface and confirm likelihood of cracking/abnormalities to structures as mining induced - Monitoring/management of heritage sites in accordance with approved Extraction Plan and CLZ (ML1814) ACHMP - Notification and consultation with relevant agencies and stakeholders as required	ACTIONS & RESPONSES: - Notify and consult with relevant stakeholders as per requirements specified within the Extraction Plan, CLZ (ML1814) ACHMP, Development Consent and related approvals - Cease mining operations in that area if appropriate (with direction from PIS³ and DPE) - Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur - Assess public safety risk and consider erecting warning signs/warning tape or restricting access in immediate area. - Monitoring/management of heritage sites in accordance with approved Extraction Plan and CLZ (ML1814) ACHMP - Investigate exceedance of subsidence prediction model - Review of mine design /predictions against mine design criteria - Implement Adaptive Management process as noted above and detailed within the Extraction Plan - Identify and implement possible changes to mine design (to make more conservative) in consultation with relevant stakeholders, if necessary (e.g. undertake review of relevant Management Plans) - Written reporting to relevant agencies as per Consent / relevant approvals as also noted within Extraction Plan
Historic Heritage	Negligible ¹ Environmental Consequences	No Historic Heritage sites are located within the Extraction Plan Area (including within the Near-field / Principal Subsidence Management Area or the Extended/Far-field Monitoring and Management Area)		
		<i>Note: Other heritage sites located elsewhere within the Airly Mine development consent area are managed under management plans previously approved for the CLZ EP Area as well as the Airly Mine Western Region Historic Heritage Management Plan, including actions for managing discovery of any new sites.</i>		

¹ Negligible impact is defined by development consent SSD_5581 as “Small and unimportant, such as to be not worth considering”. With respect to biodiversity monitoring specifically, for the purposes of the CLZ (ML1814) BMP negligible is defined as “In the longer term being small and insignificant and causing little or no impact. Short term impacts may be greater than negligible but if they are of limited duration they may be negligible when considered over the longer term”.

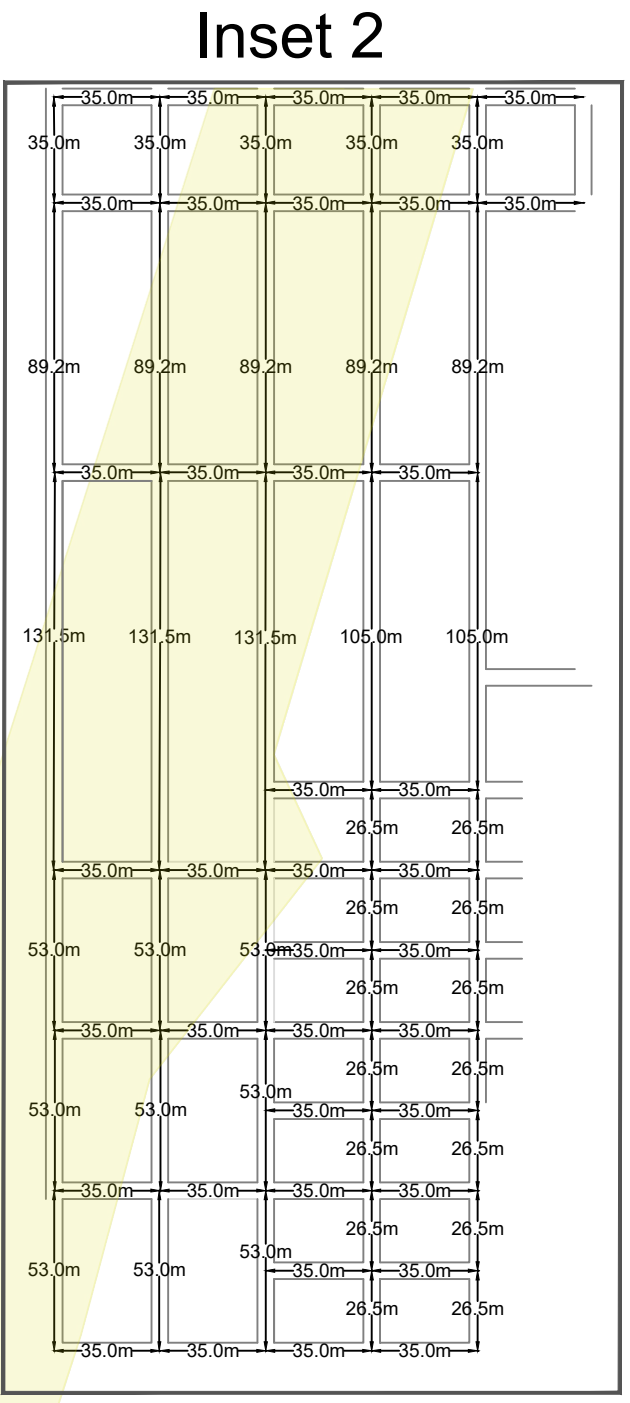
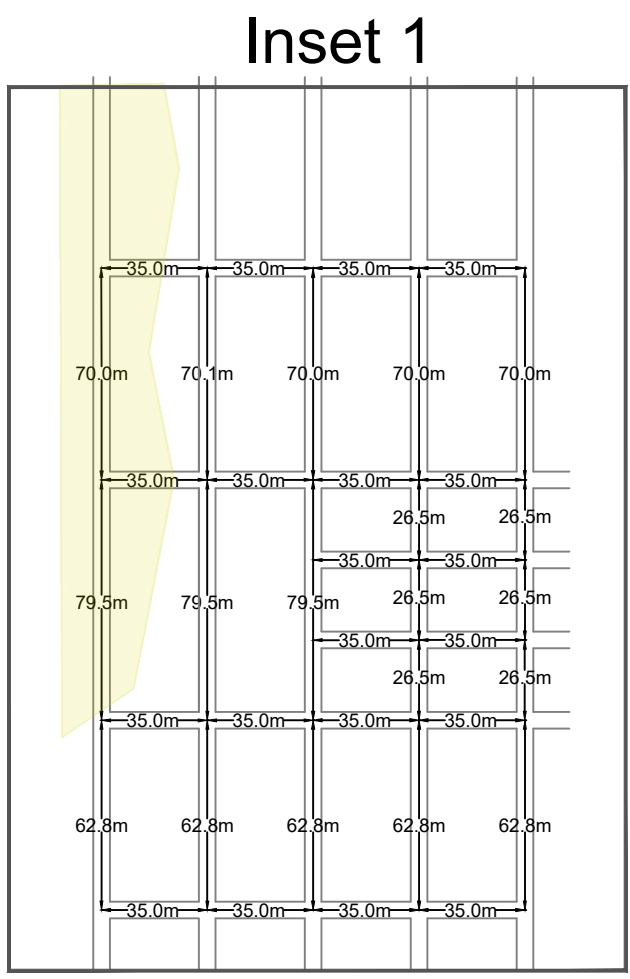
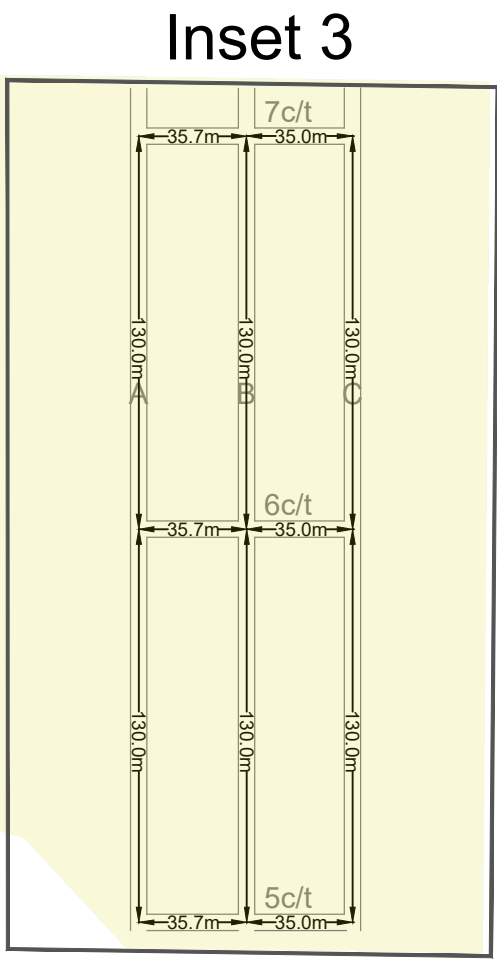
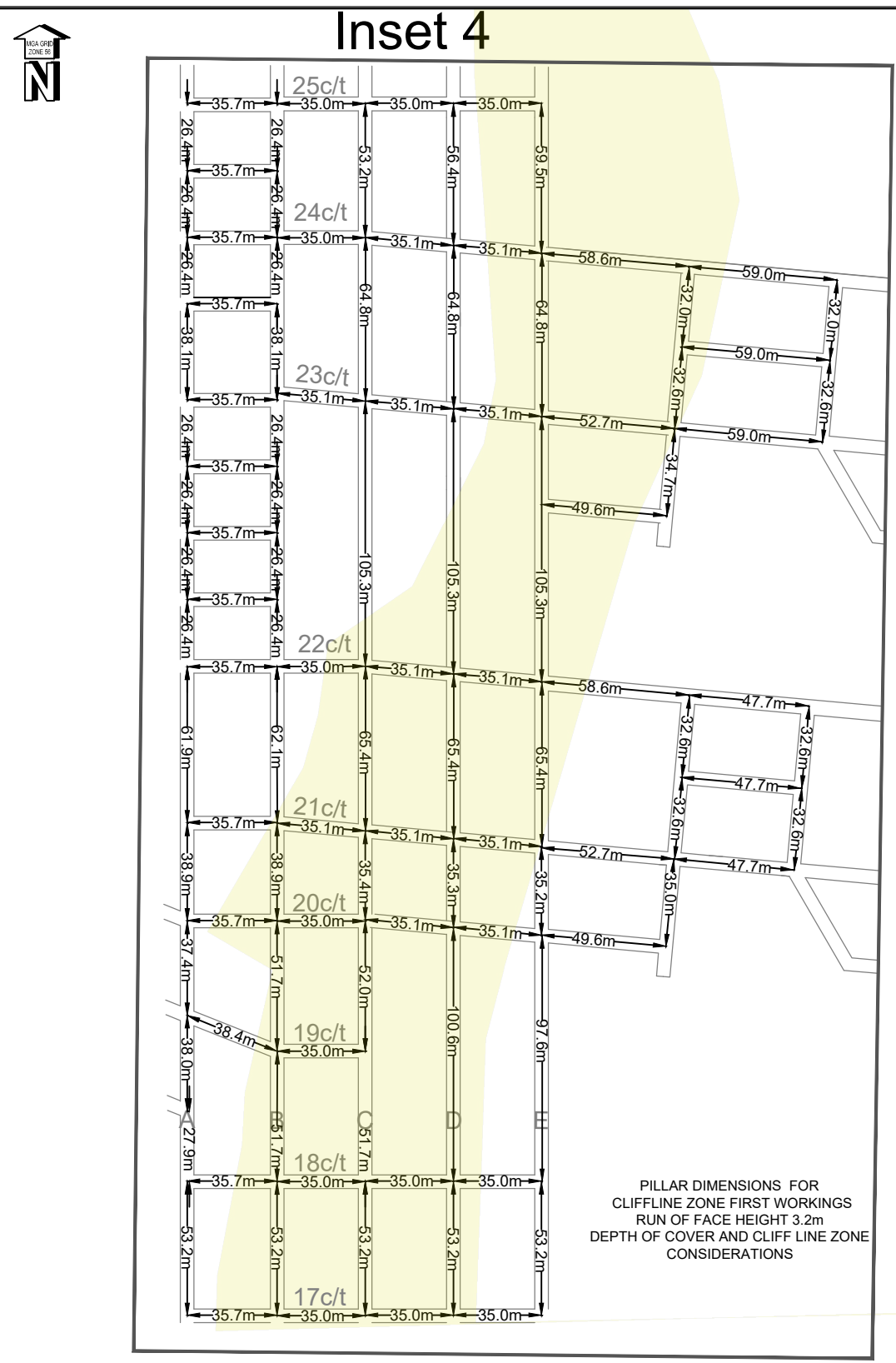
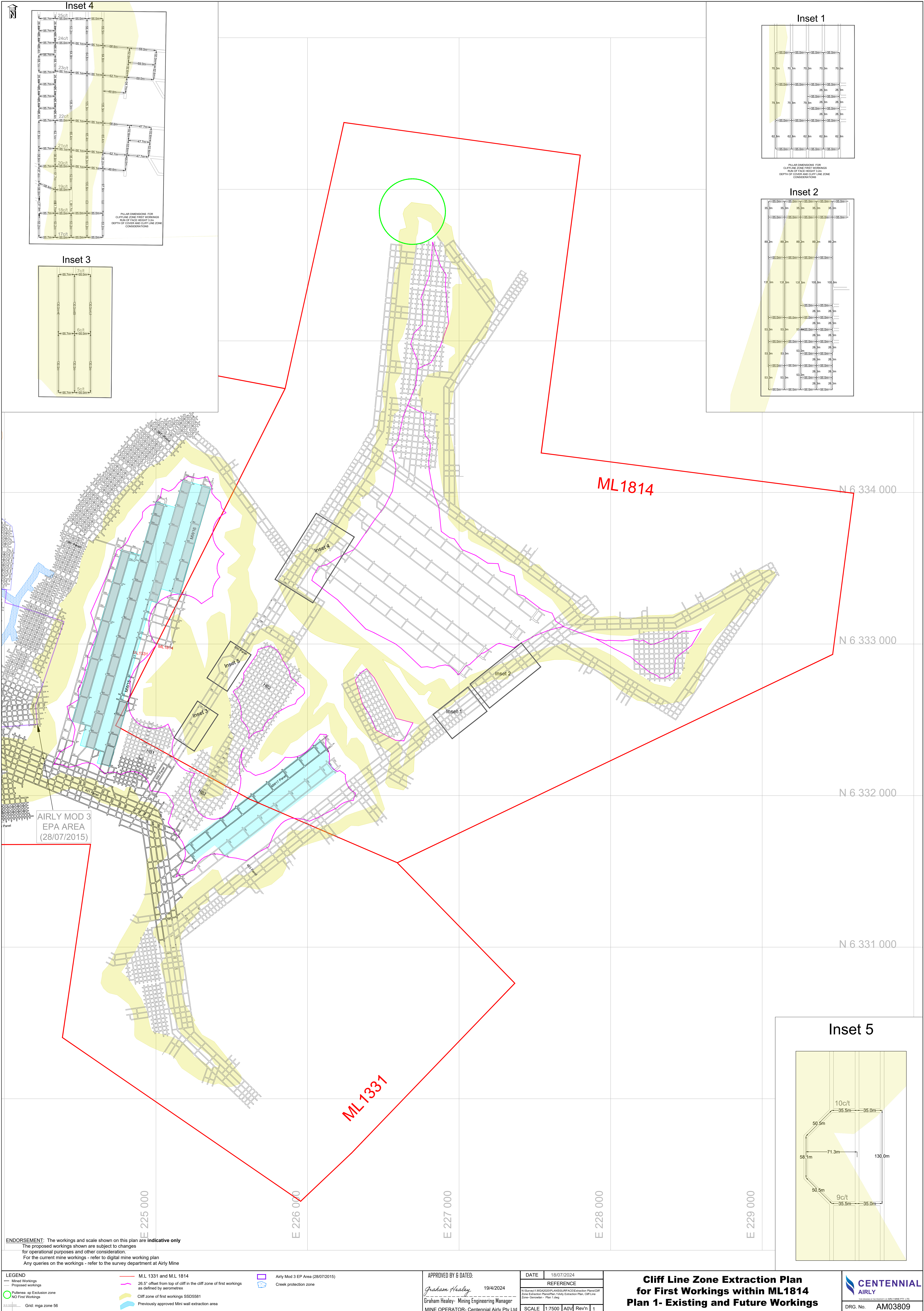
² By law, pillar sizes must conform to minimum requirements set by Schedule 3 (High Risk Activities), Part 3 (underground coal mines), Clause 16 (Formation of Non-Conforming Pillars) of the WHS (Mines and Petroleum Sites) Regulations 2022

³ PIS – Principal Inspector - Subsidence, NSW Resource Regulator (Mine Safety)

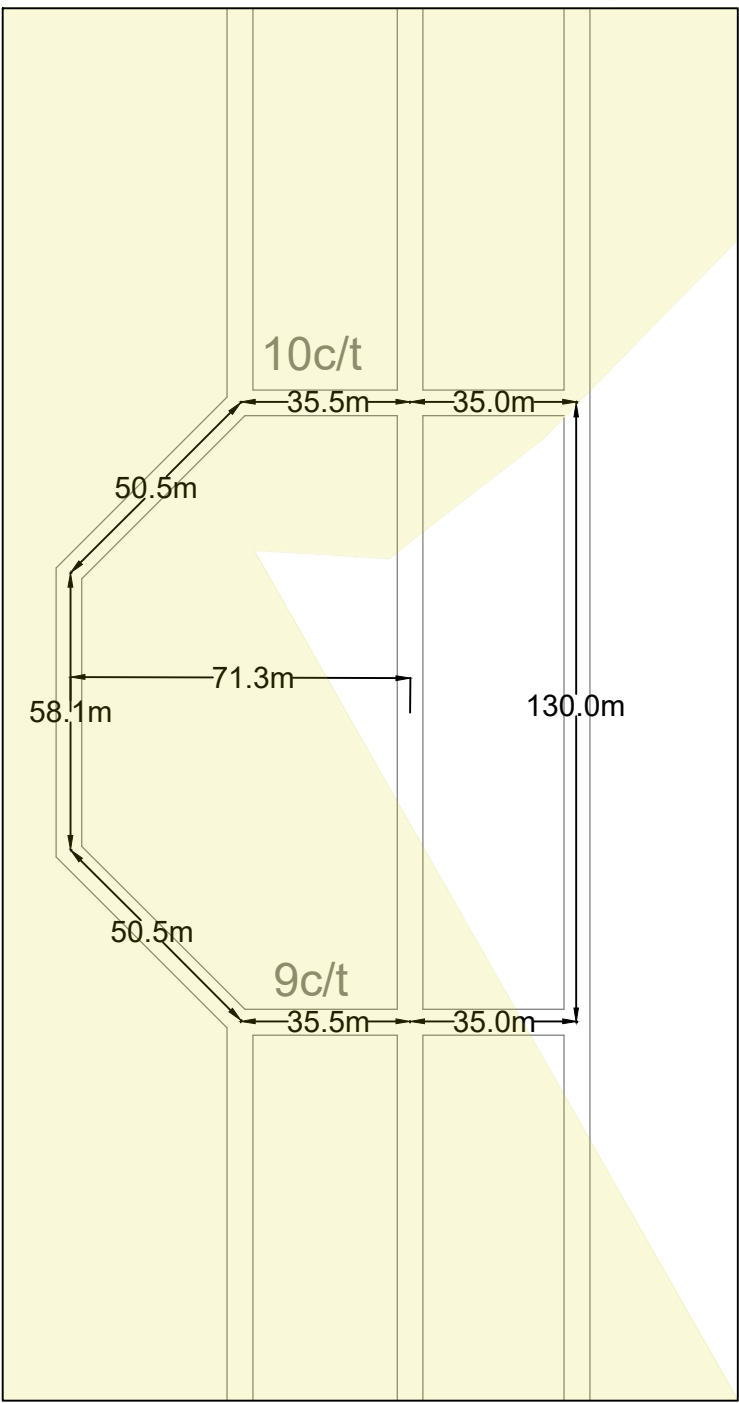
APPENDIX 8 Graphical Plans for CLZ (ML1814)

Appendix 8 contains graphical plans prepared in accordance with the *Extraction Plan Guideline* (DPE, 2022) and *Managing Risks of Subsidence Guideline* (NSW RR, 2017).

Plan 1	Existing and Future Workings
Plan 2	Surface Features (Natural and Built)
Plan 3	Geological and Seam Data
Plan 4	Existing Workings in Other Seams
Plan 5	Mining Titles and Land Ownership
Plan 6	Geological Sections
Plan 7	Subsidence Monitoring



Inset 5



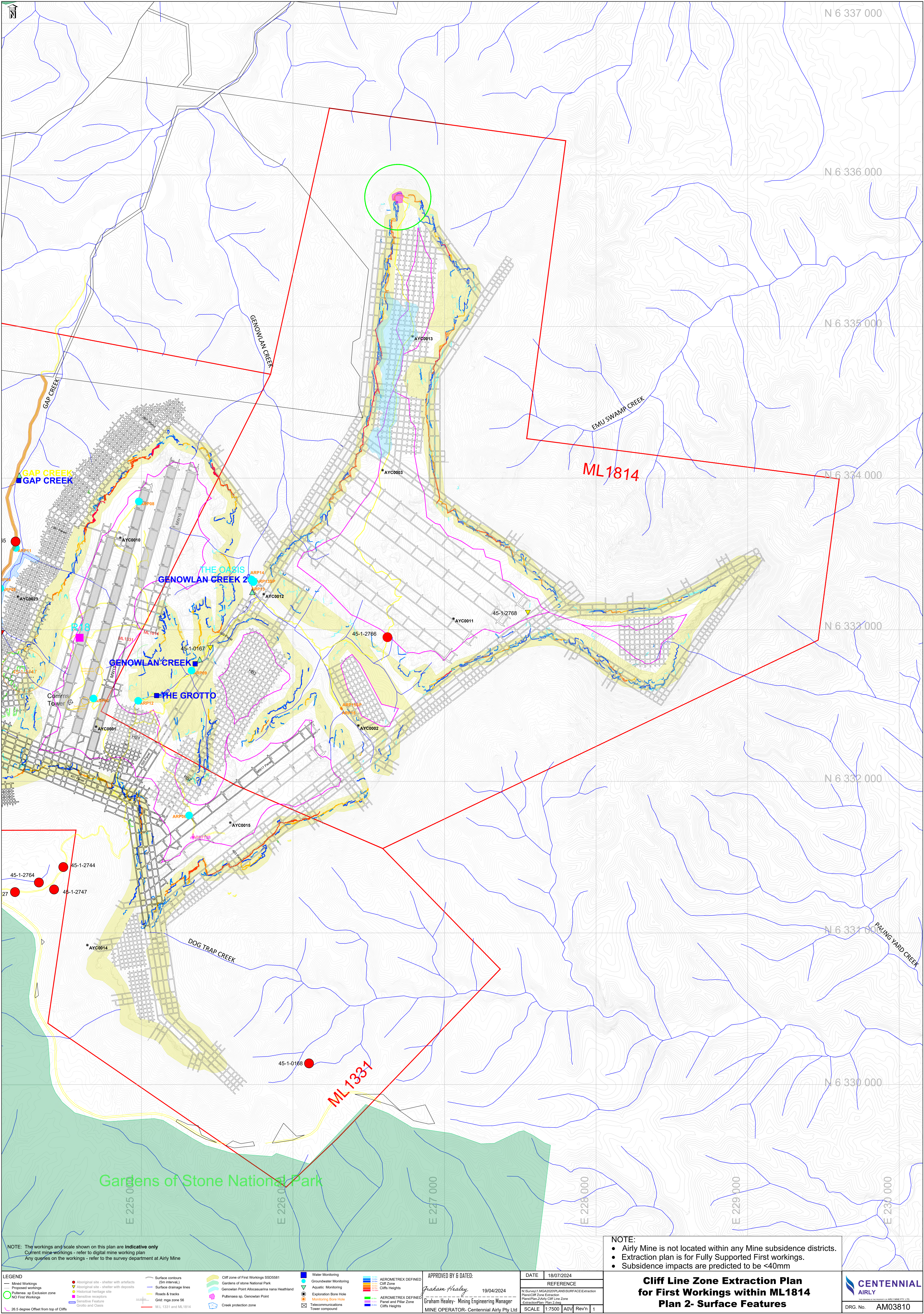
ENDORSEMENT: The workings and scale shown on this plan are **indicative only**. The proposed workings shown are subject to changes for operational purposes and other consideration. For the current mine workings - refer to digital mine working plan. Any queries on the workings - refer to the survey department at Airly Mine.

LEGEND	- M.L. 1331 and M.L. 1814 26.5° offset from top of cliff in the cliff zone of first workings as defined by aeromatrix - Cliff zone of first workings SSD5581 - Previously approved Mini wall extraction area	- Airly Mod 3 EP Area (28/07/2015) - Creek protection zone
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APPROVED BY & DATED:
19/4/2024
Graham Healey
Graham Healey - Mining Engineering Manager
MINE OPERATOR- Centennial Airly Pty Ltd

DATE	18/07/2024
REFERENCE	N:\Survey\1. MGA2020\PLANS\SURFACE\Extraction Plans\CLZ\Zone-Extraction Plans\Plan 1.dwg
SCALE	1:7500 A0V Rev'n 1

Cliff Line Zone Extraction Plan for First Workings within ML1814
Plan 1- Existing and Future Workings



NOTE: The workings and scale shown on this plan are indicative only
Current mine workings - refer to digital mine working plan
Any queries on the workings - refer to the survey department at Airly Mine

LEGEND

- Mined Workings
- Proposed workings
- Puttuea sp Exclusion zone
- NO First Workings
- 26.5 degree Offset from top of Cliffs

- Aboriginal site - shelter with artefacts
- Aboriginal site - shelter with deposits
- Historical heritage site
- Sensitive receptors
- Sensitive Feature
- Grotto and Oasis

- Surface contours (5m intervals)
- Surface drainage lines
- Roads & tracks
- Grid: mga zone 56
- ML 1331 and ML1814

- Cliff zone of First Workings SSD5581
- Gardens of stone National Park
- Genowlan Point Allocasuarina nama Heathland
- Puttuea sp. Genowlan Point
- Creek protection zone

- Water Monitoring
- Groundwater Monitoring
- Aquatic Monitoring
- Monitoring Bore Hole
- Telecommunications Tower compound

- AEROMETREX DEFINED Cliff Zone
- AEROMETREX DEFINED Panel and Pillar Zone
- Cliffs Heights

- AEROMETREX DEFINED Cliff Zone
- AEROMETREX DEFINED Panel and Pillar Zone
- Cliffs Heights

APPROVED BY & DATED:

Graham Healey 19/04/2024
Graham Healey - Mining Engineering Manager
MINE OPERATOR- Centennial Airly Pty Ltd

DATE

18/07/2024

REFERENCE

N:\Survey\1\MOA\2020\PLANS\SURFACE\Extraction Plans\Cliff Zone Extraction Plans\Plan 2\Airly Cliff Line Zone Extraction\Plan 2.dwg

SCALE

1:7500 | A0V | Rev'n | 1

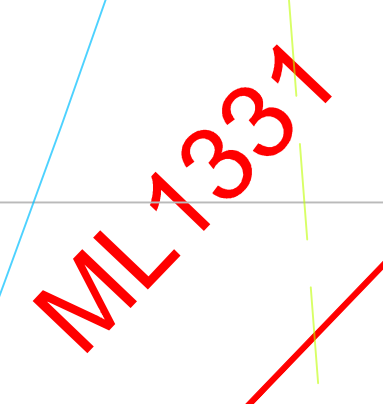
Cliff Line Zone Extraction Plan for First Workings within ML1814
Plan 2- Surface Features

CENTENNIAL AIRLY
DRG. No. AM03810

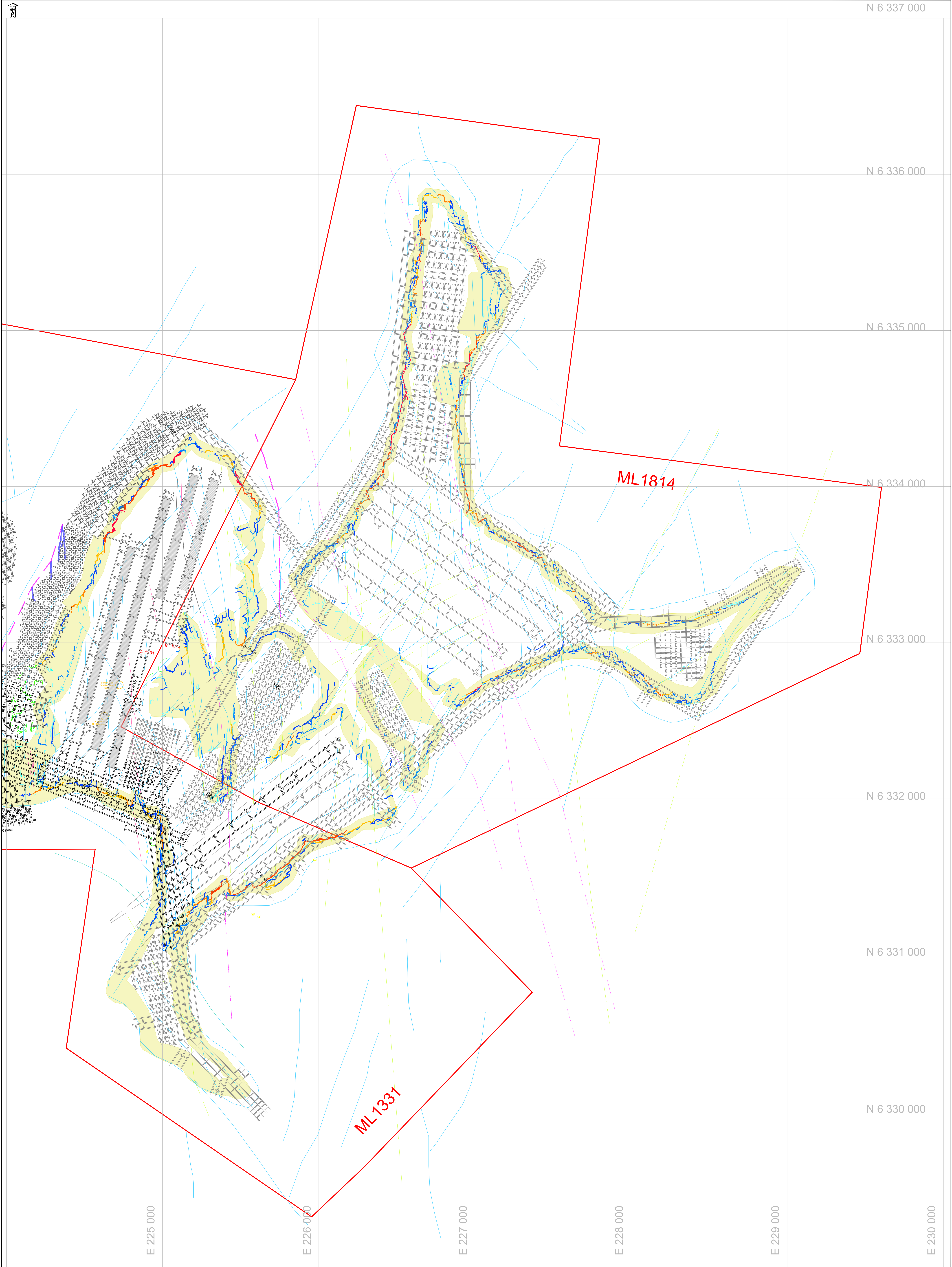
- NOTE:
- Airly Mine is not located within any Mine subsidence districts.
 - Extraction plan is for Fully Supported First workings.
 - Subsidence impacts are predicted to be <40mm



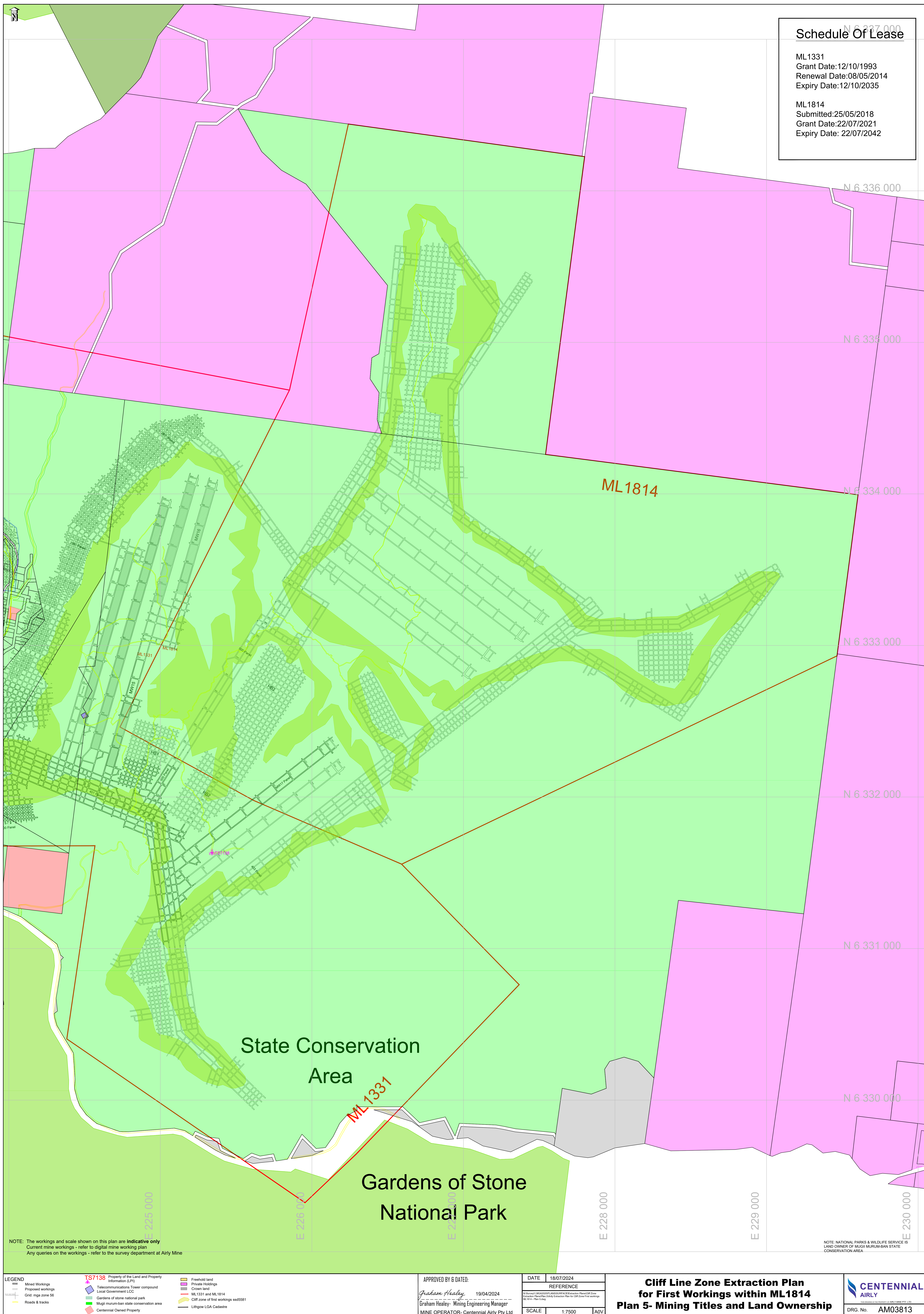
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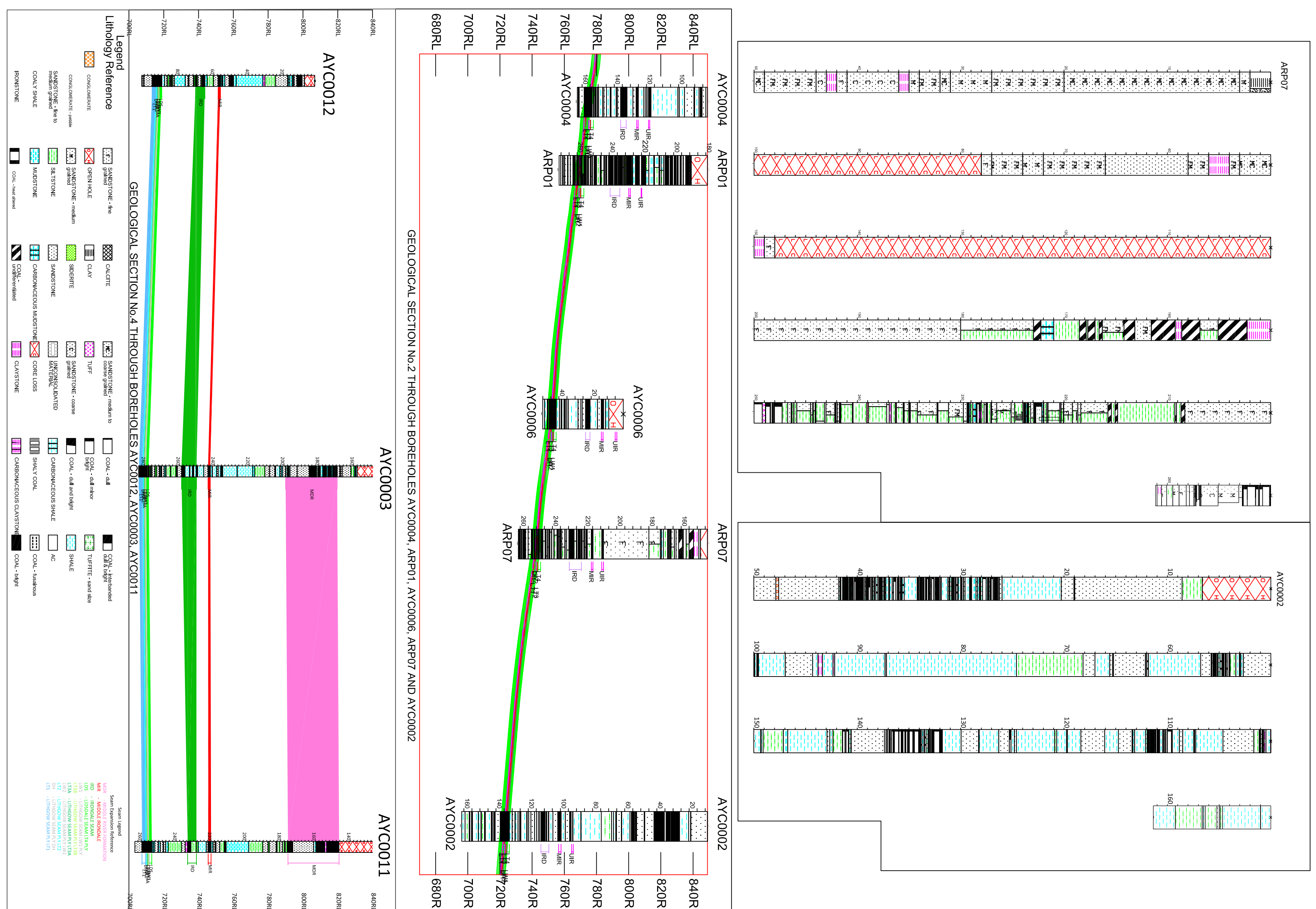
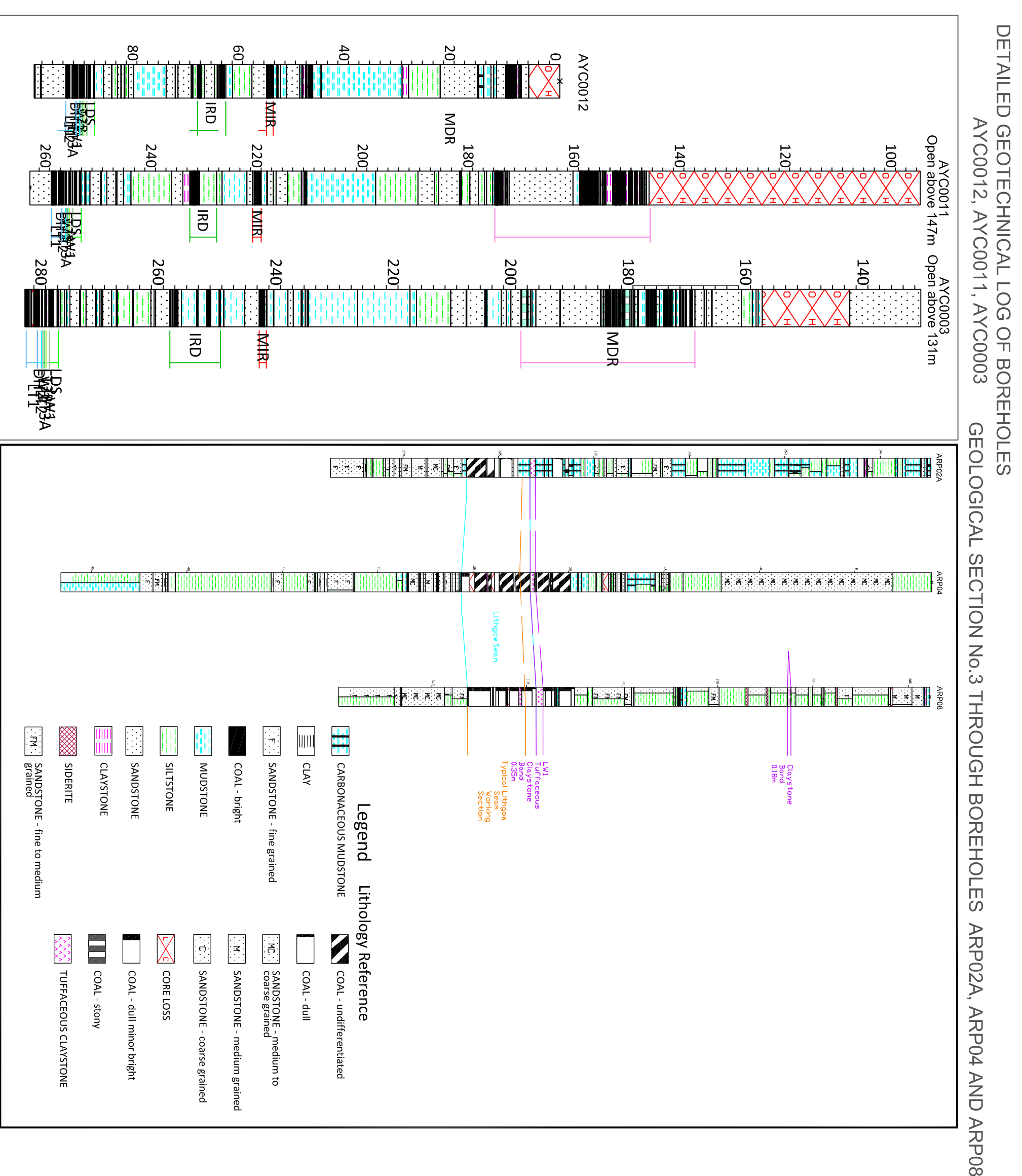
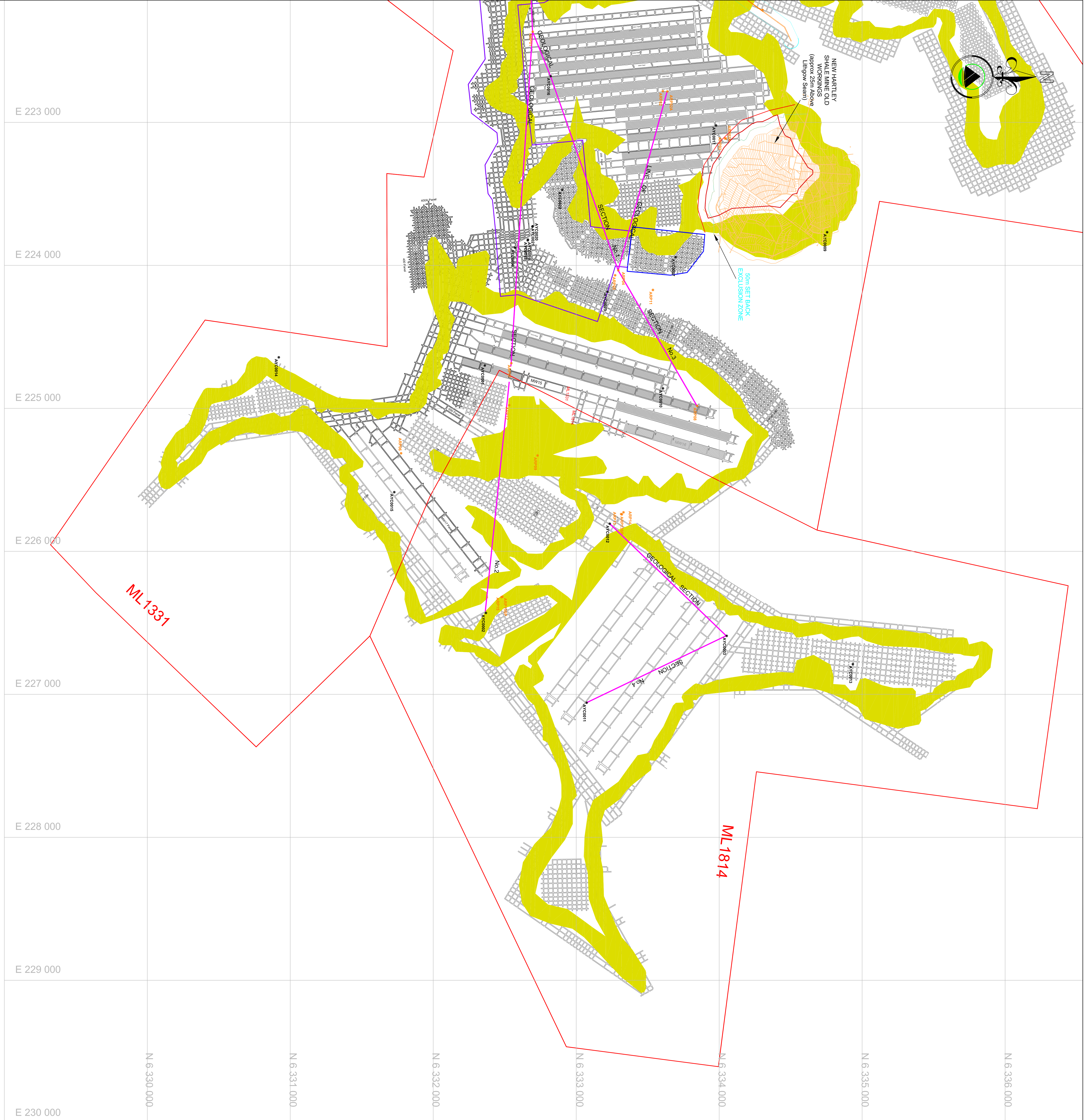


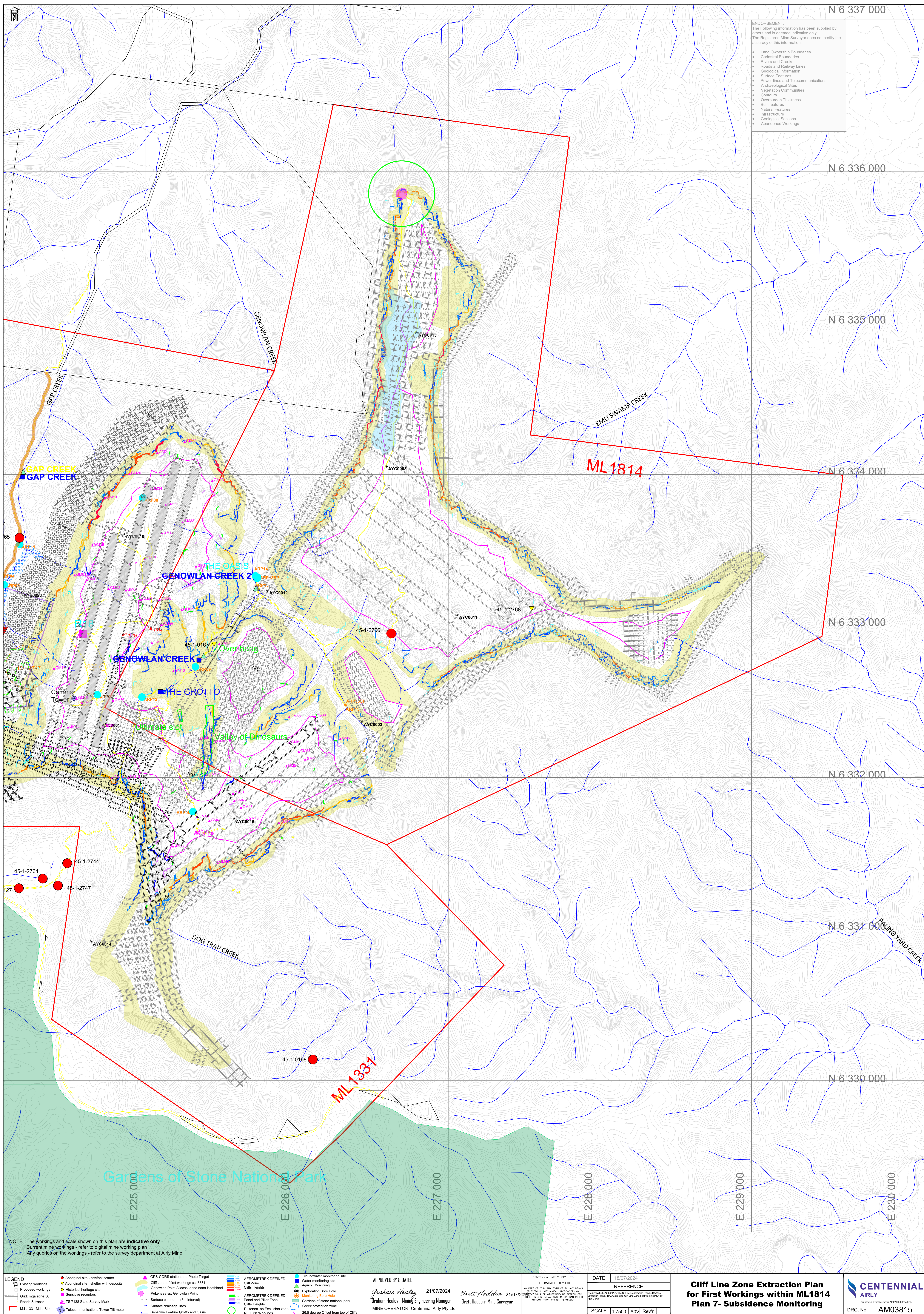
CENTENNIAL
AIRLY
THEY OWNED THE PROPERTY OF AIRLY MINE PTY. LTD.
DRG. No. **AM03811**



NOTE: The workings and scale shown on this plan are indicative only
Current mine workings - refer to digital mine working plan
Any queries on the workings - refer to the survey department at Airly Mine.
All workings are in the Lithgow seam. There are no workings in other seams in the area of interest.







Attachment A

IDENTIFICATION OF NATURAL AND BUILT FEATURES CHECKLIST

Features	CLZ (ML1814) EP Area	Comments
Natural and Heritage Features		
WATER		
Catchment areas and declared Special Areas;	x	
Rivers and creeks (including aquatic ecology);	✓	There are minor ephemeral drainage lines mapped within the Project area. A number of first and second Strahler order streams within the EP area flow into Genowlan Creek (third Strahler order stream), then on into the Capertee River.
Aquifers, known groundwater resources;	x	
Springs;	x	
Sea/lake;	x	
Shorelines;	x	
Natural dams;	x	
Any other feature considered significant.	x	
LAND		
Cliffs / minor cliffs;	✓	The Project area contains diverse geological and geomorphological features, such as cliffs, pagoda rock formations, steep slopes, sandstone escarpments deeply incised canyons/gorges including the upper reaches of an area known as the Grotto.
pagodas / rock formations;	✓	
Steep slopes;	✓	
Escarpments;	✓	
Land prone to flooding or inundation;	x	
National parks;	x	
State recreation areas;	✓	The Project area lies within the Mugii Murum-ban State Conservation Area.
State forests particularly areas zoned FMZ 1, 2 and 3;	x	
Areas of significant geological interest, and	x	
Any other feature considered significant.	x	
BIODIVERSITY		
Swamps, wetlands, water related ecosystems;	x	
Upland swamps;	x	
Hanging swamps;	x	
Endangered Ecological Communities;	✓	One threatened ecological community (TEC) occurs in the EP Area, being <i>Biodiversity Conservation Act 2016</i> (BC Act) listed Genowlan Point <i>Allocasuarina nana</i> Heathland Endangered Ecological Community (EEC, PCT 3859)
Potential for Groundwater Dependent Ecosystems and stygofauna;	✓	Facultative ecosystems may occur within the Project area, Stygofauna may be present in the groundwater.

Features	CLZ (ML1814) EP Area	Comments
Threatened and protected species;	✓	Two threatened flora species occur within the EP Area, <i>Prostanthera stricta</i> (Mount Vincent Mint Bush; BC Act: Vulnerable; EPBC Act: Vulnerable), and <i>Pultenaea sp. Genowlan Point</i> (BC Act: Critically Endangered; EPBC Act: Critically Endangered). A total of 40 threatened fauna species occur within the locality (within 10 km of the EP Area) and have habitat in the EP Area.
Natural vegetation;	✓	The Project area was found to potentially encompass twelve PCTs. Broad-scale vegetation types include dry sclerophyll forest, wet sclerophyll forest and heath.
Fauna habitats;	✓	Several key habitat features for threatened fauna are present in the Project area.
Any other feature considered significant.	✗	
HERITAGE		
Aboriginal heritage sites;	✗	Baseline assessment complete. There is one known Aboriginal heritage sites, a rock shelter (AHIMS 45-1-0167).
Non-Aboriginal (historic) heritage sites;	✗	Baseline assessment complete. There are no known historic heritage sites.
Any other feature considered significant.	✗	
Built Features:		
PUBLIC UTILITIES		
Railways;	✗	
Roads (all types);	✓	Four-wheel drive roads, management trails and walking tracks, in particular the Trig Trail.
Bridges;	✗	
Tunnels;	✗	
Culverts;	✗	
Water/gas/sewerage pipelines;	✗	
Liquid fuel pipelines;	✗	
Electricity transmission lines (overhead/underground) and associated plants;	✗	
Telecommunication lines (overhead/underground) and associated plants;	✗	
Water tanks, water and sewage treatment works;	✗	
Dams, reservoirs and associated works;	✗	
Air strips, and	✗	
Any other infrastructure items.	✗	
PUBLIC AMENITIES		
Hospitals;	✗	
Places of worship;	✗	

Features	CLZ (ML1814) EP Area	Comments
Schools;	x	
Shopping centres;	x	
Community centres;	x	
Office buildings;	x	
Swimming pools;	x	
Bowling greens;	x	
Ovals and cricket grounds;	x	
Race courses;	x	
Golf courses;	x	
Tennis courts, and	x	
Any other amenities considered significant.	x	
FARM LAND AND FACILITIES		
Agricultural utilisation or agricultural suitability of farm land;	x	
Farm buildings / sheds;	x	
Gas and / or fuel storages;	x	
Poultry sheds;	x	
Glass houses;	x	
Hydroponic systems;	x	
Irrigation systems;	x	
Fences;	x	
Farm dams;	x	
Wells, bores, and	x	
Any other feature considered significant.	x	
INDUSTRIAL, COMMERCIAL AND BUSINESS ESTABLISHMENTS		
Factories;	x	
Workshops;	x	
Business or commercial establishments;	x	
Gas and / or fuel storages and associated plants;	x	
Waste storages and associated plants;	x	
Buildings, equipment and operations that are sensitive to surface movements;	x	
Surface mining (open cut) voids and rehabilitated areas;	x	
Mine infrastructure including tailings dams and emplacement areas, and	x	
Any other feature considered significant.	x	
RESIDENTIAL ESTABLISHMENTS		
Houses;	x	
Flats / Units;	x	

Features	CLZ (ML1814) EP Area	Comments
Caravan parks;	x	
Retirement/aged care villages;	x	
Associated structures such as workshops, garages, on-site waste water systems, water or gas tanks, swimming pools and tennis courts, and	x	
Any other feature considered significant.	x	
OTHER BUILT FEATURES		
Permanent Survey Control Marks;	x	
Items of Architectural Significance;	x	
Any Known Future Developments; and	x	
Any Other Item of Significance.	x	

Attachment B

RELEVANT LEGAL AND OTHER REQUIREMENTS

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1 REQUIREMENTS OF DEVELOPMENT CONSENT CONDITIONS, EIS AND STATEMENT OF COMMITMENTS

Table 1.1, Table 1.2, Table 1.3 and Table 1.4 describe the key specific conditions of Development Consent SSD_5581 for the preparation of Extraction Plans and supporting sub-plans and other relevant requirements of the consent and documentation formally comprising the EIS as defined in SSD_5581. These include (but are not limited to) Statements of Commitments from the EIS and subsequent Responses to Submissions by Centennial, including responses to the Independent Review Panel Report.

Table 1.1: Development Consent Extraction Plan Requirements

Condition	Condition Requirement	Where Addressed
Schedule 3, Condition 7 (Extraction Plan)		
7.	Prior to carrying out any first workings within the Cliff Line Zone and Zone of First Workings (refer Figure 2 in Appendix 3), or second workings, the Applicant must prepare an Extraction Plan for the relevant workings to the satisfaction of the Secretary. Each Extraction Plan must:	Cliff Line Zone of First Workings Extraction Plan (ML1814)
7.(a)	Be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the secretary	Section 2.2.1 (Consultant Suitability and Endorsement) <i>Attachment D – Stakeholder Consultation</i>
7.(b)	Provide a detailed justification for any proposed divergence from the advice of the IEP or DRE;	<i>Attachment D – Stakeholder Consultation</i>
7.(c)	Include detailed plans of existing and proposed first and second workings and overlying surface features, including the identification of appropriate setback distances between cliffs, steep slopes, and pagodas and second workings and any applicable adaptive management measures	Section 1.3 (Extraction Plan Area) Appendix 7 – Graphical Plans for CLZ (ML1814)
7.(d)	Include adequate consideration of mine roof and floor conditions, pillar width to height ratio, final pillar design dimensions and the long-term stability of pillars, following consultation with the IEP;	Section 3 (Subsidence Assessment) Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
7.(e)	Give express consideration to the design parameters underpinning the advice in the IPRP's report, and if the proposed mine layout diverges from these parameters, provide a detailed justification for the proposed divergence, following consultation with the IEP;	Section 3 (Subsidence Assessment) Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
7.(f)	Provide an assessment of the likely stability of cliff lines, pagodas, and steep slopes, in consultation with the IEP;	Section 3.2 (Subsidence Predictions) Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b) Appendix 2 – Land Management Plan for CLZ (ML1814)
7.(g)	Provide revised predictions of the potential subsidence effects, subsidence impacts and environmental consequences of the proposed mining covered by the Extraction Plan, incorporating any relevant information obtained since this consent, in consultation with the IEP	Section 3.2 (Subsidence Predictions) Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
7.(h)	Describe in detail the performance indicators and measures that would be implemented to ensure compliance with the performance measures in Tables 1 and 2,	Section 5.1 (Performance Measures and Indicators)

Condition	Condition Requirement	Where Addressed
	and manage or remediate any impacts and/or environmental consequences to meet the rehabilitation objectives in condition 27 of Schedule 4, following consultation with the IEP.	Appendix 7 –CLZ (ML1814) Master TARP
7.(i) 7.(i) (i)	Include a: Subsidence Monitoring Program which has been prepared in consultation with the IEP, Resources Regulator, and BCD to: • Monitor the subsidence effects and subsidence impacts of the development • Develop effective remote monitoring techniques for the development • Monitor pillar loads underground to develop an understanding of the loading conditions on pillars in the vicinity of cliff lines, pagodas, and steep slopes • Provide data to assist with the management of risks associated with subsidence • Validate the subsidence predictions • Analyse the relationship between the predicted and resulting subsidence effects and predicted and resulting impacts under the plan and ensuing environmental consequences; and • Inform the contingency plan and adaptive management processes.	Section 4 (Monitoring Program) Appendix 6 – CLZ (ML1814) SMP
7.(i) (ii)	Built Features Management Plan, which has been developed in consultation with Resources Regulator, to manage the potential subsidence impacts of the proposed underground workings on built features, and which: • Has been prepared in consultation with the owners of potentially affected features; • Addresses in appropriate detail all items of key public infrastructure and other public infrastructure and all classes of other built features; • Recommends appropriate pre-mining mitigation measures to reduce subsidence impacts; and • Recommends appropriate remedial measures and includes commitments to mitigate, repair, replace or compensate predicted impacts on potentially affected built features in a timely manner.	<i>Not relevant to this Extraction Plan</i>
7.(i) (iii)	Water Management Plan which has been developed in consultation with BCD and the Water Division , which provides for the management of potential subsidence impacts and/or environmental consequences of the proposed underground workings on watercourses and aquifers, including: • Detailed baseline data on: - surface water flows and quality in Gap and Genowlan Creeks; - Airly Village Spring and the Grotto; - Groundwater levels, yields and quality in the region. • Surface and groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse impacts on water resources or quality; • A surface water monitoring program to monitor and report on: - stream flows and quality; - stream and riparian vegetation health; - channel and bank stability • A groundwater monitoring program to monitor and report on: - springs, their discharge quantity and quality, as well as any associated Groundwater Dependent Ecosystems; - groundwater inflows to the underground mine operations; - the height of groundwater depressurisation; - background changes in groundwater yield/quality against mine-induced changes, in particular on groundwater bore users;	Appendix 1 – Airly Mine WMP

Condition	Condition Requirement	Where Addressed
	- permeability, hydraulic gradient, flow direction and connectivity of the deep and shallow groundwater aquifers; • A description of any adaptive management implemented to guide future mining activities in the event of greater than predicted impacts on aquatic habitat; • A program to validate the surface water and groundwater models for the development, and compare the monitoring results with modelled predictions; and • A plan to respond to exceedance of any of the surface and groundwater assessment criteria.	
7.(i) (iv)	Biodiversity Management Plan which has been developed in consultation with DoEE and BCD, which provides for the management of potential impacts and/or environmental consequences of proposed first and second workings on aquatic and terrestrial flora and fauna, with a specific focus on threatened species populations and their habitats, Endangered Ecological Communities (EEC) and Groundwater Dependent Ecosystems (DGE's), including but not limited to: • <i>Pultenaea</i> sp. Genowlan Point • Genowlan Point <i>Allocasuarina nana</i> Heathland • <i>Prostanthera stricta</i> (Mount Vincent Mint-bush) and • <i>Eucalyptus cannonii</i> (Capertee Stringybark)	Appendix 3 – CLZ (ML1814) BMP
7.(i) (v)	Land Management Plan which has been prepared in consultation with the IEP, Resources Regulator, BCD and any affected public authorities, to manage the potential impacts and/or environmental consequences of the proposed underground workings on land in general, with a specific focus on cliffs, pagoda formations, steep slopes and gorges	Appendix 2 – CLZ (ML1814) LMP
7.(i) (vi)	Heritage Management Plan which has been prepared in consultation with Heritage Division and relevant Aboriginal stakeholders, to manage the potential environmental consequences of the proposed workings on Aboriginal and Historic Heritage and includes all requirements under Condition 19 of Schedule 4.	Appendix 4 – CLZ (ML1814) ACHMP
7.(i) (vii)	Public Safety Management Plan which has been prepared in consultation with the IEP, Resources Regulator and BCD to ensure public safety and manage access on the site	Appendix 5 – CLZ (ML1814) PSMP
7.(i) (viii)	include Trigger Action Response Plans, or equivalent, to prevent greater than predicted subsidence impacts and environmental consequences that may result from mine subsidence	Appendix 7 –CLZ (ML1814) Master TARP
7.(i) (ix)	include a contingency plan that expressly provides for adaptive management where monitoring indicates that there has been an exceedance of any performance measure in Tables 1 and 2, or where such exceedances appear likely;	Appendix 7 –CLZ (ML1814) Master TARP
7.i) (x)	Proposes appropriate revisions to the Rehabilitation Management Plan required under Condition 27 in Schedule 4;	Section 5.3 (Remediation and Rehabilitation Measures) (if triggered)
7.i) (xi)	include a program to collect sufficient baseline data for future Extraction Plans	Section 4.2 (Ongoing Baseline Data Collection Program) Appendix 6 – CLZ (ML1814) SMP
	The Applicant must implement the approved Extraction Plan for the development	Section 6.3 (Key Responsibilities)
	Notes: • <i>This condition does not apply to first or second workings which are covered by an Extraction Plan or SMP approved, or under assessment, as at the date of this development consent.</i> • <i>In accordance with Condition 4 in Schedule 6, the preparation and implementation of Extraction Plans may be staged, with each plan covering a defined area of underground workings. In addition, these plans are only required to contain</i>	- Section 1.3 (Extraction Plan Area) Extraction Plan Main Report

Condition	Condition Requirement	Where Addressed
	<i>management plans that are relevant to the specific underground workings that are being carried out.</i> • <i>Due to the sensitive and rugged terrain of the Mugii Murum-ban State Conservation Area, the Applicant may propose remote subsidence monitoring techniques.</i>	Appendix 6 – CLZ (ML1814) SMP

Table 1.2: Development Consent Management Plan Requirements

Condition	Condition Requirement	Where Addressed
Schedule 6, Condition 2 (Management Plan Requirements)		
2.	The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i>
2.(a)	Detailed baseline data;	Section 4 (Monitoring Program)
2.(b)	A description of: • The relevant statutory requirements (including any relevant approval, licence or lease conditions); • Any relevant limits or performance measures/criteria; • The specific performance indicators or triggers that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures.	Section 2.1 (Statutory Requirements) Attachment B – Relevant Legal and Other Requirements (<i>this document</i>) Section 5.1 (Performance Measures and Indicators) Appendix 7 –CLZ (ML1814) Master TARP
2.(c)	A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria.	Section 5.2 (Management and Mitigation Measures)
2.(d)	A program to monitor and report on the: • Impacts an environmental performance of the development; • Effectiveness of any management measures (see c) above);	Section 4 (Monitoring Program)
2.(e)	A contingency plan to manage any unpredicted impacts and consequences	Section 5.5 (Adaptive Management and Contingency Planning)
2.(f)	A program to investigate and implement ways to improve the environmental performance of the development over time	Section 5.7 (Reporting and Auditing)
2.(g)	A protocol for managing and reporting any: • Incidents; • Complaints; • Non-compliance with statutory requirements; and • Exceedances of the impact assessment criteria and/or performance criteria; and	Section 5.6 (Incidents, Complaints, Exceedances and Non-compliances)
2.(h)	A protocol for periodic review of the plan.	Section 6.2 (Review of the Extraction Plan)

Table 1.3: Other Relevant Conditions of Development Consent SSD_5581

Clause	Requirement	Where Addressed
Schedule 2		
Condition 1 (Obligation to minimise harm to the environment)	In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent and/or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the development.	Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)
Condition 2 (Terms of Consent)	The Applicant must carry out the development a) Generally in accordance with the EIS and the Mining Schedule (See Figure 3 in Appendix 2); and b) In accordance with the IPRP's Report and the conditions of this consent.	Attachment B – Relevant Legal and Other Requirements (this document)
Schedule 3		
Condition 1 (Restrictions on Mining)	The Applicant must not carry out any second workings: a) in the Panel and Pillar Extraction Zone within an angle of draw of 26.5 degrees of the crest of any cliffs identified in the Cliff Line Zone of First Workings before at least four adjacent extraction panels in the Panel and Pillar Zone beneath Mount Airly have completed; b) in the Partial Pillar Extraction Zone within an angle of draw of 26.5 degrees of the toe of any cliffs identified in the Cliff Line Zone of First Workings before it has completed the Trial Mining Area in Panels 206 and 207 as shown in Appendix 11; c) within an angle of draw of 26.5 degrees plus 50 metres of limit of the New Hartley Shale Mine workings.	Section 3.1 (Mine Planning and Design)
Schedule 6		
Condition 4 (Updating and Staging of Strategies, Plans or Programs)	...With the agreement of the Secretary, the Applicant may also submit any strategy, plan or program required by this consent on a staged basis.... Note: If the submission of any strategy, plan or program is to be staged, then the relevant strategy, plan or program must clearly describe the specific stage to which the strategy, plan or program applies, the relationship of the stage to any future stages, and the trigger for updating the strategy, plan or program.	Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)
Condition 5 (Relationships between Management Plans)	The Water, Biodiversity and Heritage Management Plans required by conditions 13, 15 and 19 of Schedule 4, respectively, are to be prepared in respect of all parts of the development that are not covered by an Extraction Plan approved under condition 7 of Schedule 3. In particular, those management plans should address all areas subject to existing or proposed surface disturbance associated with the development.	Airly Mine Water Management Plan (Appendix 1)
Condition 6 (Consolidation of Strategies, Plans or Programs)	With the Approval of the Secretary, the Applicant may incorporate any strategies, plans and programs required by this consent (except those required under Condition 7, Schedule 3) with the strategies, plans or programs required for Centennial Coal's mining operations in the Lithgow Local Government Area. (Centennial Note: the condition infers that management plans required for Extraction Plans cannot be 'incorporated' within Centennial's regional management plans, separate dedicated management plans must be prepared for Extraction Plans).	Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)

Clause	Requirement	Where Addressed
Condition 7 (Adaptive Management)	The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the performance measures and/or criteria in Schedules 3 and 4. Where any exceedance of these criteria and/or performance measures has occurred, the Applicant must, at the earliest opportunity: - Take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur; - Consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and - Implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary.	Appendix 7 –CLZ (ML1814) Master TARP
Condition 9 (Incident Reporting)	The applicant must immediately notify the Secretary and any other relevant agencies of any incident. Within 7 days of the date of the incident the applicant must provide the secretary and any relevant agencies with a detailed report on the incident and such further reports as may be requested. <Note: Refer SSD_5581 for definitions of incidents>	Section 5.6 (Incidents, Complaints, Exceedances and Non-compliances)
Condition 10 (Regular Reporting)	The applicant must provide regular reporting on the environmental performance of the development on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this consent.	Section 5.7 (Reporting and Auditing)
Condition 14 (Access to Information)	The applicant must: - Make the following information publicly available on its website: Approved strategies, plans or programs required under the conditions of this consent; - A comprehensive summary of the monitoring results of the development, which have been reported in accordance with the various plans and programs approved under the conditions of this consent; - A complaints register, which is to be updated on a monthly basis The last five (5) Annual Reviews Any report and/or advice issued by the IEP to the Applicant in respect of a draft or approved Extraction Plan.	Section 5.7 (Reporting and Auditing)

Table 1.4. Relevant Requirements of the EIS, Statements of Commitment, and Supporting Documents

Relevant Section	Requirement	Where Addressed
Statement Of Commitments ((Revised SOC Section 6 of the RTS (2015) as added to EIS Chapter 11 (Sep, 2014))		
Subsidence	All subsidence impacts to surface sensitive features are minimised.	Section 3.2 (Subsidence Predictions)
	Mining operations will be conducted in accordance with the design parameters and those parameters will be implemented in the areas defined in the EIS. Geotechnical reviews of first workings development prior to the commencement of any extraction that may result in surface subsidence will be undertaken on an ongoing basis.	Section 5.1 (Performance Measures and Indicators) Appendix 7 –CLZ (ML1814) Master TARP
	- A new extraction plan will be developed as required by the new consent and in accordance with any requirements of the Mining Act 1992. An independent review of the geotechnical and subsidence aspects of the EIS will be undertaken prior to the development of the Extraction Plan and as part of the Response to Submissions Process. - The Extraction Plan will provide detail around the management of subsidence impacts on the natural and built environment. The Plan is supported by a Subsidence Monitoring Program and consultation process.	Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans) Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
General	Action: Operations will be undertaken in accordance with the description provided in the EIS. (Desired Outcome: all operations are undertaken in a manner that will minimise the environmental impacts associated with the project).	Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)
Environmental Impact Statement – Airly Mine Extension Project (Sep 2014)		
Section 8.3.7.1 Proposed Mining Methods - Panel and Pillar Mining Zone	Mining in Cliff Line Zone and Zone of First Workings zone would consist of first workings only with pillars designed to be long term stable. A typical pillar layout for the cliff zone is shown in Figure 8.6 (EIS). Key features of this type of mining include: - Mining height: <3.0 m - Maximum roadway width: 5.5 m - Maximum void width: <10 m - Pillar system FOS: >2.11 (protection of key surface features) - Pillar width to height ratio: >8.0.	Section 3.1 (Mine Planning and Design) Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
Executive Summary Summary of Environmental Impacts	Hazards Management No increased environmental or safety risk from hazardous materials, spontaneous combustion, bushfire or public safety will occur due to the Project.	Appendix 5 – CLZ (ML1814) PSMP
Section 10.8.3.4 Land Use	There will be no mining impacts, including on the landforms and topography (Section 10.8.3.5), that would create a hazard to public safety or cause areas of the SCA to be closed to mining impacts. Therefore there will be no impact on the current land use for recreation.	Appendix 5 – CLZ (ML1814) PSMP
Section 10.12.3.5 Page 472	Public safety is a priority management aspect at Airly Mine. Centennial Airly recognises the proximity of the township of Capertee to Airly Mine and the mine's location within the Mugii Murum-ban SCA, and would accordingly implement procedures and controls to protect the safety of the public.	Appendix 5 – CLZ (ML1814) PSMP

Relevant Section	Requirement	Where Addressed
Responses to PAC (December 2015)		
Recommendation 5	All information relevant to the Independent Expert Panel's advice and recommendations is made publicly available on the Applicant's website.	Section 5.7 (Reporting and Auditing)
Centennial Responses to the IRP Report (8 July 2016)		
IRP Recommendation 1	<i>High confidence subsidence monitoring over initial panel and pillar mining areas (i.e. mini wall or partial extraction mining areas) is required to confirm the levels of ground movement are as predicted and the protection zones proposed are appropriate to provide a high level of protection to cliff formations. Initial monitoring should be conducted in areas remote from sensitive features and prior to any mining in these sensitive areas.</i> <u>Centennial Response Commitment:</u> Over initial panel and pillar mining areas, Centennial Airly will adopt both conventional (subsidence lines) and trial a range of non-conventional (remote sensing) subsidence monitoring methods. This will allow Centennial Airly to validate the accuracy and suitability of non-conventional subsidence monitoring methods to measure ground movements as a result of mining activities. Conventional subsidence monitoring lines will be established wherever possible in areas of existing disturbance and in consultation with the National Parks and Wildlife Service to limit impacts on the sensitive environment of the Mugii Murum-ban State Conservation Area in which Centennial Airly operates. Subsidence monitoring data collected over initial panel and pillar mining areas will be used to validate and refine the existing subsidence model and predictions. Mining will progress from areas of lower surface sensitive features to areas of higher surface sensitive features. The mine design will be adapted, if required, based on results from initial subsidence monitoring results and will be refined as the mine progresses to ensure adequate protection of cliff formations and compliance with the performance measures detailed within the conditions of consent. A conceptual plan showing the progression of mining at Airly Mine from areas of lower sensitive surface features to higher sensitivity surface features is provided as an Appendix A.	Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b) (<i>not applicable for first workings</i>)
IRP Recommendation 2	<i>The IRP recommend that at the Extraction Plan stage, an assessment of the likely stability of cliff formations at pinch points is included in the protection zone sizing strategy on a case by case basis to recognise the particular sensitivities of individual cliff formations, particularly cliff height and cliff geometry, to mining induced ground movements and to manage the range of other influences that can affect cliff line stability other than just vertical subsidence.</i> <u>Centennial Response Commitment:</u> As part of the Extraction Plan Process, Centennial Airly will include an assessment of the likely stability of cliff formations at pinch points on the protection zone sizing strategy	<i>Not relevant to this Extraction Plan</i> First workings all long-term stable Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)

Relevant Section	Requirement	Where Addressed
IRP Recommendation 3	<i>A program of further work is recommended at the Extraction Plan stage to confirm the loading distributions in the vicinity of steeply dipping terrain below high cliffs where pillar splitting-and-quarterming is proposed does not lead to loading conditions significantly higher than the tributary area loading used in the various assessments.</i> <u>Centennial Response Commitment:</u> As part of the Extraction Plan, Centennial Airly will confirm the loading distributions in the vicinity of steeply dipping terrain below high cliffs where pillar splitting-and-quarterming is proposed.	<i>Not relevant to this Extraction Plan</i>
IRP Recommendation 4	<i>Issues of public safety and how they will be managed in the vicinity of internal cliffs into the future does not appear to have been specifically addressed and would need to be addressed at EP stage</i> <u>Centennial Response Commitment:</u> As part of the Extraction Plan, Centennial Airly will develop a Public Safety Management Plan to identify management of public safety in the vicinity of internal cliffs.	Appendix 5 – CLZ (ML1814) PSMP
IRP Recommendation 5	<i>The IRP recommend conventional survey monitoring with high confidence far field GPS survey control over the initial three or four panels mined using the panel and pillar mining system in areas remote from sensitive features and at the greatest overburden depth that is practical, ideally greater than 250 m.</i> <u>Centennial Response Commitment:</u> Over initial panel and pillar mining areas, Centennial Airly will adopt both conventional (subsidence lines) and trial a range of non-conventional (remote sensing) subsidence monitoring methods. This will allow Centennial Airly to validate the accuracy and suitability of non-conventional subsidence monitoring methods to measure ground movements as a result of mining activities. Conventional subsidence monitoring lines will be established wherever possible in areas of existing disturbance and in consultation with the National Parks and Wildlife Service to limit impacts on the sensitive environment of the Mugii Murum-ban State Conservation Area in which Centennial Airly operates.	<i>Not relevant to this Extraction Plan</i>
Responses to IRP/IEP (16 July 2016)		
IRP Additional Recommendation 1	<i>The monitoring program should include re-surveys of subsidence across the first mined panels to confirm the significance or otherwise of potential delayed sag subsidence over narrow panels.</i> <u>Centennial Response Commitment:</u> The number and frequency of re-surveys and the appropriate time to cease re-surveys (i.e. when subsidence is deemed to have ceased) will be determined as part of the Extraction Plan to be developed post approval. Such details would be determined in consultation with any post approval Independent Review Panel to ensure that the subsidence impact of both multiple panels and time are properly understood.	<i>Not relevant to this Extraction Plan</i>
IRP Additional Recommendation 2	<i>It is recommended that early panels of each mining system are located in areas where high confidence measurements of the surface movements can be measured across multiple panels so that the ground movements can be confirmed as being <125mm within the survey tolerance.</i> <u>Centennial Response Commitment:</u> The panel and pillar mining system proposed will cover a wide enough area that multiple adjacent panels would be mined. Therefore it will be possible to measure the impacts of multiple panels from this mining system. Section 8.5 of the EIS and Section 8 of the associated Subsidence	<i>Not relevant to this Extraction Plan</i>

Relevant Section	Requirement	Where Addressed
	Impact Assessment mention that the initial mining area of Mount Airly is well suited to the installation of conventional, high confidence subsidence monitoring arrays to establish mining system performance. Airly has committed to carrying out such monitoring on Mount Airly. This would include multiple panel monitoring as well as correlations between surface movements and underground pillar stresses as well as proving the effectiveness of remote monitoring techniques. As the pillar splitting and quartering (shallow zone) and partial pillar extraction systems are only practiced below the cliffs in a narrow perimeter around the outside of the mesa complex, the limited area of these workings does not allow for multiple panels to be arranged side by side. It would not be possible to measure multiple panel impacts. There are some limited opportunities to install conventional subsidence monitoring for workings below the cliffs. Airly has already installed one subsidence monitoring line over the splitting and quartering workings of the 200 Panel which is currently in the post-mining phase of measurements. A further subsidence monitoring line is currently in the approval phase. This is to be located in the area of Airly Gap over the splitting and quartering workings of the 121 panel as committed to in MOD3 of DA162/91. This will monitor from the shallowest extremity to the base of the cliffs in that area to ascertain the movement from the planned extraction depth range of 30-110m and beyond to the base of the cliffs.	
IRP Additional Recommendation 3	<i>The IRP recommend monitoring strategies such as satellite interferometry is conducted across the monitoring area and adjacent areas more than once to develop confidence in the results prior to mining. Broad coverage is a strength of this system.</i> <u>Centennial Response Commitment:</u> Airly has already begun a baseline data collection of the entire mining lease using the Cosma Skymed X band InSAR satellite constellation with data analysis from TRE in Canada. A preliminary stack of 15 images was collected from February to June 2016 and assessed in July 2016. Some indications of movement were detected in the vicinity of the 101A panel that was being extracted at the time providing some initial indications that this technology may be applicable. TRE have indicated that a baseline of around 12-18 months of data is required to increase point density in treed areas and bring accuracy levels down to single digit millimetres. Airly Mine is currently reviewing a proposal to extend the baseline data collection for another 12 months. The ongoing subsidence monitoring program will be detailed within the Extraction Plan. A review of the adequacy of the baseline data and ongoing subsidence monitoring program should form part of the role of the post approval IRP.	Section 4 (Monitoring Program) Appendix 6 – CLZ (ML1814) SMP
IRP Additional Recommendation 4	<i>It is further recommended that mining under significant cliff lines that rely on subsidence being less than 125mm for their protection be delayed until there is monitoring experience to demonstrate that subsidence levels can be maintained at the same or similar levels to those experienced at Clarence Colliery.</i> <u>Centennial Response Commitment:</u> This can be accommodated in the mine plan and addressed through the post approval Extraction Plan.	<i>Not relevant to this Extraction Plan</i> First workings all long-term stable Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)

Relevant Section	Requirement	Where Addressed
IRP Additional Recommendation 5	<i>A probabilistic study to quantify the risks of sink hole formation is recommended in relation to mining in the shallow zone.</i> <u>Centennial Response Commitment:</u> Airly Mine already has two separate reports prepared on the subject of sink hole formation in shallow areas of the mine commissioned as part of the High Risk Activity (HRA) for mining at depths <50m required under the WHS (Mines) Regulation 2014. The risk from such an occurrence was considered to be low. A Public Safety Management Plan is in place for the current Extraction Plan under DA 162/91 that addresses management of sinkhole formation based on the assessment reports. This management plan was also accepted as adequate for the purposes of the HRA notification for shallow workings. Any need for further assessment of the risk of sinkhole formation will be addressed as part of the development of the Extraction Plan for shallow workings post approval.	<i>Not relevant to this Extraction Plan</i>
IRP Additional Recommendation 6	<i>The existing proposed setback for second workings to cliff lines in the vicinity of the New Hartley Shale Mine Potential Interaction Zone is a distance defined by half the depth of cover (or 26.5 degrees). The IRP recommend this be increased by an additional 50m (i.e. half DoC plus 50m) from the top of all significant and internal cliffs in the vicinity of the old workings.</i> <u>Centennial Response Commitment:</u> This can be accommodated in the mine plan and addressed through the post approval Extraction Plan.	<i>Not relevant to this Extraction Plan</i> The New Hartley Shale Mine Potential Interaction Zone is not within the current Extraction Plan Area
Additional Note	In addition to the (above) recommendations, it should be noted that the IRP Report does suggest that the Airly MEP proposed mine plan no longer involves pillar lifting as an extraction method (i.e. the partial pillar extraction zone). Although it is not currently proposed to undertake partial pillar extraction as originally proposed in the EIS, this mining method is still considered a potential option should it be considered appropriate. Any future use of this mining method will be considered as part of a future Extraction Plan and subject to review and consideration of any subsidence impacts by the post approval Independent Review Panel. Not using the partial pillar extraction method would result in less impact than originally predicted in the EIS and therefore not be a significant change to the project. The impacts to the mine plan would be as follows: • The shallow zone increase in size to move up to the maximum assessed depth of 110m; • The Cliff Line Zone of First Workings increases in size to the slopes below the cliffs to a depth of 110m; Subsidence would reduce from the maximum predicted value of 49mm at the maximum assessed depth of 100m (table 10 Golder 2014) for single sided lifting partial pillar extraction to 25.5mm at a comparative depth for splitting and quartering with a worst case including post mining flooding. Splitting and Quartering with no post mining flooding at 110m depth is predicted to have 20mm or less subsidence (Section 7 Golder 2014 SIA).	<i>Not relevant to this Extraction Plan</i>

2 MINING LEASES

Airly Mine operates under 2 leases. ML1331 and ML1814. Approved mining authorities granted under the NSW Mining Act 1992 held for Airly Mine include Mining Lease ML1331 and ML1814.

ML1331 was renewed in May 2014 and last varied on 1 September 2022 (which came into effect on 17 October 2022) to modernise the lease conditions and align with the prescribed standard conditions in the Mining Regulation 2016, Schedule 8A, Part 2.

ML1814 was granted into effect on 22 July 2021.

3 WHS LAWS

The CLZ (ML1814) Extraction Plan and Public Safety Management Plan for CLZ (ML1814) has been prepared in general accordance with the requirements in the Managing Risks of Subsidence Guideline (NSW RR, 2017). This publication provides a summary of key provisions under the Work Health and Safety Act 2011 (WHS Act), Work Health and Safety Regulation 2011 (WHS Regulation), Work Health and Safety (Mines and Petroleum Sites) Act 2013 (WHSMP Act) and the Work Health and Safety (Mines and Petroleum Sites) Regulation 2022 (WHSMP Regulation) as interpreted by the Department of Industry – Resources Regulator (Mine Safety) at the time of writing (February 2017).

The following section, including **Table 3.1** and **Table 3.2**, summarises key requirements of relevant Regulations under Work Health and Safety legislation applicable to mines.

Management of Risks to Health and Safety

Under section 14(1) of the WHSMP Regulation, a PCBU at a mine, including the mine operator, *must manage risks to health and safety associated with mining operations* at the mine in accordance with Part 3.1 of the Work Health and Safety Regulation 2011 (WHS Regulation). Specifically, under section 70(1) of the WHSMP Regulation, the mine operator of an underground coal mine *must, in complying with section 14, manage risks to health and safety associated with subsidence¹ at the mine*.

Section 70(2) sets out specific requirements in relation to subsidence as:

“..the mine operator must ensure that--

- a) so far as is reasonably practicable, the rate, method, layout, schedule and sequence of mining operations do not put the health and safety of any person at risk from subsidence, and*
- b) monitoring of subsidence is conducted, including monitoring of its effects on relevant surface and subsurface features, and*
- c) any investigation of subsidence and any interpretation of subsidence information is carried out only by a competent person, and*
- d) all subsidence monitoring data is provided to the regulator in the approved manner and form and at the times required by the regulator, and*

¹ The WHSMP Regulation defines subsidence as meaning “the deformation or displacement of any part of the ground surface or subsurface strata caused by the extraction of minerals”. Such deformation or displacement has potential to cause hazardous conditions, which must be controlled to ensure, so far as is reasonably practicable, that the health and safety of workers and other persons is not put at risk from subsidence.

- e) *so far as is reasonably practicable, procedures are implemented for the effective consultation, co-operation and co-ordination of action with respect to subsidence between the mine operator and relevant persons conducting any business or undertaking that is, or is likely to be, affected by subsidence.*

These requirements have been considered and are addressed throughout this Cliff Line Zone of First Workings Extraction Plan (ML1814).

Potential Risks to the Safety of Others

Section 19 of the Work Health and Safety Act 2011 (WHS Act) requires that all persons conducting a business or undertaking (PCBUs), including mine operators under the Work Health and Safety (Mines and Petroleum Sites) Act 2013, *must ensure, so far as is reasonably practicable,.. that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.*

In particular, the following is noted for public safety and the “safety of others”:

Public Safety: Feedback from detailed stakeholder consultation since the MEP EIS (pre 2014) and the dedicated *Subsidence and Environmental Risk Assessment* undertaken for the CLZ (ML1814) EP, provide key supporting information in the management of public safety which informed development the CLZ (ML1814) PSMP. Appropriate monitoring to support the CLZ (ML1814) PSMP and the CLZ (ML1814) Master TARP for the identified potential risks has been considered during development of the CLZ (ML1814) SMP.

Centennial Personnel and Contractor Safety: The safety of Centennial personnel and contractors engaged by the mine working in the EP Area are managed under the Airly Mine Safety Management System. This includes (but is not limited to) detailed safety communication, training and induction processes for all personnel and contractors, a dedicated *Contractor Management Plan* and supporting *Contractor Work Authorisation Permit* process.

High Risk Activity

The proposed workings are not defined as a High Risk Activity in relation to subsidence in Schedule 3 of the WHSMP Regulation.

Subsidence as a Principal Hazard

The mine operator must prepare a Principal Hazard Management Plan (PHMP) for each principal hazard associated with mining operations at the mine in accordance with Section 28 and Schedule 1 of the WHSMP Regulation.

Section 4 of the WHSMP Regulation provides the definition of a principal hazard as:

“..a principal hazard is an activity, process, procedure, plant, structure, substance, situation or other circumstance relating to the carrying out of mining operations or petroleum operations that has a reasonable potential to result in multiple deaths in a single incident or a series of recurring incidents in relation to--

(a) for mining operations--one or more of the following--:

..... (vi) subsidence,.... “

The primary design criteria used by Centennial Airly to achieve the performance outcomes, from a surface subsidence perspective, are limiting long-term subsidence nominally to not more than 125mm with minimal associated tilts and strains. The mine design factors are discussed in **Section 3.1 (Extraction Plan Main Report)**

and assessed in the specialist reports *Pillar Geometry Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a)* and the addendum *Cliff Line Zone Pillar Design Review for an Increased Extraction Height (SCT, 2023b)*, provided as *Attachment E*.

Given these design factors and detailed investigations assessing relevant risks, it is considered that there is no reasonable potential to cause multiple deaths from such a system. Accordingly, the **proposed mining within the EP Area is not considered a principal hazard** under the above WHS requirements. Notwithstanding, the *Public Safety Management Plan for CLZ (ML1814)* has been prepared generally in accordance with the relevant WHS requirements and guidelines and forms the Principal Hazard Management Plan, which is intended to manage potential risks from subsidence, particularly in the context of protection of the “safety of others” (public safety).

Table 3.1. Summary of Additional WHS Regulations Relating to Mine Subsidence

WHS Legislation Clause	Requirement	Where Addressed
WHS Regulation 2011 Clause 34	Duty to Identify Hazards: A duty holder, in managing risks to health and safety, must identify reasonably foreseeable hazards that could give rise to risks to health and safety.	Section 2.3 (Risk Assessment) Attachment C – Subsidence and Environmental Risk Assessment <i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i>
WHS Regulation 2011 Clause 35	Managing Risks to Health and Safety: A duty holder, in managing risks to health and safety, must: (a) eliminate risks to health and safety so far as is reasonably practicable, and (b) if it is not reasonably practicable to eliminate risks to health and safety, minimise those risks so far as is reasonably practicable.	Section 2.3 (Risk Assessment) Attachment C – Subsidence and Environmental Risk Assessment <i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i>
WHS Regulation 2011 Clause 36	Hierarchy of Control Measures: (1) This clause applies if it is not reasonably practicable for a duty holder to eliminate risks to health and safety. (2) A duty holder, in minimising risks to health and safety, must implement risk control measures in accordance with this clause. (3) The duty holder must minimise risks, so far as is reasonably practicable, by doing 1 or more of the following: (a) substituting (wholly or partly) the hazard giving rise to the risk with something that gives rise to a lesser risk, (b) isolating the hazard from any person exposed to it, (c) implementing engineering controls. (4) If a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by implementing administrative controls. (5) If a risk then remains, the duty holder must minimise the remaining risk, so far as is reasonably practicable, by ensuring the provision and use of suitable personal protective equipment. Note. A combination of the controls set out in this clause may be used to minimise risks, so far as is reasonably practicable, if a single control is not sufficient for the purpose.	Section 2.3 (Risk Assessment) Section 3.1 (Mine Planning and Design) Section 4 (Monitoring Program) Attachment C – Subsidence and Environmental Risk Assessment <i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i>
WHS Regulation 2011	Maintenance of Control Measures:	Section 3.1 (Mine Planning and Design)

WHS Legislation Clause	Requirement	Where Addressed
Clause 37	A duty holder who implements a control measure to eliminate or minimise risks to health and safety must ensure that the control measure is, and is maintained so that it remains, effective, including by ensuring that the control measure is and remains: (a) fit for purpose, and (b) suitable for the nature and duration of the work, and (c) installed, set up and used correctly.	Appendix 6 – CLZ (ML1814) SMP Appendix 7 –CLZ (ML1814) Master TARP
WHS Regulation 2011 Clause 38	Review of Control Measures: (1) A duty holder must review and as necessary revise control measures implemented under this Regulation so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health or safety. (2) Without limiting subclause (1), the duty holder must review and as necessary revise a control measure in the following circumstances: (a) the control measure does not control the risk it was implemented to control so far as is reasonably practicable, (b) before a change at the workplace that is likely to give rise to a new or different risk to health or safety that the measure may not effectively control, (c) a new relevant hazard or risk is identified, (d) the results of consultation by the duty holder under the Act or this Regulation indicate that a review is necessary, (e) a health and safety representative requests a review under subclause (4). (3) Without limiting subclause (2) (b), a change at the workplace includes: (a) a change to the workplace itself or any aspect of the work environment, or (b) a change to a system of work, a process or a procedure. (4) A health and safety representative for workers at a workplace may request a review of a control measure if the representative reasonably believes that: (a) a circumstance referred to in subclause (2) (a), (b), (c) or (d) affects or may affect the health and safety of a member of the work group represented by the health and safety representative, and (b) the duty holder has not adequately reviewed the control measure in response to the circumstance.	Section 2.3 (Risk Assessment) Section 3.1 (Mine Planning and Design) Section 4 (Monitoring Program) <i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Attachment C – Subsidence and Environmental Risk Assessment Appendix 7 –CLZ (ML1814) Master TARP
WHS Regulation (Mines and Petroleum Sites) 2022 Section 14	Management of Risks to Health and Safety (CI 617 model WHS Regulations): (1) A person conducting a business or undertaking at a mine must manage risks to health and safety associated with mining operations at the mine in accordance with Part 3.1 of the WHS Regulations. (2) A person conducting a business or undertaking at a mine must ensure that a risk assessment is conducted in accordance with this clause by a person who is competent to conduct the particular risk assessment having regard to the nature of the hazard. (3) In conducting a risk assessment, the person must have regard to: (a) the nature of the hazard, and	Attachment C – Subsidence and Environmental Risk Assessment

WHS Legislation Clause	Requirement	Where Addressed
	(b) the likelihood of the hazard affecting the health or safety of a person, and (c) the severity of the potential health and safety consequences. (4) Nothing in subclause (3) limits the operation of any other requirement to conduct a risk assessment under this Regulation. (5) A person conducting a business or undertaking at a mine (who is the mine operator of the mine or who is a contractor) must keep a record of the following: (a) each risk assessment conducted under this clause and the name and competency of the person who conducted the risk assessment, (b) the control measures implemented to eliminate or minimise any risk that was identified through any such risk assessment. (6) A person conducting a business or undertaking at a mine is not required to keep a record of a risk assessment if: (a) the risk assessment is one that an individual worker is required to carry out before commencing a particular task, and (b) the person keeps a record of risk assessments that addresses the overall activity being undertaken (of which the task forms a part) such as risk assessments carried out in relation to the development of the safety management system for the mine or for a principal mining hazard management plan. (7) The record kept under subclause (5) by an operator of a mine or petroleum site forms part of: (a) the safety management system of a mine or petroleum site, and (b) the records of the mine or petroleum site (8) A record, kept under subsection (5) by a contractor who has prepared a contractor health and safety management plan, forms part of the plan	
WHS Regulation (Mines and Petroleum Sites) Section 15	Review of Control Measures (CI 618 Model WHS Regulations): (1) A person conducting a business or undertaking at a mine must review and as necessary revise control measures implemented under clause 9 in the following circumstances: (a) an audit of the effectiveness of the safety management system for the mine indicates a deficiency in a control measure, (b) a worker is moved from a hazard or assigned to different work in response to a recommendation contained in a health monitoring report provided under Part 4, (c) an incident referred to in section 124 occurs, (d) any other incident occurs that is required to be notified to the regulator under the WHS laws. (2) The mine operator of a mine must ensure that a control measure that is the subject of a request by a health and safety representative under clause 38 (4) of the WHS Regulations is reviewed and as necessary revised, whether the request is made to the mine operator or notified to the mine operator under subclause (3) by another person conducting a business or undertaking at the mine. (3) A person conducting a business or undertaking at the mine who is not the mine operator of the mine must immediately notify the mine operator of a request made to the person under clause 38 (4) of the WHS Regulations.	Section 2.3 (Risk Assessment) Section 3.1 (Mine Planning and Design) Section 4 (Monitoring Program) <i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Attachment C – Subsidence and Environmental Risk Assessment Appendix 7 –CLZ (ML1814) Master TARP

WHS Legislation Clause	Requirement	Where Addressed
	(4) A health and safety representative for workers at the mine may request a review of a control measure under clause 38 (4) of the WHS Regulations as if the circumstances referred to in subclause (1) were included as a circumstance in clause 38 (4) (a) of the WHS Regulations.	
WHS Regulation (Mines and Petroleum Sites) 27 <i>Identification of principal mining hazard management plan</i>	(1) The mine operator of a mine must identify all principal mining hazards associated with mining operations at the mine. (2) The mine operator must conduct, in relation to each principal mining hazard identified, a risk assessment that involves a comprehensive and systematic investigation and analysis of all aspects of risk to health and safety associated with the principal mining hazard. (3) The mine operator, in conducting a risk assessment under subclause (2), must: (a) use investigation and analysis methods that are appropriate to the principal mining hazard being considered, and (b) consider the principal mining hazard individually and also cumulatively with other hazards at the mine.	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Attachment C – Subsidence and Environmental Risk Assessment Centennial Risk Management System – consistent with AS/NZS ISO 31000:2009 Independent Expert Panel (IEP) Review
WHS Regulation (Mines and Petroleum Sites) Section 28 <i>Preparation of principal mining hazard management plan</i>	(1) The mine operator of a mine must consider the following when preparing a principal mining hazard management plan for a principal mining hazard at the mine in accordance with this clause and Schedule 1. (2) A principal mining hazard management plan must: (a) provide for the management of all aspects of risk control in relation to the principal mining hazard, and (b) so far as is reasonably practicable, be set out and expressed in a way that is readily understandable by persons who use it. (3) A principal mining hazard management plan must: (a) describe the nature of the principal mining hazard to which the plan relates, and (b) describe how the principal mining hazard relates to other hazards associated with mining operations at the mine, and (c) describe the analysis methods used in identifying the principal mining hazard to which the plan relates, and (d) include a record of the most recent risk assessment conducted in relation to the principal mining hazard, and (e) describe the investigation and analysis methods used in determining the control measures to be implemented, and (f) describe all control measures to be implemented to manage risks to health and safety associated with the principal mining hazard, and (g) describe the arrangements in place for providing the information, training and instruction required by clause 39 of the WHS Regulations in relation to the principal mining hazard, and (h) refer to any design principles, engineering standards and technical standards relied on for control measures for the principal mining hazard, and (i) set out the reasons for adopting or rejecting each control measure considered. (4) The mine operator of a mine must consider the following when preparing a principal mining hazard management plan for a principal mining hazard at the mine:	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) <i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Attachment C – Subsidence and Environmental Risk Assessment

WHS Legislation Clause	Requirement	Where Addressed
	(a) the matters set out in Schedule 1 in respect of the principal mining hazard, and (b) any other matter relevant to managing the risks associated with the principal mining hazard at the mine. (5) The operator of a mine or petroleum site at which there is a principal hazard must ensure no mining operations or petroleum operations are carried out at the mine or petroleum site that may give rise to the hazard before the principal hazard management plan for the hazard has been prepared in accordance with this section.	
WHS Regulation (Mines and Petroleum Sites) 70 <i>Subsidence</i>	(1) In complying with section 14, the mine operator of an underground coal mine must manage risks to health and safety associated with subsidence at the mine. (2) Without limiting subclause (1), the mine operator must ensure that: (a) so far as is reasonably practicable, the rate, method, layout, schedule and sequence of mining operations do not put the health and safety of any person at risk from subsidence, and (b) monitoring of subsidence is conducted, including monitoring of its effects on relevant surface and subsurface features, and (c) an investigation of subsidence and any interpretation of subsidence information is carried out only by a competent person, and (d) all subsidence monitoring data is provided to the regulator in the form and at the times required by the regulator, and (e) so far as is reasonably practicable, procedures are implemented for the effective consultation, co-operation and co-ordination of action with respect to subsidence between the mine operator and relevant persons conducting any business or undertaking that is, or is likely to be, affected by subsidence	Section 2.3 (Risk Assessment) Section 3.1 (Mine Planning and Design) Section 4 (Monitoring Program) <i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Attachment C – Subsidence and Environmental Risk Assessment Appendix 7 –CLZ (ML1814) Master TARP
WHS Regulation (Mines and Petroleum Sites) Section 124 <i>Duty to notify regulator of certain incidents</i>	(1) The operator of a mine or petroleum site must take all reasonable steps to ensure that the regulator is notified in accordance with this clause after becoming aware of an incident (other than a notifiable incident) arising out of the carrying out of mining operations or petroleum operations at the mine or petroleum site, but only if the incident: (a) results in illness or injury that requires medical treatment within the meaning of Schedule 9, Section 12 or (b) is a high potential incident. (6) In this section 5: <i>high potential incident</i> means any of the following: an indication from monitoring data of the development of subsidence which may result in any incident referred to in clause 190 (1) (p) - a failure of ground, or of slope stability control measures, or 190 (1) (q) - rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations or release of gas at the surface, due to subsidence.	Section 5.6 (Incidents, Complaints, Exceedances and Non-compliances) Section 5.7 (Reporting and Auditing) Appendix 7 –CLZ (ML1814) Master TARP Airly Mine Safety Management System
WHS Regulation (Mines and Petroleum Sites) Schedule 1 Subsidence	Subsidence: The following matters must be considered in developing the control measures to manage the risks of subsidence: (a) the characteristics of all relevant surface and subsurface features,	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i>

WHS Legislation Clause	Requirement	Where Addressed
Section 6 3C <i>Principal hazard management plans – additional matters to be considered</i>	(b) the characteristics of all relevant geological, hydrogeological, hydrological, geotechnical, topographic and climatic conditions, including any conditions that may cause elevated or abnormal subsidence or the formation of sinkholes, (c) the characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings, (d) the existence, distribution, geometry and stability of significant voids, standing pillars or remnants within any old pillar workings that may interact with any proposed or existing mine workings, (e) the predicted and actual nature, magnitude, distribution, timing and duration of subsidence, (f) the rate, method, layout, schedule and sequence of mining operations.	Appendix 5 – CLZ (ML1814) PSMP Appendix 7 –CLZ (ML1814) Master TARP Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
WHS Regulation (Mines) 2014 Schedule 1 Clause 9	Subsidence: The following matters must be considered in developing the control measures to manage the risks of subsidence: (a) the characteristics of all relevant surface and subsurface features, (b) the characteristics of all relevant geological, hydrogeological, hydrological, geotechnical, topographic and climatic conditions, including any conditions that may cause elevated or abnormal subsidence or the formation of sinkholes, (c) the characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings, (d) the existence, distribution, geometry and stability of significant voids, standing pillars or remnants within any old pillar workings that may interact with any proposed or existing mine workings, (e) the predicted and actual nature, magnitude, distribution, timing and duration of subsidence, (f) the rate, method, layout, schedule and sequence of mining operations.	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Appendix 5 – CLZ (ML1814) PSMP Appendix 7 –CLZ (ML1814) Master TARP Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
WHS Regulation (Mines and Petroleum Sites) Schedule 3 Section 17 <i>High Risk Activities</i>	Secondary Extraction or Pillar Extraction, Splitting or Reduction: (1) Secondary extraction is identified as a high risk activity. The following are identified as high risk activities: (a) secondary extraction by longwall mining, shortwall mining or miniwall mining, (b) pillar extraction, (c) pillar splitting, (d) pillar reduction. (2) The waiting period for any such activity is 3 months. (3) The information and documents that must be provided in relation to any such activity are as follows: (a) details of the authoritative sources used in determining that the proposed method of work can be done safely, (b) engineering plans showing the manner and sequence of extraction, endorsed by the individual nominated to exercise the statutory function of mining engineering manager at the mine,	<i>Not relevant to this Extraction Plan</i> First workings only

WHS Legislation Clause	Requirement	Where Addressed
	(c) information about the land above or in the vicinity of the proposed activity including land use and details of who owns or occupies any land that may be affected by subsidence, (d) in the case of a pillar extraction, details of the procedures for the recovery of buried and immobile mining plant in or around a goaf, (e) details of how the risks to the health and safety of workers and other persons from subsidence caused by the activity will be managed.	
WHS Regulation (Mines) 2014 Schedule 3 Section 18 <i>High Risk Activities</i>	Shallow Depth of Cover Mining: (1) Mining operations in locations where the <u>depth of cover is less than 50 metres</u> is identified as a high risk activity. (2) The waiting period for the activity is 3 months. (3) The information and documents that must be provided in relation to the activity are as follows: (a) an engineering drawing of the activity, endorsed by the individual nominated to exercise the statutory function of mining engineering manager at the mine, (b) survey plans certified by an individual nominated to exercise the statutory function of mining surveyor at the mine, (c) a geotechnical report on the activity, (d) information on how the risks to the health and safety of workers and other persons from the potential formation of sinkholes will be managed.	Not relevant to this Extraction Plan Minimum depth of cover is greater than 50 metres

Table 3.2: Requirements of the Managing Risks of Subsidence Guideline (WHS Mines and Petroleum Legislation), NSW Department of Industry Resources Regulator (Mine Safety), 2017

Referenced Section	Guideline Requirement	Where Addressed
Primary Duty of Care to 'Other Persons' (S1.2, S2.1)	Under Section 19 of the Work Health and Safety Act 2011 (WHS Act) all persons conducting a business or undertaking (PCBUs), including mine operators, must ensure, so far as is reasonably practicable that: • all persons conducting a business or undertaking (PCBUs), including mine operators, must ensure, so far as is reasonably practicable, the health and safety of workers they engage or cause to be engaged, or whose work activities they influence or direct.	Airly Mine Safety Management System Appendix 5 – CLZ (ML1814) PSMP
	• that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.	Appendix 5 – CLZ (ML1814) PSMP Attachment C – Subsidence and Environmental Risk Assessment
Subsidence (S1.3)	The Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (WHSMP Regulation), defines subsidence as meaning “ <i>the deformation or displacement of any part of the ground surface or subsurface strata caused by the extraction of minerals</i> ”. Such deformation or displacement has potential to cause hazardous conditions, which must be controlled to ensure, so far as is reasonably practicable, that the health and safety of workers and other persons is not put at risk from subsidence.	Appendix 5 – CLZ (ML1814) PSMP Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
Managing Risks of Subsidence	Under clause 67(1) of the WHSMP Regulation (2014), the operator of an underground coal mine must manage risks to health and safety associated with subsidence at the mine. Clause 67(2) sets out specific requirements in	Appendix 5 – CLZ (ML1814) PSMP Attachment C – Subsidence and Environmental Risk Assessment

Referenced Section	Guideline Requirement	Where Addressed
(Overview) (S2.1); and Scope of Subsidence Risk Management (S2.2)	relation to subsidence.	
Scope of Subsidence Risk Management (S2.2) Mining Operations Where Risk Management Is Required (S2.2.1)	In defining the scope of subsidence risk management for a particular mining operation, the mine operator must consider all risks to health and safety associated with subsidence at the mine. The mine operator of an underground coal mine must manage risks of subsidence due to: (1) Secondary extraction by longwall mining, shortwall mining or miniwall mining (2) Pillar extraction, pillar splitting or pillar reduction; (3) Shallow depth of cover mining where the depth of cover is less than 50m, irrespective of first or secondary workings; (4) Highwall mining; and (5) Any other circumstances where underground coal mining may lead to subsidence, for example, subsidence observed above first workings as a result of excessive settlement of pillars on weak claystone floor strata.	Appendix 5 – CLZ (ML1814) PSMP Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
Surface and Subsurface Features Where Risk Management is Required (S2.2.2)	The surface and subsurface features refer to features which could give rise to risks to health and safety, if the features are affected by subsidence. The surface and subsurface features include: (1) Public utilities (e.g. highways, railways, tunnels, bridges, air strips, electrical transmission infrastructure or pressurised gas pipelines), (2) Public amenities (e.g. shopping centres, hospitals, churches, sport facilities, child care centres or schools), (3) Built features other than public utilities and amenities (e.g. dwellings, factories, workshops, privately owned gas storages or surface mining voids or facilities), and (4) Natural features (e.g. cliffs, steep slopes, natural caves or dams or surface of land), where subsidence may result in hazardous conditions due to instability of rock or soil masses, rock falls, landslide, fractures, sinkholes, inundation, gas release or pollution of drinking water.	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Appendix 5 – CLZ (ML1814) PSMP Attachment C – Subsidence and Environmental Risk Assessment
Area Requiring Risk Management (S2.2.3)	The area requiring risk management is defined by the areal distribution of relevant and appropriate components of subsidence. For example, the use of the vertical displacement may not be relevant and appropriate to define an area if the risks from the development of horizontal displacement need to be managed. In practice, the areal distribution of horizontal displacement can be noticeably different from the vertical displacement. When defining the area where risk management is required, consideration should be given to any factors that may cause the development of far-field subsidence, such as: (1) Overlying or underlying mine workings, in particular, old pillar workings, (2) Topographic characteristics of the land, (3) Nature and magnitude of horizontal stress field,	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Appendix 5 – CLZ (ML1814) PSMP Appendix 6 – CLZ (ML1814) SMP Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)

Referenced Section	Guideline Requirement	Where Addressed
	(4) Geological structures, and (5) Complexities or anomalies in overburden geological or geotechnical conditions. The intensity of risk management across the area may vary depending on the nature, likelihood, potential consequences and complexity of subsidence hazards at any particular location within the area where risk management is required.	
Period Requiring Risk Management (S2.2.4)	The period requiring risk management is defined from the onset of subsidence to a point in time when risks of subsidence have become negligible to the health and safety of people. The definition should be made based on relevant and appropriate components of subsidence. For example, the period requiring risk management for bridges affected by subsidence may need to be defined by considering valley closures and horizontal displacement, which may commence earlier and finish later than vertical subsidence. When defining the period of risk management, consideration should be given to any factors that may cause the development of long-term subsidence or delayed subsidence, such as: (1) Overlying or underlying mine workings, in particular, old pillar workings, (2) Topographic characteristics of the land, (3) Nature and magnitude of horizontal stress field, (4) Geological structures, (5) Climate conditions, (6) Water in the mine workings, and (7) Complexities or anomalies in overburden, roof or floor geological or geotechnical conditions, in particular, the nature and existence of claystone in the floor or roof strata, which have a potential for strength deterioration over time. The intensity of risk management may vary depending on the nature, likelihood, potential consequences and complexity of subsidence hazards at any particular time during the period requiring risk management.	Section 3.1 (Mine Planning and Design) Section 4 (Monitoring Program) <i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b) Appendix 5 – CLZ (ML1814) PSMP Appendix 6 – CLZ (ML1814) SMP
Identification and Understanding of Subsidence Hazards (S2.3)	Under clause 34 of the WHS Regulation, a duty holder, including the mine operator, must identify all reasonably foreseeable hazards that could give rise to risks to health and safety. To understand the identified subsidence hazards, the scope of investigation and analysis should include: (1) The nature of the hazards, including their magnitude, location, distribution, timing and duration, (2) The likelihood of the hazards affecting the health or safety of a person, and (3) The severity of the potential health and safety consequences. When identifying, investigating and analysing subsidence hazards, the mine operator should consider the matters set out in sections 2.3.1 to 2.3.4 below	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
Factors Affecting Subsidence Hazards (S2.3.1)	The following factors should be considered when identifying, investigating and analysing subsidence hazards: (1) The characteristics of all relevant surface and subsurface features as set out in section 2.2.2 above, including any known future developments	Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for

Referenced Section	Guideline Requirement	Where Addressed
	(e.g. sub-divisions or other improvements) within the area where risk management is required, (2) The characteristics of the mining operation, including the rate, method, layout, schedule and sequence of mining operations, the thickness of the seam to be mined, extraction height and cover depth, (3) The characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings, (4) The existence, distribution, geometry and stability of significant voids, standing pillars or remnants within any old pillar workings that may interact with any proposed or existing mine workings (for further details, refer to section 2.3.3.2 below), (5) The characteristics of all relevant geological, hydrogeological, hydrological, geotechnical, topographical and climatic conditions of the area where risk management is required, including the structural, lithological and geotechnical characteristics of the overburden, inter-burden, floor and roof strata, (6) The characteristics of any conditions that may cause elevated or abnormal subsidence or formation of sinkholes (for further details, refer to section 2.3.3 below), and (7) The predicted and actual nature, magnitude, location, distribution, timing and duration of subsidence.	Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
Uncertainty (S2.3.2)	Uncertainty has the potential to lead to an incomplete, inaccurate, inappropriate or a lack of understanding of subsidence hazards. Consequently, this may affect the basis on which risk control measures will be developed and selected. Generally, uncertainty occurs as a result of: (1) The inherent variations and complexities of the environment within which subsidence risk management takes place. This is often the case where very large volume of heterogeneous rock/soil masses containing numerous geological structures and other discontinuities are deformed as a result of underground coal mining operations, (2) The assumptions used during investigations, analysis or risk assessments, or (3) Available information that: (a) is partial, (b) is vague, (c) consists of an unknown level of accuracy or reliability, (d) is variable or subject to different interpretations, (e) is conflicting or inconsistent, (f) involves factors whose relationship or interaction is unknown, (g) involves a range of possibilities, or (h) changes over time. The characteristics of the above-mentioned information are due to the inherent variations and complexities described above and the nature of subsidence engineering, which often requires input from: (1) Multiple engineering or science disciplines, (2) Multiple organisations or stakeholders, or (3) Multiple phases of investigations with varying qualities.	Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)

Referenced Section	Guideline Requirement	Where Addressed
	Uncertainty is a significant matter when managing risks to health and safety associated with subsidence. It is important to specifically address any uncertainties when managing risks to health and safety associated with subsidence. For further guidance, refer to sections 2.5.3 and 2.7 of this guideline.	
Specific Subsidence Issues (S2.3.3)	The specific subsidence issues refer to conditions that may cause elevated or abnormal subsidence, which may result in an unplanned event that causes harm to people. For example, subsidence that occurs earlier or later than predicted could result in a hazardous condition where no risk control measures have been implemented. Abnormal subsidence means the development of subsidence that is: (1) Different from the predicted nature (e.g. tension or compression), magnitude, location, distribution, timing or duration of subsidence, or (2) Difficult to predict or unexpected in terms of the nature (e.g. tension or compression), magnitude, location, distribution, timing or duration of subsidence. Based on the current industry experience and knowledge, sections 2.3.3.1 to 2.3.3.9 of this guideline provide a non-exhaustive list of situations where there is a potential for the development of abnormal subsidence. The mine operator should ensure that hazard identification, investigation and analysis consider any situation (including the situations set out in sections 2.3.3.1 to 2.3.3.9 below, if relevant), where there is a potential for the development of abnormal subsidence. Specific considerations in risk control (see sections 2.5.3 and 2.7 below) are also necessary in these situations (including those set out in sections 2.3.3.1 to 2.3.3.9 below, if relevant) to ensure that the risk management system is capable of responding to any changes in an adequate and timely manner.	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
	Long Term or Delayed Subsidence (S2.3.3.1): Risk management of long-term subsidence or delayed subsidence is difficult due to uncertainty in the timing and duration of the risks. This is one of the important factors causing the unplanned subsidence impacts previously observed in NSW. The occurrence of either long-term or delayed subsidence is determined by the long-term stability of first workings or partially extracted workings, if these workings are not properly designed taking into consideration the site conditions. Where the long-term stability of first workings or partially extracted workings is required for the protection of surface or subsurface features, the mine operator should ensure the hazards of long-term subsidence or delayed subsidence are adequately identified and assessed taking into consideration: (1) The relevant mine design parameters, such as the layout of mine workings and the geometry and strengths of pillars, (2) The presence and characteristics of water affecting the strata surrounding the mine workings, (3) The structural, lithological and geotechnical characteristics of the overburden, inter-burden, floor and roof strata, in particular, any claystone units in the floor or roof that have a potential for strength degradation when affected by water ingress into the fabric of rocks, and (4) Any conditions that may cause increased loading on the pillars or changes to the stress environment surrounding the mine workings, for	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)

Referenced Section	Guideline Requirement	Where Addressed
	example, interactions with the adjacent old workings or the presence of any spanning massive strata in the roof or overburden	
	Multi-Seam Mining Involving Old Pillar Workings (S2.3.3.2): In the context of managing the risks of subsidence, the old pillar workings refer to: (1) Any overlying old pillar workings, and (2) Certain underlying old pillar workings, which are located within the influence of the stresses induced by any proposed or existing mine workings. The interactions of the old pillar workings with any proposed or existing mine workings have a potential to cause: (1) Far-field subsidence, (2) Elevated subsidence, (3) Irregular distribution of subsidence, or (4) Elevated strains, tilts and curvature resulting from the above-mentioned irregular distribution of subsidence. The hazard identification, investigation and analysis should consider the existence, distribution, geometry and stability of significant voids, standing pillars or remnants within any old pillar workings that may interact with any proposed or existing mine workings.	Not Applicable No previous mining in EP Area (or beyond)
	Multi-seam mining involving previously extracted longwalls (S2.3.3.3)	Not Applicable No previous longwall mining in EP Area (or beyond)
	Massive Strata (S2.3.3.4): Depending on the mechanical strengths and geometrical attributes of the massive strata in relation to the characteristics of the mine layout design, the presence of the massive strata in the roof or overburden has a potential to cause: (1) Reduced subsidence, (2) Far-field subsidence, (3) Complicated loading conditions on pillars, (4) Irregular or abrupt distribution of subsidence, or (5) Elevated strains, tilts and curvature resulting from the irregular or abrupt distribution of subsidence. The reduced subsidence may be of benefit if the mine layout can be appropriately designed in relation to the mechanical and geometrical attributes of the massive strata in the roof or overburden. However, the other above-mentioned effects will cause difficulty or uncertainty in risk management. For example, it will be difficult or impossible to predict the strains or tilts associated with the irregular or abrupt distribution of subsidence.	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
	Creek Crossings, Valleys or Gorges (S2.3.3.5): Underground coal mining beneath or in the vicinity of creek crossings, valleys or gorges, irrespective of their steepness, has a potential to cause: (1) Valley closure, and (2) Upsidence of the valley floor.	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for

Referenced Section	Guideline Requirement	Where Addressed
	Valley closure and upsidence may develop outside the normal distribution limit of the vertical displacement. Any built features or public utilities (e.g. bridges or high pressurised gas pipelines) that are located across or on the floor of these topographic features may be subject to elevated and complicated stress conditions that may exceed their design capacities for managing risks to health and safety. Creek crossings, valleys or gorges are sometimes surface expressions of geological structures (e.g. faults). In these cases, specific considerations in risk control (see sections 2.5.3 and 2.7 below) are important as it may be difficult to understand the nature of the risks prior to the development of subsidence.	Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
	Steep Topography (S2.3.3.6): Underground coal mining in areas with steep topography has a potential to: (1) Cause tensile strains on the hill tops or along the valley sides, resulting in hazardous conditions such as damage to built features, rock falls or slope instability, (2) Contribute to the development of valley closure, or (3) Contribute to the development of upsidence of the valley floor. The complex effects of steep topography on subsidence development are not at present commonly considered across the coal mining industry. As a result, there is a potential for unplanned events when undertaking underground coal mining in areas with steep topography. The effects of steep topography on subsidence development should be considered by the mine operator as part of the hazard identification, investigation and analysis.	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
	Geological Features (S2.3.3.7): Geological structures, in particular, faults, folds, sills or dykes, are one of the most important factors causing the development of abnormal subsidence. The hazard identification, investigation and analysis should consider the geological structures on both regional and local scales, as relevant	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
	Sinkhole Formations (S2.3.3.8): Sinkholes, or potholes, are the most hazardous form of subsidence because: (1) Their impacts on any affected surface or subsurface features are likely to occur rapidly or abruptly, (2) Any surface or subsurface features located within the areas affected by a sinkhole are likely to be severely damaged resulting in hazardous conditions, and (3) It is difficult to predict or monitor the timing of the impact of sinkhole formation. In NSW, sinkholes have generally been observed above partially extracted workings, including first workings, under the depth of cover generally less than 50 metres. The geological, geotechnical, hydrogeological and climatic conditions are known to be the important factors for sinkhole formation, which should be considered as part of the hazard identification, investigation and analysis	Not Applicable Minimum Depth of Cover is greater than 50 metres
	Shear Strain (S2.3.3.9): Shear strain is one of the components of deformation. However, shear strain has not been recognised in the conventional subsidence engineering theories	Section 3.1 (Mine Planning and Design)

Referenced Section	Guideline Requirement	Where Addressed
	and the coal mining industry has not commonly considered it when managing risks of subsidence. Therefore, it has a potential to cause unplanned events. In recent years, investigations have established evidence that shear strain is an inherent component of subsidence. The investigations have also shown that shear strain is a significant factor that causes damage to dwellings or other built structures in areas with deep cover depths, where the conventional horizontal strains may otherwise indicate a low level of risks. Shear strain should be considered as part of the hazard identification, investigation and analysis	Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
Procedures and Outcomes (S2.3.4)	Under clause 67(2)(c) of the WHSMP Regulation, the mine operator of an underground coal mine must ensure that any investigation of subsidence and any interpretation of subsidence information are carried out only by a competent person The mine operator of an underground coal mine should identify, investigate and analyse all reasonably foreseeable subsidence hazards by considering the matters set out in sections 2.3.1 to 2.3.3 above (as relevant), as well as any other relevant site-specific factors associated with subsidence at the mine.	
	The outcomes of the subsidence hazard identification, investigation and analysis should detail: (1) The mine operator’s understanding of all identified subsidence hazards, including: (a) The nature of the hazards, including their magnitude, location, distribution, timing and duration, (b) The likelihood of the hazards affecting the health or safety of a person, and (c) The severity of the potential health and safety consequences, (2) Any limitations and assumptions used in the investigation and analysis, (3) Any identified site-specific factors that have a potential to cause the development of abnormal subsidence, and (4) Any identified site-specific factors that may cause uncertainty which may potentially lead to incomplete, inaccurate, inappropriate or even a lack of understanding of subsidence hazards. Importantly, the mine operator should consider the above-mentioned details (see items (1) to (4) above) when: (1) Developing risk scenarios to manage uncertainty (refer to section 2.5.3 below), (2) Managing change and continual improvement to risk management (refer to section 2.7 below), or (3) Designing the subsidence monitoring program (refer to section 2.9 below).	Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
Assessment of Risks of Subsidence (S2.4)	Under clause 9(2) of the WHSMP Regulation, a PCBU at a mine, including the mine operator, must ensure that a risk assessment is conducted in accordance with clause 9 by a person who is competent to conduct the particular risk assessment having regard to the nature of the hazard.	Attachment C – Subsidence and Environmental Risk Assessment
	In conducting a risk assessment, the mine operator should have regard to the outcomes of subsidence hazard identification, investigation and analysis as set out in section 2.3.4 above.	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment

Referenced Section	Guideline Requirement	Where Addressed
		Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
	The participation in subsidence risk assessment by the stakeholders, such as authorities or operators of public utilities or amenities, is essential to ensure the validity and adequacy of the risk assessment. Further guidance on consultation, co-operation and co-ordination is provided in section 2.8 of this guideline.	Attachment C – Subsidence and Environmental Risk Assessment
	In undertaking a risk assessment, the mine operator may refer to the relevant publications, such as AS/NZS ISO 31000:2009 and SA/SNZ HB 436:2013, and specific standards adopted by stakeholders.	Attachment C – Subsidence and Environmental Risk Assessment
	Under clause 9(5) of the WHSMP Regulation, the mine operator (or a PCBU at a mine, who is a contractor) must keep a record of the following: (1) Each risk assessment conducted and the name and competency of the person who conducted the risk assessment, and (2) The control measures implemented to eliminate or minimise any risk that was identified through any such risk assessment. However, under clause 9(6) of the WHSMP Regulation, a PCBU at a mine is not required to keep a record of the risk assessment if: (a) the risk assessment is one that an individual worker is required to carry out before commencing a particular task, and (b) the person keeps a record of risk assessments that addresses the overall activity being undertaken, such as risk assessments carried out in relation to the development of the safety management system (SMS) or for a PHMP.	Attachment C – Subsidence and Environmental Risk Assessment
Development & Selection of Risk Control Measures (S2.5)	In complying with Part 3.1 of the WHS Regulation, the mine operator must develop and implement risk control measures that: (1) Eliminate risks to health and safety so far as reasonably practicable; and (2) If it is not reasonably practicable to eliminate risks to health and safety - minimise those risks so far as is reasonably practicable. The various ways of controlling risks can be ranked from the highest level of protection and reliability to the lowest. This is referred to as the hierarchy of control measures. The mine operator must apply the hierarchy of control measures to manage the risks to health and safety in accordance with clause 36 of the WHS Regulation.	Attachment C – Subsidence and Environmental Risk Assessment
	When applying the hierarchy of control measures to manage the risks of subsidence, the mine operator should consider: (1) All possible risk control measures for the identified subsidence hazards (refer to sections 2.3 and 2.4 above), and (2) The underground coal mine, including the rate, method, layout, schedule and sequence of mining operations, as one of the available risk control measures pursuant to clause 67(2)(a) of the WHSMP Regulation. For more information, refer to section 3.5.1 and Appendix A of this guideline. The mine operator should work through the hierarchy to ensure that the most effective and reliable risk control measures are developed and selected for implementation.	Attachment C – Subsidence and Environmental Risk Assessment

Referenced Section	Guideline Requirement	Where Addressed
Selection of Risk Control Measures to be Implemented Before or During Subsidence Development (S2.5.2)	There are primarily two different methods to control the risks of subsidence, namely: Method A – Selection of risk control measures to be implemented prior to the development of subsidence, and Method B – Selection of risk control measures to be implemented during the development of subsidence. The risk control measures should be implemented in a timely manner in response to the results of monitoring and consultation with stakeholders. A trigger action response plan (TARP) is commonly used by the underground coal mining industry for this method.	Section 3.1 (Mine Planning and Design) Attachment C – Subsidence and Environmental Risk Assessment Appendix 7 –CLZ (ML1814) Master TARP
Control Measures for Risk Scenarios (S2.5.3)	Where there is uncertainty about a subsidence hazard with potentially severe health and safety consequences, it is important to prepare for potential variations in the nature and likelihood of the hazard. The mine operator should establish relevant risk scenarios so that there is preparedness for change, instead of adopting a single management strategy. Effective and reliable risk control measures should be developed and selected for each of the risk scenarios in accordance with section 2.5.1 of this guideline. A contingency plan should be developed and used to implement the risk control measures selected for the risk scenarios, if changes identified by monitoring and stakeholder consultation warrant such implementation.	Section 4 (Monitoring Program) Section 5.1 (Performance Measures and Indicators) Attachment C – Subsidence and Environmental Risk Assessment Appendix 7 –CLZ (ML1814) Master TARP
Implementation and Maintenance of Risk Control Measures – General (S2.6.1)	Under clause 37 of the WHS Regulation, a duty holder, including a mine operator, who implements a control measure to eliminate or minimise risks to health and safety must ensure that the control measure is, and is maintained so that it remains, effective, including by ensuring that the control measure is and remains: (1) Fit for purpose, and (2) Suitable for the nature and duration of the work, and (3) Installed, set up and used correctly. When implementing and maintaining the risk control measures developed in accordance with sections 2.5.1 to 2.5.3 above, the mine operator should: (1) Ensure that the risk control measures are installed, set up and used correctly in terms of: (a) their design specification, (b) operational requirements, and (c) location, timing and duration of implementation or maintenance, (2) Ensure that it is feasible to implement and maintain the risk control measures having regard to: (a) site-specific conditions (e.g. land access to implement and maintain the risk control measures, (b) the weather, in particular, adverse weather conditions, (c) availability of technologies, (d) availability of resources, and (e) availability of time to complete the implementation and maintenance, (3) Have a defined schedule to implement and maintain the risk control measures, (4) Define the accountability of the competent person who implements and maintains the risk control measures,	Section 3.1 (Mine Planning and Design) Appendix 6 – CLZ (ML1814) SMP Appendix 7 –CLZ (ML1814) Master TARP

Referenced Section	Guideline Requirement	Where Addressed
	(5) Measure the progress of implementation and maintenance against the development of subsidence to ensure timely completion of the implementation and maintenance of risk control measures, (6) Ensure that the implementation and maintenance of one group of risk control measures do not adversely affect the functionality and effectiveness of other groups of risk control measures, (7) Monitor the risk control measures to ensure that they remain effective (refer to section 2.9.1 below), (8) Maintain the risk control measures so that they remain effective, (9) Rectify any failures, malfunctions, defects or deterioration of the implemented risk control measures, and (10) Ensure preparedness for change through the implementation of a contingency plan (refer to section 2.5.3 above) so that the risk control remains effective on an on-going basis.	
Trigger Action Response Plan (TARP) (S2.6.2)	A TARP should be put in place only after a risk assessment has verified the selection of the most effective control measures. In managing the risks of subsidence, a TARP may be used where: (1) There is a gradual and slow deteriorating trend in the development of subsidence, (2) The surface and subsurface features have defined tolerances for subsidence, against which certain triggers can be established and used, and (3) It is feasible to implement the selected risk control measures in a timely manner to control the risks during the development of subsidence.	Appendix 7 –CLZ (ML1814) Master TARP
Continual Improvement & Change Management (S2.7)	This section of the guideline is particularly relevant where there is a high level of uncertainty about the nature and likelihood of a subsidence hazard with potentially severe health and safety consequences.	Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
	During the development of subsidence, the mine operator should: (1) Gain an improved understanding of subsidence hazards through: (a) on-going subsidence monitoring and reviews (refer to section 2.9 below), (b) additional investigations and assessments, as necessary, (c) on-going verification of the risk assessments previously conducted, (d) on-going verification of the assumptions used during the subsidence hazard identification, investigation, analysis and risk assessment previously conducted, and (e) on-going update of relevant subsidence and geological database for the underground coal mine,	Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b) Appendix 6 – CLZ (ML1814) SMP
	(2) Revise risk control measures in response to an improved understanding of subsidence hazards through: (a) on-going testing and verification of the effectiveness and reliability of the implemented risk control measures, (b) applying the hierarchy of control measures to select the most effective risk control measures, as necessary,	Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)

Referenced Section	Guideline Requirement	Where Addressed
	(c) implementing additional risk control measures or modifications to the existing risk control measures, as necessary, and	Appendix 6 – CLZ (ML1814) SMP
	(d) modifying the rate, method, layout, schedule and sequence of mining operations, as necessary,	
	(3) Regularly consult with stakeholders in relation to managing the risks of subsidence (refer to section 2.8 below),	Section 2.5 (Consultation) Stakeholder Consultation (Attachment D)
	(4) Ensure on-going detection of early warnings of changes from the results of risk assessments to facilitate corrective or proactive management actions or the commencement of emergency procedures in a timely manner, and	Appendix 6 – CLZ (ML1814) SMP Appendix 7 –CLZ (ML1814) Master TARP
	(5) Ensure timely implementation of a contingency plan in the event that the implemented risk control measures are not effective. This contingency plan needs to be established taking into consideration the risk scenarios as discussed in section 2.5.3 of this guideline	Appendix 7 –CLZ (ML1814) Master TARP
Consultation, Co-operation, and Co-ordination (S2.8)	Under clause 67(2)(e) of the WHSMP Regulation, “the mine operator must ensure that so far as is reasonably practicable, procedures are implemented for the effective consultation, co-operation and co-ordination of action with respect to subsidence between the mine operator and relevant persons conducting any business or undertaking that is, or is likely to be, affected by subsidence”.	Section 2.5 (Consultation) Stakeholder Consultation (Attachment D)
	The procedures for consultation, co-operation and co-ordination of action with respect to subsidence should include:	
	(1) A process for identifying stakeholders, such as authorities or operators responsible for public utilities or amenities or owners or operators of an industrial or commercial establishment, who may be affected by subsidence,	Section 2.5 (Consultation) Stakeholder Consultation (Attachment D)
	(2) A mechanism to undertake and record regular consultation between the mine operator and stakeholders during subsidence risk management. The following questions should be addressed during the consultation:	
	(a) have all subsidence hazards been identified? (b) is the mine operator’s understanding of subsidence hazards still current and correct? (c) have the implemented risk control measures been working effectively? (d) are the risks of subsidence being adequately managed? (e) have there been any early warnings of changes from the results of risk assessments, which warrant corrective or proactive management actions or the commencement of emergency procedures? (f) have any incidents of subsidence occurred and what is the learning from the investigations of these incidents? (g) should the implemented risk control measures be revised according to the results of subsidence monitoring and review?	Section 2.5 (Consultation) Section 5.7 (Reporting and Auditing) Stakeholder Consultation (Attachment D)
	(3) A mechanism to ensure effective communication between the mine operator and stakeholders, and	Section 2.5 (Consultation) Section 5.7 (Reporting and Auditing)

Referenced Section	Guideline Requirement	Where Addressed
	(4) A process for obtaining stakeholder endorsement of the relevant risk management plans	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i>
Monitoring and Review (S2.9): Subsidence Monitoring (s2.9.1)	<i>Note: Refer to Subsidence Monitoring Program for compliance with guidelines requirements for s2.9.1 (Subsidence Monitoring) including detailed requirements in s2.9.1-2.9.3 (including baseline etc), as per cross references included below to the SMP where these are addressed.</i>	Appendix 6 – CLZ (ML1814) SMP
Objectives of Subsidence Monitoring (S2.9.1.1)	In undertaking subsidence monitoring, the mine operator should determine how the monitoring data is to be captured, recorded, communicated and, importantly, acted upon, for the purpose of: (1) Ensuring that the mine operator has a current and correct understanding of the hazards of subsidence (2) Ensuring that the risk control measures are maintained so that they remain effective, (3) Avoiding unplanned events. (4) Detecting early warnings of changes from the results of risk assessments to facilitate corrective or proactive management actions or the commencement of emergency procedures, (5) Identifying emerging new risks of subsidence, and (6) Informing the continual improvement and change management.	Appendix 6 – CLZ (ML1814) SMP
Scope of Subsidence Monitoring (S2.9.1.2)	The scope of subsidence monitoring must include:	
	Monitoring of subsidence Monitoring of the effects of subsidence on relevant surface or subsurface features	Appendix 6 – CLZ (ML1814) SMP
Design, Implementation and Maintenance of Subsidence Monitoring (S2.9.1.3)	When designing, implementing and maintaining a subsidence monitoring program, the mine operator of an underground coal mine should:	
	(1) Address the objective and scope of the subsidence monitoring program (refer to sections 2.9.1.1 and 2.9.1.2 above) (2) Consider the outcomes of subsidence hazard identification, investigation and analysis (refer to section 2.3.4 above). In particular, the subsidence monitoring program should be designed and implemented to assist with: (a) the verification of the risk assessments previously conducted, (b) the verification of the assumptions used during the investigations, analyses or risk assessments previously conducted; (c) the management of uncertainty and abnormal subsidence, (3) Consider the results of stakeholder consultation (4) Ensure that the monitoring activities are carried out by a competent person	Appendix 6 – CLZ (ML1814) SMP
	The subsidence monitoring program should specify:	
	(1) The individual monitoring activities of the subsidence monitoring program,	Appendix 6 – CLZ (ML1814) SMP

Referenced Section	Guideline Requirement	Where Addressed
	(2) The information to be captured from each of the individual monitoring activities (3) The locations and area where each of the individual monitoring activities will be undertaken, in particular, the layout and/or locations of instrumentation, monitoring points and inspections, (4) The timing, frequency and duration of monitoring activities and reporting (5) The monitoring methods, technologies, industry standards and codes of practice that apply when undertaking the monitoring activities (6) The measures and procedures for quality assurance (7) The measures and procedures for detecting emerging new risks or early warnings of changes from the results of risk assessments (8) The measures and procedures for recording and reporting monitoring results to the regulator and stakeholders (9) The measures and procedures for rectifying any disturbances to or malfunctions of the implemented monitoring device in a timely manner so that the subsidence monitoring program remains effective (10) A set of criteria, which if satisfied, enables a competent person to vary the implemented subsidence monitoring program (e.g. timing, frequency or duration of subsidence monitoring or reporting) (11) Any necessary “redundancies”, that is, different monitoring technologies or procedures that are to be used to monitor the same subsidence hazard. “Redundancies” should be considered where the subsidence hazard may have potentially severe health and safety consequences (12) Relevant details of a proposed subsidence monitoring program should be demonstrated on a graphical plan (i.e. Plan 7) that is part of the HRA notification (refer to the NSW Department of Industry WHS guideline “Notifying the regulator of a high risk activity”).	
Baseline Subsidence Data (S2.9.1.4)	Prior to the development of subsidence, the mine operator should complete: (1) The design and implementation of the subsidence monitoring program in accordance with section 2.9.1.3 above (2) The collection of base-line subsidence data in accordance with the subsidence monitoring program	Appendix 6 – CLZ (ML1814) SMP
Review (Subsidence Monitoring) (S2.9.2)	The mine operator must ensure that any interpretation of subsidence information (e.g. reviewing the risk control measures for subsidence) is carried out only by a competent person The mine operator must review and as necessary revise the risk control measures implemented for subsidence in accordance with clause 10 of the WHSMP Regulation In undertaking the reviews, the stakeholders must, so far as is reasonably practicable, be consulted and the following questions should be addressed” (1) Have all subsidence hazards been identified? (2) Is the mine operator’s understanding of subsidence hazards still current and correct? (3) Have the implemented risk control measures been working effectively?	Section 6.2 (Review of the Extraction Plan) Appendix 6 – CLZ (ML1814) SMP

Referenced Section	Guideline Requirement	Where Addressed
	(4) Are the risks of subsidence being adequately managed? (5) Have there been any early warnings of changes from the results of risk assessments, which warrant corrective or proactive management actions or the commencement of emergency procedures? (6) Have any incidents of subsidence occurred and what is the learning from the investigations of these incidents? (7) Should the implemented risk control measures be revised according to the results of subsidence monitoring and review?	
PRINCIPAL HAZARD MANAGEMENT PLANS		
Principle Hazard Management Plan for subsidence (S3), General (S3.1)	The guidance notes provided for the development and selection of risk control measures (refer to sections 2.5.1 to 2.5.3 above) and management of uncertainty, abnormal subsidence and changes (refer to sections 2.3 and 2.7 above) are particularly relevant to a PHMP for subsidence. Sections 2 and 3 of this guideline should be considered when identifying a principal hazard and developing and implementing a PHMP for subsidence.	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Appendix 7 –CLZ (ML1814) Master TARP Attachment C – Subsidence and Environmental Risk Assessment
Identifying Principal Hazards in Relation to Subsidence (S3.2)	To identify principal hazards in relation to subsidence, the mine operator should conduct a comprehensive and systematic investigation and analysis of all relevant matters set out in section 2 of this guideline, in particular, sections 2.2, 2.3 and 2.8 above.	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Appendix 7 –CLZ (ML1814) Master TARP Attachment C – Subsidence and Environmental Risk Assessment
Risk Assessment (S3.3)	In satisfying Clause 23(2) of the WHSMP Regulation...The mine operator, in undertaking a risk assessment for a principal hazard of subsidence, must: (1) Ensure that the risk assessment involves a comprehensive and systematic investigation and analysis of all aspects of risk to health and safety associated with the principal hazard, (2) Use investigation and analysis methods that are appropriate to the principal hazard being considered. For example: (a) a historical mine layout plan is not appropriate for assessing the stability of overlying or underlying old pillar workings underneath a major public utility if the accuracy of the layout plan cannot be verified, (b) any structural conditions of a dwelling that may become hazardous when affected by subsidence should be identified and assessed by a competent person prior to the development of subsidence. The results of the investigation should be used for the development and implementation of appropriate risk control measures, or (c) it is not appropriate to assess the stability of embankments supporting critical transport infrastructure based on assumed mechanical parameters for the embankments. These parameters should be obtained through site-specific investigations, and (3) Consider the principal hazard individually and also cumulatively with other hazards at the mine (e.g. inflow or inrush of water). To conduct the risk assessment for a principal hazard of subsidence, the mine operator should conduct a comprehensive and systematic investigation and analysis of all relevant matters set out in section 2 of this guideline, in particular, sections 2.2 to 2.5 and section 2.8 above.	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b) Attachment C – Subsidence and Environmental Risk Assessment

Referenced Section	Guideline Requirement	Where Addressed
Preparing a PHMP for Subsidence (S3.4)	Under clause 24 of the WHSMP Regulation, the mine operator must prepare a PHMP for each principal hazard associated with mining operations at the mine in accordance with clause 24 and Schedule 1. Clause 3C of Schedule 1 of the WHSMP Regulation states that: “The following matters must be considered in developing the control measures to manage the risks of subsidence: (a) the characteristics of all relevant surface and subsurface features, (b) the characteristics of all relevant geological, hydrogeological, hydrological, geotechnical, topographic and climatic conditions, including any conditions that may cause elevated or abnormal subsidence or the formation of sinkholes, (c) the characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings, (d) the existence, distribution, geometry and stability of significant voids, standing pillars or remnants within any old pillar workings that may interact with any proposed or existing mine workings, (e) the predicted and actual nature, magnitude, distribution, timing and duration of subsidence, (f) the rate, method, layout, schedule and sequence of mining operations.”	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Appendix 7 –CLZ (ML1814) Master TARP Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b) Attachment C – Subsidence and Environmental Risk Assessment
	In addition to the requirements of clause 3C of Schedule 1, the mine operator should prepare the PHMP for subsidence by comprehensively and systematically considering all relevant matters set out in section 2 of this guideline.	
	The PHMP for subsidence is part of the SMS for a mine (see clause 14(1)(c)(i)) of the WHSMP Regulation, which must be implemented so far as is reasonably practicable under clause 13(2) of the WHSMP Regulation). For guidance notes on SMS, refer to “NSW code of practice - Safety management systems in mines”.	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Airly Mine Safety Management System
	Under clause 24(3) of the WHSMP Regulation, the PHMP for subsidence must: (1) Describe the nature of the principal hazard of subsidence to which the plan relates. The descriptions should be based on the results of investigations and analyses undertaken in accordance with the relevant matters set out in section 2 of this guideline, in particular, sections 2.2 to 2.4 and 2.8 above, (2) Describe how the principal hazard of subsidence relates to other hazards associated with mining operations at the mine, (3) Describe the analysis methods used in identifying the principal hazard of subsidence to which the plan relates, (4) Include a record of the most recent risk assessment conducted in relation to the principal hazard of subsidence, (5) Describe the investigation and analysis methods used in determining the control measures to be implemented, (6) Describe all control measures to be implemented to manage risks to health and safety associated with the principal hazard of subsidence. The descriptions should be provided in accordance with all relevant matters set out in section 2 of this guideline, in particular sections 2.5 to 2.9 above,	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Appendix 7 –CLZ (ML1814) Master TARP Attachment C – Subsidence and Environmental Risk Assessment

Referenced Section	Guideline Requirement	Where Addressed
	(7) Refer to any design principles, engineering standards and technical standards relied on for control measures for the principal hazard of subsidence, and (8) Set out the reasons for adopting or rejecting each control measure considered.	
	Under clause 24(5) of the WHSMP Regulation, the mine operator must ensure that no mining operations are carried out at the mine that may give rise to a principal hazard before the PHMP for that hazard has been prepared. A PHMP for subsidence should be prepared and implemented prior to the development of subsidence that may give rise to the principal hazard of subsidence.	Section 2.1.2 (Work, Health and Safety Laws (subsidence related))
Other Matters Relevant to Managing Risks Associated with a Principal Hazard in Relation to Subsidence (S3.5)	Under clause 24(4)(b) of the WHSMP Regulation, when preparing a PHMP, the mine operator must consider “any other matter relevant to managing the risks associated with the principal hazard at the mine”.	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i> Appendix 7 –CLZ (ML1814) Master TARP Attachment C – Subsidence and Environmental Risk Assessment Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
Mining Operation as a Risk Control Measure (S3.5.1)	When applying the hierarchy of control measures (refer to section 2.5 above), the mine operator should consider the underground coal mine, including its rate, method, layout, schedule, or sequence of mining operations, as one of the available risk control measures in accordance with clause 67(2)(a) of the WHSMP Regulation. It is important that a PHMP for subsidence incorporates a procedure that activates and implements “controlled mining operation” as a risk control measure. While using the mining operation to control subsidence hazards can be effective, the implementation of this control measure may require specific and significant planning and preparation.	Appendix 6 – CLZ (ML1814) SMP Attachment C – Subsidence and Environmental Risk Assessment Appendix 7 –CLZ (ML1814) Master TARP
Management Status Reporting to Assist with Regular Consultation (S3.5.2)	Appendix B of the guidelines provides an example. No requirement is specified.	Section 5.7 (Reporting and Auditing)
Other Examples of Best Industry Practices Relevant to PHMP (S3.5.3)	Appendix C of the guidelines provides an example for managing WHS aspects of dwellings and similar civil structures. No requirement is specified.	Noted in the development of ongoing consultation with relevant stakeholders
Review, Audit & Maintenance (Of PHMPs) (S3.6)	The mine operator must ensure that the PHMP for subsidence is reviewed and as necessary revised in accordance with clause 25 of the WHSMP Regulation.	Section 6.2 (Review of the Extraction Plan)
	If the PHMP for subsidence is revised, the mine operator must record the revision, including any revision of a risk assessment, by amending the plan in writing.	Section 6.2 (Review of the Extraction Plan)

Referenced Section	Guideline Requirement	Where Addressed
Review and Maintenance (S3.6.1)	A PHMP is part of the SMS for a mine (see clause 14(1)(c)(i)), which must be audited under clause 15, maintained under clause 16 and reviewed, and as necessary revised, under clause 17 of the WHSMP Regulation.	Section 6.2 (Review of the Extraction Plan) Airly Mine Safety Management System
	For further guidance notes in relation to maintenance and review, refer to sections 2.6 and 2.9 of this guideline.	<i>refer to sections 2.6 and 2.9 above</i>
Audit (S3.6.2)	The mine operator must audit a PHMP for subsidence as part of auditing the effectiveness of the SMS in accordance with clause 15 of the WHSMP Regulation.	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Section 5.7 (Reporting and Auditing)
	Under clause 15(c) of the WHSMP Regulation, the system for auditing the effectiveness of the SMS must be set against the performance standards for measuring the effectiveness of all aspects of the SMS, including the methods, frequency and results of the audit process. The audit should also consider the following matters: (1) Competency of the auditor, (2) The person responsible for ensuring the audit is conducted, and (3) The person responsible for implementing the results of the audit.	Section 2.1.2 (Work, Health and Safety Laws (subsidence related)) Section 5.7 (Reporting and Auditing) Appendix 6 – CLZ (ML1814) SMP
High Risk Activity Notification in Relation to Subsidence (S4)	A mine operator must give notice of a HRA to the regulator and ensure that the requirements of clause 33 and Schedule 3 of the WHSMP Regulation are complied with. In Schedule 3 of the WHSMP Regulation, there are three HRAs that relate to subsidence: (1) Clause 16 - Secondary extraction or pillar extraction, splitting or reduction, (2) Clause 17 - Shallow depth of cover mining, and (3) Clause 28 - Highwall mining.	Not applicable First workings only
	Specifically, when submitting a HRA notification that involves subsidence, the mine operator must provide: (1) Details of how the risks to the health and safety of workers and other persons from subsidence caused by the activity will be managed - refer to clause 16, Schedule 3 - Secondary extraction or pillar extraction, splitting or reduction, (2) Information on how the risks to the health and safety of workers and other persons from the potential formation of sinkholes will be managed - refer to clause 17, Schedule 3 - Shallow depth of cover mining, or A) (3) information on how the risks to the health and safety of workers and other persons from subsidence caused by the activity will be managed - refer to clause 28, Schedule 3 - Highwall mining.	
	The HRA notification should consider and address all relevant matters set out in section 2 of this guideline, in particular sections 2.2 to 2.9 above.	
	The level of detail required for all the relevant matters set out in section 2 of this guideline should be commensurate with the nature, likelihood, potential consequences and complexity of subsidence hazards identified.	
Engineering Plans and Drawings (S5)	Engineering plans and drawings are part of the results of the mine operator's investigation, assessment and consideration. The mine operator should refer to the NSW Department of Industry, WHS guideline "Notifying the regulator of a	Not applicable First workings only

Referenced Section	Guideline Requirement	Where Addressed
	<i>high risk activity</i>” for guidance notes on how to prepare and submit the engineering plans and drawings in relation to: (1) Secondary extraction or pillar extraction, splitting or reduction, (2) Shallow depth of cover mining, or (3) Highwall mining.	
Notification of Incident or Injury (S6)	For guidance notes on how to notify the regulator of subsidence-related incidents or injuries, refer to the NSW Department of Industry, WHS guide “<i>Notification of incident and injury</i>” Accordingly the following is provided:” Under Clause 128 of the WHSMP Regulations (Duty to Notify Regulator): (1) The operator of a mine or petroleum site must take all reasonable steps to ensure that the regulator is notified in accordance with this clause after becoming aware of an incident (other than a notifiable incident) arising out of the carrying out of mining operations or petroleum operations at the mine or petroleum site, but only if the incident: (a) results in illness or injury that requires medical treatment within the meaning of clause 13 of Schedule 9, or (b) is a high potential incident. (6) In this clause: high potential incident means any of the following: (n) any indication from monitoring data of the development of subsidence which may result in any incident referred to in clause: 179 (a) (xvi)-a failure of ground, or of slope stability control measures, or 179 (a) (xvii) rock falls, instability of cliffs, steep slopes or natural dams, occurrence of sinkholes, development of surface cracking or deformations or release of gas at the surface, due to subsidence.	Section 5.6 (Incidents, Complaints, Exceedances and Non-compliances)
Notification of Reportable Events (S7)	For guidance notes on how to notify the regulator of reportable events relevant to subsidence, e.g. commencement of mining operations or proposed material changes in relation PHMP, refer to the NSW Department of Industry, WHS factsheet “<i>Notifying the regulator of reportable events factsheet</i>”. Accordingly, notification requirements for high potential incidents are as per s6 of guideline immediately above.	Section 5.6 (Incidents, Complaints, Exceedances and Non-compliances)

Note: Section 2 of the Guidelines includes aspects relating to subsidence monitoring which have been listed separately within the Subsidence Monitoring Program document for the Cliff Line Zone of First Workings Extraction Plan.

4 EXTRACTION PLAN GUIDELINES

The Extraction Plan Guidelines (DPE, 2022) identifies typical requirements for the Extraction Plan and supporting management plans. The requirements from the Guideline are presented in **Table 4.1**.

Table 4.1 Extraction Plan Guidelines Requirements

Referenced Section	Guideline Requirement	Where Addressed
3.2 Introduction	The introductory section should include a title page containing the: • extraction plan title, date and version number • name of the mining company • name of the mine • development consent and mining lease reference numbers • signature(s) of person(s) taking responsibility for the accuracy and comprehensiveness of the information contained within the Plan. The introductory section should include an executive summary and a clear and comprehensive table of contents. It should also include background information about the project (including the approvals history) and the scope and structure of the extraction plan. It should also include graphical figures that clearly show the approved development including the approved mining area, the associated surface development and the underground mining area to which the plan applies.	Section 1 (Introduction)
3.3.1 Plan development	This subsection should describe the process that the mining company took to develop the extraction plan. It should address relevant requirements of the development consent, mining lease, mine safety legislation, mine subsidence compensation legislation, environment protection licence and any other approvals. It should indicate the independent consultants or internal technical specialists engaged in preparing the plan or any specialist assessments that support it, and provide a brief overview of the purpose and content of these specialist assessments. This subsection should describe the process of reviewing and updating previous subsidence predictions used in the environmental impact assessment or in any previous extraction plan. This subsection should also provide assurances that previous predictions remain relevant or have been revised to consider more recent monitoring. Extraction plans should be supported by at least two years of appropriate baseline data. This subsection should summarise the type and extent of baseline data collection undertaken, including whether the two-year standard has been met (or would be met prior to subsidence impacts occurring). If circumstances prevent this standard being met, then justification must be provided. This section should also outline the approach taken by the mining company to risk assessment in developing the plan. Any risk minimisation or avoidance strategies that have resulted from the risk assessment or the decisions of the mining company should also be outlined.	Section 2 (Plan Development and Consultation)
3.3.2 Consultation	This subsection should address all consultation undertaken by the mining company with relevant agencies and other key stakeholders (such as the owners and/or operators of both publicly and privately owned land and infrastructure and the mine's community consultative committee). Where conditions of consent require consultation with agencies, include or append evidence of this consultation. This evidence should address who was consulted and when, and to what degree the feedback has been incorporated into the plan.	Section 2.6 (Consultation) Stakeholder Consultation (Attachment D)

Referenced Section	Guideline Requirement	Where Addressed
3.4 Subsidence assessment	Include a short overview of the subsidence impact assessment in the body of the plan and attach the full subsidence assessment.	Section 3 (Subsidence assessment) Attachment E – Technical Report: Pillar Design and Assessment for Cliff Line Zone Extraction Plan (SCT, 2023a; SCT 2023b)
3.5.1 Subsidence monitoring program	The subsidence monitoring program should have clearly stated objectives and include: • proposed subsidence monitoring activities, including the use of land-based and/or satellite and other remote survey techniques and the accuracy of proposed techniques • information or subsidence parameters to be obtained from each monitoring activity • proposed locations and/or extents where each monitoring activity will take place – in particular, the proposed layout and/or locations of instrumentation, monitoring points or inspections (including plans) • proposed timing, frequency and duration of each monitoring activity • proposed monitoring methods and technologies and industry standards or codes of practice to be applied • proposed measures and procedures for quality assurance and competence of personnel undertaking monitoring • proposed procedures to record monitoring results • proposed reporting of monitoring results, including the frequency of reporting, which will depend on the nature of the risk • capacity of the program to detect early warning of deviations from the consent’s performance measures and associated performance indicators.	Section 4 (Monitoring Program) Appendix 6 – CLZ (ML1814) SMP
3.5.2 Environmental monitoring program	This subsection should summarise and consolidate the environmental monitoring programs presented in each of the key sub-plans (see section 3.8.1). The environmental monitoring program should have clearly stated objective(s) and be based on contemporary best practice. It should provide detailed information on the existing baseline and proposed monitoring programs, with a similar level of detail that was suggested for the subsidence monitoring program. This subsection should contain figures showing existing baseline and proposed impact monitoring sites for each of the various monitoring programs, as well as a consolidated figure showing all monitoring sites.	Section 4 (Monitoring Program) Appendix 6 – CLZ (ML1814) SMP
3.5.3 Ongoing baseline data collection program	This section must outline a data collection program that is designed to collect baseline data for any future extraction plan(s).	Section 4.2 (Ongoing Baseline Data Collection Program) Appendix 6 – CLZ (ML1814) SMP
3.6.1 Performance measures and performance indicators	Conditions of consent generally require the mining company to develop performance indicators to ensure that the subsidence impact performance measures are not exceeded. Careful selection of performance indicators will provide an early warning mechanism that can lead to successful adaptive management. Wherever possible, performance indicators should be quantitative and not rely on qualitative interpretation. The language used should be clear and straightforward. The subsection should describe how the performance indicators will help achieve the performance measures. This should include a summary table listing the relevant performance measures and the proposed performance indicators and cross-references to where these are discussed in detail.	Section 5.1 (Performance Measures and Indicators)

Referenced Section	Guideline Requirement	Where Addressed
3.6.2 Management and mitigation measures	This subsection should set out any subsidence management and mitigation measures that would be implemented in response to predicted subsidence impacts and/or environmental consequences.	Section 5.2 (Management and Mitigation Measures)
3.6.3 Remediation and rehabilitation measures	This subsection should address the remediation and rehabilitation measures proposed to be implemented in response to predicted subsidence impacts and/or environmental consequences.	Section 5.3 (Remediation and Rehabilitation Measures)
3.6.4 TARPs	Conditions of consent generally require the use of TARPs within extraction plans and key sub-plans. TARPs are key forward-looking management documents that tabulate what, when and how specified management responses will be implemented if certain triggers are exceeded. TARPs should be aimed at ensuring compliance with all relevant performance measures and other restrictions set within the consent. TARPs may also address achievement of limits that are self-imposed by the mining company to achieve appropriate outcomes (for example reducing damage to built and/or natural features to reduce remediation costs). All TARPs should be presented in table form and include at a minimum: • relevant performance measures and performance indicators • multilevel triggers • containment and remediation measures • actions that will be implemented in response to any triggers (including adaptive management measures and contingency plans). Triggers should generally be set as exceedances of particular performance indicators. However, it may be appropriate to include a trigger level before a performance indicator is exceeded. Any exceedance of a trigger should lead to specific listed actions in response. These may include additional monitoring, reporting, investigation, rehabilitation actions and adaptive management. TARPs should also include the responsible role. TARPs should be easily understood by operational personnel, contractors, regulatory agencies, and the community. They should be self-contained documents that are consistent, comprehensive, and not subject to external variables that may turn particular actions on or off. If they make references to other documents, these references should be transparent and straightforward. TARPs should include regular reporting (typically 3 monthly or 6 monthly) of all trigger exceedances and company actions taken in response. TARPs should involve regulatory agencies in discussions about the design and implementation of corrective management actions where applicable.	Section 5.4 (Master Trigger Action Response Plan) Appendix 7 –CLZ (ML1814) Master TARP
3.6.5 Adaptive management and contingency planning	Adaptive management involves the monitoring and periodic evaluation of environmental consequences against performance measures. Where unpredicted subsidence impacts and/or environmental consequences have occurred, adaptive management requires implementation of measures to prevent their recurrence. This subsection should address any specific requirements for adaptive management included in the conditions of consent, particularly regarding TARPs and contingency planning. For ease of reference, this information is best presented in a tabulated 'master TARP' that consolidates all TARPs included in the sub-plans. It should also include all specific adaptive management measures aimed at	Section 5.5 (Adaptive Management and Contingency Planning)

Referenced Section	Guideline Requirement	Where Addressed
	achieving the performance measures and responding to any triggers or potential exceedances of the performance measures. Conditions of consent generally require developing a contingency plan. This plan provides for adaptive management when monitoring indicates an exceedance of any of the consent's subsidence impact performance measures, or where any such exceedance appears likely. It should also include an assessment of remediation measure and the capacity to implement those measures. At times, mine planning and design must change to avoid repetition of unpredicted subsidence impacts and/or environmental consequences, particularly if these exceed performance measures. If necessary, mitigation measures, mine design and/or mining extent may need to be adjusted to achieve the performance measures.	
3.6.6 Incidents, complaints, exceedances and non-compliances	This subsection should include procedures for investigating environmental incidents, community complaints, exceedances of performance measures and any non-compliances. It should also outline an appropriate response to these issues.	Section 5.6 (Incidents, Complaints, Exceedances and Non-compliances)
3.6.7 Reporting, review and auditing	The reporting framework is another important section of the extraction plan. The plan must describe elements of this framework including: • environmental incident reporting following any incident (as defined in the consent) in accordance with the conditions of consent and/or environment protection licence • any additional requirements for reporting set out within the TARPs (for example, reporting trigger exceedances and company actions taken in response) • an annual review of all subsidence impacts, environmental consequences and environmental monitoring results, including: - o a comprehensive summary of all quantitative and qualitative environmental monitoring results, including landscape monitoring, water quality data, water flow and pool level data, piezometer readings and other results - o a summary of the results of the subsidence monitoring program - o a comprehensive summary of all subsidence impacts and environmental consequences - o a full description of subsidence impacts and environmental consequences, including location identification using aerial photos with longwall layout superimposed and characterisation of the impact in accordance with the relevant TARP(s) - o clear distinction between impacts and consequences that are within predictions, those that exceed predictions but remain within performance measures and/or performance indicators, and those that exceed performance measures and/or performance indicators - o an assessment of compliance with all relevant performance measures and indicators - o proposed actions or responses resulting from TARP triggers being exceeded - o any other proposed actions or responses. The department may require reporting at more regular intervals than the annual review (for example, biannual, quarterly or monthly reporting) where subsidence impacts and/or environmental consequences are significant or are exceeding predictions.	Section 5.7 (Reporting and Auditing)

Referenced Section	Guideline Requirement	Where Addressed
	Other agencies may require other regular reports for their own purposes, such as reports to the NSW Resources Regulator or Dams Safety NSW. This may include reports assessing impacts of mining close to sensitive features, such as dams, railways, bridges, pipelines, transmission towers, optic fibre cables and waterfalls. The department expects to receive copies of these reports. Other regular reports, such as regular subsidence management status reports (sometimes required by the NSW Resources Regulator) or end of panel reports (unless separately required by conditions of consent), do not need to be provided to the department. This section of the extraction plan should also set out clearly in a table which agencies will receive copies of each of the types of reports discussed above. The timeframes and means of submission should also be set out.	
3.7.1 Review of other management plans	Development of an extraction plan may lead to a requirement to review other management plans. This section of the extraction plan should set out the process and general results of this review, but not the proposed revisions themselves. The proposed revisions should be forwarded separately as proposed amendments to the relevant plans.	Section 6.1 (Review Other Management Plans)
3.7.2 Review of the extraction plan	Processes for the future review of the extraction plan should also be set out. Such reviews should take place: • as required under consent conditions • where the application of adaptive management strategies requires a review (where exceedances are significant and/or are continuing to occur) • where unpredicted subsidence impacts and/or environmental consequences have required implementation of a contingency plan • when preparing a subsequent extraction plan (see section 2.2).	Section 6.2 (Review of the Extraction Plan)
3.7.3 Key responsibilities	This subsection should set out who is responsible for implementing the extraction plan and its various requirements. It should clearly identify which officers of the mining company have key responsibility for: • ensuring implementation of the extraction plan and its key sub-plans and other elements • incident and other reporting • decisions to activate TARP responses and/or contingency planning • initiating and/or undertaking required or occasional review of the plan or any of its elements.	Section 6.3 (Key Responsibilities)
3.8.1 Key sub-plans	Key sub-plans are required to support the extraction plan and must be revised during the preparation of each new extraction plan. Sub-plans are generally best presented as Appendices to the main body of the extraction plan.	Appendix 1 – Airly Mine WMP Appendix 3 – CLZ (ML1814) BMP Appendix 2 – CLZ (ML1814) LMP Appendix 4 – CLZ (ML1814) ACHMP Appendix 5 – CLZ (ML1814) PSMP Appendix 6 – CLZ (ML1814) SMP
3.8.2 Required figures	Mining companies must include detailed figures as appendices in the extraction plan. The requirements for these figures are outline in Table 3. Mining companies may be asked to supply any or all of the data incorporated within these figures as geographic information system (GIS) files.	Appendix 8 – Graphical Plans for CLZ (ML1814)

5 OTHER RELATED APPROVALS AND GUIDELINES

Preparation of the Extraction Plan and supporting management plans is also directed by compliance with other related approvals and guidelines in accordance with Condition 2 of Schedule 6 of SSD_5581 as outlined below.

5.1 Environmental Protection Licenses

Airly Mine operates under Environment Protection Licence (EPL) 12374 (as varied 2018) issued under the Protection of the Environment Operations Act (POEO Act) 1997. EPL12374 permits coal works and mining for coal to a scale of up to 2 million tonnes per annum handled and produced. There are no conditions of EPL 12374 specifically related to mine subsidence and extraction plans, however general and specific environment requirements as relevant to this extraction plan are listed in **Table 5.1** below.

Table 5.1 Relevant Conditions of EPL12374 Relevant to This Management Plan

Clause	Requirement	Where Addressed
Condition R2		
EPL 12374 Requirements	R2 Notification of Environmental Harm General Note - The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act. R2.1 - Notifications must be made by telephoning the Environment Line service on 131 555 R2.2 - The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.	Section 5.6 (Incidents, Complaints, Exceedances and Non-compliances)

5.2 EPBC Approval

Conditional approval of referral 2013/7076 was granted by the Commonwealth Department of Environment and Energy for the Airly Mine Extension Project on 18th May 2017 under sections 130(1) and 133 of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Aspects of the approval which are considered relevant to this management plan for the current Extraction Plan are listed in **Table 5.2** below, including conditions relating to bilateral agreement with NSW under Part 5 of the EPBC Act.

Table 5.2 Relevant EPBC Approval Requirements

Clause	Requirement	Where Addressed
Schedule 2 (Compliance with Conditions of the NSW development consent (SSD_5581):		
	For the Protection of matters of national environmental significance, the person taking the action must comply with the following conditions of the New South Wales development consent <SSD5581> :	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i>
Condition 1	General obligation to prevent environmental harm.	Refer Tables 1.3
Schedule 3		
Condition 1	Schedule 3, Condition 1: Restrictions on Mining in geologically sensitive areas.	Section 3.1 (Mine Planning and Design)
Condition 2	Schedule 3, Condition 2: Performance measures for the protection of identified commonwealth natural and heritage features.	Section 5.1 (Performance Measures and Indicators)

Clause	Requirement	Where Addressed
Condition 7	Schedule 3, Condition 7: Preparation, approval, and implementation of extraction plans, incorporating a range of relevant management sub-plans ¹ .	<i>Extraction Plan Main Report, and Appendix 1 to Appendix 6 (sub-management plans)</i>
	<i>Centennial Note: Additional referenced conditions 11-29 in Schedule 4 relate to the general whole of site Management Plans which include aspects not related to subsidence management (e.g. surface facilities). Only aspects and measures relevant to subsidence are applicable to the extraction plan as addressed via Condition 7 above.</i>	
Administrative Conditions		
Condition 2	Within fourteen days after the commencement of the action ⁴ , the person taking the action must advise the Department ³ in writing of the actual date of commencement of the action.	Section 5.7 (Reporting and Auditing)
Condition 3	The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, and make them available upon request to the Department ³ . Such records may be subject to audit by the Department or an independent auditor in accordance with Section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Department's ³ website. The results of audits may also be publicised through the general media.	Section 5.7 (Reporting and Auditing)
Condition 4	Within 3 (three) months of every twelve (12) month anniversary of the commencement of the action ⁴ , the person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans as specified in the conditions. Documentary evidence providing proof of date of publication and non-compliance with any of the conditions of this approval must be provided to the Department ³ at the same time as the compliance report is published.	Section 5.7 (Reporting and Auditing)
Condition 5	Upon the direction of the Minister ² , the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.	Section 5.7 (Reporting and Auditing)
Condition 7	Unless otherwise agreed to in writing by the Minister ² , the person taking the action must publish all management documents referred to in these conditions of approval on their website. This includes documents required indirectly through the New South Wales development consent. Each document must be published on the website within one (1) month of being approved by the Minister ² .	Section 5.7 (Reporting and Auditing)

Notes: 1. Refer Table 1.1 for specific wording of the referenced conditions of NSW Development Consent SSD_5581.

2. The Minister means the Australian Government minister responsible for administering the EPBC Act and includes any delegate of the Minister.

3. The Department means the Australian Government department responsible for administering the EPBC Act

4. Commencement of Action, means the first instance of an activity described in the EIS as being part of the action, or, in relation to Condition 1, has the meaning given through the NSW development consent (SSD_5581).

Site: Airly
Title: ML1814 Cliff Line Zone Extraction Plan
Stature ID:1001330039
Version: 1
Lifecycle State:

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Stature for Risk Management

Administration:

Risk Assessment Title: ML1814 Cliff Line Zone Extraction Plan

Revision: 1

Region: West

Site: Airly

Department: ZZZZ Whole Site

Equipment / Process: Community

Stature Risk Assessment No.: 1001330039

Study Lifecycle State: Risk Assessment Made Effective

Potential Hazard No.: 59640

PULSE Actions Required URL:

Site Risk Assessment Ref. No. (Optional):

Executive Summary of Top 10 Risks

Background	Potential Incident	RR
Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ::: degradation or loss of Genowlan Pea ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	14 (S)
Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the EP Area (and/or adjacent to the EP Area) beyond approved consent criteria/performance measures ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Public safety hazard (personal injury PI) .	10 (M)
Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining -induced surface instability / Land slip ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Public safety hazard (personal injury PI) .	10 (M)
Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the cliff zone within ML1814 Mine Potential Interaction Zone beyond approved consent criteria/performance measures ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in:	9 (M)

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Background	Potential Incident	RR
	Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	
Surface Water Courses - Located within the EP Area. Including the Grotto & The Oasis (upper Genowlan Creek)	There is a risk to Airly from ::: Cracking of stream channel / localised loss of water flow ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	9 (M)
Aboriginal and Cultural Heritage Sites Located within the EP Area	There is a risk to Airly from ::: Damage to Aboriginal and Cultural Heritage Sites Located within the EP Area ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	9 (M)
Steeply Dipping Terrain Effects - Potential for interaction between workings downslope of the CLZ and extraction within the EP Area	There is a risk to Airly from ::: impact to cliffs and associated features in steeply dipping terrain:: ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	9 (M)
Groundwater- Centennial surface water monitoring bores Located within the EP Area	There is a risk to Airly from ::: Reduction or loss of monitoring capacity ::: Caused by: Fire or Geological anomaly or lightning or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA or tree fall or Vandalism	8 (M)

Background	Potential Incident	RR
	Resulting in: Business interruption. or Non compliance or Reputation .	
Pagodas / Rock Formations Located within the EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Cracking of pagodas or rock formations ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	6 (L)
Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining -induced surface instability / Land slip ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	5 (L)
Groundwater - Aquifers above Lithgow seam - (including Shallow Quaternary Alluvial, Triassic	There is a risk to Airly from ::: Loss of ground water that impacts on ground water dependent eco system or water supply ::: Caused by: Draw down due to depressurisation of Permian and/or Triassic strata. or Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	5 (L)
Groundwater - Aquifers in and immediately above Lithgow seam - Permian and Located within the EP Area	There is a risk to Airly from ::: Loss of ground water that impacts on ground water dependent eco system or water supply beyond approved impact level ::: Caused by:	5 (L)

Background	Potential Incident	RR
	Draw down due to depressurisation of Permian and/or Triassic strata. or Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	
Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ::: Refer Groundwater Aquifers information above which includes information on Groundwater Dependent Ecosystems and facultative ecosystems. ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	5 (L)
Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ::: Loss of base ground water flow- degradation or loss of species or habitat ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	5 (L)
Groundwater Stygofauna - Located within the EP Area	There is a risk to Airly from ::: Mining related impacts to stygofauna ::: Caused by: Mining Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	5 (L)
Threatened AQUATIC FAUNA & potential habitat for threatened fauna and KEY FISH HABITAT (e.g. dragon fly,Macquarie perch) Located within and downstream of the EP Area	There is a risk to Airly from ::: Loss of stream flow - degradation or loss of species or habitat ::: Caused by:	5 (L)

Background	Potential Incident	RR
	Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	
Threatened terrestrial FAUNA Located within the EP Area - Threatened birds and habitat for bird species e.g. Hollow dependent owls, Glossy Black Cockatoo, Gang Gang Cockatoo, Flame Robin, Scarlett Robin, Varied Sitella	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	5 (L)
Threatened terrestrial FAUNA Located within the EP Area - Threatened mammal species (excluding microbats) and their habitats e.g. Gliders, Koala, Spotted Tail Quoll, Rock Wallaby	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	5 (L)
Threatened terrestrial FAUNA Located within the EP Area - Threatened Reptile species and their habitats - e.g. broad headed snake	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	5 (L)
Threatened terrestrial FAUNA Located within the EP Area - Microbats and their habitats (Cliff rock overhangs and tree hollows) e.g. Eastern False Pipestrelle, Eastern Free Tailed Bat, Large Bent Wing Bat, Large-eared Pied Bat, Little Bent-winged Bat, Little Pied Bat.	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological	5 (L)

Background	Potential Incident	RR
	anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	
Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	5 (L)
Endangered Ecological Communities (EEC) Located within the EP Area	There is a risk to Airly from ::: Changes in species diversity or extent within EECs (genowlan Pt) ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage / loss of biodiversity or Loss of Intergenerational Equity, or Non compliance or Reputation or Social impact or Business interruption..	5 (L)
Natural vegetation - (General, including sheltered gullies) Located within the EP Area	There is a risk to Airly from ::: Changes in species diversity or extent ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	5 (L)
Unsealed Roads, four wheel drive tracks and trails (SCA Management Trails) Located within the EP Area	There is a risk to Airly from ::: Damage to road/track/trail surface from cracking or slabbing, or rock fall from adjacent cliffs, pagodas and steep slope areas ::: :::	5 (L)

Background	Potential Incident	RR
	Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Public safety hazard (personal injury PI) or Reputation or Social impact..	
Geological Structures (including faults, folds, sills or dykes) Located within the EP Area	There is a risk to Airly from ::: Increased subsidence / impacts arising from potential effects of geological structures (local or regional) ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	5 (L)
Far Field Movements and Effects beyond the EP Area	There is a risk to Airly from ::: Mining induced far field movements potentially impacting surface features (eg cliffs and pagodas) beyond approved consent criteria/performance measures, and affecting the extent of the required management area (EP Area) ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	5 (L)
Valley Closure or Upsidence Movements and Effects within and beyond the EP Area (gorges, valleys,creek crossings)	There is a risk to Airly from ::: Mining induced valley closure movements potentially causing impacts to natural features such as cliffs, minor cliffs and pagodas within and beyond the EP Area beyond approved consent criteria/performance measures ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage	5 (L)

Background	Potential Incident	RR
Movements and Effects Beyond Predictions within and beyond the EP Area	Impact or Reputation or Social impact or Business interruption.. There is a risk to Airly from ::: Mining induced movements and effects BEYOND PREDICTIONS potentially causing impacts to natural features (including cliffs, minor cliffs and pagodas) within and beyond the EP Area, beyond approved consent criteria/performance measures ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	5 (L)
Movements and Effects Beyond Predictions within and beyond the EP Area	There is a risk to Airly from ::: Mining induced effects BEYOND PREDICTIONS causing surface cracking and gas release (e.g.with public safety implications) ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	5 (L)
Delayed / Long Term Subsidence (period/duration of subsidence management)	There is a risk to Airly from ::: Development of delayed or long term subsidence movements beyond predictions (affecting timing / duration of subsidence management) ::: Caused by: Anomolies/complexities or deterioration in roof/floor/ geotechnical conditions (eg due to clay stone bands) or climatic conditions or Flooded Workings or Geological Structures or Nature and magnitude of horizontal stress field or Overlying or Underlying Workings or Topographic terrain Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	5 (L)
Future Developments / Change within EP Area affecting subsidence management	There is a risk to Airly from ::: Future changes or development within the EP Area influencing management requirements (e.g.	5 (L)



Background	Potential Incident	RR
	long term post-mining intention to transition surface lands from from SCA to NP) ... Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	

Executive Summary of Top 10 Severities

Background	Potential Incident	MRC
Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ∴ Mining induced impacts to cliffs, minor cliffs and pagodas in the cliff zone within ML1814 Mine Potential Interaction Zone beyond approved consent criteria/performance measures ∴ Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	3
Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ∴ Mining induced impacts to cliffs, minor cliffs and pagodas in the EP Area (and/or adjacent to the EP Area) beyond approved consent criteria/performance measures ∴ Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Public safety hazard (personal injury PI) .	4
Pagodas / Rock Formations Located within the EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ∴ Cracking of pagodas or rock formations ∴ Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	3
Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ∴ Mining -induced surface instability / Land slip ∴ Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA	2

Background	Potential Incident	MRC
	Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	
Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining -induced surface instability / Land slip ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Public safety hazard (personal injury PI) .	4
Surface Water Courses - Located within the EP Area. Including the Grotto & The Oasis (upper Genowlan Creek)	There is a risk to Airly from ::: Cracking of stream channel / localised loss of water flow ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	3
Surface Water Courses - Located within the EP Area. Including the Grotto & The Oasis (upper Genowlan Creek)	There is a risk to Airly from ::: Changes to creek habitat from changes to geomorphology ::: Caused by: Geological anomaly or Lineament zone link to surface to underground workings or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact..	2
Groundwater - Aquifers above Lithgow seam - (including Shallow Quaternary Alluvial, Triassic	There is a risk to Airly from ::: Loss of ground water that impacts on ground water dependent eco system or water supply ::: Caused by: Draw down due to depressurisation of Permian and/or Triassic strata. or Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring	2

Background	Potential Incident	MRC
	LTA Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	
Groundwater - Aquifers in and immediately above Lithgow seam - Permian and Located within the EP Area	There is a risk to Airly from ::: Loss of ground water that impacts on ground water dependent eco system or water supply beyond approved impact level ::: Caused by: Draw down due to depressurisation of Permian and/or Triassic strata. or Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	2
Groundwater- Centennial surface water monitoring bores Located within the EP Area	There is a risk to Airly from ::: Reduction or loss of monitoring capacity ::: Caused by: Fire or Geological anomaly or lightning or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA or tree fall or Vandalisum Resulting in: Business interruption. or Non compliance or Reputation .	2
Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ::: Refer Groundwater Aquifers information above which includes information on Groundwater Dependent Ecosystems and facultative ecosystems. ::: Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	2
Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ::: Loss of base ground water flow- degradation or loss of species or habitat :::	2

Background	Potential Incident	MRC
	Caused by: Geological anomaly or Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	
Groundwater Stygofauna - Located within the EP Area	There is a risk to Airly from ::: Mining related impacts to stygofauna ::: Caused by: Mining Resulting in: Business interruption. or Environmental damage or Non compliance or Reputation or Social impact..	2
Threatened AQUATIC FAUNA & potential habitat for threatened fauna and KEY FISH HABITAT (e.g. dragon fly,Macquarie perch) Located within and downstream of the EP Area	There is a risk to Airly from ::: Loss of stream flow - degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	2
Threatened terrestrial FAUNA Located within the EP Area - Threatened birds and habitat for bird species e.g. Hollow dependent owls, Glossy Black Cockatoo, Gang Gang Cockatoo, Flame Robin, Scarlett Robin, Varied Sitella	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	2
Threatened terrestrial FAUNA Located within the EP Area - Threatened mammal species (excluding microbats) and their habitats e.g. Gliders, Koala, Spotted Tail Quoll, Rock Wallaby	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by:	2

Background	Potential Incident	MRC
	Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	
Threatened terrestrial FAUNA Located within the EP Area - Threatened Reptile species and their habitats - e.g. broad headed snake	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	2
Threatened terrestrial FAUNA Located within the EP Area - Microbats and their habitats (Cliff rock overhangs and tree hollows) e.g. Eastern False Pipestrelle, Eastern Free Tailed Bat, Large Bent Wing Bat, Large-eared Pied Bat, Little Bent-winged Bat, Little Pied Bat.	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	2
Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	2
Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ::: degradation or loss of Genowlan Pea ::: Caused by:	4

Background	Potential Incident	MRC
	Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	
Endangered Ecological Communities (EEC) Located within the EP Area	There is a risk to Airly from ∴ Changes in species diversity or extent within EECs (genowlan Pt) ∴ Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage / loss of biodiversity or Loss of Intergenerational Equity, or Non compliance or Reputation or Social impact or Business interruption..	2
Natural vegetation - (General, including sheltered gullies) Located within the EP Area	There is a risk to Airly from ∴ Changes in species diversity or extent ∴ Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	2
Unsealed Roads, four wheel drive tracks and trails (SCA Management Trails) Located within the EP Area	There is a risk to Airly from ∴ Damage to road/track/trail surface from cracking or slabbing, or rock fall from adjacent cliffs, pagodas and steep slope areas ∴ Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Public safety hazard (personal injury PI) or Reputation or Social impact..	2
Aboriginal and Cultural Heritage Sites Located within the EP Area	There is a risk to Airly from ∴ Damage to Aboriginal and Cultural Heritage Sites Located within the EP Area ∴	3

Background	Potential Incident	MRC
	Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	
Geological Structures (including faults, folds, sills or dykes) Located within the EP Area	There is a risk to Airly from ... Increased subsidence / impacts arising from potential effects of geological structures (local or regional) ... Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	2
Far Field Movements and Effects beyond the EP Area	There is a risk to Airly from ... Mining induced far field movements potentially impacting surface features (eg cliffs and pagodas) beyond approved consent criteria/performance measures, and affecting the extent of the required management area (EP Area) ... Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	2
Valley Closure or Upsidence Movements and Effects within and beyond the EP Area (gorges, valleys,creek crossings)	There is a risk to Airly from ... Mining induced valley closure movements potentially causing impacts to natural features such as cliffs, minor cliffs and pagodas within and beyond the EP Area beyond approved consent criteria/performance measures ... Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage	2

Background	Potential Incident	MRC
Movements and Effects Beyond Predictions within and beyond the EP Area	Impact or Reputation or Social impact or Business interruption.. There is a risk to Airly from ::: Mining induced movements and effects BEYOND PREDICTIONS potentially causing impacts to natural features (including cliffs, minor cliffs and pagodas) within and beyond the EP Area, beyond approved consent criteria/performance measures ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	2
Movements and Effects Beyond Predictions within and beyond the EP Area	There is a risk to Airly from ::: Mining induced effects BEYOND PREDICTIONS causing surface cracking and gas release (e.g.with public safety implications) ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	2
Sinkhole development within or beyond the EP Area	There is a risk to Airly from ::: Mining induced development of sinkhole(s) with associated potential impact to public safety, drainage and/or surface features (including cliffs, minor cliffs and pagodas) located within or beyond in the EP Area, above approved consent criteria/performance measures ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	2
Steeply Dipping Terrain Effects - Potential for interaction between workings downslope of the CLZ and extraction within the EP Area	There is a risk to Airly from ::: impact to cliffs and associated features in steeply dipping terrain:: :::	3

Background	Potential Incident	MRC
	Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	
Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Pillar punching occurring ::: Caused by: low strength roof/ floor material or Pillar design LTA or pillar stress excessively high or Water flooding Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	2
Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Systemic failure ::: Caused by: High proportion of low strength roof material or Reactive strata (i.e. tuff material) or Water flooding Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	2
Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Excessive Pillar Compression ::: Caused by: High proportion of low strength roof material or Pillar design LTA or Reactive strata (i.e. tuff material) or Water flooding Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	2
Delayed / Long Term Subsidence (period/duration of subsidence management)	There is a risk to Airly from	2

Background	Potential Incident	MRC
	::: Development of delayed or long term subsidence movements beyond predictions (affecting timing / duration of subsidence management) ::: Caused by: Anomalies/complexities or deterioration in roof/floor/ geotechnical conditions (eg due to clay stone bands) or climatic conditions or Flooded Workings or Geological Structures or Nature and magnitude of horizontal stress field or Overlying or Underlying Workings or Topographic terrain Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	
Future Developments / Change within EP Area affecting subsidence management	There is a risk to Airlly from ::: Future changes or development within the EP Area influencing management requirements (e.g. long term post-mining intention to transition surface lands from from SCA to NP) ::: Caused by: Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	2

Study Approval

Approver	Approved / Rejected	Date	Comments
1. Ryan Davidson [Ryan.Davidson]	Approved	July 18, 2023	

1. Background

As per commitments within the Environmental Impact Statement (EIS) for SSD_5581, Airly Mine is implementing a conservative and staged approach to mining. Accordingly, in consultation with regulators and the IEP, Airly mine have undertaken extensive modelling and mine design revisions in order to achieve a mine design which is consistent with EIS predictions (i.e. maximum vertical subsidence <125mm). The development of management and monitoring programs for Extraction Plans are required to be risk-based in accordance with development consent Condition 7(i)(i) of SSD_5581, Extraction Plan Guidelines (DP&E 2015) and the Guide to Managing Risks of Subsidence (NSW Resources Regulator (Mine Safety), 2017). This Risk Assessment is intended to identify the potential risks to sensitive landscapes and built features with public safety implications and inform the development of the ML1814 CLZ Extraction Plan and its supporting management plans.

2. Objective

The following Hierarchy of Controls offers a framework for considering the effectiveness of controls. Note that the effectiveness of a control that is intended to reduce a risk decreases from top to bottom of the list. In other words, the closer the control type is to the top of the hierarchy, the more potentially effective the control.

- Eliminate the hazard or energy source (do not use the energy)
- Minimise or replace the hazard or energy source (reduce the amount of energy to a less damaging level or replace the energy with another that has less potential negative consequences)
- Control the hazard or energy using engineered devices (ex. Lock outs, chemical containers, mechanical roof support, gas monitors, etc.)
- Control the hazard or energy by using physical barriers (ex. machine guarding, fences or enclosures, etc.)
- Control the hazard or energy with procedures (ex. Isolation procedures, standard operating procedures, etc.)
- Control the hazard or energy with personal protective equipment (ex. hard hats, boots with toe caps, gloves, safety glasses, welding gear, etc.)
- Control the hazard or energy with warnings and awareness (ex. posters, labels, warning signs, verbal warnings, etc.)

To identify, assess and control the risks to people, plant and environment to safely mine First workings in the ML1814 Cliff Line Zone.

3. Potential Hazards

The following features have been considered within this risk assessment.

- Cliffs and Minor Cliffs
- Pagodas and rock formations
- Steep Slopes
- General Land Surface of the Mugii Murum-ban SCA
- Surface Water (including aquatic ecology)
- Groundwater (including potential for Groundwater dependant ecosystems, stygofauna and any potential private bores)
- Terrestrial Ecology - including threatened flora and fauna species, populations and ecological communities (or their habitats),occurring in the Extraction Plan Area, as listed under the NSW Biodiversity Conservation Act 2016 (BC Act) and/or listed under the Commonwealth Environment Protection and Biodiversity Act 1999 (EPBC Act)
- Aquatic Ecology - Including threatened species and Key Fish Habitat as listed under the Fisheries Management Act 1994 (FM Act)
- Heritage Sites (Aboriginal and Cultural Heritage sites and Historic Heritage sites) if/where located within the Extraction Plan Area.
- Any Built Features within EP Area including minor signage and fencing, minor unsealed 4WD tracks and trails and related gates.

The location of key sensitive surface features (built and environmental) within and surrounding the EP Area are illustrated in figures considered during the risk assessment, as presented in **Appendix 2 of the Risk Assessment**.

Major Potential Hazards Considered

Potential for impacts of greater than predicted subsidence due to factors affecting subsidence and uncertainties.
Potential for impacts or significant rock falls to cliffs, minor cliffs or pagodas (particularly beyond performance measures prescribed by consent SSD_5581).
Potential for public safety hazards (primarily due to the above).
Potential for impacts on built features (SCA management trails and other unsealed 4wd tracks)
Potential for impacts on threatened biodiversity, including threatened flora and fauna or their habitats occurring within the EP area.
Potential for impacts on surface water and ground water (including potential for Groundwater Dependent Ecosystems or stygofauna).
Potential for impacts on downstream threatened fish habitat such as the Capertee River downstream from the Project area which is mapped as habitat for the Macquarie Perch (*Macquaria australasica*: Threatened species under the FM Act) and the Genowlan Creek, which is mapped as Key Fish Habitat under the FM Act.
Potential for impacts to heritage sites (Historic Heritage and Aboriginal and Cultural Heritage sites)

Further information on these will be provided within the supporting management plans for a related Extraction Plan for the EP Area (including the Subsidence Monitoring Program (SMP), Land Management Plan (LMP), Biodiversity Management Plan (BMP), Aboriginal & Cultural Heritage Management Plan (ACHMP), site

Water Management Plan (WMP), and the Airlly MEP EIS (2014) and its supporting documents.

4a. Risk Assessment Boundary Definition

The scope of this risk assessment is to identify, assess and control the risks to people, plant and environment associated with potential subsidence from proposed underground workings within the EP Area as follows:

- Spatial extent is limited to the ML1814 Cliff Line Zone Extraction Plan area.

- Includes all proposed underground workings where first workings within the Cliff Line Zone will take place in the EP Area under the current mine plan.

-Only aspects potentially affected directly by subsidence are considered. Other secondary environmental risks (e.g. associated with coal processing) are beyond the scope of this risk assessment.

- Assesses all surface and sub-surface features, including both natural and built features, that may have the potential to be adversely impacted by subsidence.

Features for risk assessment were based upon those identified in the checklist provided in **Appendix 1 of the Risk Assessment**.

- Assesses the potential risks to all personnel underground and any person/s accessing the Extraction Plan (surface) Area, including any members of the public accessing the Mugii Murum-ban State Conservation Area.

- The focus is for first workings within the Cliff Line Zone which by designed limit subsidence. Other mining methods approved by consent SSD_5581 are beyond scope.

Additional Notes for Specific Inclusions and Exclusions for this Risk Assessment:

Inclusions:

- All surface areas identified as within the zone of potential subsidence impact for the first workings within the Cliff Line Zone Extraction Plan. This includes areas of potential impact by mining.
- mine development (first workings) only
- Any potentially impacted Surface water systems, ground water systems, Surface infrastructure or Ecology
- Activities of any persons who may need to legally access the surface that could be potentially impacted. This includes all recreational activities within that part of the Mugii Murum Ban State Conservation Area (SCA), mine site personnel, contractors working for Airlly Mine, National Parks and Wildlife Officers performing their duties.

Exclusions:

- Any lands outside the Cliff Line Zone Extraction Plan.
- Impacts caused by natural (non-mining induced) processes including (but not limited to) erosion by wind or rain or streams, cliff falls not related to mining, impacts of drought or flooding, impacts from users of the SCA.
- Existing approved EP Areas (existing approved mining)
- Underground mine safety

This risk assessment applies to the **Cliff Line Zone Extraction Plan area**, which is comprised of proposed mine development (first workings) within the Cliff Line Zone approved under SSD_5581 and located within the existing Mining Lease ML1814,

Context Notes:

1. *Very low levels of vertical movement are predicted in the Near-field / Principal Subsidence Management Area.*

5. Risk Assessment Methods

Risk Assessment Methods:

Workplace Risk Assessment and Control (WRAC): Yes

Fault Tree Analysis (FTA):

Safety Integrity Level Analysis to Australian Standard 61508 (SIL):

Bow Tie Analysis (BTA):

Failure Modes and Effects Analysis (FMEA):

Hazard and Operability Analysis (HAZOP):

6. Previous Risk Assessment and other documents to be used and/or referenced

Document Name	Title	Version	Referenced Document Date
Cliff Line Zone of First Workings Extraction Plan (ML1331) - Subsidence Environmental Risk Assessment (2017)	Risk assessment regarding potential impacts from mining within the Cliff Line Zone of First Workings Extraction Plan of ML1331, parts of which are included in this Extraction Plan Area.	Rev1	01-Sep-2017
Mt Airly PPMZ Extraction Plan (ML1331) - Subsidence Environmental Risk Assessment (2019)	Risk assessment regarding potential impacts from miniwall operations in the Panel and Pillar Mining Zone beneath the Mt Airly mesa	Rev1	20-Mar-2019
Subsidence and Environmental Risk Assessment: Genowlan PPMZ Stage 1 Area (2019)	The initial risk assessment regarding subsidence and environmental risks for this Extraction Plan to inform development of a baseline monitoring program.	Rev0	13-Nov-2019
Airly Mine Subsidence and Pillar Width Modelling Assessment - Point Hatteras Mining Area, Mt Genowlan AIRLY5265 (SCT, 2021)	Modelling assessment for appropriate pillar sizes for the mining operation to control the subsidence to 125mm.	Final	27-Jul-2021
Airly Mine – Point Hatteras Cliff Impact Assessment Report Due to proposed extraction of Miniwalls 13 to 16 (MSEC, 2021)	Details the site inspection undertaken to supplement the extensive aerial photogrammetry and cliff identification work to verify the cliff mapping being used to inform mine design and assess the stability of cliff, minor cliffs, pagodas or other sensitive surface features based on the subsidence modelling	0	01-Jul-2021

Document Name	Title	Version	Referenced Document Date
	by SCT.		
Point Hatteras Panel and Pillar Mining Zone: Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs Assessment Report (RPS, 2021)	Characterisation of the composition and status of flora and fauna within the Project Area and identification of any data gaps to address during an onsite risk assessment workshop.	V1.0	23-Jul-2021
Point Hatteras, Airly: Heritage Baseline Assessment (RPS, 2021)	Full desktop review of the previous field data collected and reports and plans relevant to the project to identify the heritage items within the region and data gaps to be addressed during the proposed onsite risk assessment workshop.	V1.0	25-Jun-2021
Pt Hatteras Panel and Pillar Extraction Plan MW13-MW16	Risk assessment regarding potential impacts from miniwall operations in the Panel and Pillar Mining Zone beneath Pt Hatteras	Rev 0	29-Jul-2021

7. Information Required for Risk Assessment

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8. Venue and Time

Date	Description	Location	Start Time	End Time	Comment
1. 19-Jun-2023	Scoping	Airly Mine	10:00 AM	3:00 PM	
2. 20-Jun-2023	Assessment	Airly Mine	10:00 AM	3:00 PM	

9. Risk Assessment Team Selection

Name	Position	Company	Industry Start Date	E-Mail Address	Role	Experience relevant to the role in the risk assessment	Pulse User No.	Attendance	
								1. 19-Jun-2023	2. 20-Jun-2023
Jacqueline Cooke RIIRIS402D	Mining Engineer, Compliance Manager, Technical Services, Ventilation Officer	Airly Coal P/L	12-Feb-2001	Jacqueline.Cooke@centennialcoal.com.au	Facilitator	G2A Risk assessment facilitation	90030	P	P
Sam Price	Environment & Community Officer	Airly Coal P/L	19-Jan-2009	sam.price@centennialcoal.com.au			90039	P	P
Ryan Davidson	Mine Manager	Airly Coal P/L			Risk Assessment Owner	+10 Years Mining Engineering	0196		P
Brett Haddon	Statutory Mine Surveyor	Airly Coal P/L	21-Apr-1986	brett.haddon@centennialcoal.com.au			90045		P
Grant Purcell	Team Leader-Ranger	NPWS							P
Tara Boreham	Senior Ecologist	RPS							P
Tessa Boermah	Principle Heritage Consultant	Heritage Now							P
Anthony Reid	Consultant	Catalyst				Extraction plan preparation, environmental consultant			P

WRAC Analysis Worksheet

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extens ion
1. Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the cliff zone within ML1814 Mine Potential Interaction Zone beyond approved consent criteria/performance measures ::: Caused by: • Geological anomaly • Mine design LTA (Less Than Adequate) • Mining method implementation LTA • Monitoring LTA Resulting in: • Cultural heritage impact • Environmental damage • Non compliance or Public safety hazard (personal injury PI) • Reputation • Social impact..	1.1.a. Mine design limits subsidence to level where surface cracking will not occur. 1.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 1.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs 1.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 1.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 1.1.f. Mining method and design reviewed	D (Pb)	3 (L)	9 (M)	1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site). 2. Develop a Land Management Plan in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program 3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 1.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 1.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 1.1.i. Underground geological mapping during development advance 1.1.j. Detailed updated mapping of cliffs within ML1814 1.1.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 1.1.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria					
	There is a risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the EP Area (and/or adjacent to the EP Area) beyond approved consent criteria/performance measures ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Public safety hazard (personal injury PI) .	1.2.a. Mine design limits subsidence to level where surface cracking will not occur. 1.2.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 1.2.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs	E (IF)	4 (PI)	10 (M)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		1.2.d. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 1.2.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 1.2.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 1.2.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 1.2.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 1.2.i. Underground geological mapping during development advance 1.2.j. Detailed updated mapping of cliffs, within ML1814 1.2.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 1.2.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria 1.2.m. NPWS Signage at entry to SCA 1.2.n. Single lockable access point to Mt Genowlan triggered by NPWS or Centennial TARPS					
2. Pagodas / Rock Formations Located within the EP Area (Cliff Line Zone of First Workings -	There is a risk to Airly from ::: Cracking of pagodas or rock formations :::	2.1.a. Mine design limits subsidence to level where surface cracking will not occur.	E (IF)	3 (R)	6 (L)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extens ion
ML1814)	Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard (personal injury PI) - Reputation - Social impact..					SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.	
		2.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent				1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).	
		2.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs				2. Develop a <i>Land Management Plan</i> in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program	
		2.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.					
		2.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted.					
		2.1.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan					
		2.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements					
		2.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		2.1.i. Underground geological mapping during development advance 2.1.j. Strata Management Plan, TARP and support rules for installation of additional support 2.1.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 2.1.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria					
	There is a risk to Airly from ::: Cracking of pagodas or rock formations ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Public safety hazard (personal injury PI) .	2.2.a. Mine design limits subsidence to level where surface cracking will not occur. 2.2.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 2.2.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs 2.2.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 2.2.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 2.2.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised	E (Pb)	1 (PI)	1 (L)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 2.2.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 2.2.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 2.2.i. Underground geological mapping during development advance 2.2.j. Strata Management Plan, TARP and support rules for installation of additional support 2.2.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 2.2.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria					
3. Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ∴ Mining -induced surface instability / Land slip ∴ Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard (personal injury PI) - Reputation	3.1.a. Mine design limits subsidence to level where surface cracking will not occur. 3.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 3.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs	D (IF)	2 (E)	5 (L)	7. Verify existing proposed workings fall within DOC greater than 50m. 8. Develop HRA for shallow workings in ML1814. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Social impact..	3.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 3.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 3.1.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 3.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 3.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 3.1.i. Underground geological mapping during development advance 3.1.j. Strata Management Plan, TARP and support rules for installation of additional support 3.1.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 3.1.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				2. Develop a Land Management Plan in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program	
	There is a risk to Airly from ∴ Mining -induced surface instability / Land slip ∴ Caused by:	3.2.a. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 3.2.b. Mining method and design reviewed by geotechnical engineering experts (SCT)	E (IF)	4 (PI)	10 (M)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	- Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Public safety hazard (personal injury PI) .	3.2.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)). 3.2.d. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). 3.2.e. Geological mapping during development advance 3.2.f. Qualified mine surveyor and calibrated survey equipment 3.2.g. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval. 3.2.h. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. 3.2.i. Independent Expert Panel (IEP) required by consent to be established (post-consent) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. 3.2.j. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. 3.2.k. Airly Panel Design Standard. (AIR-SS-9001) addresses first workings, implementation, inspection and monitoring (to survey and audit first workings pillars as formed against design). 3.2.l. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent				consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
4. Surface Water Courses - Located within the EP Area. Including the Grotto & The Oasis (upper Genowlan Creek)	There is a risk to Airly from ::: Cracking of stream channel / localised loss of water flow ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard (personal injury PI) - Reputation - Social impact..	4.1.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.	D (D)	3 (R)	9 (M)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.	
		4.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.	
		4.1.c. Mine design limits subsidence to level where surface cracking will not occur.					
		4.1.d. Negligible mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected) due to first workings only.					
		4.1.e. Water courses on the mountain are ephemeral and 1st or 2nd order within EP Area.					
		4.1.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.					
		4.1.g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared).					
		4.1.h. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2).					
		4.1.i. Geological mapping during development advance					
		4.1.j. Qualified mine surveyor and calibrated survey equipment					
		4.1.k. No greater impact permitted than outlined in performance measures of Table					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		1 Schedule 3, Condition 2 of SSD_5581 consent 4.1.l. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.1.m. Surface water baseline monitoring including surface water flows, quality, ground water levels, aquatic ecology, stygofauna, stream stability monitoring, 4.1.n. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs					
	There is a risk to Airly from ::: Changes to creek habitat from changes to geomorphology ::: Caused by: ▪ Geological anomaly ▪ Lineament zone link to surface to underground workings ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Cultural heritage impact ▪ Environmental damage ▪ Non compliance or Public safety hazard (personal injury PI) ▪ Reputation	4.2.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 4.2.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 4.2.c. Mine design limits subsidence to level where surface cracking will not occur. 4.2.d. Negligible mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected) due to first workings only. 4.2.e. Water courses on the mountain are	E (D)	2 (E)	3 (L)	9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis. 4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	No

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Social impact..	ephemeral and 1st or 2nd order within EP Area. 4.2.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 4.2.g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared). 4.2.h. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). 4.2.i. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.2.j. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.2.k. Surface water baseline monitoring including surface water flows, quality, ground water levels, aquatic ecology, stygofauna, stream stability monitoring, 4.2.l. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs					
5. Groundwater - Aquifers above Lithgow seam - (including	There is a risk to Airly from	5.1.a. Limited height of fracturing does not interact with potential aquifers in	D (Pb)	2 (E)	5 (L)	4. Revise mine <i>site Water Management Plan</i> in consultation with stakeholders in accordance	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extens ion
Shallow Quaternary Alluvial, Triassic	∴ Loss of ground water that impacts on ground water dependent eco system or water supply ∴ Caused by: ▪ Draw down due to depressurisation of Permian and/or Triassic strata. ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	sandstone				with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.	
		5.1.b. Sandstones are highly fractured, conduits to side of the mountain				1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).	
		5.1.c. No alluvial basins within the EP Area				5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	
		5.1.d. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.					
		5.1.e. Performance Criteria limits set by SSD_5581					
		5.1.f. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence					
		5.1.g. Mine Design modified following Mt Airly exceedance of subsidence predictions, modified Mine Design reviewed by IEP					
		5.1.h. No high priority GDEs have been identified within the EP area, although there is potential for 'Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017). Three Plant Community Types (PCTs) within the EP area are associated with Facultative Ecosystems being PCT 3226, 3495 and 3731. The					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		Grotto and Oasis occur within this EP area. Whilst monitoring has shown water flow to be rainfall dependant, Biodiversity Monitoring and Baseline Assessment has been established to monitoring for vegetation and surface flow changes within the Facultative Ecosystems, and within the Grotto and Oasis."					
		5.1.i. Stygofauna monitoring program inplace					
		5.1.j. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.					
		5.1.k. No registered bores using these aquifers as private water supply in the EP Area.					
		5.1.l. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders					
6. Groundwater - Aquifers in and immediately above Lithgow seam - Permian and Located within the EP Area	There is a risk to Airly from ::: Loss of ground water that impacts on ground water dependent eco system or water supply beyond approved impact level ::: Caused by: ▪ Draw down due to depressurisation of Permian and/or Triassic strata. ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption.	6.1.a. Mining and monitoring experience to date shows minimal water make in Permian 6.1.b. No users of upper Permian aquifers 6.1.c. No high priority GDEs have been identified within the EP area, although there is potential for 'Facultative	D (Pb)	2 (E)	5 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity. 9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	- Environmental damage - Non compliance - Reputation - Social impact..	Ecosystems' existing as moist sheltered gully forests or along creek lines. Facultative Ecosystems are not entirely dependent on groundwater, and may rely on groundwater on a seasonal basis or only during extended drought periods. At other times, water requirements may be met by soil or surface water (RPS 2014; RPS 2023; GHD 2017). 6.1.d. Ground water systems in the EP area are in the Narabeen Sandstone and surface alluvial basins 6.1.e. Limited height of fracturing does not interact with potential aquifers in sandstone 6.1.f. Sandstones are highly fractured, conduits to side of the mountain 6.1.g. No alluvial basins within the EP Area 6.1.h. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 6.1.i. Performance Criteria limits set by SSD 5581 6.1.j. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 6.1.k. No high priority GDEs have been identified within the EP area, although there is potential for Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017). Three Plant Community Types (PCTs) within the EP area are associated with Facultative Ecosystems being PCT 3226, 3495 and 3731. The Grotto and Oasis occur within this EP area.					

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		Whilst monitoring has shown water flow to be rainfall dependant, Biodiversity Monitoring and Baseline Assessment has been established to monitoring for vegetation and surface flow changes within the Facultative Ecosystems, and within the Grotto and Oasis 6.1.l. Stygofauna monitoring program inplace 6.1.m. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 6.1.n. No registered bores using these aquifers as private water supply in the EP Area. 6.1.o. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders					
	There is a risk to Airly from ∴ Depressurisation of Permian aquifer leading to ground water inflow to mine workings and subsequent dewatering with potential for water quality impacts ∴ Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Business interruption. - Environmental damage - Non compliance - Reputation	6.2.a. Impact assessed in EIS and approved by consent SSD_5581 6.2.b. Mining and monitoring experience to date shows minimal water make in Permian 6.2.c. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 6.2.d. Water balance shows deficit and negligible requirement for discharge 6.2.e. EPL allows for limits in discharge water quality. 6.2.f. Mine water inflow water quality to date is within EPL limits. 6.2.g. Mine Design modified following Mt Airly exceedance of subsidence	E (Pb)	1 (L)	1 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Social impact..	predictions, modified Mine Design reviewed by IEP 6.2.h. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.					
7. Regional Groundwater - Regional Aquifers - Permian below the Lithgow seam and any associated GDEs Located within the EP Area	There is a risk to Airly from ∴ Loss of ground water that impacts on regional ground water dependent eco system or water supply ∴ Caused by: - Upwelling of ground water into mine workings due to mining activity Resulting in: - Business interruption. - Environmental damage - Non compliance - Reputation - Social impact..	7.1.a. No significant water sources or aquifers in the floor within the zone of influence of the mine workings. 7.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 7.1.c. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 7.1.d. No GDE relying on regional ground water system in EP area 7.1.e. Mine Design reviewed by IEP 7.1.f. To date no observed upwelling of water through the floor	E (Pb)	1 (E)	1 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.	
	There is a risk to Airly from ∴ Depressurisation of Permian aquifer leading to ground water inflow to mine workings ∴ Caused by: - Upwelling of ground water into mine workings due to mining activity Resulting in: - Business interruption. - Environmental damage - Non compliance - Reputation	7.2.a. Impact assessed in EIS and approved by consent SSD_5581 7.2.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 7.2.c. Mine Design reviewed by IEP 7.2.d. Mining and monitoring experience to date shows minimal water make in the Lower Permian 7.2.e. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.	E (Pb)	1 (BI)	1 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Social impact..	7.2.f. EPL allows for limits in discharge water quality. 7.2.g. Mine water inflow water quality to date is within EPL limits. 7.2.h. To date no observed upwelling of water through the floor					
8. Groundwater- Centennial surface water monitoring bores Located within the EP Area	There is a risk to Airly from ∴ Reduction or loss of monitoring capacity ∴ Caused by: - Fire - Geological anomaly - lightning - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA - tree fall - Vandalism Resulting in: - Business interruption. - Non compliance - Reputation .	8.1.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below). 8.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 8.1.c. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details). 8.1.d. No registered bores using these aquifers as private water supply in the EP Area. 8.1.e. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders. 8.1.f. Monthly monitoring of ground water management system sites 8.1.g. NPWS consultation process in relation to protection of assets during hazard reduction process or wildfire. 8.1.h. Baseline and ongoing ecological monitoring has been established for				4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARP's for potential impacts on watercourses and aquifers. 1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs					
9. Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ::: Refer Groundwater Aquifers information above which includes information on Groundwater Dependent Ecosystems and facultative ecosystems. ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Business interruption. - Environmental damage - Non compliance - Reputation - Social impact..	9.1.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below). 9.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 9.1.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)). 9.1.d. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan 9.1.e. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details). 9.1.f. No registered bores using these aquifers as private water supply in the EP Area. 9.1.g. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders 9.1.h. Baseline and ongoing ecological monitoring has been established for	D (Pb)	2 (E)	5 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs					
	There is a risk to Airly from ::: Loss of base ground water flow- degradation or loss of species or habitat ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	9.2.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below). 9.2.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 9.2.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)). 9.2.d. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan 9.2.e. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details). 9.2.f. No registered bores using these aquifers as private water supply in the EP Area. 9.2.g. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders 9.2.h. Baseline and ongoing ecological monitoring has been established for	D (Pb)	2 (E)	5 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs					
10. Groundwater Stygofauna - Located within the EP Area	There is a risk to Airly from ::: Mining related impacts to stygofauna ::: Caused by: ▪ Mining Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	10.1.a. Stygofauna monitoring program	D (Pb)	2 (R)	5 (L)		
11. Threatened AQUATIC FAUNA & potential habitat for threatened fauna and KEY FISH HABITAT (e.g. dragon fly,Macquarie perch) Located within and downstream of the EP Area	There is a risk to Airly from ::: Loss of stream flow - degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	11.1.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 11.1.b. Site Biodiversity Management plan 11.1.c. Aquatic ecology monitoring in accordance with the Site Water Management Plan 11.1.d. Water courses on the mountain are ephemeral and 1st or 2nd order within EP Area. 11.1.e. Mine design limits subsidence to level where surface cracking will not occur. 11.1.f. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 11.1.g. No mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected)	D (IF)	2 (E)	5 (L)		
12. Threatened terrestrial FAUNA	There is a risk to Airly from	12.1.a. Site Biodiversity Management plan 12.1.b. Predicted subsidence magnitudes	D (Pb)	2 (E)	5 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
Located within the EP Area - Threatened birds and habitat for bird species e.g. Hollow dependent owls, Glossy Black Cockatoo, Gang Gang Cockatoo, Flame Robin, Scarlett Robin, Varied Sitella	::: degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	are very small relative to credible values associated with the onset of damage 12.1.c. Mine design limits subsidence to level where surface cracking will not occur. 12.1.d. No mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected)					
13. Threatened terrestrial FAUNA Located within the EP Area - Threatened mammal species (excluding microbats) and their habitats e.g. Gliders, Koala, Spotted Tail Quoll, Rock Wallaby	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	13.1.a. Site Biodiversity Management plan 13.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 13.1.c. Mine design limits subsidence to level where surface cracking will not occur. 13.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 13.1.e. No mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected)	D (D)	2 (E)	5 (L)		
14. Threatened terrestrial FAUNA Located within the EP Area - Threatened Reptile species and their habitats - e.g. broad headed snake	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	14.1.a. Site Biodiversity Management plan 14.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 14.1.c. Mine design limits subsidence to level where surface cracking will not occur. 14.1.d. Mine design reviewed in the context of subsidence monitoring over Mt	D (D)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity. 1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program,	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				monitoring requirements around sensitive features (heritage site).	
15. Threatened terrestrial FAUNA Located within the EP Area - Microbats and their habitats (Cliff rock overhangs and tree hollows) e.g. Eastern False Pipestrelle, Eastern Free Tailed Bat, Large Bent Wing Bat, Large-eared Pied Bat, Little Bent-winged Bat, Little Pied Bat.	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	15.1.a. Site Biodiversity Management plan				5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	
		15.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).	
		15.1.c. Mine design limits subsidence to level where surface cracking will not occur.	D (Pb)	2 (E)	5 (L)		
		15.1.d. Hollow bearing trees are avoided in installation of subsidence monitoring infrastructure.					
		15.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence					
16. Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	16.1.a. Site Biodiversity Management plan				5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	
		16.1.b. E Canonii and P Stricta not ground or surface water dependent plants.					
		16.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage					
		16.1.d. Mine design limits subsidence to level where surface cracking will not occur.	D (Pb)	2 (E)	5 (L)		
		16.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence					
	There is a risk to Airly from ::: degradation or loss of Genowlan Pea :::	16.2.a. Site Biodiversity Management plan 16.2.b. Predicted subsidence magnitudes are very small relative to credible values	D (Pb)	4 (E)	14 (S)	10. Review proposed mine working with offsets. Implement mine design change.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	associated with the onset of damage 16.2.c. Mine design limits subsidence to level where surface cracking will not occur. 16.2.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence					
17. Endangered Ecological Communities (EEC) Located within the EP Area	There is a risk to Airly from ::: Changes in species diversity or extent within EECs (genowlan Pt) ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage / loss of biodiversity or Loss of Intergenerational Equity, or Non compliance or Reputation or Social impact or Business interruption..	17.1.a. Site Biodiversity Management plan 17.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 17.1.c. Predicted subsidence magnitudes are very small relative to credible values and site specific experience of associated with the onset of damage 17.1.d. Mine design limits subsidence to level where surface cracking will not occur. 17.1.e. Not ground or surface water dependent plants. 17.1.f. Ground disturbance permit prior to clearing.	D (D)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	
18. Natural vegetation - (General, including sheltered gullies) Located within the EP Area	There is a risk to Airly from ::: Changes in species diversity or extent ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business	18.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 18.1.b. Site Biodiversity Management plan 18.1.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 18.1.d. Mine design limits subsidence to level where surface cracking will not occur. 18.1.e. Not ground or surface water	D (D)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	interruption..	dependent plants. 18.1.f. Ground disturbance permit prior to clearing.					
19. Unsealed Roads, four wheel drive tracks and trails (SCA Management Trails) Located within the EP Area	There is a risk to Airly from ::: Damage to road/track/trail surface from cracking or slabbing, or rock fall from adjacent cliffs, pagodas and steep slope areas ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Public safety hazard (personal injury PI) or Reputation or Social impact..	19.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage Mine design limits subsidence to level where surface cracking will not occur.				11. Consult with NPWS to Install Safety Warning Signage (Active Mining Area) on mountain	
		19.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.	
		19.1.c. Mine design limits subsidence to level where surface cracking will not occur.	D (Pb)	2 (E)	5 (L)	1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).	
		19.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				6. Develop a Built Features Management Plan in accordance with Condition 7, Schedule 3 of Consent in consultation with relevant stakeholders This is a recommend control that was applied in the first version of the Risk assessment, which has been moved to a current control in this review so as to not cause the action to be applied again through PULSE	
20. Aboriginal and Cultural Heritage Sites Located within the EP Area	There is a risk to Airly from ::: Damage to Aboriginal and Cultural Heritage Sites Located within the EP Area :::	20.1.a. One identified ACH site in the EP area.	D (Pb)	3 (R)	9 (M)	1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	20.1.b. Mine design limits subsidence to level where surface cracking will not occur. 20.1.c. Site Aboriginal and Cultural Heritage Management Plan (Site ACHMP) 20.1.d. Regional Aboriginal and Cultural Heritage Management Plan (Regional ACHMP) 20.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site). 12. Develop ACHPM for CLZ EP area 10. Review proposed mine working with offsets. Implement mine design change.	
21. Historic Heritage / Sites of Archaeological heritage significance Located within the EP	There is a risk to Airly from ::: Damage to heritage item as a result of cliff fall from cliffs adjacent to shale mine interaction zone ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	21.1.a. Not Applicable baseline assessment undertaken. No actual or potential sites of historical heritage identified	E (Pb)	1 (E)	1 (L)		
22. Geological Structures (including faults, folds, sills or dykes) Located within the EP Area	There is a risk to Airly from ::: Increased subsidence / impacts arising from potential effects of geological structures (local or regional) :::	22.1.a. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 22.1.b. Mine design limits subsidence to	D (Pb)	2 (E)	5 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	level where surface cracking will not occur. 22.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 22.1.d. Geotechnical characterisation (GRR) . 22.1.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 22.1.f. Strata Management Plan, TARP and support rules for installation of additional support 22.1.g. Geological mapping during development advance					
23. Far Field Movements and Effects beyond the EP Area	There is a risk to Airly from ::: Mining induced far field movements potentially impacting surface features (eg cliffs and pagodas) beyond approved consent criteria/performance measures, and affecting the extent of the required management area (EP Area) ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	23.1.a. Far field movements are limited by the boundary of the mesa 23.1.b. Mine design limits subsidence to level where surface cracking will not occur. 23.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 23.1.d. Geotechnical characterisation (GRR) .	D (Pb)	2 (E)	5 (L)		
24. Valley Closure or Upsidence Movements and Effects within and beyond the EP Area (gorges, valleys,creek crossings)	There is a risk to Airly from ::: Mining induced valley closure movements potentially causing impacts to natural features	24.1.a. Far field movements are limited by the boundary of the mesa 24.1.b. Mine design reviewed in the context of subsidence monitoring over Mt	D (Pb)	2 (E)	5 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extens ion
	such as cliffs, minor cliffs and pagodas within and beyond the EP Area beyond approved consent criteria/performance measures ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 24.1.c. Mine design limits subsidence to level where surface cracking will not occur. 24.1.d. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 24.1.e. Geotechnical characterisation (GRR) .					
25. Shear Strain Effects (on Built Features) (particularly to dwellings & infrastructure in deep DOC)	There is a risk to Airly from ::: Not Applicable (none within EP Area / potentially affected area) ::: Caused by: ▪ Resulting in: ▪		()	0	0		
26. Movements and Effects Beyond Predictions within and beyond the EP Area	There is a risk to Airly from ::: Mining induced movements and effects BEYOND PREDICTIONS potentially causing impacts to natural features (including cliffs, minor cliffs and pagodas) within and beyond the EP Area, beyond approved consent criteria/performance measures ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing	26.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 26.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 26.1.c. Mine design limits subsidence to level where surface cracking will not occur. 26.1.d. Geotechnical characterisation (GRR) .	D (Pb)	2 (E)	5 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..						
	There is a risk to Airly from ::: Mining induced effects BEYOND PREDICTIONS causing surface cracking and gas release (e.g.with public safety implications) ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	26.2.a. Negligible levels of seam gas 26.2.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 26.2.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 26.2.d. Mine design limits subsidence to level where surface cracking will not occur. 26.2.e. Geotechnical characterisation (GRR) .	D (Pb)	2 (E)	5 (L)		
27. Sinkhole development within or beyond the EP Area	There is a risk to Airly from ::: Mining induced development of sinkhole(s) with associated potential impact to public safety, drainage and/or surface features (including cliffs, minor cliffs and pagodas) located within or beyond in the EP Area, above approved consent criteria/performance measures ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage	27.1.a. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 27.1.b. Strata Management Plan, TARP and support rules for installation of additional support	E (Pb)	2 (PI)	3 (L)	11. Consult with NPWS to Install Safety Warning Signage (Active Mining Area) on mountain	

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	to reputation or business interruption, or social impact..						
28. Steeply Dipping Terrain Effects - Potential for interaction between workings downslope of the CLZ and extraction within the EP Area	There is a risk to Airly from ∴ impact to cliffs and associated features in steeply dipping terrain:: ∴ Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	28.1.a. The Cliff Line Zone forms a barrier 28.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 28.1.c. Mine design limits subsidence to level where surface cracking will not occur. 28.1.d. Geotechnical characterisation (GRR) . 28.1.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	D (Pb)	3 (E)	9 (M)		
29. Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ∴ Pillar punching occurring ∴ Caused by: ▪ low strength roof/ floor material ▪ Pillar design LTA ▪ pillar stress excessively high ▪ Water flooding Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	29.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 29.1.c. Mine design limits subsidence to level where surface cracking will not occur. 29.1.d. Geotechnical characterisation (GRR) . 29.1.e. Strata Management Plan, TARP and support rules for installation of additional support 29.1.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 29.1.g. Inseam water make has historically been minimal. Conditions generally dry	E (Pb)	2 (L)	3 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extens ion
		underground					
	There is a risk to Airly from ::: Systemic failure ::: Caused by: ▪ High proportion of low strength roof material ▪ Reactive strata (i.e. tuff material) ▪ Water flooding Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	29.2.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.2.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 29.2.c. Mine design limits subsidence to level where surface cracking will not occur. 29.2.d. Geotechnical characterisation (GRR) . 29.2.e. Strata Management Plan, TARP and support rules for installation of additional support 29.2.f. Inseam water make has historically been minimal. Conditions generally dry underground 29.2.g. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	E (Pb)	2 (L)	3 (L)		
	There is a risk to Airly from ::: Excessive Pillar Compression ::: Caused by: ▪ High proportion of low strength roof material ▪ Pillar design LTA ▪ Reactive strata (i.e. tuff material) ▪ Water flooding Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	29.3.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.3.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 29.3.c. Mine design limits subsidence to level where surface cracking will not occur. 29.3.d. Geotechnical characterisation (GRR) . 29.3.e. Strata Management Plan, TARP and support rules for installation of additional support	E (Pb)	2 (L)	3 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
		29.3.f. Inseam water make has historically been minimal. Conditions generally dry underground 29.3.g. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.					
30. Interaction with old workings or proposed/future multi seam mining) potentially affecting subsidence conditions	There is a risk to Airly from ::: Not Applicable ::: Caused by: ▪ Resulting in: ▪.	30.1.a. Not Applicable 30.1.b. Formal record tracings indicate no workings 30.1.c. Ground truthing of surface extense identify possible workings	()	0	0	13. Identify locations of surface adit/shafts (gold/diamond) , add to mineplan with inrush control zones.	
31. Presence of Massive Strata in Roof or Overburden	There is a risk to Airly from ::: Not Applicable ::: Caused by: ▪ Resulting in: ▪.	31.1.a. Not Applicable	()	0	0		
32. Uncertainty in subsidence predictions, hazard assessment and underlying inputs/assumptions	There is a risk to Airly from ::: Uncertainty in predictions and/or subsidence hazard analysis ::: Caused by: ▪ Anomolies/complexities or deterioration in geotechnical conditions ▪ Discontinuities, heterogeneity effecting subsidence assessment ▪ Inadequate assumptions used in subsidence assessment ▪ Inadequate or incomplete data used in subsidence assessment	32.1.a. Baseline subsidence estimates assume conservative input parameters 32.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 32.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 32.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence	C (Pb)	1 (R)	4 (L)		

Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extension
	- Temporal variability in input data or assumptions used for subsidence assessment Resulting in: - Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	32.1.e. Mine design limits subsidence to level where surface cracking will not occur. 32.1.f. Geotechnical characterisation (GRR) . 32.1.g. Strata Management Plan, TARP and support rules for installation of additional support					
33. Delayed / Long Term Subsidence (period/duration of subsidence management)	There is a risk to Airly from ∴ Development of delayed or long term subsidence movements beyond predictions (affecting timing / duration of subsidence management) ∴ Caused by: - Anomalies/complexities or deterioration in roof/floor/ geotechnical conditions (eg due to clay stone bands) - climatic conditions - Flooded Workings - Geological Structures - Nature and magnitude of horizontal stress field - Overlying or Underlying Workings - Topographic terrain Resulting in: - Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	33.1.a. Baseline subsidence estimates assume conservative input parameters 33.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 33.1.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 33.1.d. Mine design limits subsidence to level where surface cracking will not occur. 33.1.e. Geotechnical characterisation (GRR) . 33.1.f. Survey methods selected for monitoring are well suited to repeatable survey (if required) to be undertaken	D (Pb)	2 (E)	5 (L)		
34. Future Developments / Change within EP Area affecting subsidence management	There is a risk to Airly from ∴ Future changes or development within the EP Area influencing management requirements (e.g. long term post-mining intention to transition surface lands from from SCA to NP) ∴	34.1.a. Rehabilitation and closure Management Plan 34.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 34.1.c. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than	D (Pb)	2 (E)	5 (L)		



Step	Potential Incident	Current Controls	L	MR C	RR	Recommended Control	Bow Tie Extens ion
	Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	approved in EIS. Long-term stable.					

WRAC Analysis Sorted by RR

Instructions:

WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
16. Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ::: degradation or loss of Genowlan Pea ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	16.2.a. Site Biodiversity Management plan 16.2.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 16.2.c. Mine design limits subsidence to level where surface cracking will not occur. 16.2.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence	D (Pb)	4 (E)	14 (S)	10. Review proposed mine working with offsets. Implement mine design change.
1. Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the EP Area (and/or adjacent to the EP Area) beyond approved consent criteria/performance measures ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Public safety hazard (personal injury PI)	1.2.a. Mine design limits subsidence to level where surface cracking will not occur. 1.2.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 1.2.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs 1.2.d. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 1.2.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 1.2.f. Mining method and design reviewed by geotechnical engineering experts (Pillar	E (IF)	4 (PI)	10 (M)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.

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WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 1.2.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 1.2.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 1.2.i. Underground geological mapping during development advance 1.2.j. Detailed updated mapping of cliffs, within ML1814 1.2.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 1.2.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria 1.2.m. NPWS Signage at entry to SCA 1.2.n. Single lockable access point to Mt Genowlan triggered by NPWS or Centennial TARPS				
3. Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining -induced surface instability / Land slip ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Public safety hazard (personal injury PI)	3.2.a. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 3.2.b. Mining method and design reviewed by geotechnical engineering experts (SCT) 3.2.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)). 3.2.d. Consent conditions require first	E (IF)	4 (PI)	10 (M)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). 3.2.e. Geological mapping during development advance 3.2.f. Qualified mine surveyor and calibrated survey equipment 3.2.g. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval. 3.2.h. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. 3.2.i. Independent Expert Panel (IEP) required by consent to be established (post-consent) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. 3.2.j. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. 3.2.k. Airly Panel Design Standard. (AIR-SS-9001) addresses first workings, implementation, inspection and monitoring (to survey and audit first workings pillars as formed against design). 3.2.l. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent				
1. Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the cliff zone within ML1814 Mine Potential Interaction Zone beyond approved consent criteria/performance measures :::	1.1.a. Mine design limits subsidence to level where surface cracking will not occur.	D (Pb)	3 (L)	9 (M)	1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).

Instructions:

WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard (personal injury PI) - Reputation - Social impact..	1.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent				2. Develop a Land Management Plan in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program
		1.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs				3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.
		1.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.
		1.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted.				
		1.1.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan				
		1.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements				
		1.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP				
		1.1.i. Underground geological mapping during development advance				
		1.1.j. Detailed updated mapping of cliffs within ML1814				
		1.1.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		survey tool or method. Approx 6 monthly with results analysed for changed.				
		1.1.I. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				
4. Surface Water Courses - Located within the EP Area. Including the Grotto & The Oasis (upper Genowlan Creek)	There is a risk to Airly from ::: Cracking of stream channel / localised loss of water flow ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard (personal injury PI) - Reputation - Social impact..	4.1.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.				4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.
		4.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.
		4.1.c. Mine design limits subsidence to level where surface cracking will not occur.				
		4.1.d. Negligible mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected) due to first workings only.				
		4.1.e. Water courses on the mountain are ephemeral and 1st or 2nd order within EP Area.	D (D)	3 (R)	9 (M)	
		4.1.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		4.1.g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared).				
		4.1.h. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2).				
		4.1.i. Geological mapping during development advance				

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		4.1.j. Qualified mine surveyor and calibrated survey equipment 4.1.k. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.1.l. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.1.m. Surface water baseline monitoring including surface water flows, quality, ground water levels, aquatic ecology, stygofauna, stream stability monitoring, 4.1.n. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				
20. Aboriginal and Cultural Heritage Sites Located within the EP Area	There is a risk to Airly from ::: Damage to Aboriginal and Cultural Heritage Sites Located within the EP Area ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	20.1.a. One identified ACH site in the EP area.	D (Pb)	3 (R)	9 (M)	1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
		20.1.b. Mine design limits subsidence to level where surface cracking will not occur.				12. Develop ACHPM for CLZ EP area
		20.1.c. Site Aboriginal and Cultural Heritage Management Plan (Site ACHMP)				10. Review proposed mine working with offsets. Implement mine design change.
		20.1.d. Regional Aboriginal and Cultural Heritage Management Plan (Regional ACHMP)				
		20.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and				

Instructions:

WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
28. Steeply Dipping Terrain Effects - Potential for interaction between workings downslope of the CLZ and extraction within the EP Area	There is a risk to Airly from ::: impact to cliffs and associated features in steeply dipping terrain:: ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	28.1.a. The Cliff Line Zone forms a barrier 28.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 28.1.c. Mine design limits subsidence to level where surface cracking will not occur. 28.1.d. Geotechnical characterisation (GRR) . 28.1.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	D (Pb)	3 (E)	9 (M)	
8. Groundwater- Centennial surface water monitoring bores Located within the EP Area	There is a risk to Airly from ::: Reduction or loss of monitoring capacity ::: Caused by: ▪ Fire ▪ Geological anomaly ▪ lightning ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA ▪ tree fall ▪ Vandalism Resulting in: ▪ Business interruption. ▪ Non compliance ▪ Reputation .	8.1.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below). 8.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 8.1.c. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details). 8.1.d. No registered bores using these aquifers as private water supply in the EP Area. 8.1.e. Baseline and ongoing monitoring of relevant ground water monitoring bores to	C (Pb)	2 (L)	8 (M)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers. 1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		support the site Water Management Plan developed in consultation with stakeholders. 8.1.f. Monthly monitoring of ground water management system sites 8.1.g. NPWS consultation process in relation to protection of assets during hazard reduction process or wildfire. 8.1.h. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				
2. Pagodas / Rock Formations Located within the EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Cracking of pagodas or rock formations ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Cultural heritage impact ▪ Environmental damage ▪ Non compliance or Public safety hazard (personal injury PI) ▪ Reputation ▪ Social impact..	2.1.a. Mine design limits subsidence to level where surface cracking will not occur.	E (IF)	3 (R)	6 (L)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.
		2.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent				1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
		2.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs				2. Develop a Land Management Plan in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program
		2.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		2.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted.				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		2.1.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 2.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 2.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 2.1.i. Underground geological mapping during development advance 2.1.j. Strata Management Plan, TARP and support rules for installation of additional support 2.1.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 2.1.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				
3. Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining -induced surface instability / Land slip ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard	3.1.a. Mine design limits subsidence to level where surface cracking will not occur. 3.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 3.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs	D (IF)	2 (E)	5 (L)	7. Verify existing proposed workings fall within DOC greater than 50m. 8. Develop HRA for shallow workings in ML1814. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	(personal injury PI) • Reputation • Social impact..	3.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 3.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 3.1.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 3.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 3.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 3.1.i. Underground geological mapping during development advance 3.1.j. Strata Management Plan, TARP and support rules for installation of additional support 3.1.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 3.1.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				2. Develop a Land Management Plan in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program
5. Groundwater - Aquifers above Lithgow seam - (including Shallow Quaternary Alluvial, Triassic	There is a risk to Airly from ::: Loss of ground water that impacts on ground water dependent eco system or water supply :::	5.1.a. Limited height of fracturing does not interact with potential aquifers in sandstone	D (Pb)	2 (E)	5 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.

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	Caused by: - Draw down due to depressurisation of Permian and/or Triassic strata. - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Business interruption. - Environmental damage - Non compliance - Reputation - Social impact..	5.1.b. Sandstones are highly fractured, conduits to side of the mountain				1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
		5.1.c. No alluvial basins within the EP Area				5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.
		5.1.d. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.				
		5.1.e. Performance Criteria limits set by SSD_5581				
		5.1.f. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
		5.1.g. Mine Design modified following Mt Airly exceedance of subsidence predictions, modified Mine Design reviewed by IEP				
		5.1.h. No high priority GDEs have been identified within the EP area, although there is potential for 'Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017). Three Plant Community Types (PCTs) within the EP area are associated with Facultative Ecosystems being PCT 3226, 3495 and 3731. The Grotto and Oasis occur within this EP area. Whilst monitoring has shown water flow to be rainfall dependant, Biodiversity Monitoring and Baseline Assessment has been established to monitoring for vegetation and surface flow changes within the Facultative Ecosystems, and within the Grotto and Oasis."				
		5.1.i. Stygofauna monitoring program				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		inplace				
		5.1.j. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		5.1.k. No registered bores using these aquifers as private water supply in the EP Area.				
		5.1.l. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders				
6. Groundwater - Aquifers in and immediately above Lithgow seam - Permian and Located within the EP Area	There is a risk to Airly from ::: Loss of ground water that impacts on ground water dependent eco system or water supply beyond approved impact level ::: Caused by: ▪ Draw down due to depressurisation of Permian and/or Triassic strata. ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	6.1.a. Mining and monitoring experience to date shows minimal water make in Permian 6.1.b. No users of upper Permian aquifers 6.1.c. No high priority GDEs have been identified within the EP area, although there is potential for 'Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines. Facultative Ecosystems are not entirely dependent on groundwater, and may rely on groundwater on a seasonal basis or only during extended drought periods. At other times, water requirements may be met by soil or surface water (RPS 2014; RPS 2023; GHD 2017). 6.1.d. Ground water systems in the EP area are in the Narabeen Sandstone and surface alluvial basins 6.1.e. Limited height of fracturing does not interact with potential aquifers in sandstone				4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity. 9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.

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		6.1.f. Sandstones are highly fractured, conduits to side of the mountain				
		6.1.g. No alluvial basins within the EP Area				
		6.1.h. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.				
		6.1.i. Performance Criteria limits set by SSD_5581				
		6.1.j. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
		6.1.k. No high priority GDEs have been identified within the EP area, although there is potential for Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017). Three Plant Community Types (PCTs) within the EP area are associated with Facultative Ecosystems being PCT 3226, 3495 and 3731. The Grotto and Oasis occur within this EP area. Whilst monitoring has shown water flow to be rainfall dependant, Biodiversity Monitoring and Baseline Assessment has been established to monitoring for vegetation and surface flow changes within the Facultative Ecosystems, and within the Grotto and Oasis				
		6.1.l. Stygofauna monitoring program inplace				
		6.1.m. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		6.1.n. No registered bores using these aquifers as private water supply in the EP Area.				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		6.1.o. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders				
9. Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ::: Refer Groundwater Aquifers information above which includes information on Groundwater Dependent Ecosystems and facultative ecosystems. ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	9.1.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below).	D (Pb)	2 (E)	5 (L)	
		9.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		9.1.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)).				
		9.1.d. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan				
		9.1.e. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details).				
		9.1.f. No registered bores using these aquifers as private water supply in the EP Area.				
		9.1.g. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders				
		9.1.h. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per				

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		the Site Specific BMP, and additional EP specific BMPs				
9. Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ::: Loss of base ground water flow-degradation or loss of species or habitat ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	9.2.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below).	D (Pb)	2 (E)	5 (L)	
		9.2.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		9.2.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)).				
		9.2.d. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan				
		9.2.e. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details).				
		9.2.f. No registered bores using these aquifers as private water supply in the EP Area.				
		9.2.g. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders				
		9.2.h. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				

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10. Groundwater Stygofauna - Located within the EP Area	There is a risk to Airly from ::: Mining related impacts to stygofauna ::: Caused by: ▪ Mining Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	10.1.a. Stygofauna monitoring program	D (Pb)	2 (R)	5 (L)	
11. Threatened AQUATIC FAUNA & potential habitat for threatened fauna and KEY FISH HABITAT (e.g. dragon fly,Macquarie perch) Located within and downstream of the EP Area	There is a risk to Airly from ::: Loss of stream flow - degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	11.1.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 11.1.b. Site Biodiversity Management plan 11.1.c. Aquatic ecology monitoring in accordance with the Site Water Management Plan 11.1.d. Water courses on the mountain are ephemeral and 1st or 2nd order within EP Area. 11.1.e. Mine design limits subsidence to level where surface cracking will not occur. 11.1.f. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 11.1.g. No mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected)	D (IF)	2 (E)	5 (L)	
12. Threatened terrestrial FAUNA Located within the EP Area - Threatened birds and habitat for bird species e.g. Hollow dependent owls, Glossy Black Cockatoo, Gang Gang Cockatoo, Flame Robin, Scarlett Robin, Varied Sitella	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or	12.1.a. Site Biodiversity Management plan 12.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 12.1.c. Mine design limits subsidence to level where surface cracking will not occur. 12.1.d. No mining-induced change in	D (Pb)	2 (E)	5 (L)	

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	geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	hydrology expected (no surface cracking, no significant changes to drainage profile expected)				
13. Threatened terrestrial FAUNA Located within the EP Area - Threatened mammal species (excluding microbats) and their habitats e.g. Gliders, Koala, Spotted Tail Quoll, Rock Wallaby	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	13.1.a. Site Biodiversity Management plan 13.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 13.1.c. Mine design limits subsidence to level where surface cracking will not occur. 13.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 13.1.e. No mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected)	D (D)	2 (E)	5 (L)	
14. Threatened terrestrial FAUNA Located within the EP Area - Threatened Reptile species and their habitats - e.g. broad headed snake	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	14.1.a. Site Biodiversity Management plan 14.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 14.1.c. Mine design limits subsidence to level where surface cracking will not occur. 14.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence	D (D)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity. 1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
15. Threatened terrestrial FAUNA Located within the EP Area - Microbats and their habitats (Cliff rock overhangs and tree hollows)	There is a risk to Airly from ::: Degradation or loss of species or habitat :::	15.1.a. Site Biodiversity Management plan	D (Pb)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential

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e.g. Eastern False Pipestrelle, Eastern Free Tailed Bat, Large Bent Wing Bat, Large-eared Pied Bat, Little Bent-winged Bat, Little Pied Bat.	Caused by: • Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: • Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	15.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 15.1.c. Mine design limits subsidence to level where surface cracking will not occur. 15.1.d. Hollow bearing trees are avoided in installation of subsidence monitoring infrastructure. 15.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				impacts on biodiversity. 1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
16. Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: • Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: • Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	16.1.a. Site Biodiversity Management plan 16.1.b. E Canonii and P Stricta not ground or surface water dependent plants. 16.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 16.1.d. Mine design limits subsidence to level where surface cracking will not occur. 16.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence	D (Pb)	2 (E)	5 (L)	5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.
17. Endangered Ecological Communities (EEC) Located within the EP Area	There is a risk to Airly from ::: Changes in species diversity or extent within EECs (genowlan Pt) ::: Caused by: • Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in:	17.1.a. Site Biodiversity Management plan 17.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 17.1.c. Predicted subsidence magnitudes are very small relative to credible values and site specific experience of associated with the onset of damage 17.1.d. Mine design limits subsidence to level where surface cracking will not occur.	D (D)	2 (E)	5 (L)	5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.

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	Environmental damage / loss of biodiversity or Loss of Intergenerational Equity, or Non compliance or Reputation or Social impact or Business interruption..	17.1.e. Not ground or surface water dependent plants. 17.1.f. Ground disturbance permit prior to clearing.				
18. Natural vegetation - (General, including sheltered gullies) Located within the EP Area	There is a risk to Airly from ::: Changes in species diversity or extent Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	18.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 18.1.b. Site Biodiversity Management plan 18.1.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 18.1.d. Mine design limits subsidence to level where surface cracking will not occur. 18.1.e. Not ground or surface water dependent plants. 18.1.f. Ground disturbance permit prior to clearing.	D (D)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARP's for potential impacts on biodiversity.
19. Unsealed Roads, four wheel drive tracks and trails (SCA Management Trails) Located within the EP Area	There is a risk to Airly from ::: Damage to road/track/trail surface from cracking or slabbing, or rock fall from adjacent cliffs, pagodas and steep slope areas Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Public safety hazard (personal injury PI) or Reputation or Social impact..	19.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage Mine design limits subsidence to level where surface cracking will not occur. 19.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 19.1.c. Mine design limits subsidence to level where surface cracking will not occur.	D (Pb)	2 (E)	5 (L)	11. Consult with NPWS to Install Safety Warning Signage (Active Mining Area) on mountain 3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded. 1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		19.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				6. Develop a Built Features Management Plan in accordance with Condition 7, Schedule 3 of Consent in consultation with relevant stake holders This is a recommend control that was applied in the first version of the Risk assessment, which has been moved to a current control in this review so as to not cause the action to be applied again through PULSE
22. Geological Structures (including faults, folds, sills or dykes) Located within the EP Area	There is a risk to Airly from ::: Increased subsidence / impacts arising from potential effects of geological structures (local or regional) ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	22.1.a. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence	D (Pb)	2 (E)	5 (L)	
		22.1.b. Mine design limits subsidence to level where surface cracking will not occur.				
		22.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				
		22.1.d. Geotechnical characterisation (GRR)				
		22.1.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		22.1.f. Strata Management Plan, TARP and support rules for installation of additional support				
		22.1.g. Geological mapping during development advance				
23. Far Field Movements and Effects beyond the EP Area	There is a risk to Airly from ::: Mining induced far field movements potentially impacting surface features (eg cliffs and pagodas) beyond approved consent criteria/performance measures, and affecting the extent of the required management area (EP Area) ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or	23.1.a. Far field movements are limited by the boundary of the mesa	D (Pb)	2 (E)	5 (L)	
		23.1.b. Mine design limits subsidence to level where surface cracking will not occur.				
		23.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				
		23.1.d. Geotechnical characterisation (GRR)				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..					
24. Valley Closure or Upsidence Movements and Effects within and beyond the EP Area (gorges, valleys,creek crossings)	There is a risk to Airly from ::: Mining induced valley closure movements potentially causing impacts to natural features such as cliffs, minor cliffs and pagodas within and beyond the EP Area beyond approved consent criteria/performance measures ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	24.1.a. Far field movements are limited by the boundary of the mesa	D (Pb)	2 (E)	5 (L)	
		24.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
		24.1.c. Mine design limits subsidence to level where surface cracking will not occur.				
		24.1.d. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				
		24.1.e. Geotechnical characterisation (GRR)				
26. Movements and Effects Beyond Predictions within and beyond the EP Area	There is a risk to Airly from ::: Mining induced movements and effects BEYOND PREDICTIONS potentially causing impacts to natural features (including cliffs, minor cliffs and pagodas) within and beyond the EP Area, beyond approved consent criteria/performance measures ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or	26.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage	D (Pb)	2 (E)	5 (L)	
		26.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
		26.1.c. Mine design limits subsidence to level where surface cracking will not occur.				
		26.1.d. Geotechnical characterisation (GRR)				

Instructions:

WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..					
26. Movements and Effects Beyond Predictions within and beyond the EP Area	There is a risk to Airly from ::: Mining induced effects BEYOND PREDICTIONS causing surface cracking and gas release (e.g.with public safety implications) ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	26.2.a. Negligible levels of seam gas	D (Pb)	2 (E)	5 (L)	
		26.2.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				
		26.2.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
		26.2.d. Mine design limits subsidence to level where surface cracking will not occur.				
		26.2.e. Geotechnical characterisation (GRR)				
33. Delayed / Long Term Subsidence (period/duration of subsidence management)	There is a risk to Airly from ::: Development of delayed or long term subsidence movements beyond predictions (affecting timing / duration of subsidence management) ::: Caused by: ▪ Anomalies/complexities or deterioration in roof/floor/ geotechnical conditions (eg due to clay stone bands) ▪ climatic conditions ▪ Flooded Workings ▪ Geological Structures ▪ Nature and magnitude of horizontal	33.1.a. Baseline subsidence estimates assume conservative input parameters	D (Pb)	2 (E)	5 (L)	
		33.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				
		33.1.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
		33.1.d. Mine design limits subsidence to level where surface cracking will not occur.				
		33.1.e. Geotechnical characterisation (GRR)				

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WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	stress field - Overlying or Underlying Workings - Topographic terrain Resulting in: - Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	33.1.f. Survey methods selected for monitoring are well suited to repeatable survey (if required) to be undertaken				
34. Future Developments / Change within EP Area affecting subsidence management	There is a risk to Airly from ::: Future changes or development within the EP Area influencing management requirements (e.g. long term post-mining intention to transition surface lands from from SCA to NP) ::: Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	34.1.a. Rehabilitation and closure Management Plan 34.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 34.1.c. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	D (Pb)	2 (E)	5 (L)	
32. Uncertainty in subsidence predictions, hazard assessment and underlying inputs/assumptions	There is a risk to Airly from ::: Uncertainty in predictions and/or subsidence hazard analysis ::: Caused by: - Anomolies/complexities or deterioration in geotechnical conditions - Discontinuities, heterogeneity effecting subsidence assessment - Inadequate assumptions used in	32.1.a. Baseline subsidence estimates assume conservative input parameters 32.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 32.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 32.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and	C (Pb)	1 (R)	4 (L)	

Instructions:

WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	subsidence assessment - Inadequate or incomplete data used in subsidence assessment - Temporal variability in input data or assumptions used for subsidence assessment Resulting in: - Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 32.1.e. Mine design limits subsidence to level where surface cracking will not occur. 32.1.f. Geotechnical characterisation (GRR) . 32.1.g. Strata Management Plan, TARP and support rules for installation of additional support				
4. Surface Water Courses - Located within the EP Area. Including the Grotto & The Oasis (upper Genowlan Creek)	There is a risk to Airlly from ... Changes to creek habitat from changes to geomorphology ... Caused by: - Geological anomaly - Lineament zone link to surface to underground workings - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard (personal injury PI) - Reputation - Social impact..	4.2.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.	E (D)	2 (E)	3 (L)	9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.
		4.2.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage				4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.
		4.2.c. Mine design limits subsidence to level where surface cracking will not occur.				5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.
		4.2.d. Negligible mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected) due to first workings only.				
		4.2.e. Water courses on the mountain are ephemeral and 1st or 2nd order within EP Area.				
		4.2.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		4.2.g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared).				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		4.2.h. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). 4.2.i. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.2.j. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.2.k. Surface water baseline monitoring including surface water flows, quality, ground water levels, aquatic ecology, stygofauna, stream stability monitoring, 4.2.l. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				
27. Sinkhole development within or beyond the EP Area	There is a risk to Airly from ::: Mining induced development of sinkhole(s) with associated potential impact to public safety, drainage and/or surface features (including cliffs, minor cliffs and pagodas) located within or beyond in the EP Area, above approved consent criteria/performance measures ::: Caused by: • Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA	27.1.a. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 27.1.b. Strata Management Plan, TARP and support rules for installation of additional support	E (Pb)	2 (PI)	3 (L)	11. Consult with NPWS to Install Safety Warning Signage (Active Mining Area) on mountain

Instructions:

WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Resulting in: Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..					
29. Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Pillar punching occurring ::: Caused by: - low strength roof/ floor material - Pillar design LTA - pillar stress excessively high - Water flooding Resulting in: - Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	29.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 29.1.c. Mine design limits subsidence to level where surface cracking will not occur. 29.1.d. Geotechnical characterisation (GRR) 29.1.e. Strata Management Plan, TARP and support rules for installation of additional support 29.1.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 29.1.g. Inseam water make has historically been minimal. Conditions generally dry underground	E (Pb)	2 (L)	3 (L)	
29. Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Systemic failure ::: Caused by: - High proportion of low strength roof material - Reactive strata (i.e. tuff material) - Water flooding Resulting in: - Higher than expected subsidence causing environmental damage or public	29.2.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.2.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 29.2.c. Mine design limits subsidence to level where surface cracking will not occur. 29.2.d. Geotechnical characterisation (GRR)	E (Pb)	2 (L)	3 (L)	

Instructions:

WRAC Analysis Sorted by RR (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	29.2.e. Strata Management Plan, TARP and support rules for installation of additional support 29.2.f. Inseam water make has historically been minimal. Conditions generally dry underground 29.2.g. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
29. Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Excessive Pillar Compression ::: Caused by: ▪ High proportion of low strength roof material ▪ Pillar design LTA ▪ Reactive strata (i.e. tuff material) ▪ Water flooding Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	29.3.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.3.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 29.3.c. Mine design limits subsidence to level where surface cracking will not occur. 29.3.d. Geotechnical characterisation (GRR) 29.3.e. Strata Management Plan, TARP and support rules for installation of additional support 29.3.f. Inseam water make has historically been minimal. Conditions generally dry underground 29.3.g. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	E (Pb)	2 (L)	3 (L)	
2. Pagodas / Rock Formations Located within the EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Cracking of pagodas or rock formations ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate)	2.2.a. Mine design limits subsidence to level where surface cracking will not occur. 2.2.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in	E (Pb)	1 (PI)	1 (L)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	- Mining method implementation LTA - Monitoring LTA Resulting in: - Public safety hazard (personal injury PI)	performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 2.2.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs 2.2.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 2.2.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 2.2.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 2.2.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 2.2.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 2.2.i. Underground geological mapping during development advance 2.2.j. Strata Management Plan, TARP and support rules for installation of additional support 2.2.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 2.2.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
6. Groundwater - Aquifers in and immediately above Lithgow seam - Permian and Located within the EP Area	There is a risk to Airly from ...: Depressurisation of Permian aquifer leading to ground water inflow to mine workings and subsequent dewatering with potential for water quality impacts ... Caused by: • Geological anomaly • Mine design LTA (Less Than Adequate) • Mining method implementation LTA • Monitoring LTA Resulting in: • Business interruption. • Environmental damage • Non compliance • Reputation • Social impact..	6.2.a. Impact assessed in EIS and approved by consent SSD_5581 6.2.b. Mining and monitoring experience to date shows minimal water make in Permian 6.2.c. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 6.2.d. Water balance shows deficit and negligible requirement for discharge 6.2.e. EPL allows for limits in discharge water quality. 6.2.f. Mine water inflow water quality to date is within EPL limits. 6.2.g. Mine Design modified following Mt Airly exceedance of subsidence predictions, modified Mine Design reviewed by IEP 6.2.h. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	E (Pb)	1 (L)	1 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.
7. Regional Groundwater - Regional Aquifers - Permian below the Lithgow seam and any associated GDEs Located within the EP Area	There is a risk to Airly from ...: Loss of ground water that impacts on regional ground water dependent eco system or water supply ... Caused by: • Upwelling of ground water into mine workings due to mining activity Resulting in: • Business interruption. • Environmental damage • Non compliance • Reputation • Social impact..	7.1.a. No significant water sources or aquifers in the floor within the zone of influence of the mine workings. 7.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 7.1.c. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 7.1.d. No GDE relying on regional ground water system in EP area 7.1.e. Mine Design reviewed by IEP 7.1.f. To date no observed upwelling of water through the floor	E (Pb)	1 (E)	1 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.
7. Regional Groundwater -	There is a risk to Airly from	7.2.a. Impact assessed in EIS and approved	E	1	1	4. Revise mine site Water Management Plan in

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
Regional Aquifers - Permian below the Lithgow seam and any associated GDEs Located within the EP Area	Depressurisation of Permian aquifer leading to ground water inflow to mine workings Caused by: - Upwelling of ground water into mine workings due to mining activity Resulting in: - Business interruption. - Environmental damage - Non compliance - Reputation - Social impact..	by consent SSD_5581 7.2.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 7.2.c. Mine Design reviewed by IEP 7.2.d. Mining and monitoring experience to date shows minimal water make in the Lower Permian 7.2.e. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 7.2.f. EPL allows for limits in discharge water quality. 7.2.g. Mine water inflow water quality to date is within EPL limits. 7.2.h. To date no observed upwelling of water through the floor	(Pb)	(BI)	(L)	consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.
21. Historic Heritage / Sites of Archaeological heritage significance Located within the EP	There is a risk to Airly from Damage to heritage item as a result of cliff fall from cliffs adjacent to shale mine interaction zone Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	21.1.a. Not Applicable baseline assessment undertaken. No actual or potential sites of historical heritage identified	E (Pb)	1 (E)	1 (L)	
25. Shear Strain Effects (on Built Features) (particularly to dwellings)	There is a risk to Airly from		()	0	0	

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& infrastructure in deep DOC)	∴ Not Applicable (none within EP Area / potentially affected area) ∴ Caused by: ▪ Resulting in: ▪					
30. Interaction with old workings or proposed/future multi seam mining) potentially affecting subsidence conditions	There is a risk to Airly from ∴ Not Applicable ∴ Caused by: ▪ Resulting in: ▪	30.1.a. Not Applicable 30.1.b. Formal record tracings indicate no workings 30.1.c. Ground truthing of surface extense identify possible workings	()	0	0	13. Identify locations of surface adit/shafts (gold/diamond) , add to mineplan with inrush control zones.
31. Presence of Massive Strata in Roof or Overburden	There is a risk to Airly from ∴ Not Applicable ∴ Caused by: ▪ Resulting in: ▪	31.1.a. Not Applicable	()	0	0	

WRAC Analysis Sorted by Consequence

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
1. Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the EP Area (and/or adjacent to the EP Area) beyond approved consent criteria/performance measures ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Public safety hazard (personal injury PI)	1.2.a. Mine design limits subsidence to level where surface cracking will not occur. 1.2.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 1.2.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs 1.2.d. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 1.2.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 1.2.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 1.2.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 1.2.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 1.2.i. Underground geological mapping during development advance 1.2.j. Detailed updated mapping of cliffs,	E (IF)	4 (PI)	10 (M)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		within ML1814 1.2.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 1.2.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria 1.2.m. NPWS Signage at entry to SCA 1.2.n. Single lockable access point to Mt Genowlan triggered by NPWS or Centennial TARPS				
3. Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining -induced surface instability / Land slip ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Public safety hazard (personal injury PI)	3.2.a. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 3.2.b. Mining method and design reviewed by geotechnical engineering experts (SCT) 3.2.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)). 3.2.d. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). 3.2.e. Geological mapping during development advance 3.2.f. Qualified mine surveyor and calibrated survey equipment 3.2.g. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval. 3.2.h. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports	E (IF)	4 (PI)	10 (M)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.

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		prior to granting development consent. 3.2.i. Independent Expert Panel (IEP) required by consent to be established (post-consent) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. 3.2.j. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. 3.2.k. Airly Panel Design Standard. (AIR-SS-9001) addresses first workings, implementation, inspection and monitoring (to survey and audit first workings pillars as formed against design). 3.2.l. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent				
16. Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ::: degradation or loss of Genowlan Pea ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	16.2.a. Site Biodiversity Management plan 16.2.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 16.2.c. Mine design limits subsidence to level where surface cracking will not occur. 16.2.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence	D (Pb)	4 (E)	14 (S)	10. Review proposed mine working with offsets. Implement mine design change.
2. Pagodas / Rock Formations Located within the EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Cracking of pagodas or rock formations ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate)	2.1.a. Mine design limits subsidence to level where surface cracking will not occur.	E (IF)	3 (R)	6 (L)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Cultural heritage impact ▪ Environmental damage ▪ Non compliance or Public safety hazard (personal injury PI) ▪ Reputation ▪ Social impact..	2.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 2.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs 2.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 2.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 2.1.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 2.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 2.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 2.1.i. Underground geological mapping during development advance 2.1.j. Strata Management Plan, TARP and support rules for installation of additional support 2.1.k. Baseline monitoring of cliffs and				1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site). 2. Develop a <i>Land Management Plan</i> in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed.				
		2.1.1. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				
4. Surface Water Courses - Located within the EP Area. Including the Grotto & The Oasis (upper Genowlan Creek)	There is a risk to Airly from ::: Cracking of stream channel / localised loss of water flow ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Cultural heritage impact ▪ Environmental damage ▪ Non compliance or Public safety hazard (personal injury PI) ▪ Reputation ▪ Social impact..	4.1.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 4.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 4.1.c. Mine design limits subsidence to level where surface cracking will not occur. 4.1.d. Negligible mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected) due to first workings only. 4.1.e. Water courses on the mountain are ephemeral and 1st or 2nd order within EP Area. 4.1.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 4.1.g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared). 4.1.h. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2).	D (D)	3 (R)	9 (M)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers. 9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		4.1.i. Geological mapping during development advance 4.1.j. Qualified mine surveyor and calibrated survey equipment 4.1.k. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.1.l. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.1.m. Surface water baseline monitoring including surface water flows, quality, ground water levels, aquatic ecology, stygofauna, stream stability monitoring, 4.1.n. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				
20. Aboriginal and Cultural Heritage Sites Located within the EP Area	There is a risk to Airlly from ::: Damage to Aboriginal and Cultural Heritage Sites Located within the EP Area ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or	20.1.a. One identified ACH site in the EP area.	D (Pb)	3 (R)	9 (M)	1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
		20.1.b. Mine design limits subsidence to level where surface cracking will not occur.				12. Develop ACHPM for CLZ EP area
		20.1.c. Site Aboriginal and Cultural Heritage Management Plan (Site ACHMP)				10. Review proposed mine working with offsets. Implement mine design change.
		20.1.d. Regional Aboriginal and Cultural				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Reputation or Social impact or Business interruption..	Heritage Management Plan (Regional ACHMP) 20.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
1. Cliffs and minor cliffs located within EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the cliff zone within ML1814 Mine Potential Interaction Zone beyond approved consent criteria/performance measures ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Cultural heritage impact ▪ Environmental damage ▪ Non compliance or Public safety hazard (personal injury PI) ▪ Reputation ▪ Social impact..	1.1.a. Mine design limits subsidence to level where surface cracking will not occur.	D (Pb)	3 (L)	9 (M)	1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
		1.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent				2. Develop a <i>Land Management Plan</i> in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program
		1.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs				3. Develop a <i>Public Safety Management Plan</i> in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.
		1.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 1.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted.				5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		1.1.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 1.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 1.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 1.1.i. Underground geological mapping during development advance 1.1.j. Detailed updated mapping of cliffs within ML1814 1.1.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 1.1.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				
28. Steeply Dipping Terrain Effects - Potential for interaction between workings downslope of the CLZ and extraction within the EP Area	There is a risk to Airly from ::: impact to cliffs and associated features in steeply dipping terrain:: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business	28.1.a. The Cliff Line Zone forms a barrier 28.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 28.1.c. Mine design limits subsidence to level where surface cracking will not occur. 28.1.d. Geotechnical characterisation (GRR) . 28.1.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	D (Pb)	3 (E)	9 (M)	

Instructions:

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	interruption, or social impact..					
10. Groundwater Stygofauna - Located within the EP Area	There is a risk to Airly from ::: Mining related impacts to stygofauna ::: Caused by: ▪ Mining Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	10.1.a. Stygofauna monitoring program	D (Pb)	2 (R)	5 (L)	
27. Sinkhole development within or beyond the EP Area	There is a risk to Airly from ::: Mining induced development of sinkhole(s) with associated potential impact to public safety, drainage and/or surface features (including cliffs, minor cliffs and pagodas) located within or beyond in the EP Area, above approved consent criteria/performance measures ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	27.1.a. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 27.1.b. Strata Management Plan, TARP and support rules for installation of additional support	E (Pb)	2 (PI)	3 (L)	11. Consult with NPWS to Install Safety Warning Signage (Active Mining Area) on mountain
8. Groundwater- Centennial surface water monitoring bores Located within the EP Area	There is a risk to Airly from ::: Reduction or loss of monitoring capacity ::: Caused by: ▪ Fire	8.1.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below).	C (Pb)	2 (L)	8 (M)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	- Geological anomaly - lightning - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA - tree fall - Vandalisum Resulting in: - Business interruption. - Non compliance - Reputation .	8.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 8.1.c. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details). 8.1.d. No registered bores using these aquifers as private water supply in the EP Area. 8.1.e. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders. 8.1.f. Monthly monitoring of ground water management system sites 8.1.g. NPWS consultation process in relation to protection of assets during hazard reduction process or wildfire. 8.1.h. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
29. Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Pillar punching occurring ::: Caused by: - low strength roof/ floor material - Pillar design LTA - pillar stress excessively high - Water flooding Resulting in: - Higher than expected subsidence causing	29.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 29.1.c. Mine design limits subsidence to level where surface cracking will not occur. 29.1.d. Geotechnical characterisation	E (Pb)	2 (L)	3 (L)	

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	(GRR) . 29.1.e. Strata Management Plan, TARP and support rules for installation of additional support 29.1.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 29.1.g. Inseam water make has historically been minimal. Conditions generally dry underground				
29. Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Systemic failure ::: Caused by: ▪ High proportion of low strength roof material ▪ Reactive strata (i.e. tuff material) ▪ Water flooding Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	29.2.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.2.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 29.2.c. Mine design limits subsidence to level where surface cracking will not occur. 29.2.d. Geotechnical characterisation (GRR) . 29.2.e. Strata Management Plan, TARP and support rules for installation of additional support 29.2.f. Inseam water make has historically been minimal. Conditions generally dry underground 29.2.g. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	E (Pb)	2 (L)	3 (L)	
29. Roof/Floor Conditions - Potential impacts of low strength roof and/ or low strength floor	There is a risk to Airly from ::: Excessive Pillar Compression ::: Caused by: ▪ High proportion of low strength roof material	29.3.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 29.3.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS	E (Pb)	2 (L)	3 (L)	

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	- Pillar design LTA - Reactive strata (i.e. tuff material) - Water flooding Resulting in: - Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	criteria for subsidence 29.3.c. Mine design limits subsidence to level where surface cracking will not occur. 29.3.d. Geotechnical characterisation (GRR) . 29.3.e. Strata Management Plan, TARP and support rules for installation of additional support 29.3.f. Inseam water make has historically been minimal. Conditions generally dry underground 29.3.g. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
3. Steep Slopes (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from ::: Mining -induced surface instability / Land slip ::: Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard (personal injury PI) - Reputation - Social impact..	3.1.a. Mine design limits subsidence to level where surface cracking will not occur. 3.1.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 3.1.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs 3.1.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 3.1.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 3.1.f. Mining method and design reviewed by geotechnical engineering experts (Pillar	D (IF)	2 (E)	5 (L)	7. Verify existing proposed workings fall within DOC greater than 50m. 8. Develop HRA for shallow workings in ML1814. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity. 2. Develop a Land Management Plan in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		Stability Assessment including revised subsidence predictions for specific mine plan prepared by SCT for the Extraction Plan 3.1.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 3.1.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 3.1.i. Underground geological mapping during development advance 3.1.j. Strata Management Plan, TARP and support rules for installation of additional support 3.1.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 3.1.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				
4. Surface Water Courses - Located within the EP Area. Including the Grotto & The Oasis (upper Genowlan Creek)	There is a risk to Airly from ∴ Changes to creek habitat from changes to geomorphology ∴ Caused by: - Geological anomaly - Lineament zone link to surface to underground workings - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Cultural heritage impact - Environmental damage - Non compliance or Public safety hazard	4.2.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 4.2.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 4.2.c. Mine design limits subsidence to level where surface cracking will not occur. 4.2.d. Negligible mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile)	E (D)	2 (E)	3 (L)	9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis. 4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	(personal injury PI) ▪ Reputation ▪ Social impact..	expected) due to first workings only. 4.2.e. Water courses on the mountain are ephemeral and 1st or 2nd order within EP Area. 4.2.f. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 4.2.g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared). 4.2.h. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). 4.2.i. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.2.j. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 4.2.k. Surface water baseline monitoring including surface water flows, quality, ground water levels, aquatic ecology, stygofauna, stream stability monitoring, 4.2.l. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				biodiversity.
5. Groundwater - Aquifers above Lithgow seam - (including Shallow	There is a risk to Airly from	5.1.a. Limited height of fracturing does not interact with potential aquifers in sandstone	D (Pb)	2 (E)	5 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
Quaternary Alluvial, Triassic	::: Loss of ground water that impacts on ground water dependent eco system or water supply ::: Caused by: ▪ Draw down due to depressurisation of Permian and/or Triassic strata. ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..					Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.
		5.1.b. Sandstones are highly fractured, conduits to side of the mountain				1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
		5.1.c. No alluvial basins within the EP Area				5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.
		5.1.d. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.				
		5.1.e. Performance Criteria limits set by SSD_5581				
		5.1.f. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
		5.1.g. Mine Design modified following Mt Airly exceedance of subsidence predictions, modified Mine Design reviewed by IEP				
		5.1.h. No high priority GDEs have been identified within the EP area, although there is potential for 'Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017). Three Plant Community Types (PCTs) within the EP area are associated with Facultative Ecosystems being PCT 3226, 3495 and 3731. The Grotto and Oasis occur within this EP area. Whilst monitoring has shown water flow to be rainfall dependant,				

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		Biodiversity Monitoring and Baseline Assessment has been established to monitoring for vegetation and surface flow changes within the Facultative Ecosystems, and within the Grotto and Oasis."				
		5.1.i. Stygofauna monitoring program inplace				
		5.1.j. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
		5.1.k. No registered bores using these aquifers as private water supply in the EP Area.				
		5.1.l. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders				
6. Groundwater - Aquifers in and immediately above Lithgow seam - Permian and Located within the EP Area	There is a risk to Airly from ::: Loss of ground water that impacts on ground water dependent eco system or water supply beyond approved impact level ::: Caused by: ▪ Draw down due to depressurisation of Permian and/or Triassic strata. ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	6.1.a. Mining and monitoring experience to date shows minimal water make in Permian 6.1.b. No users of upper Permian aquifers 6.1.c. No high priority GDEs have been identified within the EP area, although there is potential for 'Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines. Facultative Ecosystems are not entirely dependent on groundwater, and may rely on groundwater on a seasonal basis or only during extended drought	D (Pb)	2 (E)	5 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers. 5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity. 9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.

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		periods. At other times, water requirements may be met by soil or surface water (RPS 2014; RPS 2023; GHD 2017). 6.1.d. Ground water systems in the EP area are in the Narabeen Sandstone and surface alluvial basins 6.1.e. Limited height of fracturing does not interact with potential aquifers in sandstone 6.1.f. Sandstones are highly fractured, conduits to side of the mountain 6.1.g. No alluvial basins within the EP Area 6.1.h. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 6.1.i. Performance Criteria limits set by SSD_5581 6.1.j. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 6.1.k. No high priority GDEs have been identified within the EP area, although there is potential for Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017). Three Plant Community Types (PCTs) within the EP area are associated with Facultative Ecosystems being PCT 3226, 3495 and 3731. The Grotto and Oasis occur within this EP area. Whilst monitoring has shown water flow to be rainfall dependant, Biodiversity Monitoring and Baseline Assessment has been established to monitoring for vegetation and surface flow changes within the Facultative Ecosystems, and within the Grotto and Oasis				

Instructions:

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		6.1.l. Stygofauna monitoring program inplace 6.1.m. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 6.1.n. No registered bores using these aquifers as private water supply in the EP Area. 6.1.o. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders				
9. Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ∴ Refer Groundwater Aquifers information above which includes information on Groundwater Dependent Ecosystems and facultative ecosystems. ∴ Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	9.1.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below). 9.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 9.1.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)). 9.1.d. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan 9.1.e. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details). 9.1.f. No registered bores using these aquifers as private water supply in the EP	D (Pb)	2 (E)	5 (L)	

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		Area. 9.1.g. Baseline and ongoing monitoring of relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders 9.1.h. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				
9. Groundwater Dependent Ecosystems (GDE's)	There is a risk to Airly from ::: Loss of base ground water flow-degradation or loss of species or habitat ::: Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation ▪ Social impact..	9.2.a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below). 9.2.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 9.2.c. No surface or sub surface cracking predicted (consistent with EIS). Predicted pillar compression subsidence for the CLZ EP Area is lower than predicted and approved in the EIS (including worst case ≤53mm vs 65mm EIS)). 9.2.d. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan 9.2.e. Identification and specialist impact assessment of aquifers for MEP EIS (GHD, 2014) which addressed broad range of assessment factors/aspects in consultation with regulators (refer EIS and responses to submissions for details). 9.2.f. No registered bores using these aquifers as private water supply in the EP Area. 9.2.g. Baseline and ongoing monitoring of	D (Pb)	2 (E)	5 (L)	

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		relevant ground water monitoring bores to support the site Water Management Plan developed in consultation with stakeholders 9.2.h. Baseline and ongoing ecological monitoring has been established for threatened flora, threatened fauna and threatened ecological communities as per the Site Specific BMP, and additional EP specific BMPs				
11. Threatened AQUATIC FAUNA & potential habitat for threatened fauna and KEY FISH HABITAT (e.g. dragon fly,Macquarie perch) Located within and downstream of the EP Area	There is a risk to Airly from ::: Loss of stream flow - degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	11.1.a. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 11.1.b. Site Biodiversity Management plan 11.1.c. Aquatic ecology monitoring in accordance with the Site Water Management Plan 11.1.d. Water courses on the mountain are ephemeral and 1st or 2nd order within EP Area. 11.1.e. Mine design limits subsidence to level where surface cracking will not occur. 11.1.f. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 11.1.g. No mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected)	D (IF)	2 (E)	5 (L)	
12. Threatened terrestrial FAUNA Located within the EP Area - Threatened birds and habitat for bird species e.g. Hollow dependent owls, Glossy Black Cockatoo, Gang Gang Cockatoo, Flame Robin, Scarlett Robin, Varied Sitella	There is a risk to Airly from ::: degradation or loss of species or habitat ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in:	12.1.a. Site Biodiversity Management plan 12.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 12.1.c. Mine design limits subsidence to level where surface cracking will not occur. 12.1.d. No mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected)	D (Pb)	2 (E)	5 (L)	

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Environmental damage or Non compliance or Reputation or Social impact or Business interruption..					
13. Threatened terrestrial FAUNA Located within the EP Area - Threatened mammal species (excluding microbats) and their habitats e.g. Gliders, Koala, Spotted Tail Quoll, Rock Wallaby	There is a risk to Airly from ::: degradation or loss of species or habitat Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	13.1.a. Site Biodiversity Management plan 13.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 13.1.c. Mine design limits subsidence to level where surface cracking will not occur. 13.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 13.1.e. No mining-induced change in hydrology expected (no surface cracking, no significant changes to drainage profile expected)	D (D)	2 (E)	5 (L)	
14. Threatened terrestrial FAUNA Located within the EP Area - Threatened Reptile species and their habitats - e.g. broad headed snake	There is a risk to Airly from ::: degradation or loss of species or habitat Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	14.1.a. Site Biodiversity Management plan 14.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 14.1.c. Mine design limits subsidence to level where surface cracking will not occur. 14.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence	D (D)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity. 1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
15. Threatened terrestrial FAUNA Located within the EP Area - Microbats and their habitats (Cliff rock overhangs and tree hollows) e.g. Eastern False Pipestrelle, Eastern Free Tailed Bat, Large Bent Wing Bat, Large-eared Pied	There is a risk to Airly from ::: Degradation or loss of species or habitat Caused by:	15.1.a. Site Biodiversity Management plan	D (Pb)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
Bat, Little Bent-winged Bat, Little Pied Bat.	- Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	15.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 15.1.c. Mine design limits subsidence to level where surface cracking will not occur. 15.1.d. Hollow bearing trees are avoided in installation of subsidence monitoring infrastructure. 15.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).
16. Threatened FLORA Threatened flora and fauna located within the EP Area e.g. E Canonii, P Stricta,	There is a risk to Airly from ∴ Degradation or loss of species or habitat ∴ Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	16.1.a. Site Biodiversity Management plan 16.1.b. E Canonii and P Stricta not ground or surface water dependent plants. 16.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 16.1.d. Mine design limits subsidence to level where surface cracking will not occur. 16.1.e. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence	D (Pb)	2 (E)	5 (L)	5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.
17. Endangered Ecological Communities (EEC) Located within the EP Area	There is a risk to Airly from ∴ Changes in species diversity or extent within EECs (genowlan Pt) ∴ Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage / loss of	17.1.a. Site Biodiversity Management plan 17.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 17.1.c. Predicted subsidence magnitudes are very small relative to credible values and site specific experience of associated with the onset of damage 17.1.d. Mine design limits subsidence to level where surface cracking will not occur. 17.1.e. Not ground or surface water	D (D)	2 (E)	5 (L)	5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	biodiversity or Loss of Intergenerational Equity, or Non compliance or Reputation or Social impact or Business interruption..	dependent plants.				
		17.1.f. Ground disturbance permit prior to clearing.				
18. Natural vegetation - (General, including sheltered gullies) Located within the EP Area	There is a risk to Airly from ::: Changes in species diversity or extent ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Reputation or Social impact or Business interruption..	18.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 18.1.b. Site Biodiversity Management plan 18.1.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 18.1.d. Mine design limits subsidence to level where surface cracking will not occur. 18.1.e. Not ground or surface water dependent plants. 18.1.f. Ground disturbance permit prior to clearing.	D (D)	2 (E)	5 (L)	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.
19. Unsealed Roads, four wheel drive tracks and trails (SCA Management Trails) Located within the EP Area	There is a risk to Airly from ::: Damage to road/track/trail surface from cracking or slabbing, or rock fall from adjacent cliffs, pagodas and steep slope areas ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Public safety hazard (personal injury PI) or Reputation or Social impact..	19.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage Mine design limits subsidence to level where surface cracking will not occur. 19.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 19.1.c. Mine design limits subsidence to level where surface cracking will not occur.	D (Pb)	2 (E)	5 (L)	11. Consult with NPWS to Install Safety Warning Signage (Active Mining Area) on mountain 3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded. 1. Develop a Subsidence Monitoring Program in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage

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		19.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				site). 6. Develop a Built Features Management Plan in accordance with Condition 7, Schedule 3 of Consent in consultation with relevant stake holders This is a recommend control that was applied in the first version of the Risk assessment, which has been moved to a current control in this review so as to not cause the action to be applied again through PULSE
22. Geological Structures (including faults, folds, sills or dykes) Located within the EP Area	There is a risk to Airly from ::: Increased subsidence / impacts arising from potential effects of geological structures (local or regional) ::: Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	22.1.a. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 22.1.b. Mine design limits subsidence to level where surface cracking will not occur. 22.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 22.1.d. Geotechnical characterisation (GRR) . 22.1.e. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 22.1.f. Strata Management Plan, TARP and support rules for installation of additional support 22.1.g. Geological mapping during development advance	D (Pb)	2 (E)	5 (L)	
23. Far Field Movements and Effects beyond the EP Area	There is a risk to Airly from ::: Mining induced far field movements potentially impacting surface features (eg cliffs and pagodas) beyond approved consent criteria/performance measures, and affecting the extent of the required management area (EP Area) ::: Caused by:	23.1.a. Far field movements are limited by the boundary of the mesa 23.1.b. Mine design limits subsidence to level where surface cracking will not occur. 23.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 23.1.d. Geotechnical characterisation (GRR) .	D (Pb)	2 (E)	5 (L)	

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	▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..					
24. Valley Closure or Upsidence Movements and Effects within and beyond the EP Area (gorges, valleys,creek crossings)	There is a risk to Airly from ∴ Mining induced valley closure movements potentially causing impacts to natural features such as cliffs, minor cliffs and pagodas within and beyond the EP Area beyond approved consent criteria/performance measures ∴ Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	24.1.a. Far field movements are limited by the boundary of the mesa 24.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 24.1.c. Mine design limits subsidence to level where surface cracking will not occur. 24.1.d. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 24.1.e. Geotechnical characterisation (GRR) .	D (Pb)	2 (E)	5 (L)	
26. Movements and Effects Beyond Predictions within and beyond the EP Area	There is a risk to Airly from ∴ Mining induced movements and effects BEYOND PREDICTIONS potentially causing impacts to natural features (including cliffs, minor cliffs and pagodas) within and beyond the EP Area, beyond approved consent criteria/performance measures ∴	26.1.a. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 26.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 26.1.c. Mine design limits subsidence to level where surface cracking will not occur.	D (Pb)	2 (E)	5 (L)	

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	26.1.d. Geotechnical characterisation (GRR) .				
26. Movements and Effects Beyond Predictions within and beyond the EP Area	There is a risk to Airly from ∴ Mining induced effects BEYOND PREDICTIONS causing surface cracking and gas release (e.g.with public safety implications) ∴ Caused by: ▪ Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: ▪ Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	26.2.a. Negligible levels of seam gas 26.2.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 26.2.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 26.2.d. Mine design limits subsidence to level where surface cracking will not occur. 26.2.e. Geotechnical characterisation (GRR) .	D (Pb)	2 (E)	5 (L)	
33. Delayed / Long Term Subsidence (period/duration of subsidence management)	There is a risk to Airly from ∴ Development of delayed or long term subsidence movements beyond predictions (affecting timing / duration of subsidence management) ∴ Caused by: ▪ Anomalies/complexities or deterioration in roof/floor/ geotechnical conditions (eg due to clay stone bands) ▪ climatic conditions	33.1.a. Baseline subsidence estimates assume conservative input parameters 33.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 33.1.c. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 33.1.d. Mine design limits subsidence to	D (Pb)	2 (E)	5 (L)	

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	- Flooded Workings - Geological Structures - Nature and magnitude of horizontal stress field - Overlying or Underlying Workings - Topographic terrain Resulting in: - Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	level where surface cracking will not occur. 33.1.e. Geotechnical characterisation (GRR) . 33.1.f. Survey methods selected for monitoring are well suited to repeatable survey (if required) to be undertaken				
34. Future Developments / Change within EP Area affecting subsidence management	There is a risk to Airly from ∴ Future changes or development within the EP Area influencing management requirements (e.g. long term post-mining intention to transition surface lands from from SCA to NP) ∴ Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	34.1.a. Rehabilitation and closure Management Plan 34.1.b. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage 34.1.c. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.	D (Pb)	2 (E)	5 (L)	
32. Uncertainty in subsidence predictions, hazard assessment and underlying inputs/assumptions	There is a risk to Airly from ∴ Uncertainty in predictions and/or subsidence hazard analysis ∴ Caused by: Anomalies/complexities or deterioration in geotechnical conditions	32.1.a. Baseline subsidence estimates assume conservative input parameters 32.1.b. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 32.1.c. Predicted subsidence magnitudes are very small relative to credible values associated with the onset of damage	C (Pb)	1 (R)	4 (L)	

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Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	- Discontinuities, heterogeneity effecting subsidence assessment - Inadequate assumptions used in subsidence assessment - Inadequate or incomplete data used in subsidence assessment - Temporal variability in input data or assumptions used for subsidence assessment Resulting in: - Higher than expected subsidence causing environmental damage or public safety hazard (personal injury) or non-compliance or damage to reputation or business interruption, or social impact..	32.1.d. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 32.1.e. Mine design limits subsidence to level where surface cracking will not occur. 32.1.f. Geotechnical characterisation (GRR) 32.1.g. Strata Management Plan, TARP and support rules for installation of additional support				
2. Pagodas / Rock Formations Located within the EP Area (Cliff Line Zone of First Workings - ML1814)	There is a risk to Airly from Cracking of pagodas or rock formations Caused by: - Geological anomaly - Mine design LTA (Less Than Adequate) - Mining method implementation LTA - Monitoring LTA Resulting in: - Public safety hazard (personal injury PI)	2.2.a. Mine design limits subsidence to level where surface cracking will not occur. 2.2.b. Performance Criteria limits set by SSD_5581 Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with-negligible impact (Sch 3, Cond 2). No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent 2.2.c. Cliff characterisation studies for CLZ EP including ground truthing and surface feature impact assessment, project area and in the adjacent cliff zone, rank cliffs in terms of height, identify top and toe of cliffs 2.2.d. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable. 2.2.e. SCT Subsidence assessment report Cliff Line Zone indicate no surface or sub-surface cracking predicted. 2.2.f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine	E (Pb)	1 (PI)	1 (L)	3. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.

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Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		plan prepared by SCT for the Extraction Plan 2.2.g. Qualified mine surveyor and calibrated survey equipment, Survey Arrangements 2.2.h. Primary and Secondary survey to ensure conforming pillars in accordance with approved EP 2.2.i. Underground geological mapping during development advance 2.2.j. Strata Management Plan, TARP and support rules for installation of additional support 2.2.k. Baseline monitoring of cliffs and pagodas methodology using detailed aerial survey tool or method. Approx 6 monthly with results analysed for changed. 2.2.l. ATM and mining sequence planning process will identify surface constraints and ensure pillar size satisfies EIS / Development consent criteria				
6. Groundwater - Aquifers in and immediately above Lithgow seam - Permian and Located within the EP Area	There is a risk to Airly from ∴∴∴ Depressurisation of Permian aquifer leading to ground water inflow to mine workings and subsequent dewatering with potential for water quality impacts ∴∴∴ Caused by: ▪ Geological anomaly ▪ Mine design LTA (Less Than Adequate) ▪ Mining method implementation LTA ▪ Monitoring LTA Resulting in: ▪ Business interruption. ▪ Environmental damage ▪ Non compliance ▪ Reputation	6.2.a. Impact assessed in EIS and approved by consent SSD_5581 6.2.b. Mining and monitoring experience to date shows minimal water make in Permian 6.2.c. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 6.2.d. Water balance shows deficit and negligible requirement for discharge 6.2.e. EPL allows for limits in discharge water quality. 6.2.f. Mine water inflow water quality to date is within EPL limits. 6.2.g. Mine Design modified following Mt Airly exceedance of subsidence predictions, modified Mine Design reviewed by IEP	E (Pb)	1 (L)	1 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Social impact..	6.2.h. Mine design using complying pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than approved in EIS. Long-term stable.				
7. Regional Groundwater - Regional Aquifers - Permian below the Lithgow seam and any associated GDEs Located within the EP Area	There is a risk to Airly from ∴ Loss of ground water that impacts on regional ground water dependent eco system or water supply ∴ Caused by: - Upwelling of ground water into mine workings due to mining activity Resulting in: - Business interruption. - Environmental damage - Non compliance - Reputation - Social impact..	7.1.a. No significant water sources or aquifers in the floor within the zone of influence of the mine workings. 7.1.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence 7.1.c. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities. 7.1.d. No GDE relying on regional ground water system in EP area 7.1.e. Mine Design reviewed by IEP 7.1.f. To date no observed upwelling of water through the floor	E (Pb)	1 (E)	1 (L)	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.
21. Historic Heritage / Sites of Archaeological heritage significance Located within the EP	There is a risk to Airly from ∴ Damage to heritage item as a result of cliff fall from cliffs adjacent to shale mine interaction zone ∴ ∴ Caused by: - Mine design LTA (Less Than Adequate), or Mining method implementation LTA, or geological anomaly, or Monitoring LTA, or Set back distance LTA Resulting in: - Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Heritage Impact or Reputation or Social impact or Business interruption..	21.1.a. Not Applicable baseline assessment undertaken. No actual or potential sites of historical heritage identified	E (Pb)	1 (E)	1 (L)	
7. Regional Groundwater - Regional	There is a risk to Airly from	7.2.a. Impact assessed in EIS and	E	1	1	4. Revise mine site Water Management Plan in

Instructions:

WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
Aquifers - Permian below the Lithgow seam and any associated GDEs Located within the EP Area	∴∴∴ Depressurisation of Permian aquifer leading to ground water inflow to mine workings ∴∴∴ Caused by: - Upwelling of ground water into mine workings due to mining activity Resulting in: - Business interruption. - Environmental damage - Non compliance - Reputation - Social impact..	approved by consent SSD_5581	(Pb)	(BI)	(L)	consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.
		7.2.b. Mine design reviewed in the context of subsidence monitoring over Mt Airly and numerical modelling by SCT with a high level of confidence of meeting the EIS criteria for subsidence				
		7.2.c. Mine Design reviewed by IEP				
		7.2.d. Mining and monitoring experience to date shows minimal water make in the Lower Permian				
		7.2.e. Site Water Management Plan incorporating surface and ground water monitoring program. Developed in consultation with Regulatory authorities.				
		7.2.f. EPL allows for limits in discharge water quality.				
		7.2.g. Mine water inflow water quality to date is within EPL limits.				
		7.2.h. To date no observed upwelling of water through the floor				
25. Shear Strain Effects (on Built Features) (particularly to dwellings & infrastructure in deep DOC)	There is a risk to Airly from ∴∴∴ Not Applicable (none within EP Area / potentially affected area) ∴∴∴ Caused by: Resulting in:		()	0	0	
30. Interaction with old workings or proposed/future multi seam mining) potentially affecting subsidence conditions	There is a risk to Airly from ∴∴∴ Not Applicable ∴∴∴ Caused by: Resulting in:	30.1.a. Not Applicable	()	0	0	13. Identify locations of surface adit/shafts (gold/diamond) , add to mineplan with inrush control zones.
		30.1.b. Formal record tracings indicate no workings				
		30.1.c. Ground truthing of surface extense identify possible workings				



Instructions:
WRAC Analysis Sorted by Consequence (hover for instructions):

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
31. Presence of Massive Strata in Roof or Overburden	There is a risk to Airly from ⋮⋮⋮ Not Applicable ⋮⋮⋮ Caused by: ▪ Resulting in: ▪	31.1.a. Not Applicable	()	0	0	

Recommended Controls

Recommended Controls	Place(s) Used	Risk Ranking			Allocated To	Required By Date	Control Importance	Pulse User No.	PULSE Ref. No.
		L	C	RR					
1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).	Events: 1.1, 2.1, 5.1, 8.1, 14.1, 15.1, 19.1, 20.1	D	3	9 (M)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2	90030	59640.164599
2. Develop a <i>Land Management Plan</i> in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program	Events: 1.1, 2.1, 3.1	D	3	9 (M)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2	90030	59640.164600
3. Develop a <i>Public Safety Management Plan</i> in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.	Events: 1.1, 1.2, 2.1, 2.2, 3.2, 19.1	E	4	10 (M)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2	90030	59640.164601
4. Revise mine <i>site Water Management Plan</i> in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.	Events: 4.1, 4.2, 5.1, 6.1, 6.2, 7.1, 7.2, 8.1	D	3	9 (M)	Sam Price	15-Aug-2023	2	90039	59640.164602
5. Develop a <i>Biodiversity Management Plan</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	Events: 1.1, 3.1, 4.2, 5.1, 6.1, 14.1, 15.1, 16.1, 17.1, 18.1	D	3	9 (M)	Sam Price	15-Aug-2023	2	90039	59640.164603

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Recommended Controls	Place(s) Used	Risk Ranking			Allocated To	Required By Date	Control Importance	Pulse User No.	PULSE Ref. No.
		L	C	RR					
6. Develop a Built Features Management Plan in accordance with Condition 7, Schedule 3 of Consent in consultation with relevant stake holders This is a recommend control that was applied in the first version of the Risk assessment, which has been moved to a current control in this review so as to not cause the action to be applied again through PULSE	Events: 19.1	D	2	5 (L)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2	90030	59640.164604
7. Verify existing proposed workings fall within DOC greater than 50m.	Events: 3.1	D	2	5 (L)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2	90030	59640.164605
8. Develop HRA for shallow workings in ML1814.	Events: 3.1	D	2	5 (L)	Jacqueline Cooke RIIRIS402D	17-Jun-2024	2	90030	59640.164606
9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.	Events: 4.1, 4.2, 6.1	D	3	9 (M)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2	90030	59640.164607
10. Review proposed mine working with offsets. Implement mine design change.	Events: 16.2, 20.1	D	4	14 (S)	Brett Haddon	15-Aug-2023	2	90045	59640.164608
11. Consult with NPWS to Install Safety Warning Signage (Active Mining Area) on mountain	Events: 19.1, 27.1	D	2	5 (L)	Sam Price	15-Aug-2023	2	90039	59640.164609
12. Develop ACHPM for CLZ EP area	Events: 20.1	D	3	9 (M)	Sam Price	15-Aug-2023	2	90039	59640.164610
13. Identify locations of surface adit/shafts (gold/diamond) , add to mineplan with inrush control zones.	Events: 30.1				Brett Haddon	15-Aug-2023	2	90045	59640.164611

Controls Completion Details

PULSE Ref. No.	Recommended Controls	Risk Ranking			Allocated To	Require d By Date	Control Importan ce	Controls Completion Details		
		L	C	RR				Action Completion Comments	Action Completed By	Completed Date
59640.164599	1. Develop a <i>Subsidence Monitoring Program</i> in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 to monitor Performance Measures for cliffs (and pagodas) set by development consent, including baseline monitoring and strategy for identifying natural rock falls (non-mining induced) . Include within Subsidence Monitoring program, monitoring requirements around sensitive features (heritage site).	D	3	9 (M)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2			
59640.164600	2. Develop a <i>Land Management Plan</i> in consultation with stakeholders as required by Condition 7 (Sch3) of consent SSD_5581, that includes: identification, monitoring and management of significant cliff and pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program	D	3	9 (M)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2			
59640.164601	3. Develop a <i>Public Safety Management Plan</i> in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publicly accessible areas, identifies key risks, appropriate management and mitigation measures in consultation with land owners, a TARP that defines actions to be taken if triggers are exceeded.	E	4	10 (M)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2			

PULSE Ref. No.	Recommended Controls	Risk Ranking			Allocated To	Require d By Date	Control Importan ce	Controls Completion Details		
		L	C	RR				Action Completion Comments	Action Completed By	Completed Date
59640.164602	4. Revise mine site Water Management Plan in consultation with stakeholders in accordance with Condition 15, Schedule 4 and also satisfying Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on watercourses and aquifers.	D	3	9 (M)	Sam Price	15-Aug-2023	2			
59640.164603	5. Develop a Biodiversity Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581 that outlines monitoring and management measures including TARPs for potential impacts on biodiversity.	D	3	9 (M)	Sam Price	15-Aug-2023	2			
59640.164604	6. Develop a Built Features Management Plan in accordance with Condition 7, Schedule 3 of Consent in consultation with relevant stake holders This is a recommend control that was applied in the first version of the Risk assessment, which has been moved to a current control in this review so as to not cause the action to be applied again through PULSE	D	2	5 (L)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2			
59640.164605	7. Verify existing proposed workings fall within DOC greater than 50m.	D	2	5 (L)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2			
59640.164606	8. Develop HRA for shallow workings in ML1814.	D	2	5 (L)	Jacqueline Cooke RIIRIS402D	17-Jun-2024	2			
59640.164607	9. Develop linament zone proximity report to identify impact of mining within the lineament zone and connection to the grotto and the oasis.	D	3	9 (M)	Jacqueline Cooke RIIRIS402D	15-Aug-2023	2			
59640.164608	10. Review proposed mine working	D	4	14	Brett Haddon	15-Aug-	2			

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PULSE Ref. No.	Recommended Controls	Risk Ranking			Allocated To	Require d By Date	Control Importan ce	Controls Completion Details		
		L	C	RR				Action Completion Comments	Action Completed By	Completed Date
	with offsets. Implement mine design change.			(S)		2023				
59640.164609	11. Consult with NPWS to Install Safety Warning Signage (Active Mining Area) on mountain	D	2	5 (L)	Sam Price	15-Aug-2023	2			
59640.164610	12. Develop ACHPM for CLZ EP area	D	3	9 (M)	Sam Price	15-Aug-2023	2			
59640.164611	13. Identify locations of surface adit/shafts (gold/diamond) , add to mineplan with inrush control zones.				Brett Haddon	15-Aug-2023	2			

CEY Risk Matrix Page 1

CENTENNIAL RISK MATRIX							Likelihood					Description (D)
Rating	Consequence Note: Consequence may result from a single event or may represent a cumulative impact over a period of 12 months. Use the worst case reasonable consequence if there is more than one.						A Certain	B Probable	C Possible	D Remote	E Improbable	
	Financial Impact to Annual Business Plan (F)	Personal Injury (PI)	Business Interruption (BI)	Legal (L)	Reputation (R)	Environment (E)	Common	Has Happened within Centennial	Could Happen & has happened in non-CEY operations	Not Likely	Practically impossible	Probability (Pb)
							Frequent incidents	Regular incidents	Infrequent incidents	Unlikely to occur. Very few recorded or known incidents	May occur in exceptional circumstances. Almost no recorded incidents.	Incident Frequency (IF)
							Operations – within 3 months	Operations – within 2 years	Operations – within 5 years	Operations – within 10 years	Operations – within 30 years	Operations (Op)
							Project – Every project	Project – Every 2 projects	Project – Every 5 projects	Project – Every 10 projects	Project – Every 30 projects	Project (Pr)
5. Catastrophic	>\$50m	Multiple Fatalities	> 1month	Prolonged litigation, heavy fines, potential jail term	Prolonged International media attention	Long term impairment habitats/ ecosystem	25 (E)	24 (E)	21 (H)	19 (H)	15 (S)	
4. Major	\$10m - \$50m	Single Fatality	1 week to 1 month	Major breach/ major litigation	International media attention	Long term effects of ecosystem	23 (E)	22 (E)	18 (H)	14 (S)	10 (M)	
3. Moderate	\$1m - \$10m	Serious/ Disabling Injury	1 day to 1 week	Serious breach of regulation, prosecution/ fine	National media attention	Serious medium term environmental effects	20 (H)	17 (H)	13 (S)	9 (M)	6 (L)	
2. Minor	\$100k - \$1m	Lost Time Injury	12 hrs to 1 day	Non-compliance, breaches in regulation	Adverse local public attention	Minor effects to physical environment	16 (S)	12 (S)	8 (M)	5 (L)	3 (L)	
1. Insignificant	<\$100k	First Aid Treatment Only	< 12 hrs	Low level compliance issue	Local complaints	Limited physical damage	11 (S)	7 (M)	4 (L)	2 (L)	1 (L)	

CEY Risk Matrix Page 2

Risk Rating	Risk Category		Generic Management Actions
22 to 25	E	Extreme	Action is required to eliminate or reduce the risk. If the risk is considered to be ALARP then the decision to accept the risk is to be made by Centennial Coal Chief Executive
17 to 21	H	High	Action is required to eliminate or reduce the risk. If the risk is considered to be ALARP then the decision to accept the risk is to be made by the relevant Centennial Coal Executive General Manager
11 to 16	S	Significant	Action is required to eliminate or reduce the risk. If the risk is considered to be ALARP then the decision to accept the risk is to be made by the Manager of the Centennial Coal Operation
7 to 10	M	Moderate	Action is required to eliminate or reduce the risk. If the risk is considered to be ALARP then the decision to accept the risk is to be made by the Manager of the Centennial Coal Operation
1 to 6	L	Low	Actions to eliminate or further reduce the risk should be considered. If risk is considered to be ALARP then the decision to accept the risk is to be made by the risk assessment owner (no recommended control is required to be created for this)

CEY Risk Matrix Page 3

BOW TIE ANALYSIS - Control Effectiveness Matrix									
TYPE OF CONTROL	Examples	Description	Rank	Control Category	CONTROL – Impact / Status / Quality				
					A ≥ 80%	B 50 – 80%	C 50 / 50%	D 50 – 20%	E ≤ 20%
	Replace electric hand tools with compressed air alternatives in wet conditions	Eliminates a hazard by removal	1.	Elimination of hazard	100	45.0	40.0	14.0	10.0
	Replace large diameter, heavy cables with smaller ones that are easier to handle manually	Replace element with less risky alternative	2.	Substitution	85.0	40.0	35.0	13.0	8.5
	Automatic fire fighting sprinkler systems, Earth Leakage protection devices	An automatic device that operates without intervention by personnel	3.	Engineered without people	70.0	30.0	25.0	12.0	7.0
	Fire alarm that sounds & the operator then has to initiate an evacuation	A device that requires personnel to respond to a stimulus	4.	Engineered with people	50.0	20.0	14.0	10.0	5.0
	Inspection, maintenance and repair of machinery	A process carried out by personnel	5.	Procedural	20.0	15.0	10.0	6.5	2.0
	Employee made aware of dangers of large moving equipment where the operators have limited vision	Induction training programs	6.	Awareness	5.0	3.0	2.5	1.5	1.0

Attachment D

STAKEHOLDER CONSULTATION & CORRESPONDANCE

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List of Stakeholder Correspondence and Presentations Provided

APPENDIX A: LETTER FROM DPE PROVIDING ENDORSEMENT OF PROJECT TEAM (DATED 21/9/22)

APPENDIX B: LETTER FROM DPE PROVIDING ENDORSEMENT OF PROJECT TEAM (DATED 20/9/23)

APPENDIX C: PRESENTATION BY CENTENNIAL AIRLY PROVIDING EXTRACTION PLAN PROJECT UPDATE (PRIOR TO SUBMISSION OF FIRST DRAFT FOR EXTERNAL CONSULTATION) (DATED 1/11/23)

APPENDIX D: LETTER FROM HERITAGE NSW PROVIDING RESPONSE TO DRAFT CLZ EP (ML1814) (DATED 10/1/24)

APPENDIX E: LETTER FROM DCCEEW WATER GROUP PROVIDING RESPONSE TO DRAFT CLZ EP (ML1814) (DATED 11/1/24)

APPENDIX F: LETTER FROM BCS AND NPWS PROVIDING RESPONSE TO DRAFT CLZ EP (ML1814) (DATED 2/2/24)

APPENDIX G: LETTER FROM CENTENNIAL AIRLY PROVIDING RESPONSE DETAILED RESPONSE TO RECOMMENDATIONS FROM BCS AND NPWS (DATED 22/3/24)

APPENDIX H: LETTER FROM NSW RR PROVIDING RESPONSE TO DRAFT CLZ EP (ML1814) (DATED 20/12/23)

APPENDIX I: PRESENTATION BY CENTENNIAL AIRLY PROVIDING EXTRACTION PLAN PROJECT UPDATE (FOLLOWING RECEIVAL OF RESPONSES AND RECOMMENDATIONS FROM EXTERNAL CONSULTATION) (DATED 12/02/24)

APPENDIX J: LETTER FROM WELLINGTON VALLEY WIRADJURI ABORIGINAL CORPORATION PROVIDING RESPONSE TO DRAFT (REV 1) ACHMP CLZ EP (ML1814) (DATED 9/3/24)

APPENDIX K: LETTER FROM WARRABINGA – WIRADJURI #7 NATIVE TITLE CLAIMANTS GROUP PROVIDING RESPONSE TO DRAFT (REV 1) ACHMP CLZ EP (ML1814) (DATED 12/3/24)

APPENDIX L: LETTER FROM NSW PLANNING REQUESTING RESPONSE TO AGENCY ADVICE ON CLZ EP (ML1814) (REV 1) (DATED 24/5/24)

1 STAKEHOLDER CONSULTATION

Table 1.1 provides a summary of stakeholder consultation specifically undertaken for the current Extraction Plan and supporting reports, and where those have been addressed. It is noted that this consultation is in addition to and builds upon previous and ongoing consultation with various stakeholders for the approved Airly EIS (2014) for SSD_5581, previously approved extraction plans, and during existing operations at the mine. Copies of written correspondence with each stakeholder for the current Extraction Plan is also provided as appendices.

It is noted that stakeholder consultation for separate sub-plans for the Environmental Management Plans supporting the Extraction Plan (including the Airly Mine WMP) is described separately within each of those documents and is not included below.

Table 1.1: Summary of Stakeholder Consultation Outcomes for the Extraction Plan

Stakeholder	Consultation	Comment	Response
DPE	6/9/22 Letter from Centennial Airly seeking endorsement of Project Team	21/9/22 Letter from DPE endorsing the Project Team (refer Appendix A)	Nil required
DPE	7/9/22 Centennial Airly supplied an overview presentation of the CLZ (ML1814) Extraction Plan	11/1/23 email from DPE recommending a detailed mine plan be developed for the CLZ (ML1814) Extraction Plan on the basis of some concerns raised by the IEP.	Further consultation undertaken (refer below).
DPE, IEP	13/2/23 Centennial Airly supplied an update presentation of the CLZ (ML1814) Extraction Plan, addressing concerns raised by the IEP and clarifying the proposed approach 7/6/23 Centennial Airly emailed with further information requesting feedback from DPE	27/6/23 email from DPE confirming recommendation that a detailed mine plan be developed for the CLZ (ML1814) Extraction Plan.	Noted during development of Extraction Plan. The detailed mine plan with proposed mining within the CLZ (ML1814) EP Area is illustrated on Plan 1 - Existing and Future Workings .
DPE	13/9/23 Letter from Centennial Airly seeking endorsement of change to specialist for heritage	20/9/23 Letter from DPE endorsing the Project Team (refer Appendix B)	Nil required
DPE, IEP	1/11/23 Centennial Airly supplied an update presentation of the CLZ (ML1814) Extraction Plan prior to submission of the Revision 0 draft for consultation, including presentation of the proposed mine layout and an approach to manage the flexibility required for operational continuity (refer Appendix C)	Refinements options discussed during meeting. No further written comments received.	Noted during development of Extraction Plan.

Stakeholder	Consultation	Comment	Response
DPE, IEP	1/12/23 Centennial Airly supplied draft CLZ (ML1814) Extraction Plan (entire report including all attachments and appendices) for review.	No formal correspondence / feedback received.	Nil required
Heritage NSW	1/12/23 Centennial Airly supplied draft CLZ (ML1814) Extraction Plan (entire report including all attachments and appendices) for review.	10/1/24 Response received from Heritage NSW with recommendations to be addressed (refer Appendix D); including: 1. Demonstrate that the ACHMP was provided to the Registered Aboriginal Parties for review and comment, provide copies of any comments received and document responses addressing comments provided (where relevant). 2. Include a detailed procedure for ongoing consultation with the Registered Aboriginal Parties in the ACHMP. 3. Include and detail the requirement for Registered Aboriginal Parties involvement in baseline recording and monitoring of AHIMS sites (Section 5.2 of the ACHMP) in accordance with Section 6.5 of Western Region - Aboriginal Cultural Heritage Management Plan (Centennial Coal and RPS, 2021). Please also provide a mechanism for reporting the results of monitoring to the Registered Aboriginal Parties. 4. Include a procedure for the management of unexpected Aboriginal objects, as per the Western Region - Aboriginal Cultural Heritage Management Plan (Section 6.7). 5. Include a requirement to notify and consult with Registered Aboriginal Parties and Heritage NSW in the development of rehabilitation and remediation measures for Aboriginal cultural heritage sites in the event of subsidence impacts to any AHIMS sites.	A minor revision to the ACHMP (Rev1), addressing the recommendations, was prepared and provided to RAPs for consultation (refer below for outcomes of consultation with RAPs).

Stakeholder	Consultation	Comment	Response
DCCEEW Water Group	1/12/23 Centennial Airly supplied draft CLZ (ML1814) Extraction Plan (entire report including all attachments and appendices) for review.	13/9/23 Response received from DCCEEW Water Group noting no further comments or recommendations in relation to the first workings within the cliff line zone extraction plan (refer Appendix E).	Nil required <i>It is noted consultation for, and approval of, the Airly Mine WMP is being undertaken concurrently but separately to the Extraction Plan. Consultation for the WMP is detailed in Appendix A and Appendix B in the Airly Mine WMP.</i>
BCS & NPWS	1/12/23 Centennial Airly supplied draft CLZ (ML1814) Extraction Plan (entire report including all attachments and appendices) for review.	13/9/23 Response received from BCS and NPWS with recommendations to be addressed (refer Appendix F); including: 1.1 Should the proposed mining under Genowlan Mountain within Mugii Murum-ban State Conservation Area be approved, the consent authority should include the following in the conditions of consent: • No mining is permitted to occur within the lineament zone of The Grotto and The Oasis. • The proponent must provide NPWS and BCS all raw subsidence, groundwater piezometer and stream level/flow data for Airly mine (in an excel file(s)) with quarterly (3 month basis) updates. • Any surface impacts or exceedance of the maximum permitted subsidence (125mm) are reported immediately to NPWS and BCS. 1.2 Increase monitoring of flow and pool levels for The Grotto and The Oasis, unless conditions of consent specify no mining takes place within the lineament zone of The Grotto and The Oasis. 2.1 Replace subjective terms used such as “unlikely” with well-defined terms, and provide either an unambiguous definition or a quantitative risk	22/3/24 Centennial Airly has carefully considered the recommendations and responses received from BCS and NPWS. Centennial provided a detailed formal response to the BCS and NPWS which demonstrates that all recommendations have been considered and have now been adequately addressed (refer Appendix G). In summary, in response to the recommendations Centennial Airly has undertaken or has committed to the following: 1. Engaged SCT to complete the “High level subsidence, conductivity and connectivity review for The Grotto and The Oasis at Airly Mine” (report no. AIRLY5650 – Rev 2, dated 14 March 2024) 2. Revised the proposed mine layout in the vicinity of The Oasis 3. Revised the Cliff line zone of first workings extraction plan (ML1814) to include the findings of the SCT report (AIRLY5650) (refer Section 2.2.2 and Attachment I in the revised extraction plan), and updated the proposed mine layout in the vicinity of The Oasis (refer Section 3.1.1 in the revised extraction plan) 4. Will continue to provide the relevant data at a frequency and in a format agreed with NPWS in

Stakeholder	Consultation	Comment	Response
		assessment value (e.g. 1 in 1,000, 1 in 1,000,000, or smaller). 3.1 Any approval of an increase in extraction height to 3.2m should be conditional on: • All ribs being effectively supported with bolts and mesh. • Further details / assessments being provided where depths of cover may be approaching 260m over proposed workings, with an increased monitoring program for pillar stability in these areas. 4.1 Provide a quantitative measure of the total area of defined cliffs and pagodas in the extraction area. Undertake regular monitoring to ensure that any impacts do not exceed 2% of the defined total areas of cliffs and pagodas in the extraction area (as per the performance level for the approval for SSD 5581). Individually number each cliff and pagoda in the Mt Genowlan mine area and state the length and height (and therefore calculated area) of the individual cliffs and pagodas. 5.1 Provide much greater detail, including specific detailed diagrams, for mining areas of the CLZ where depth of cover is close to or exceeds 260m. 6.1 Identify and implement a robust and demonstrably adequate subsidence monitoring program pre-approval, prior to mining being undertaken in cliff line zone areas.	accordance with Condition 2 of the MW17-18 Extraction Plan Approval 5. Will implement the CLZ (ML1814) EP Master TARP, including notification to NPWS and key stakeholders, in the unlikely event that surface impacts or exceedance of the maximum permitted subsidence (125mm) are observed 6. The revised extraction plan will be submitted to DPHI for assessment 7. Is considering additional regular photo monitoring of The Grotto and The Oasis areas (in consultation with NPWS) 8. Provided spatial data, including the mine design layout and depth of cover contours, to BCS / NPWS
NSW RR	4/12/23 Centennial Airly supplied draft CLZ (ML1814) Extraction Plan (entire report including all attachments and appendices) for review.	20/12/23 Response received from NSW Resources Regulator noting no specific comments regarding mine safety or mine rehabilitation in relation to the proposals (refer Appendix H).	Nil required

Stakeholder	Consultation	Comment	Response
DPE, IEP	12/2/24 Centennial Airly supplied an update presentation of the CLZ (ML1814) Extraction Plan after receiving responses and recommendations relating to the Revision 0 draft for consultation (refer Appendix I)	No issues raised during the meeting. No formal written comments received.	Nil required
Registered Aboriginal Parties	12/2/24 Centennial Airly supplied the draft Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) (Rev1) to the Registered Aboriginal Parties for review and comment. 6/3/24 Centennial Airly supplied an update presentation of the Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) to the Centennial Western Region Aboriginal Heritage Committee meeting 11/3/24 Centennial Airly sent email to all RAPs as a reminder that all responses are requested by COB Wednesday 13/3/24	9/3/24 Response received from Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) with recommendations to be addressed (refer Appendix J); including: 1. Request that as part of the proposed Phase 1: Baseline archival recording the Aboriginal Heritage Site is 3D photographed/scanned using an iPhone and the Polycam App or similar that uses a combination Hi-resolution images and 3D scanning. 12/3/24 Response received from Warrabinga – Wiradjuri #7 Native title Claimants group with support for the ACHMP (refer Appendix K).	A minor revision to the ACHMP (Rev2), addressing the recommendation from WVWAC, was prepared and will be submitted for approval.
NSW Planning	26/3/24 Centennial Airly supplied final CLZ (ML1814) Extraction Plan – Rev 1 (entire report including all attachments and appendices) addressing all comments and feedback during consultation for review and approval.	24/5/24 Request for Information (RFI) received from NSW Planning noting comments and recommendations were received from various agencies, including the Airly Mine Independent Expert Panel (IEP), Department of Regional NSW - Mining, Exploration and Geoscience, NSW Resources Regulator, Heritage NSW, Groups of the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) – Biodiversity, Conservation and Science (BCS), and NSW National Parks and Wildlife Service (NPWS). (refer Appendix L).	19/7/24 Centennial Airly provided response to the NSW Planning RFI 25/7/24 A minor revision to the CLZ (ML1814) Extraction Plan – Rev 2, addressing the comments and recommendations, was prepared and is submitted for approval.

STAKEHOLDER CORRESPONDENCE AND PRESENTATIONS

Appendix A: Letter from DPE providing Endorsement of Project Team (dated 21/9/22)

Ms Veronica Howat
Assurance Specialist
Centennial Airly Pty Limited
Via email: dpiepostapproval@centennialcoal.com.au

21/09/2022

Subject: Airy Mine - Endorsement of Project Team – MW17-19 and Cliff Line Zone First Workings Extraction Plans

Dear Ms Howat

I refer to your request dated 6 September 2022 for the Planning Secretary's endorsement of a team of suitably qualified persons to prepare two Extraction Plans in accordance with Condition 7 of Schedule 3 of Development Consent SSD 5581. The proposed Extraction Plans relate to secondary extraction of MW17-19 in the south-eastern part of Genowlan Mountain and first workings in the Cliff Line Zone (CLZ) in Mining Lease 1814.

The Department has reviewed the nominations and information you have provided and is satisfied that these experts are suitably qualified and experienced. Accordingly, I can advise that the Planning Secretary endorses the appointment of the following team to prepare the Extraction Plans for MW17-19 and first workings in the CLZ.

Table 1: MW17-19 and CLZ first workings Extraction Plan Team

Team Member	Role
Anthony Reid - Catalyst Environmental Management	Lead consultant and project management Author - Extraction Plan Main Report
Yvette Heritage - SCT Operations	Technical Specialist - Mine Design and Subsidence Predictions
Don Kay - MSEC	Technical Specialist - Subsidence Impact Assessment and Cliff Stability Assessment
Ian Gilmore - GHD Dr Stuart Gray - GHD	Technical Specialists - Water Management Plan
Susan Kennedy - RPS	Technical Specialist - Heritage Management Plan
Mark Aitkens - RPS	Technical Specialist - Biodiversity Management Plan
Michael Nicholson - Michael Nicholson Consulting	Technical Specialist - Subsidence Monitoring Program

If you wish to discuss the matter further, please contact Gabrielle Allan on 9585 6078.

Yours sincerely

A handwritten signature in cursive script that reads "J Evans". The signature is written in dark ink and is positioned above the printed name and title.

Jessie Evans
Director, Resource Assessments
Resource Assessments

As nominee of the Planning Secretary

Appendix B: Letter from DPE providing Endorsement of Project Team (dated 20/9/23)

Ms Jacqueline Cooke
Compliance Manager
Centennial Coal Company Limited

Via: NSW Major Projects portal
20/09/2023

Subject: Endorsement of Heritage Specialist - Cliff Line Zone First Workings Extraction Plan

Dear Ms Cooke,

I refer to your request dated 13 September 2023 for the Planning Secretary's endorsement of Tessa Boer-Mah as a suitably qualified and experienced person to prepare the Extraction Plan Heritage Management Plan for the Cliff Line Zone First Workings Extraction Plan required under Schedule 3, Condition 7 of SSD-5581. I note that Ms Boer-Mah would replace the previously endorsed Heritage Specialist, Susan Kennedy (RPS).

The Department has reviewed the nomination and information you have provided and is satisfied that Tessa Boer-Mah is suitably qualified and experienced. Accordingly, I can advise that the Planning Secretary endorses the appointment of Tessa Boer-Mah of Heritage Now as Technical Specialist – Heritage Management Plan for the Cliff Line Zone First Workings Extraction Plan at Airly Mine (SSD-5581) in place of Susan Kennedy (RPS).

If you wish to discuss the matter further, please contact Emily Pemberton on 02 8275 1783.

Yours sincerely

A handwritten signature in black ink, appearing to read "J. Evans".

Director
Energy and Resource Assessments

As nominee of the Planning Secretary

Appendix C: Presentation by Centennial Airly providing Extraction Plan Project Update (prior to submission of first draft for external consultation) (dated 1/11/23)

Note, only slides within this presentation relating to the CLZ (ML1814) Extraction Plan have been provided in this attachment.

CEY- DPE

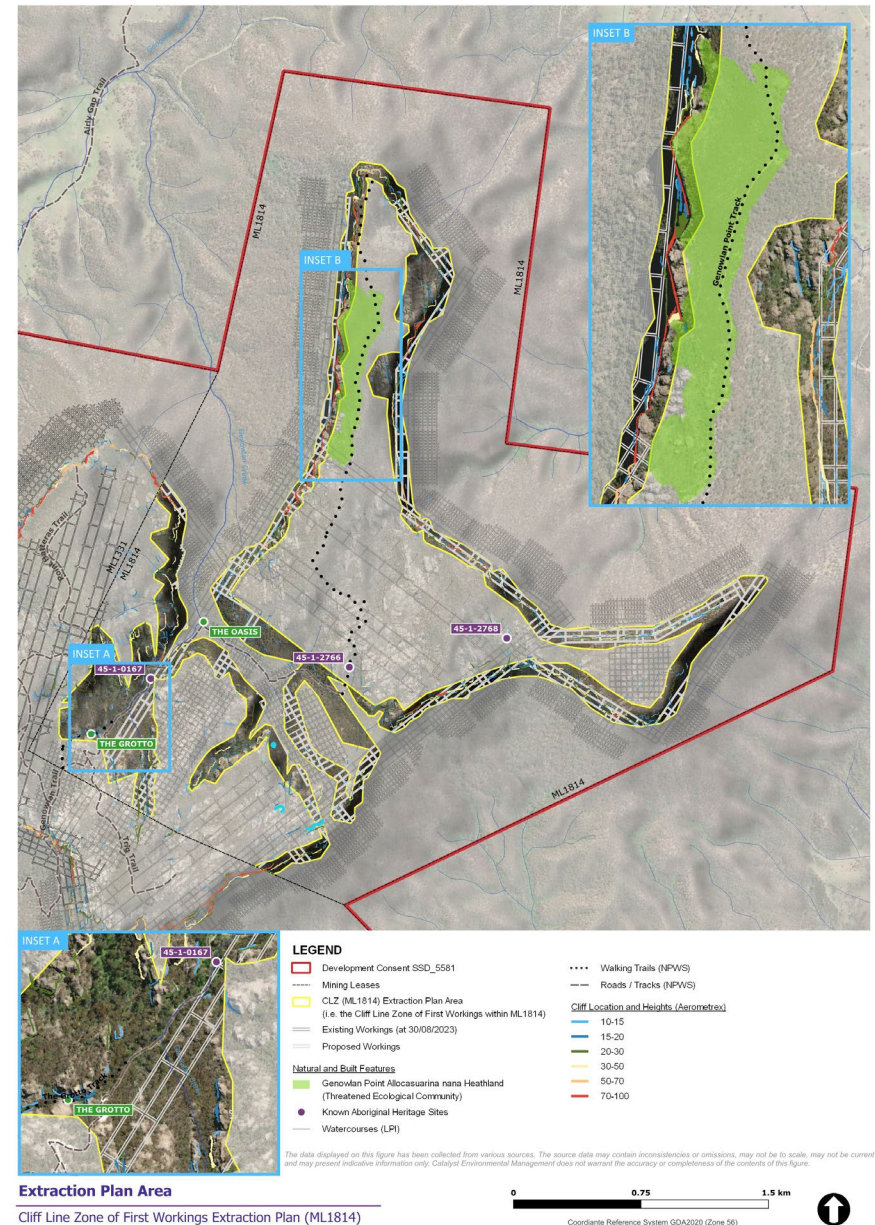
IEP Quarterly Engagement
1st November 2023

Cliffline Zone (CLZ) EP

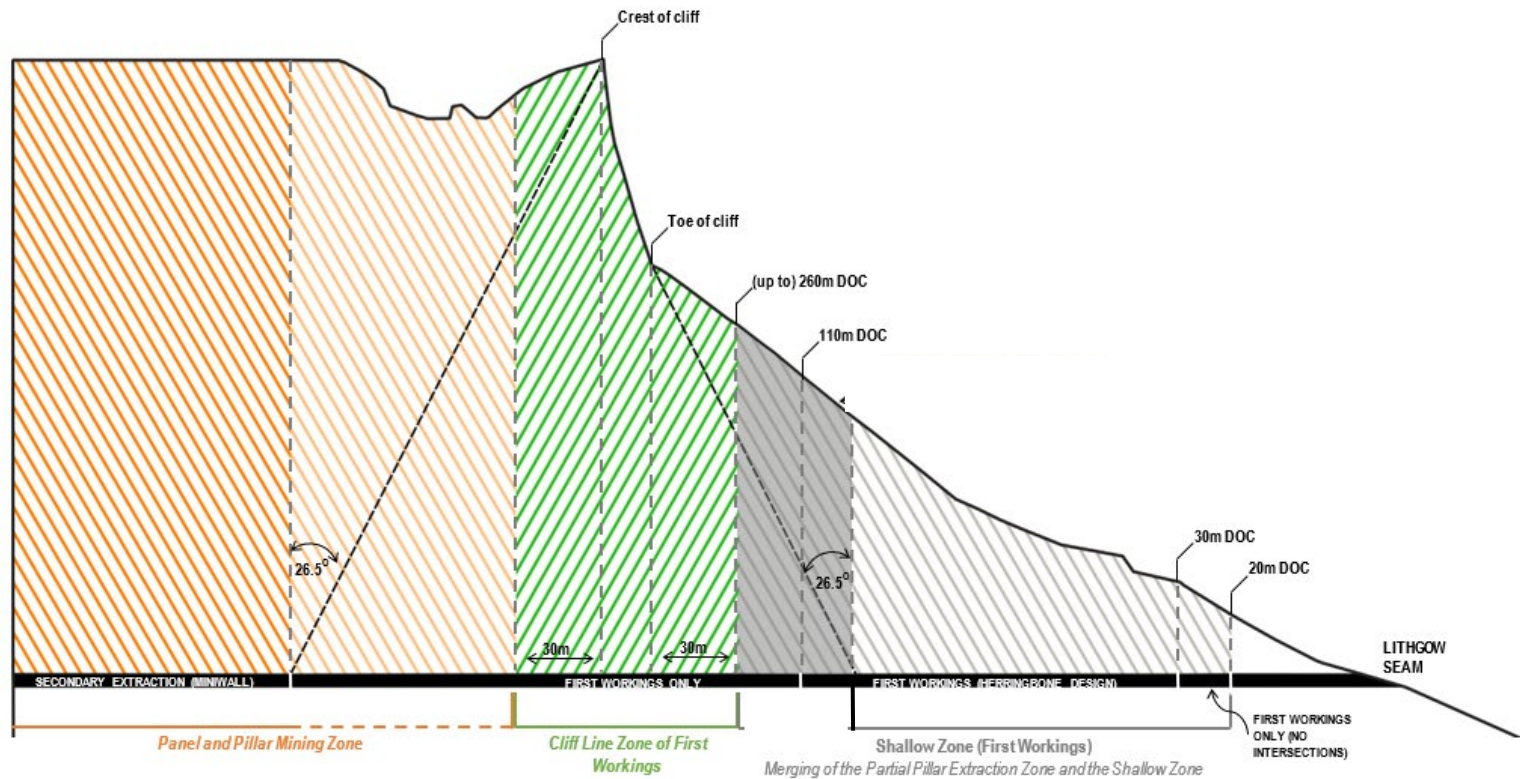
Update on EP progress and timing
Influence of the Shallow Zone on CLZ Mine plan layout
Proposed Approach for flexibility

Update on EP Progress and Timing

- Draft Extraction Plan complete
- External consultation to commence in November following consideration of feedback regarding future mining in the Shallow Zone
- Approval required by June 2024 to allow commencement of the 500 panel

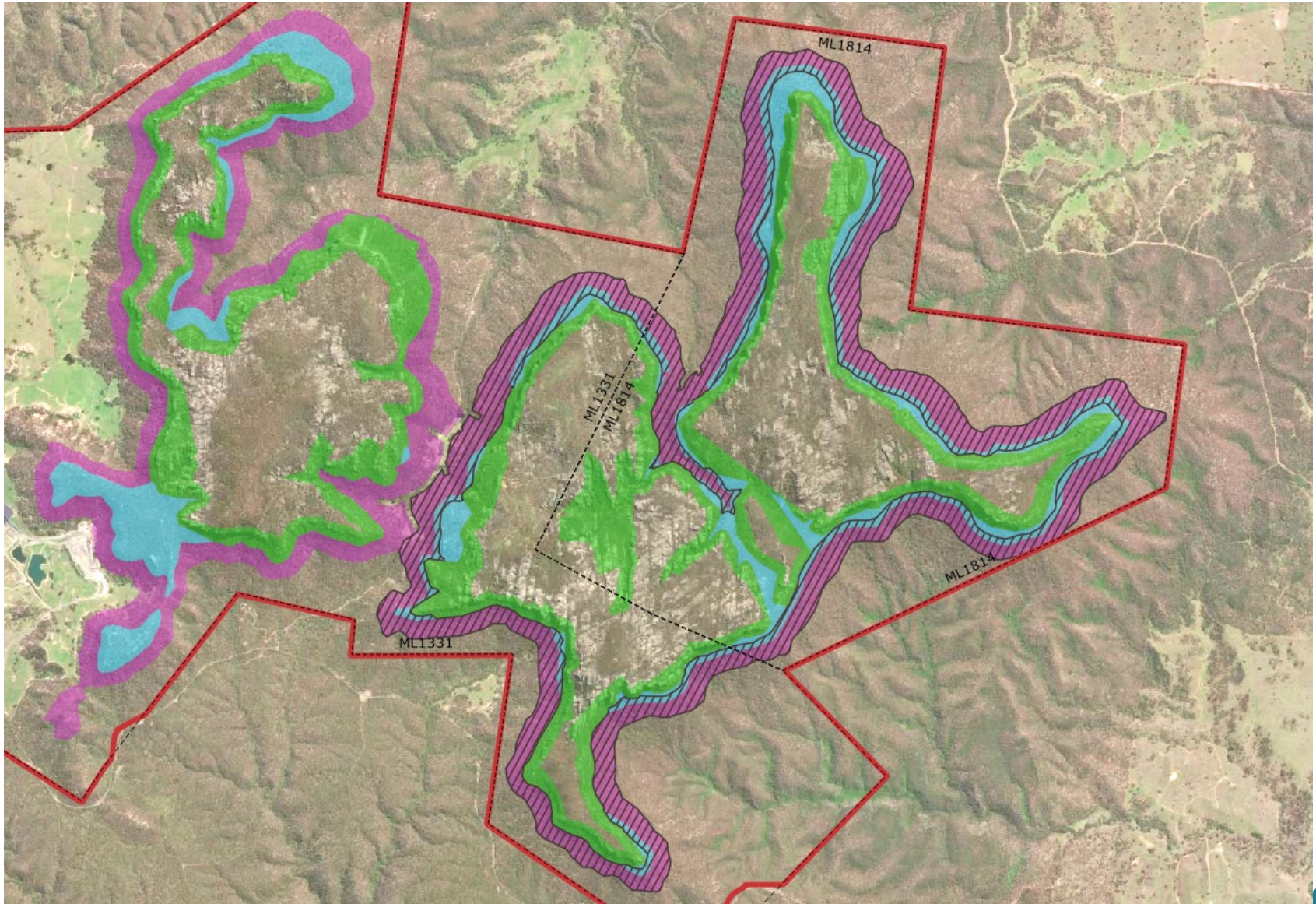


Shallow Zone

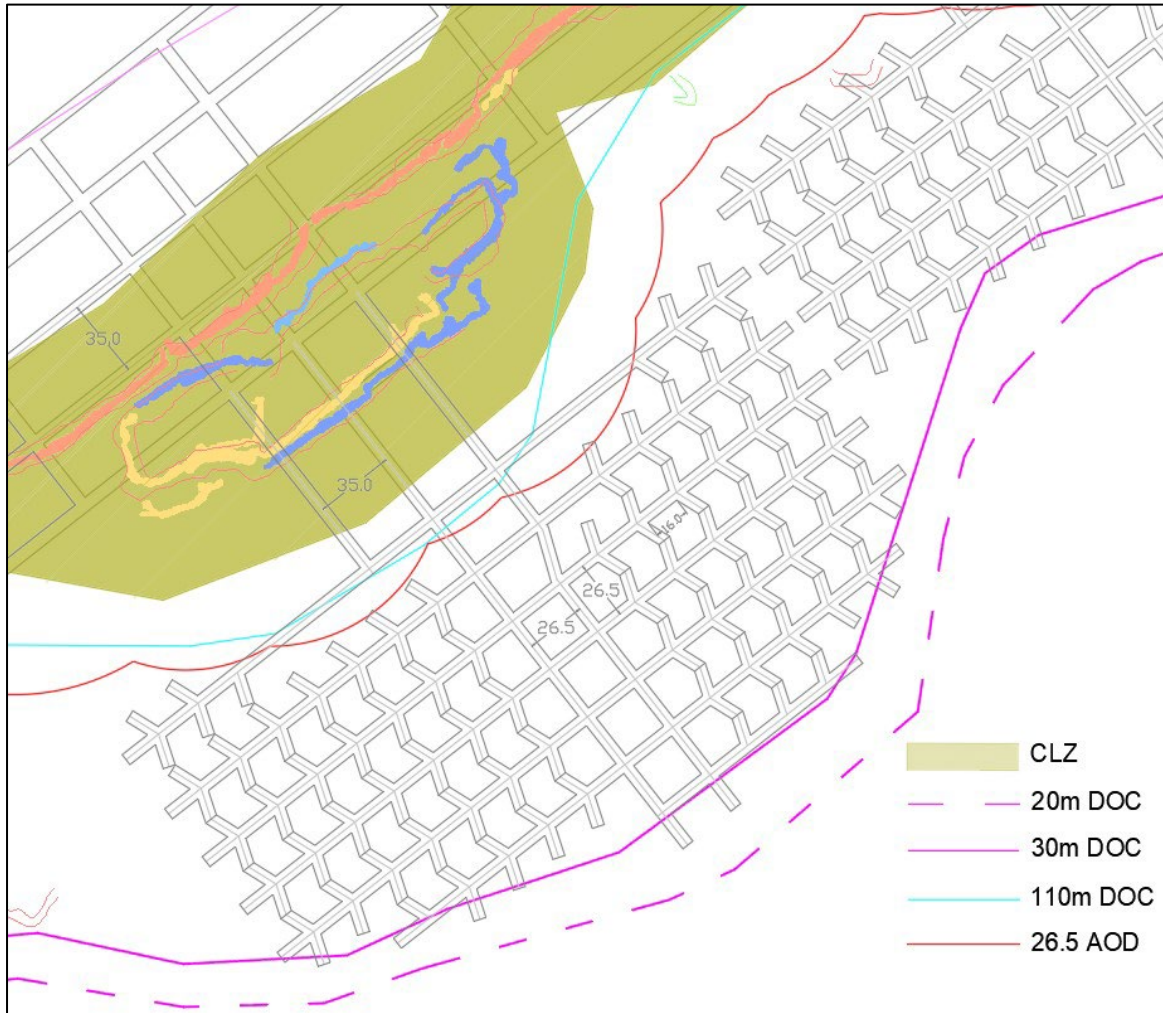


- Shallow zone definition
- Herringbone panels (1st workings) proposed in shallow zone
- Herringbone panels accessed underground via Main headings
- Main headings that are developed beneath CLZ are designed with long term stable pillars

Shallow Zone



Shallow Zone Panel Design wrt CLZ Pillar Dimensions



Design criteria:

CLZ + 26.5 AOD

Within CLZ – min. Pillar 35m x 35m (c-c), $w/h > 8$, long term stable pillars ($FOS > 2.11$), no unsupported roadways

CLZ to 26.5 AOD - long term stable pillars, no unsupported roadways

DOC > 30m – $w/h > 5$

30m to 20m – no intersections

DOC < 20m – no roadways

Cliff surcharge considered via additional loading on pillars

Proposed Approach for CLZ EP Flexibility

Purpose of the CLZ is development of roadways/headings and cut throughs to access production panels outside of CLZ. There is a need to acknowledge some flexibility for the first workings.

Insignificant changes permissible without notification

- Changes to cut-through location which result in pillars that still meet minimum design criteria (i.e.,
 - 35m x 35m (centres) for DOC up to 290m,
 - 39m x 39m (centres) for DOC >290m - <320
- Reduction in the number of roadways/headings or cut-throughs
- Move a roadway/heading or cut through up to ½ pillar length (increasing pillar size only) while maintaining minimum 35m x 35m (centres) as per above (ie so long as minimum design criteria is achieved)
- Correction of offline driveage
- Driveage of stub to create pit space for storage, operational requirements <10m in length from stub side rib

Proposed Approach for CLZ EP Flexibility

Minor changes permissible with geotechnical assessment and confirmation pillar system remains long-term stable

- Isolated cases where minimum pillar is $< 35\text{m}$ centres, but is $> 1/10^{\text{th}}$ Depth of cover or $> 10\text{m}$
- Isolated change in roadway width $> 5.5\text{m}$ (but void width $< 10\text{m}$)
- Irregular shaped pillar determined to be long term stable

Moderate changes permissible with geotechnical assessment, notification to IEP and confirmation pillar system remains long-term stable

- Isolated cases where minimum pillar size is $< 1/10^{\text{th}}$ depth of cover, with High Risk Activity notification undertaken as per WHS legislation
- Driveage of roadways/headings greater than $\frac{1}{2}$ pillar width from proposed workings

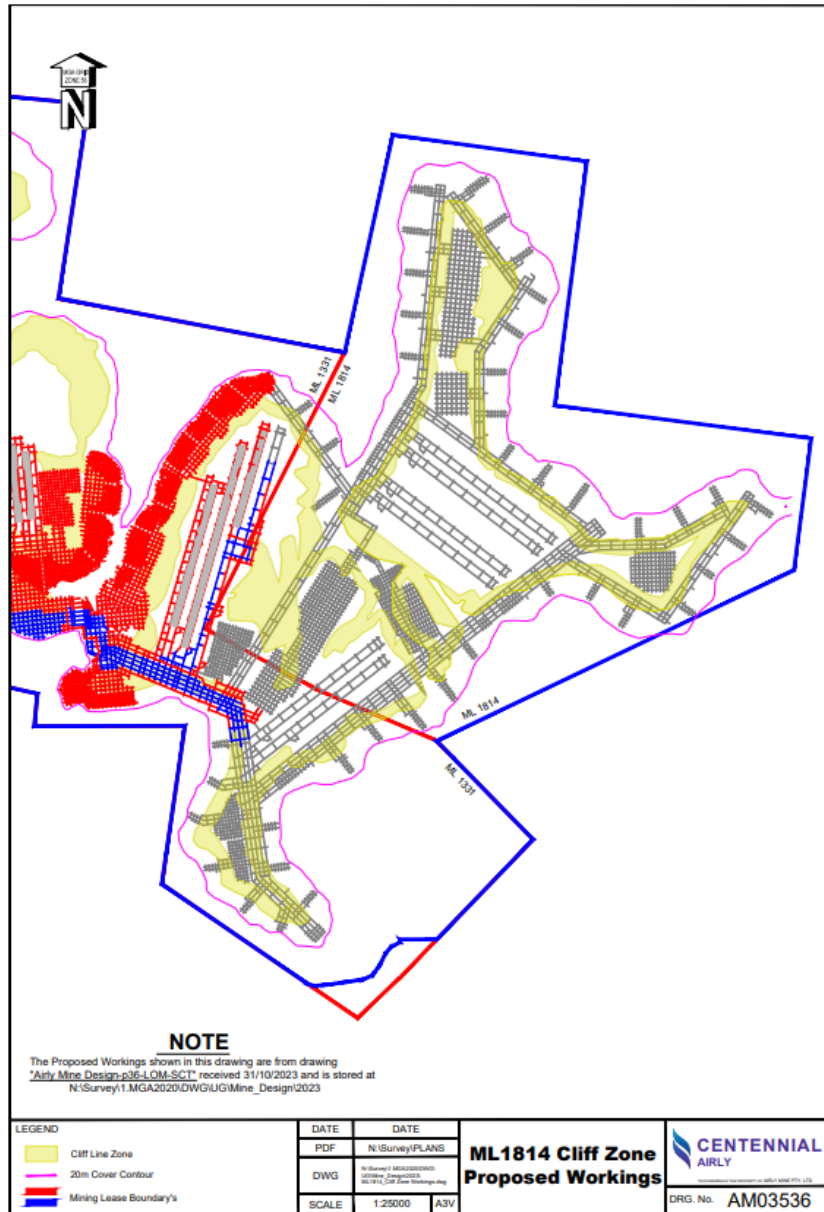
Major changes requiring modification of the Extraction Plan

- Additional roadways/headings
- Change in roadway/headings direction / location $> 5\text{m}$ from proposed workings.

Proposed Approach for CLZ EP Flexibility

Category	Change Process	Example Scenarios
Insignificant	Internal management of change processes implemented	- Changes to cut-through location which result in pillars that still meet minimum design criteria (i.e., 35m x 35m (centres) for DOC up to 290m, 39m x 39m (centres) for DOC >290m - <320) - Reduction in the number of roadways or cut-throughs - Driveage of roadways <2m from proposed workings - Move a roadway or cut through inbye up to 15-20m or ½ pillar length (increasing pillar size only) while maintaining minimum 35m x 35m (centres) - Correction of offline driveage - Driveage of stub to create pit space for storage, operational requirements <10m in length from stub side rib
Minor	Internal management of change processes implemented, including geotechnical assessment and confirmation pillar system remain long-term stable	- Isolated cases where minimum pillar size is <35m centres, but is >1/10th depth of cover or >10m - Isolated change in roadway width >5.5 (but void width <10m)
Moderate	geotechnical assessment, notification to IEP and confirmation pillar system remain long-term stable	- Isolated cases where minimum pillar size is <1/10th depth of cover, with High Risk Activity notification undertaken as per WHS legislation - Driveage of roadways within 2-5m from proposed workings
Major	Modification of the Extraction Plan	- Additional roadways - Change in roadway direction / location >5m from proposed workings

Proposed CLZ EP layout ML1813



Appendix D: Letter from Heritage NSW providing response to draft CLZ EP (ML1814) (dated 10/1/24)

Our ref: DOC23/1052974

Your ref: SSD-5581-PA-86

Ms Veronica Howat

Centennial Coal

dpiepostapproval@centennialcoal.com.au

Letter uploaded to the Major Projects Planning Portal

Aboriginal Cultural Heritage Management Plan – State Significant Development

Proposal: Airly Coal Mine Expansion - Airly CLZEP (ML1814)

Major Project reference: SSD-5581-PA-86

Received: 1 December 2023

Dear Veronica

Thank you for your referral seeking advice on the Aboriginal Cultural Heritage Management Plan dated 1 December 2023 for the above State Significant Development. Thank you for the continued opportunity to comment on the project.

Unfortunately, the ACHMP provided to Heritage NSW does not include comments from the Registered Aboriginal Parties (RAPs). Once the ACHMP has been updated to include RAP comments and addressed any comments raised, then the plan can be resubmitted to Heritage NSW for further comment.

Based on a preliminary review of the Draft ACHMP, Heritage NSW has provided comments below. Following revision of the ACHMP to address the comments (and consultation with Registered Aboriginal Parties, as discussed above), please resubmit the Plan to Heritage NSW for comment.

1. Please demonstrate that the ACHMP was provided to the Registered Aboriginal Parties for review and comment, provide copies of any comments received and document responses addressing comments provided (where relevant).
2. Ongoing consultation with Registered Aboriginal Parties is required as a part of review and updates to the ACHMP. Include a detailed procedure for ongoing consultation with the Registered Aboriginal Parties in the ACHMP.
3. Include and detail the requirement for Registered Aboriginal Parties involvement in baseline recording and monitoring of AHIMS sites (Section 5.2 of the ACHMP) in accordance with Section 6.5 of Western Region – Aboriginal Cultural Heritage Management Plan (Centennial

Coal and RPS, 2021). Please also provide a mechanism for reporting the results of monitoring to the Registered Aboriginal Parties.

4. The ACHMP does not include a procedure for the management of unexpected Aboriginal objects. Heritage NSW recommends the inclusion the unexpected finds methodology from Western Region – Aboriginal Cultural Heritage Management Plan (Section 6.7).
5. In the event of subsidence impacts to AHIMS site 45-1-0167, the development of rehabilitation and remediation measures for Aboriginal cultural heritage sites must be undertaken in consultation with the Registered Aboriginal Parties and Heritage NSW. Please include a requirement to notify and consult with Registered Aboriginal Parties and Heritage NSW in the event of subsidence impacts to any AHIMS sites.

Please note that the above comments relate only to Aboriginal cultural heritage regulation matters. If you have any questions regarding these comments, please contact Alison Lamond, Aboriginal Senior Assessments Officer, at Heritage NSW on 0419 762 918 or alison.lamond@environment.nsw.gov.au.

Yours sincerely

Nicola Roche

Nicola Roche
Acting Manager, Assessments
Heritage NSW
Department of Climate Change, Energy, the Environment and Water
As Delegate under National Parks and Wildlife Act 1974
10 January 2024

Appendix E: Letter from DCCEW Water Group providing response to draft CLZ EP (ML1814) (dated 11/1/24)

Our ref: OUT24/118

Veronica Howat
Centennial Coal

Email: dpiepostapproval@centennialcoal.com.au

11 January 2024

Subject: Airly Coal Mine Expansion - Airly CLZ EP (ML1814) (SSD-5581-PA-86)

Dear Veronica,

I refer to your request for advice sent on 1 December 2023 to the Department of Planning and Environment (DPE) Water, now the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Water Group about the above matter.

Airly Coal Pty Ltd submitted a draft extraction plan for the first workings within the cliff line zone on ML1814 for review.

The DCCEEW Water Group has no further comments or recommendations in relation to the first workings within the cliff line zone extraction plan.

However, DCCEEW Water notes that the approval of the extraction plan is provisional pending update of the Water Management Plan as per previous communications. The Water Management plan should be fully implemented along with the associated groundwater monitoring program.

Should you have any further queries in relation to this submission please do not hesitate to contact DCCEEW Water Assessments water.assessments@dpie.nsw.gov.au.

Yours sincerely

A handwritten signature in black ink, appearing to read "Rob Brownbill".

Rob Brownbill,
Manager, Water Assessments, Knowledge Division
Department of Climate Change, Energy, the Environment and Water

Appendix F: Letter from BCS and NPWS providing response to draft CLZ EP (ML1814) (dated 2/2/24)



Our ref: DOC24/52957
Your ref: Airly CLZ (ML 1814)

Edwina White
Group Manager Approvals
Centennial Coal
E-mail: edwina.white@centennial.com.au

Dear Edwina,

Subject: Airly Coal – Cliff line zone of first workings extraction plan (ML1814)

Thank you for your request via the NSW Planning Portal dated 1 December 2023 to the Biodiversity, Conservation and Science (BCS) Group of the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) inviting comments on the Airly Coal cliff line zone of first workings extraction plan. Please note that this response represents the combined views of the BCS and the NSW National Parks and Wildlife Service (NPWS) Groups of NSW DCCEEW.

We have reviewed the draft extraction plan and, while noting the proposed mining involves first workings bord and pillar operations only, have identified some concerns including:

- The use of terms that are subjective and not specifically defined.
- The proposed increase in roadway heights from 2.8m to 3.2m.
- The apparent increase in roadway width from 5.5m to up to 10m.
- Limited precautions or appropriate management regimes when mining near geological structures such as faults and lineaments.
- Uncertainty regarding the accuracy and reliability of cliff and pagoda mapping, especially in relation to cliff and pagoda position, height and length, and subsequent ability to demonstrate stated performance measures have been met.
- Limited discussion of depth of cover and pillar stability in areas where depths of cover approach 260m
- The lack of identified subsidence monitoring for proposed workings in the cliff line zone of workings (CLZ) for Mt Genowlan.

We recommend that you prepare an updated extraction plan that incorporates the recommendations listed in **Attachment A**, prior to formal lodgement of the final extraction plan with the Department of Planning, Housing and Infrastructure (DPHI) for approval.

Our recommendations are provided in **Attachment A**, and detailed comments are provided in **Attachment B**.

If you have any questions about this advice, please do not hesitate to contact Liz Mazzer, Senior Conservation Planning Officer, via liz.mazzer@environment.nsw.gov.au or (02) 6883 5325.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Sarah Carr', with a stylized, cursive script.

Sarah Carr
Director North West
Biodiversity, Conservation and Science

2 February 2024

Attachment A – BCS and NPWS Recommendations

Attachment B – BCS and NPWS Detailed Comments

BCS and NPWS recommendations

Airly cliff zone of first workings extraction plan (ML1814)

Acronyms

CLZ EP	Cliff line zone of first workings extraction plan
FOS	Pillar system factor of safety
MW	Mini wall
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water

Recommendations

- 1.1 Should the proposed mining under Genowlan Mountain within Mugii Murum-ban State Conservation Area be approved, the consent authority should include the following in the conditions of consent:
 - No mining is permitted to occur within the lineament zone of The Grotto and The Oasis.
 - The proponent must provide NPWS and BCS all raw subsidence, groundwater piezometer and stream level/flow data for Airly mine (in an excel file(s)) with quarterly (3 month basis) updates.
 - Any surface impacts or exceedance of the maximum permitted subsidence (125mm) are reported immediately to NPWS and BCS.
- 1.2 Increase monitoring of flow and pool levels for The Grotto and The Oasis, unless conditions of consent specify no mining takes place within the lineament zone of The Grotto and The Oasis.
- 2.1 Replace subjective terms used such as “unlikely” with well-defined terms, and provide either an unambiguous definition or a quantitative risk assessment value (e.g. 1 in 1,000, 1 in 1,000,000, or smaller).
- 3.1 Any approval of an increase in extraction height to 3.2m should be conditional on:
 - All ribs being effectively supported with bolts and mesh.
 - Further details / assessments being provided where depths of cover may be approaching 260m over proposed workings, with an increased monitoring program for pillar stability in these areas.
- 4.1 Provide a quantitative measure of the total area of defined cliffs and pagodas in the extraction area. Undertake regular monitoring to ensure that any impacts do not exceed 2% of the defined total areas of cliffs and pagodas in the extraction area (as per the performance level for the approval for SSD 5581). Individually number each cliff and pagoda in the Mt Genowlan mine area and state the length and height (and therefore calculated area) of the individual cliffs and pagodas.

- 5.1 Provide much greater detail, including specific detailed diagrams, for mining areas of the CLZ where depth of cover is close to or exceeds 260m.
- 6.1 Identify and implement a robust and demonstrably adequate subsidence monitoring program pre-approval, prior to mining being undertaken in cliff line zone areas.

BCS and NPWS detailed comments

Airly cliff line zone of first workings extraction plan (ML 1814)

1. The potential interaction of mining subsidence with geological structures has not been fully assessed.

NSW DCCEEW has undertaken an independent specialist review of the cliff line zone of first workings extraction plan (CLZ EP). We consider that the assessment of the potential for faults and lineaments to interact with mining induced subsidence has not been fully or appropriately considered.

Comments in the CLZ EP regarding the potential interaction of faults/lineaments with subsidence contradict earlier comments from the proponent in previous extraction plans. For example, the Mt Airly & Pt Hatteras Extraction Plans and MW17 & 18 Extraction Plans largely dismissed the relevance of lineaments in mining impacts and consequence.

Whilst not modelled in the CLZ EP, some proposed 'future miniwalls' appear to potentially interact with the proposed mining in the cliff protection zone. The CLZ EP states that SCT (2023) concluded there is a moderate potential risk of downward flow through the fracture network and lineaments resulting in a reduction in head level of creek alluvials.

The Grotto has a performance measure of *"Negligible subsidence impacts or environmental consequences"*. If impacts like those identified for Gap Creek occur at The Grotto, there is likely to be a breach of the performance measure for The Grotto and therefore a breach of the SSD 5581 conditions of consent.

It is noted that there is no specific monitoring of groundwater, flow, or pool levels at The Grotto currently proposed. It is therefore not currently possible to demonstrate whether groundwater, flow and pool levels for The Grotto can meet the performance measure of *"negligible subsidence impacts or environmental consequences"*.

For mining near The Grotto and The Oasis, in terms of lineaments the risk assessment WRAC analysis worksheet recommends a control, *"Develop lineament zone proximity report to identify impact of mining within the lineament zone and connection to The Grotto and The Oasis"*.

Recommendations

- 1.1 Should the proposed mining under Genowlan Mountain within Mugii Murum-ban State Conservation Area be approved, the consent authority should include the following in the conditions of consent:
 - No mining is permitted to occur within the lineament zone of The Grotto and The Oasis.
 - The proponent must provide NPWS and BCS all raw subsidence, groundwater piezometer and stream level/flow data for Airly mine (in an excel file(s)) with quarterly (3 month basis) updates.
 - Any surface impacts or exceedance of the maximum permitted subsidence (125mm) are reported immediately to NPWS and BCS.
- 1.2 Increase monitoring of flow and pool levels for The Grotto and The Oasis, unless conditions of consent specify no mining takes place within the lineament zone of The Grotto and The Oasis.

2. Subjective terminology should be replaced with unambiguous definitions or quantitative risk assessment value

It is noted that many statements in the Extraction Plan (EP) are based on subjective statements and ambiguously defined terms. For example, it is stated that:

*“The predicted levels of subsidence from first workings proposed in this CLZ (ML1814) Extraction Plan are similar to those provided in the 2014 EIS. The assessed levels of potential impact are similar to those based on the EIS Layout. The performance measures for subsidence for the Airly Mine are outlined in Condition 2 in Schedule 3 of SSD_5581. **At these predicted low subsidence levels, it is unlikely that performance measures of SSD_5581 will be exceeded by the proposed first workings**”.*

It is noted in this specific context it unclear what “unlikely” means in practice. It is preferable that the risk of impact to cliffs and rock formations that are considered highly significant be remote or non-existent, not simply unlikely. The use of subjective terms used such as “unlikely” should be replaced with either an unambiguous definition or a quantitative risk assessment value (e.g. 1 in 1,000, 1 in 1,000,000, or smaller).

Recommendation

- 2.1 Replace subjective terms used such as “unlikely” with well-defined terms, and provide either an unambiguous definition or a quantitative risk assessment value (e.g. 1 in 1,000, 1 in 1,000,000, or smaller).

3. Potential impacts of increased extraction height have not been adequately assessed

The original roadway geometry in the CLZ at Airly was modelled using 5m roadways with 20m pillars and 2.8m extraction height. Both the roadway width (now up to 10m wide) and extraction heights (now 3.2m) have increased in the current CLZ EP. It is unclear whether the current modelling has allowed for both of these increases (i.e. 10m roadway width and 3.2m extraction height).

By increasing the height of the roadways from 2.8m to 3.2m, 35m pillar centres now appear unable to “cope” (i.e. be long-term stable) where depths of cover of greater than 260m occur. There is very limited discussion of pillar stability as depth of cover approaches this 260m threshold. The presentation of depth of cover contours in the CLZ EP are insufficient to be able to tell where such areas are or could be. GIS layers for depth of cover have been requested from the proponent and would be required for verification.

Recommendation

- 3.1 Any approval of an increase in extraction height to 3.2m should be conditional on:
- All ribs being effectively supported with bolts and mesh.
 - Further details/assessments being provided where depths of cover may be approaching 260m over proposed workings, with an increased monitoring program for pillar stability in these areas.

4. Quantitative measurement of cliffs and pagodas is required

Aerometrix (2021 and 2022) were engaged by the proponent to identify the cliffs and other sensitive surface features within ML1814 that satisfied the rock feature definitions in the development consent. Michael Nicholson Consulting Pty Ltd (MNC) was then engaged to undertake ground truthing of the cliffs that were identified as being located within the CLZ.

The objectives of the ground truthing reports (MNC, 2023a, 2023b) were to primarily provide ground truthing verification of the cliff mapping and cliff identification completed in desktop studies by Aerometrix. A site inspection was also undertaken to inspect for any cliffs or other features not previously identified/mapped, as well as inspecting the area to check there were no rock features (i.e. pinch points, overhangs, etc.) that would be particularly sensitive to subsidence ground movements.

The key findings of the report are:

- Good positional correlation was noted with cliff segments digitised by MNC and those identified by the Aerometrex process – the site inspection supports using the cliff mapping provided by Aerometrex for developing setbacks to future secondary extraction.
- There were no particularly vulnerable features identified in the extraction plan area that would need to be avoided through mine design.

It is noted that the MNC 2023a, 2023b reports have not been provided with the extraction plan. The phrase “good positional correlation” is also not explained in the CLZ EP. As such it is unclear whether there is a statistical number attributable to this correlation (e.g., $r=0.9$) or if it is an unquantified subjective opinion.

This raises the question of how well the position, length and height of cliffs and pagodas have been mapped by Aerometrix and MNC. The proponent has not provided any estimate of the total areas of “such cliffs” and “such pagodas” in order to meet the performance measures for cliffs and pagodas. To test whether impacts to cliffs and pagodas in total do not reach “2% of the total area of such cliffs” or “2% of the total area of such pagodas” requires accurate mapping of these areas. The area of “such cliffs” and “such pagodas” are not stated or quantified anywhere in the extraction plan. Due to this, it is difficult to measure and enforce the performance measures for cliffs and pagodas.

The Aerometrix mapping of cliffs, minor cliffs and pagodas can be seriously affected by:

- Angle of flightpath relative to the feature
- Inability of Lidar to penetrate tree cover (there is the potential for additional effects due to shadow and how the Aerometrix algorithm deals with such issues).
- Obvious cliffs are missed
- No validation has been applied to the methodology to define cliffs, minor cliffs and pagodas, or their height and extent.

We remain concerned that cliffs may not be fully mapped using these techniques, and an arbitrary cut-off point is specified for what is a cliff and what is a pagoda. The effect this has on mapping of the height and extent of cliffs needs far better definition and further validation.

Recommendation

- 4.1 Provide a quantitative measure of the total area of defined cliffs and pagodas in the extraction area. Undertake regular monitoring to ensure that any impacts do not exceed 2% of the defined total areas of cliffs and pagodas in the extraction area (as per the performance level for the approval for SSD 5581). Individually number each cliff and pagoda in the Mt Genowlan mine area and state the length and height (and therefore calculated area) of the individual cliffs and pagodas.

5. Pillar stability where depth of cover is close to or greater than 260m requires review

According to SCT (2023b):

“The design review found that a 3.2m roadway height for 35m pillar centres at a depth of cover greater than 260m would have a FOS <2.11 (and not be considered long-term stable)”.

By increasing the height of the roadways from 2.8m to 3.2m, the 35m pillar centres now appear unable to “cope” (i.e., be long-term stable) with depths of cover greater than 260m. There is very limited discussion for pillar stability as depth of cover approaches this 260m threshold. The presentation of depth of cover contours in the extraction plan are insufficient to be able to tell exactly where such areas are or could be. The spatial data layer for depth of cover has been requested from the proponent to enable verification.

While SCT stated that the proposed mine plan does not contain any full 35m square pillars under the cliff line zone at a depth greater than 260m, two pillars with 35m centres were stated to be partially located at depth of cover greater than 260m. This was qualified by stating that both pillars are adjacent to solid coal barriers.

Based on past experience (e.g. MSEC 2015), despite the low levels of subsidence predicted (<37mm), there remains some risk of adverse impacts such as cliff falls to Mugii Murum-ban State Conservation Area where subsidence is greater than 20mm.

Recommendation

- 5.1 Provide much greater detail, including specific detailed diagrams, for mining areas of the CLZ where depth of cover is close to or exceeds 260m.

6. A subsidence monitoring program is required

Plan 7 of the extraction plan purports to illustrate subsidence monitoring for the area, but the only monitoring identified is over earlier workings or approved miniwalls. Without an identified subsidence monitoring program for the CLZ there can be no assessment of, or agreement with, predictions or consent approval conditions.

Recommendation

- 6.1 Identify and implement a robust and demonstrably adequate subsidence monitoring program pre-approval, prior to mining being undertaken in cliff line zone areas.

References

Aerometrex (2021). *Major Cliff Identification Genowlan Mountain “Phase 2”*

Aerometrex (2022). *Major Cliff Identification Genowlan Mountain “Phase 4”*

MNC (2023a). *Site Inspection and Ground Truthing: Genowlan Creek Valley – Grotto to Oasis*

MNC (2023b). *Site Inspection and Ground Truthing: Central Genowlan – Genowlan Point*

MSEC (2015). *Mine Subsidence Consulting Engineering Peer Review of Report on Subsidence Predictions and Impact Assessments for Airly Mine*

SCT (2023a). *Centennial Coal Pillar Geometry Assessment for Cliff Line Zone Extraction Plan* (AIRLY5535 15 May 2023)

SCT 2023b. *Cliff Line Zone Pillar Design Review For An Increased Extraction Height* AIRLY5702 16 November 2023

Appendix G: Letter from Centennial Airly providing response detailed response to recommendations from BCS and NPWS (dated 22/3/24)

22 March 2024

Sarah Carr
Director North West
Biodiversity, Conservation and Science

Dear Sarah,

Subject: Airly Mine – Cliff line zone of first workings extraction plan (ML1814) – Response to comments from BCS and NPWS

Centennial Airly Pty Limited (Centennial Airly) thanks the Biodiversity, Conservation and Science (BCS) and the NSW National Parks and Wildlife Service (NPWS) Groups of the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) for providing comments on the draft extraction plan for the Cliff Line Zone of First Workings (ML1814) your reference DOC24/52957 (received 2 February 2024).

Centennial Airly has carefully considered the recommendations and detailed comments received from BCS and NPWS. Our response to the recommendations are provided in **Attachment 1**.

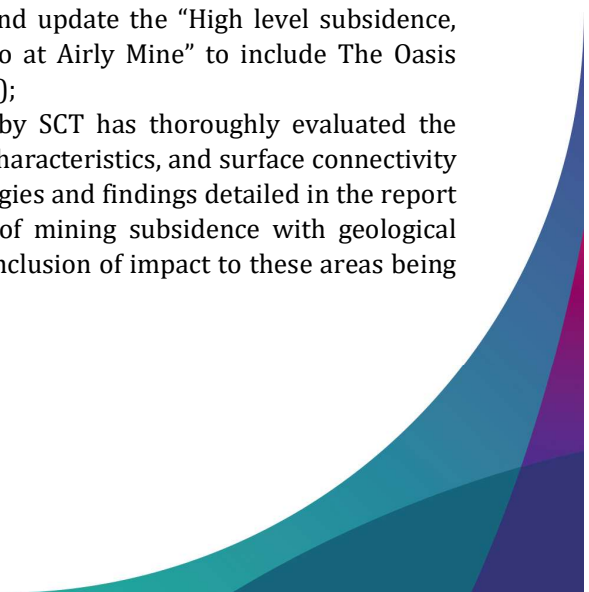
Our responses demonstrate that all recommendations have been considered and have now been adequately addressed.

In response to the recommendations, Centennial Airly has:

- Undertaken further consultation with the Airly Mine Independent Expert Panel (IEP) regarding the CLZ EP (ML 1814);
- Provided spatial data, including the mine design layout and depth of cover contours, to BCS / NPWS;
- Reviewed and revised the proposed layout of the 500 Panel main heading drivage in the vicinity of the groundwater monitoring wells (The Oasis area), by stepping to the east away from the groundwater monitoring wells we will maintain the water monitoring data from these installations. This data will be included in the information supplied to NPWS / BCS on a quarterly basis. Note, this revised proposed layout has been assessed by SCT and is confirmed to provide long-term stable pillars;
- Engaged SCT Operations Pty Ltd (SCT) to review and update the “High level subsidence, conductivity and connectivity review for The Grotto at Airly Mine” to include The Oasis (report no. AIRLY5650 – Rev 3, dated 21 March 2024);
 - The comprehensive assessment conducted by SCT has thoroughly evaluated the potential subsidence impacts, groundwater characteristics, and surface connectivity for The Grotto and The Oasis. The methodologies and findings detailed in the report demonstrate that the potential interaction of mining subsidence with geological structures has been fully assessed, with a conclusion of impact to these areas being unlikely.

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- Key findings of the report are discussed in the responses below. The findings have also been included in the revised extraction plan and the report included as an attachment to the extraction plan; and
- Revised the Cliff line zone of first workings extraction plan (ML1814) to address the responses and recommendations where necessary, including presenting key findings of the SCT report (AIRLY5650) and the revised proposed 500 Panel main heading layout.

Furthermore, Centennial Airly proposes to:

- Consider implementing a program for routine photo monitoring at The Grotto and The Oasis (in addition to the existing monitoring); and
- If required, facilitate a technical meeting with relevant stakeholders including Department of Planning, Housing and Infrastructure (DPHI), the IEP, BCS and NPWS to address any outstanding issues and concerns.

The final extraction plan is expected to be lodged with the DPHI in March 2024 for approval. Mining within the extraction plan area is planned to commence by June 2024.

If you have any further questions in regard to the above information, please contact me on 02 6359 2101 or email Graham.C.Healey@centennialcoal.com.au.

Yours sincerely,



22/03/2024

Graham Healey

Mining Engineering Manager

Attached

- Attachment 1: Centennial responses to BCS and NPWS detailed comments on the CLZ EP (ML 1814)

Attachment 1: BCS and NPWS detailed comments and recommendations on the CLZ EP (ML 1814) - with Centennial responses in blue text

1. The potential interaction of mining subsidence with geological structures has not been fully assessed.

NSW DCCEEW has undertaken an independent specialist review of the cliff line zone of first workings extraction plan (CLZ EP). We consider that the assessment of the potential for faults and lineaments to interact with mining induced subsidence has not been fully or appropriately considered.

Comments in the CLZ EP regarding the potential interaction of faults/lineaments with subsidence contradict earlier comments from the proponent in previous extraction plans. For example, the Mt Airly & Pt Hatteras Extraction Plans and MW17 & 18 Extraction Plans largely dismissed the relevance of lineaments in mining impacts and consequence.

Whilst not modelled in the CLZ EP, some proposed 'future miniwalls' appear to potentially interact with the proposed mining in the cliff protection zone. The CLZ EP states that SCT (2023) concluded there is a moderate potential risk of downward flow through the fracture network and lineaments resulting in a reduction in head level of creek alluvials.

The Grotto has a performance measure of "Negligible subsidence impacts or environmental consequences". If impacts like those identified for Gap Creek occur at The Grotto, there is likely to be a breach of the performance measure for The Grotto and therefore a breach of the SSD 5581 conditions of consent.

It is noted that there is no specific monitoring of groundwater, flow, or pool levels at The Grotto currently proposed. It is therefore not currently possible to demonstrate whether groundwater, flow and pool levels for The Grotto can meet the performance measure of "negligible subsidence impacts or environmental consequences".

For mining near The Grotto and The Oasis, in terms of lineaments the risk assessment WRAC analysis worksheet recommends a control, "Develop lineament zone proximity report to identify impact of mining within the lineament zone and connection to The Grotto and The Oasis".

Recommendations

1.1 Should the proposed mining under Genowlan Mountain within Mugii Murum-ban State Conservation Area be approved, the consent authority should include the following in the conditions of consent:

- No mining is permitted to occur within the lineament zone of The Grotto and The Oasis.
- The proponent must provide NPWS and BCS all raw subsidence, groundwater piezometer and stream level/flow data for Airly mine (in an excel file(s)) with quarterly (3 month basis) updates.
- Any surface impacts or exceedance of the maximum permitted subsidence (125mm) are reported immediately to NPWS and BCS.

In response to Recommendation 1.1, Centennial Airly:

1. Revised the proposed mine layout in the 500 Mains Panel to avoid Groundwater monitoring Wells (The Oasis area) to maintain continuity of water information– **Complete**
2. Inseam drilling in the 500 Mains Panel area has been undertaken with results indicating the location of a high confidence zone where significant faulting is likely to be present. The magnitude and nature of the fault are not known but are in a similar position to an interpreted surface lineament. In an adjacent inseam borehole approximately 100m to the south, seam undulations and possible small faulting were identified along a similar strike. The revised proposed mine layout to avoid intersecting exiting Groundwater monitoring Wells in the 500 Mains Panel will also avoid mining under the Oasis or through the area identified as significantly faulted – **Complete**
3. Engaged SCT to complete the “High level subsidence, conductivity and connectivity review for The Grotto and The Oasis at Airly Mine” (report no. AIRLY5650 – Rev 3, dated 21 March 2024) – **Complete**
4. Revised the Cliff line zone of first workings extraction plan (ML1814) to include the findings of the SCT report (AIRLY5650) (refer Section 2.2.2 and Attachment I in the revised extraction plan), and updated the proposed mine layout in the vicinity of The Oasis (refer Section 3.1.1 in the revised extraction plan) – **Complete**
5. Will continue to provide the relevant data at a frequency and in a format agreed with NPWS in accordance with Condition 2 of the MW17-18 Extraction Plan Approval – **Existing (ongoing)**
6. Will implement the CLZ (ML1814) EP Master TARP, including notification to NPWS and key stakeholders, in the unlikely event that surface impacts or exceedance of the maximum permitted subsidence (125mm) are observed – **Existing (ongoing)**
7. The revised extraction plan will be submitted to DPHI for assessment – **Planned by 22 March 2024**

Interpretation of faults and lineaments is an ongoing process and the Airly Mine geological model is under constant development as mining progresses and new information and data becomes available. The intersection of faults underground has caused minimal adverse effects to date. The faults expressed at Airly aren't comparable to other sites within the western region, typically we have little issue with the intersections due to the low horizontal stresses encountered within the mesa. During mining of The Gap the area between Mount Airly and Genowlan we encountered a reverse fault, the effects underground were still manageable, with negligible water ingress observed and minimal surface effects.

Following the completion of the inseam drilling program a revised mining layout has been developed in the vicinity of the Oasis which will avoid areas where significant faulting is inferred and will also avoid damage to the groundwater monitoring wells in the vicinity of the 500 Mains Panel and The Oasis, which are well located to detect impact and have a long baseline data record. There will be a slight increase in the amount of workings in the EP Area.

SCT prepared a review of the potential interaction of mining subsidence with geological structures near The Grotto and The Oasis. The review conducted by SCT provides a thorough assessment and comprehensive evaluation of potential impacts. The report details the considerations and methodologies used to assess the potential subsidence impacts, groundwater characteristics, and surface connectivity for both The Grotto and The Oasis, which incorporated understanding from industry standards, experience at other mines, and experience from Airly Mine in adjacent mining in the vicinity of Gap Creek and miniwall mining to the east and north of The Grotto and inclusion of the most up to date geological information and proposed mine design revisions.

The following provides a summary of the key findings of the report:

1. Negligible Subsidence Predictions: The estimated subsidence magnitudes for the planned mining layout and proposed workings have been designed to produce negligible subsidence effects around The Grotto and The Oasis (and the adjacent cliff line zone). The report included assessment of the first workings associated with this Extraction Plan as well as other adjacent proposed workings in other mining zones. Negligible subsidence effects are predicted at The Grotto and The Oasis (and on the adjacent CLZ) based on the estimated subsidence magnitudes of all proposed workings.
2. Low Impact of Horizontal Movements: Horizontal movements due to mining extraction are predicted and have been measured to be small at The Grotto and predicted to be negligible at The Oasis. The subcritical mining geometry and low horizontal stress environment at Airly Mine are expected to result in negligible horizontal movements, further minimising potential impacts on these areas.
3. Consideration of Geological Structures: The review addressed the potential for increased connectivity from faulting but concluded that the probability of reactivation of faults and lineaments traversing the area and adjacent workings is considered low due to the low stress environment and low stress redistribution from first workings.
4. Groundwater and Connectivity Assessment: The assessment found that downward flow can be facilitated by lineaments that may be present between the defined caving zones, although the geometry of the first workings at The Grotto and The Oasis, depth of cover, and the distance from secondary extraction (miniwalls) would make this unlikely. Notably, underground workings at Airly Mine are typically observed to be dry even in areas previously mined where underground workings have intersected faults associated with lineament zones.

The assessment concluded that the perched aquifer in the alluvium of The Grotto or The Oasis is not expected to be impacted by adjacent mining.

Condition 2 of the MW17-18 Extraction Plan Approval requires Centennial Airly to provide environmental monitoring data relevant to the Mugii Murum-ban State Conservation Area to the NSW National Parks and Wildlife Service (NPWS), at a frequency and in a format agreed with NPWS.

Centennial Airly will continue to provide the relevant data at a frequency and in a format agreed with NPWS.

As this is an existing requirement no further action is required.

The CLZ (ML1814) EP Master TARP requires notification to NPWS and key stakeholders if surface impacts are observed.

The maximum subsidence for the EP Area was assessed in the *"Pillar Geometry Assessment for Cliff Line Zone Extraction Plan"* and the addendum *"Cliff Line Zone Pillar Design Review for an Increased Extraction Height"* (SCT, 2023a; 2023b) and is predicted to be <37mm. Exceedance of the maximum permitted subsidence (125mm) is not expected, however it is noted that exceedance of this threshold would require notification under other existing Trigger Action Response Plans (e.g. MW13-16, MW17-18).

As this is an existing requirement no further action is required.

- 1.2 Increase monitoring of flow and pool levels for The Grotto and The Oasis, unless conditions of consent specify no mining takes place within the lineament zone of The Grotto and The Oasis.

In response to Recommendation 1.2, Centennial Airly:

8. Will consider implementing additional regular photo monitoring of The Grotto and The Oasis areas – **to be determined in consultation with NPWS**

The proposed mine layout within the EP Area, as illustrated on Plan 1 - Existing and Future Workings of the extraction plan, show The Grotto and The Oasis areas will not be directly undermined.

SCT prepared a review of the potential interaction of mining subsidence with geological structures near The Grotto and The Oasis and concluded that the perched aquifer in the alluvium of The Grotto or The Oasis is not expected to be impacted by adjacent mining.

Monitoring locations and monitoring equipment directly within The Grotto has been avoided, as consultation with stakeholders at the time of developing baseline monitoring for the project determined that direct monitoring would detract from aesthetics of the area. The existing monitoring in the vicinity of The Grotto and The Oasis is considered adequate and consists of:

- Monitoring for the presence/absence of mine-induced damage or change to features (no significant rock falls or surface cracking) via routine remote aerial survey and visual inspection which may be opportunistic or targeted (if triggered).
- Watercourse quality and flow volumes
- Groundwater (levels and quality), including a revision to the mine design which will provide for continued monitoring of alluvial bores post mining
- Aquatic ecology
- Fauna monitoring
- Flora composition, vegetation structure and ecological function (as defined by the Biodiversity Assessment Method)
- Rapid aquatic assessment (modified from the AUSRIVAS methodology)

2. **Subjective terminology should be replaced with unambiguous definitions or quantitative risk assessment value**

It is noted that many statements in the Extraction Plan (EP) are based on subjective statements and ambiguously defined terms. For example, it is stated that:

*“The predicted levels of subsidence from first workings proposed in this CLZ (ML1814) Extraction Plan are similar to those provided in the 2014 EIS. The assessed levels of potential impact are similar to those based on the EIS Layout. The performance measures for subsidence for the Airly Mine are outlined in Condition 2 in Schedule 3 of SSD_5581. **At these predicted low subsidence levels, it is unlikely that performance measures of SSD_5581 will be exceeded by the proposed first workings**”.*

It is noted in this specific context it unclear what “unlikely” means in practice. It is preferable that the risk of impact to cliffs and rock formations that are considered highly significant be remote or non-existent, not simply unlikely. The use of subjective terms used such as “unlikely” should be replaced with either an unambiguous definition or a quantitative risk assessment value (e.g. 1 in 1,000, 1 in 1,000,000, or smaller).

Recommendation

- 2.1 Replace subjective terms used such as “unlikely” with well-defined terms, and provide either an unambiguous definition or a quantitative risk assessment value (e.g. 1 in 1,000, 1 in 1,000,000, or smaller).

The process for risk ranking across Centennial operations is as per the Centennial Risk Matrix. Centennials risk ranking follows AS/NZS 31000:2018.

Centennial's use of wording "unlikely" complies to the following standards for risk management.

- [AS/NZS ISO 31000:2018, Risk management - Guidelines](#)
- [AS/NZS IEC 31010:2020 Risk management – Risk assessment techniques](#)
- [MDG 1010 Risk Management Handbook for the Mining Industry](#)
- [MDG1014 Guide to reviewing a Risk Assessment of Mine Equipment and Operations](#)

3. Potential impacts of increased extraction height have not been adequately assessed

The original roadway geometry in the CLZ at Airly was modelled using 5m roadways with 20m pillars and 2.8m extraction height. Both the roadway width (now up to 10m wide) and extraction heights (now 3.2m) have increased in the current CLZ EP. It is unclear whether the current modelling has allowed for both of these increases (i.e. 10m roadway width and 3.2m extraction height).

By increasing the height of the roadways from 2.8m to 3.2m, 35m pillar centres now appear unable to "cope" (i.e. be long-term stable) where depths of cover of greater than 260m occur. There is very limited discussion of pillar stability as depth of cover approaches this 260m threshold. The presentation of depth of cover contours in the CLZ EP are insufficient to be able to tell where such areas are or could be. GIS layers for depth of cover have been requested from the proponent and would be required for verification.

Recommendation

3.1 Any approval of an increase in extraction height to 3.2m should be conditional on:

- All ribs being effectively supported with bolts and mesh.
- Further details/assessments being provided where depths of cover may be approaching 260m over proposed workings, with an increased monitoring program for pillar stability in these areas.

In response to Recommendation 3.1, Centennial Airly:

9. Provided spatial data, including the mine design layout and depth of cover contours, to BCS / NPWS – **Complete**

Systematic rib support is installed as required in accordance with existing Centennial Airly Standard Operating Procedures and Strata TARPs.

The subsidence assessment by SCT (2023a; 2023b) has assessed the detailed mine plan, including areas where depths of cover may be approaching 260m over proposed workings and confirmed that all proposed pillars will remain long-term stable.

The proposed subsidence monitoring for the area, as described in the *Subsidence Monitoring Program for CLZ (ML1814)*, is an integrated subsidence monitoring program that includes a monitoring program for underground mining control that includes routine survey of workings and inspections by mining officials to ensure mining is strictly implemented as designed (primary control utilised at Airly Mine for subsidence impact avoidance).

It is considered that the current rib support procedures, subsidence assessment (SCT, 2023a; 2023b) and monitoring program (CLZ (ML1814) SMP) are adequate, therefore no further action is required.

4. Quantitative measurement of cliffs and pagodas is required

Aerometrix (2021 and 2022) were engaged by the proponent to identify the cliffs and other sensitive surface features within ML1814 that satisfied the rock feature definitions in the development consent. Michael Nicholson Consulting Pty Ltd (MNC) was then engaged to undertake ground truthing of the cliffs that were identified as being located within the CLZ.

The objectives of the ground truthing reports (MNC, 2023a, 2023b) were to primarily provide ground truthing verification of the cliff mapping and cliff identification completed in desktop studies by Aerometrix. A site inspection was also undertaken to inspect for any cliffs or other features not previously identified/mapped, as well as inspecting the area to check there were no rock features (i.e. pinch points, overhangs, etc.) that would be particularly sensitive to subsidence ground movements.

The key findings of the report are:

- Good positional correlation was noted with cliff segments digitised by MNC and those identified by the Aerometrix process – the site inspection supports using the cliff mapping provided by Aerometrix for developing setbacks to future secondary extraction.
- There were no particularly vulnerable features identified in the extraction plan area that would need to be avoided through mine design.

It is noted that the MNC 2023a, 2023b reports have not been provided with the extraction plan. The phrase “good positional correlation” is also not explained in the CLZ EP. As such it is unclear whether there is a statistical number attributable to this correlation (e.g., $r=0.9$) or if it is an unquantified subjective opinion.

This raises the question of how well the position, length and height of cliffs and pagodas have been mapped by Aerometrix and MNC. The proponent has not provided any estimate of the total areas of “such cliffs” and “such pagodas” in order to meet the performance measures for cliffs and pagodas. To test whether impacts to cliffs and pagodas in total do not reach “2% of the total area of such cliffs” or “2% of the total area of such pagodas” requires accurate mapping of these areas. The area of “such cliffs” and “such pagodas” are not stated or quantified anywhere in the extraction plan. Due to this, it is difficult to measure and enforce the performance measures for cliffs and pagodas.

The Aerometrix mapping of cliffs, minor cliffs and pagodas can be seriously affected by:

- Angle of flightpath relative to the feature
- Inability of Lidar to penetrate tree cover (there is the potential for additional effects due to shadow and how the Aerometrix algorithm deals with such issues).
- Obvious cliffs are missed
- No validation has been applied to the methodology to define cliffs, minor cliffs and pagodas, or their height and extent.

We remain concerned that cliffs may not be fully mapped using these techniques, and an arbitrary cut-off point is specified for what is a cliff and what is a pagoda. The effect this has on mapping of the height and extent of cliffs needs far better definition and further validation.

Recommendation

- 4.1 Provide a quantitative measure of the total area of defined cliffs and pagodas in the extraction area. Undertake regular monitoring to ensure that any impacts do not exceed 2% of the defined total areas of cliffs and pagodas in the extraction area (as per the performance level for the approval for SSD 5581). Individually number each cliff and pagoda in the Mt Genowlan mine area

and state the length and height (and therefore calculated area) of the individual cliffs and pagodas.

As discussed in Section 2.2.2 of the Extraction Plan Main Report, cliff mapping and identification has been completed by Aerometrex and Michael Nicholson Consulting Pty Ltd (MNC).

As part of monitoring programs for existing extraction plans LiDAR surveys are undertaken at approximately six-month intervals. These surveys include areas not yet mined, building a baseline dataset which can be used for future comparisons. At least three baseline surveys of the EP Area have been undertaken to date, ongoing surveys will be increasing the baseline data set through to commencement of mining.

It is considered unnecessary to quantitatively define the cliff area unless impacts occur. There are no predicted impacts to the cliffs and pagodas in the extraction plan area.

The CLZ (ML1814) EP Master TARP outlines appropriate actions/responses to be undertaken should any of the monitoring indicate there is potential for surface impacts to occur.

As there are no predicted impacts to the cliffs and pagodas in the extraction area, the existing actions/responses outlined within Extraction Plan (including in the CLZ (ML1814) EP Master TARP) are considered adequate, therefore no further action is required.

5. Pillar stability where depth of cover is close to or greater than 260m requires review

According to SCT (2023b):

“The design review found that a 3.2m roadway height for 35m pillar centres at a depth of cover greater than 260m would have a FOS <2.11 (and not be considered long-term stable)”.

By increasing the height of the roadways from 2.8m to 3.2m, the 35m pillar centres now appear unable to “cope” (i.e., be long-term stable) with depths of cover greater than 260m. There is very limited discussion for pillar stability as depth of cover approaches this 260m threshold. The presentation of depth of cover contours in the extraction plan are insufficient to be able to tell exactly where such areas are or could be. The spatial data layer for depth of cover has been requested from the proponent to enable verification.

While SCT stated that the proposed mine plan does not contain any full 35m square pillars under the cliff line zone at a depth greater than 260m, two pillars with 35m centres were stated to be partially located at depth of cover greater than 260m. This was qualified by stating that both pillars are adjacent to solid coal barriers.

Based on past experience (e.g. MSEC 2015), despite the low levels of subsidence predicted (<37mm), there remains some risk of adverse impacts such as cliff falls to Mugii Murum-ban State Conservation Area where subsidence is greater than 20mm.

Recommendation

5.1 Provide much greater detail, including specific detailed diagrams, for mining areas of the CLZ where depth of cover is close to or exceeds 260m.

The subsidence assessment by SCT (2023a; 2023b) has assessed the detailed mine plan, including areas where depths of cover may be approaching 260m over proposed workings and confirmed that all proposed pillars will remain long-term stable.

It is considered that the current rib support procedures, subsidence assessment (SCT, 2023a; 2023b) and monitoring program (CLZ (ML1814) SMP) are adequate, therefore no further action is required.

6. A subsidence monitoring program is required

Plan 7 of the extraction plan purports to illustrate subsidence monitoring for the area, but the only monitoring identified is over earlier workings or approved miniwalls. Without an identified subsidence monitoring program for the CLZ there can be no assessment of, or agreement with, predictions or consent approval conditions.

Recommendation

6.1 Identify and implement a robust and demonstrably adequate subsidence monitoring program pre-approval, prior to mining being undertaken in cliff line zone areas.

It is noted that Plan 7 can only illustrate the Global Navigation Satellite System (GNSS) Monitoring Stations, however the proposed subsidence monitoring for the area, as described in the *Subsidence Monitoring Program for CLZ (ML1814)*, is an integrated subsidence monitoring program that includes;

- **Subsidence effects monitoring** that includes monitoring programs for:
 - **Underground Mining Control** routine survey of workings and inspections by mining officials to ensure mining is strictly implemented as designed (primary control utilised at Airly Mine for subsidence impact avoidance);
 - **Monitoring ground movement** and surface subsidence impacts via Global Navigation Satellite System (GNSS) Monitoring Stations / Continually Operating Reference Station (CORS) – Long occupation real time point data base stations;
 - **Remote monitoring of the Surface Environment** via LiDAR for monitoring of vertical subsidence over the EP Area relative to baseline and Performance Measures;
 - **Trigger-based Targeted Surface Inspections** where required (where safely and readily accessible, such as where 4WD trails traverse or are close to the EP Area, and where otherwise triggered by the CLZ (ML1814) TARP);
 - **Data analysis and reporting** will monitor specifically for change and target:
 - Any areas detected for significant change by remote monitoring results (including pre and post mining areas), triggering further detailed analysis under the CLZ (ML1814) TARP, including a process for determining natural or mining-induced rock fall.
 - The process for this detection is detailed further in the CLZ (ML1814) SMP and CLZ (ML1814) TARP respectively. Data for natural rock falls in areas yet to be mined will also provide additional data to the baseline data set; and
- **Natural and Built Features monitoring** that includes monitoring programs for:
 - Surface Water
 - Groundwater
 - Aquatic Ecology & Stream Health
 - Cliffs, Minor Cliffs and Pagodas
 - General Land Surface – Mugii Murum-ban State Conservation Area
 - SCA Management Four-wheel Drive and Walking Trails

- Biodiversity
- Aboriginal Heritage Site (AHIMS 45-1-0167)

The current integrated subsidence monitoring program is considered adequate and commensurate with subsidence levels / effects expected from this type of mining; therefore no further action is required.

Appendix H: Letter from NSW RR providing response to draft CLZ EP (ML1814) (dated 20/12/23)

Wednesday, 20 December 2023

Ms Jacqueline Cooke

Via: Major Projects Portal

Dear Jacqueline,

I refer to your request of 4 December 2023 for advice regarding Airly Colliery - Extraction Plan (draft) (SSD-5581). The Resources Regulator has reviewed the request.

Based on the review of the document, the Resources Regulator advises that it has no specific comments regarding mine safety or mine rehabilitation matters in relation to the proposals.

LIMITATIONS

The Extraction Plan is assessed and determined by Department of Planning and Environment (DPE) under the conditions of the development consent. The Resources Regulator provides advice to DPE to assist in the determination.

REGULATORY REQUIREMENTS IF APPROVED

The authorisation holder is required to ensure that the rehabilitation commitments outlined in any approved Extraction Plan are regulated by the Resources Regulator under the conditions of the mining lease and the *Mining Act 1992*.

The Resources Regulator may undertake assessments of the mine operators' proposed mining activities under the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and Regulation as well as other WHS regulatory obligations.

Subsidence associated with the proposed Extraction Plan will be regulated by under relevant provisions of WHS laws in particular Clause 35 and Clause 70 of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014* relating to High-Risk Activities and Subsidence.

BACKGROUND

The NSW Resources Regulator is responsible for compliance and enforcement of the Extraction Plan is so far as it relates to requirements under the *Mining Act 1992* and Work Health and Safety legislation. This role principally relates to rehabilitation, workplace safety and public safety.

The Mining Act Inspectorate within the Resources Regulator undertake risk-based compliance and enforcement activities in relation to obligations under the *Mining Act 1992*. This includes undertaking assessment and compliance activities in relation to mine rehabilitation activities and determination of security deposits.

The Mine Safety Inspectorate within the Resources Regulator is responsible for ensuring the mine operators' compliance with the Work Health and Safety (WHS) legislation, in particular the effective management of risks associated with the principal hazards as specified in the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2022*.

CONTACT

Should you require any further information or clarification, please contact the Regulator on 1300 814 609 (Press Option 2 Press Option 5) or email nswresourcesregulator@service-now.com.

Yours sincerely,



Anthony Margetts

Chief Inspector of Mines
Resources Regulator

Appendix I: Presentation by Centennial Airly providing Extraction Plan Project Update (following receipt of responses and recommendations from external consultation) (dated 12/02/24)

Note, only slides within this presentation relating to the CLZ (ML1814) Extraction Plan have been provided in this attachment.

CEY- DPE

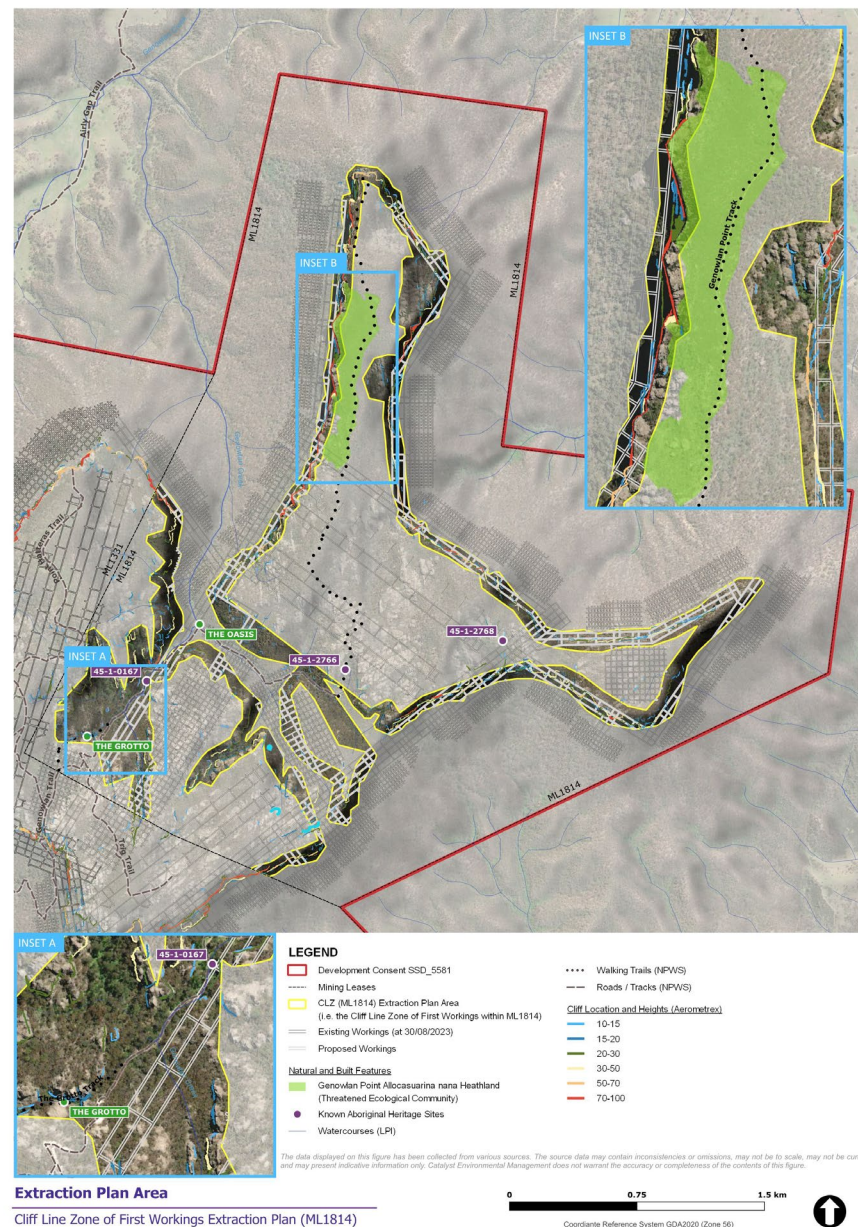
IEP Quarterly Engagement
12th February 2024

Cliffline Zone (CLZ) EP

Update on EP progress and timing
CLZ EP Consultation Feedback - General
CLZ EP Consultation Feedback - ACHMP
CLZ EP Summary of Document Status

Update on EP Progress and Timing

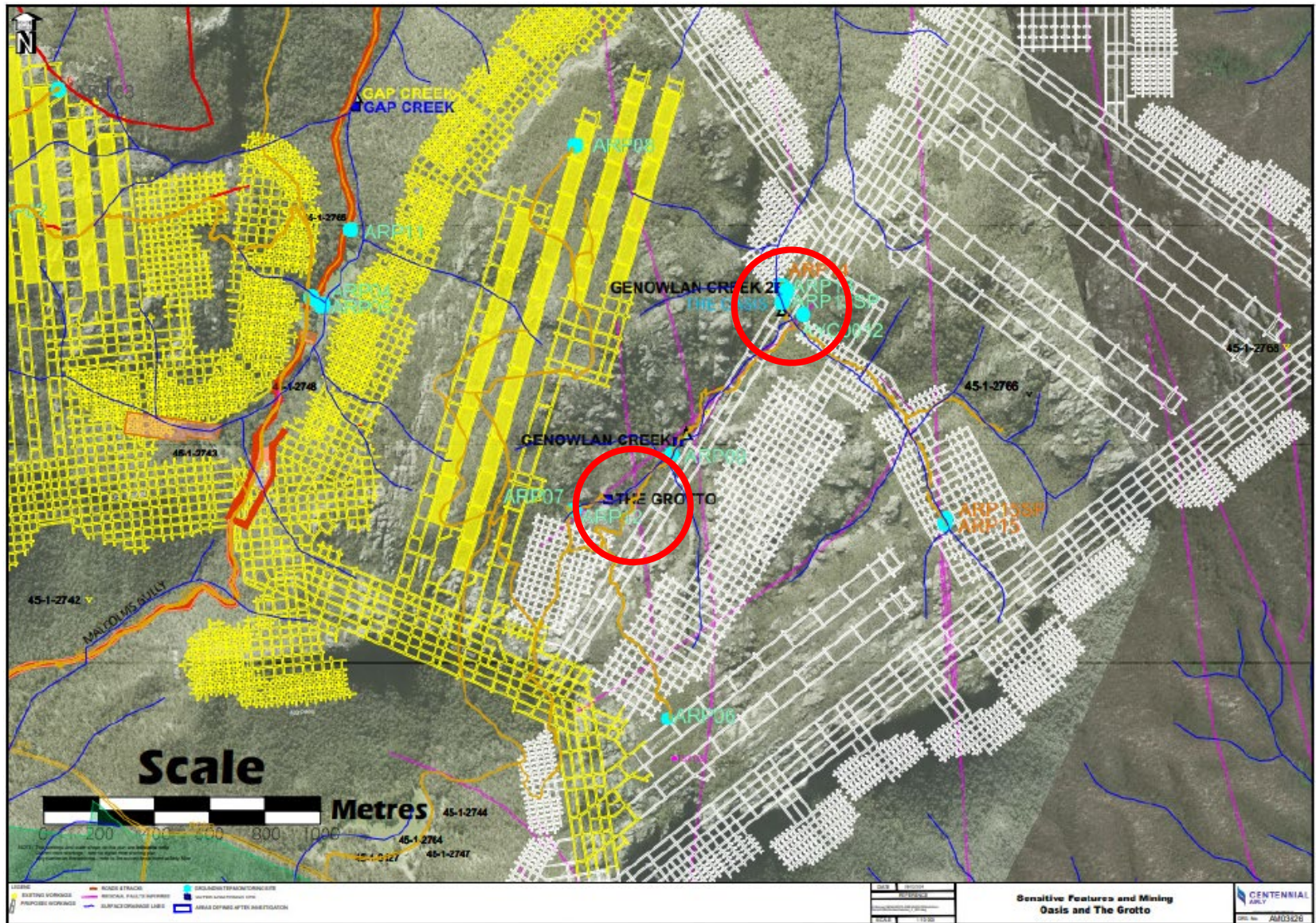
- Draft Extraction Plan complete and provided for external consultation in December 2023
- Comments / feedback received from:
 - Resources Regulator (21 December 2023)
 - Heritage NSW (10 January 2024)
 - DCCEE Water Group (11 January 2024)
 - BCS and NPWS (2 February 2024)
- Summary of feedback provided on following slides
- Revision of the CLZ (ML1814) EP to be prepared and submitted by mid-March
- Approval required by June 2024 to allow commencement of the 500 panel



CLZ EP Consultation Feedback - General

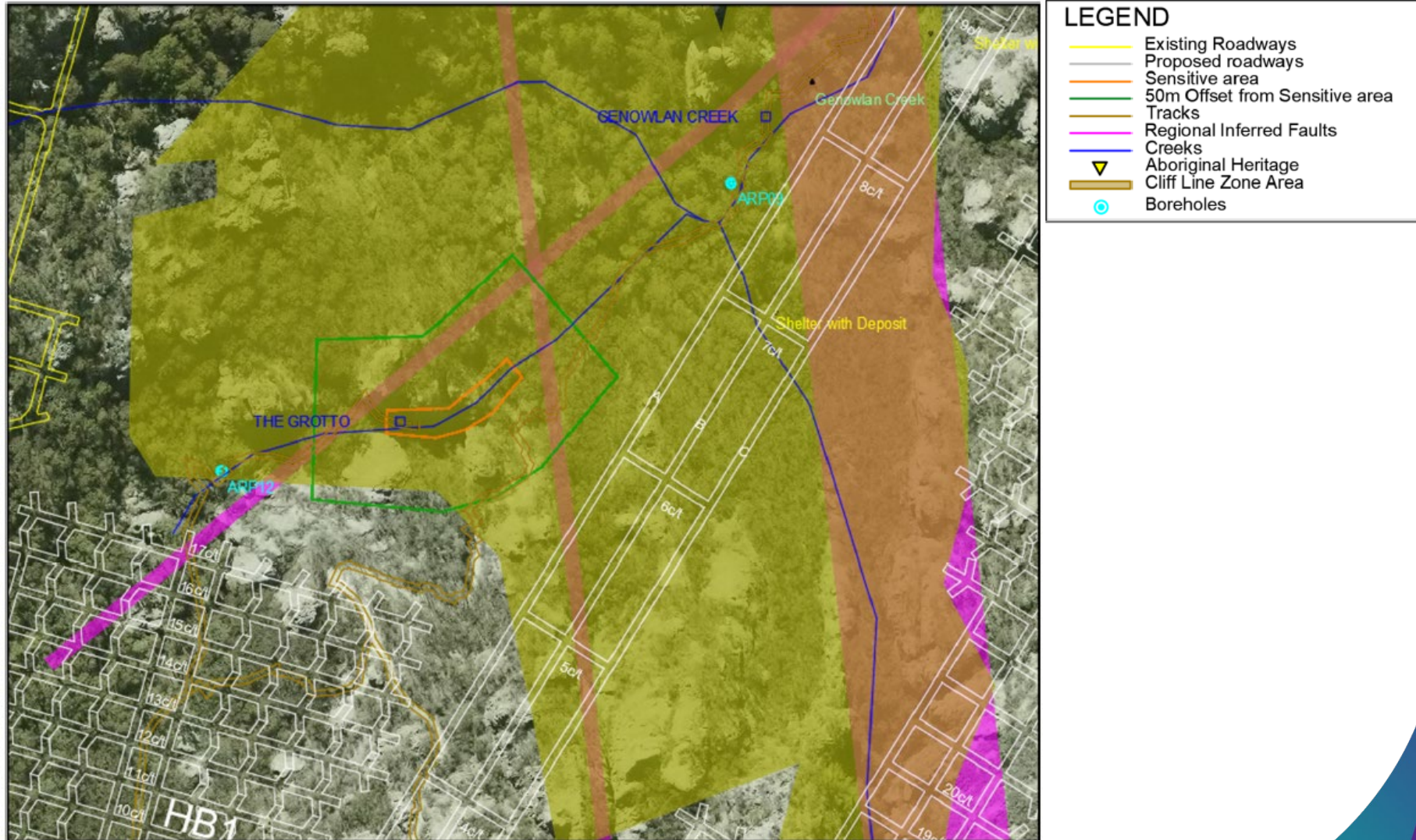
Recommendation/s	Centennial Response
BCS/NPWS Recommendation 1.1 - Should the proposed mining under Genowlan Mountain within Mugii Murum-ban State Conservation Area be approved, the consent authority should include the following in the conditions of consent: • No mining is permitted to occur within the lineament zone of The Grotto and The Oasis. • The proponent must provide NPWS and BCS all raw subsidence, groundwater piezometer and stream level/flow data for Airly mine (in an excel file(s)) with quarterly (3 month basis) updates. • Any surface impacts or exceedance of the maximum permitted subsidence (125mm) are reported immediately to NPWS and BCS.	The lineament zone within The Grotto and The Oasis areas will not be directly undermined (to be confirmed on later slides). Condition 2 of the MW17-18 Extraction Plan Approval requires Centennial Airly to provide environmental monitoring data relevant to the Mugii Murum-ban State Conservation Area to the NSW National Parks and Wildlife Service (NPWS), at a frequency and in a format agreed with NPWS. The CLZ (ML1814) EP Master TARP requires notification to NPWS and key stakeholders if surface impacts are observed. The maximum predicted subsidence is XXmm, however exceedance of the maximum permitted subsidence (125mm) would be notified under other existing Trigger Action Response Plans (e.g. MW13-16, MW17-18).
BCS/NPWS Recommendation 1.2 - Increase monitoring of flow and pool levels for The Grotto and The Oasis, unless conditions of consent specify no mining takes place within the lineament zone of The Grotto and The Oasis.	The lineament zone within The Grotto and The Oasis areas will not be directly undermined (to be confirmed on later slides), existing monitoring is adequate (Genowlan Creek is proxy for The Grotto – monitoring directly within would detract from aesthetics of the area) and increased monitoring is not required.
BCS/NPWS Recommendation 2.1 - Replace subjective terms used such as “unlikely” with well-defined terms, and provide either an unambiguous definition or a quantitative risk assessment value (e.g. 1 in 1,000, 1 in 1,000,000, or smaller).	The term unlikely is used in the way it is defined in the Centennial Risk Matrix to reflect the likelihood of a scenario occurring and is understood to reflect a likelihood which is “remote”, “not likely”, “unlikely to occur”, “very few recorded or known incidents”.

Overview of Area - Grotto and Oasis



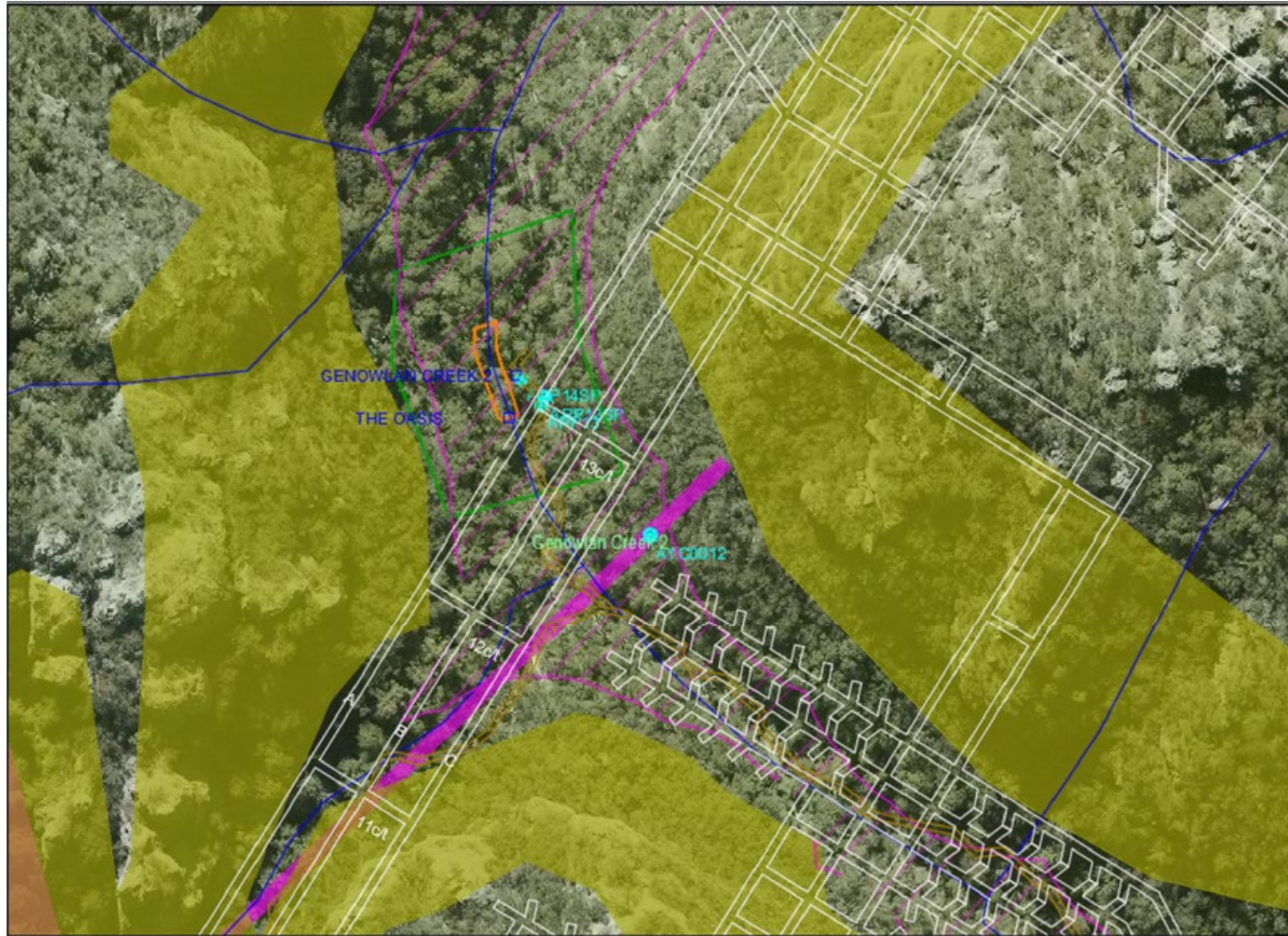
Location defined by ground truth

The Grotto



Location defined by ground truth

The Oasis

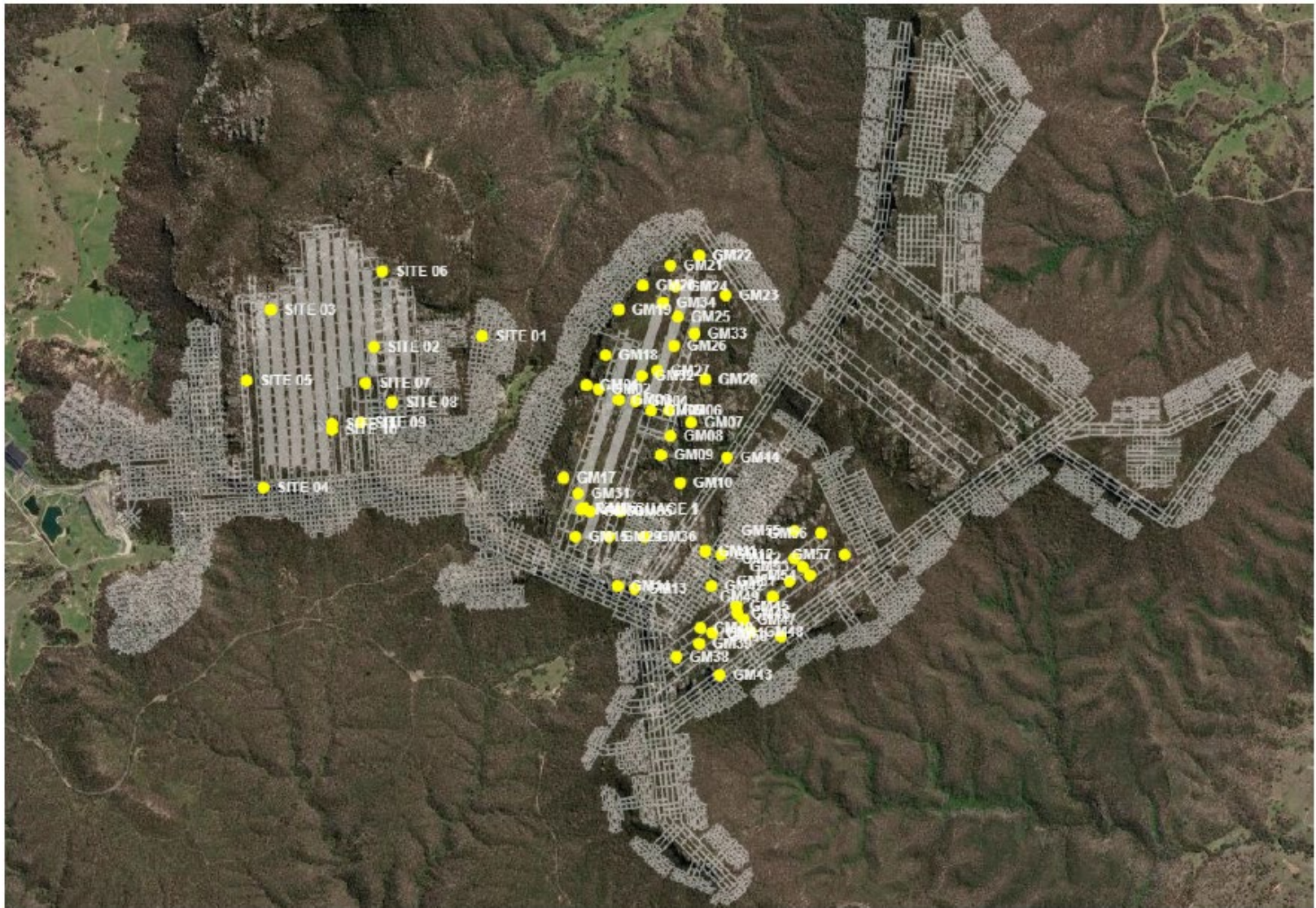


LEGEND	
	Existing Roadways
	Proposed roadways
	Sensitive area
	50m Offset from Sensitive area
	Tracks
	Regional Inferred Faults
	Creeks
	Shallow Mining Zone
	Cliff Line Zone Area
	Boreholes

CLZ EP Consultation Feedback - General

Recommendation/s	Centennial Response
BCS/NPWS Recommendation 3.1 - Any approval of an increase in extraction height to 3.2m should be conditional on: • All ribs being effectively supported with bolts and mesh. • Further details / assessments being provided where depths of cover may be approaching 260m over proposed workings, with an increased monitoring program for pillar stability in these areas.	The detailed mine plan was assessed by SCT (2023) and confirmed that the pillars will remain long-term stable. Systematic rib support is installed as required in accordance with existing strata TARPs. Additional plans to be prepared showing areas where depths of cover may be approaching 260m over proposed workings.
BCS/NPWS Recommendation 4.1 - Provide a quantitative measure of the total area of defined cliffs and pagodas in the extraction area. Undertake regular monitoring to ensure that any impacts do not exceed 2% of the defined total areas of cliffs and pagodas in the extraction area (as per the performance level for the approval for SSD 5581). Individually number each cliff and pagoda in the Mt Genowlan mine area and state the length and height (and therefore calculated area) of the individual cliffs and pagodas.	There are no predicted impacts to the cliffs and pagodas in the extraction area. It is unnecessary to quantitatively define the cliff area unless impacts occur. The CLZ (ML1814) EP Master TARP outlines appropriate actions/responses to be undertaken should any of the monitoring indicate there is potential for surface impacts to occur.
BCS/NPWS Recommendation 5.1 - Provide much greater detail, including specific detailed diagrams, for mining areas of the CLZ where depth of cover is close to or exceeds 260m.	The detailed mine plan was assessed by SCT (2023) and confirmed that the pillars will remain long-term stable. Spatial data, including the mine design layout and depth of cover contours, will be provided to BCS / NPWS.
BCS/NPWS Recommendation 6.1 - Identify and implement a robust and demonstrably adequate subsidence monitoring program pre-approval, prior to mining being undertaken in cliff line zone areas.	The current monitoring program considered adequate and commensurate with subsidence levels / effects expected from this type of mining.

GNSS Monitoring unit locations



CLZ EP Consultation Feedback - ACHMP

Recommendation/s	Centennial Response
Heritage NSW Recommendation 1 - Please demonstrate that the ACHMP was provided to the Registered Aboriginal Parties for review and comment, provide copies of any comments received and document responses addressing comments provided (where relevant).	Minor revision (Rev1) to be prepared to include comments from Registered Aboriginal Parties (RAPs) and address comments from Heritage NSW.
Heritage NSW Recommendation 2 - Ongoing consultation with Registered Aboriginal Parties is required as a part of review and updates to the ACHMP. Include a detailed procedure for ongoing consultation with the Registered Aboriginal Parties in the ACHMP.	
Heritage NSW Recommendation 3 - Include and detail the requirement for Registered Aboriginal Parties involvement in baseline recording and monitoring of AHIMS sites (Section 5.2 of the ACHMP) in accordance with Section 6.5 of Western Region - Aboriginal Cultural Heritage Management Plan (Centennial Coal and RPS, 2021). Please also provide a mechanism for reporting the results of monitoring to the Registered Aboriginal Parties.	
Heritage NSW Recommendation 4 - The ACHMP does not include a procedure for the management of unexpected Aboriginal objects. Heritage NSW recommends the inclusion the unexpected finds methodology from Western Region - Aboriginal Cultural Heritage Management Plan (Section 6.7).	
Heritage NSW Recommendation 5 - In the event of subsidence impacts to AHIMS site 45-1-0167, the development of rehabilitation and remediation measures for Aboriginal cultural heritage sites must be undertaken in consultation with the Registered Aboriginal Parties and Heritage NSW. Please include a requirement to notify and consult with Registered Aboriginal Parties and Heritage NSW in the event of subsidence impacts to any AHIMS sites.	

CLZ EP Summary of Document Status

Management Plan	Department	Comment
Extraction Plan Main Report	DPE / IEP, Resources Regulator, BCD, NPWS	<i>Minor revision (Rev1) to be prepared to address comments from BCS / NPWS.</i>
Airly Mine Water Management Plan	BCD, NPWS, DPE (Water)	Consultation for, and approval of, the Airly Mine WMP is being undertaken concurrently but separately to the Extraction Plan. DCCEE Water Group raised no further comments or recommendations in relation to the CLZ EP. <i>Submitted as final.</i>
Land Management Plan for CLZ (ML1814) EP	DPE / IEP, Resources Regulator, BCD, NPWS	No comments / issues raised. <i>Minor revision (Rev1) to be prepared to align with any edits in the Extraction Plan Main Report.</i>
Biodiversity Management Plan for CLZ (ML1814) EP	DoEE, BCD, NPWS	No comments / issues raised. <i>Minor revision (Rev1) to be prepared to align with any edits in the Extraction Plan Main Report.</i>
Aboriginal Cultural Heritage Management Plan for CLZ (ML1814) EP	Heritage Division, relevant Aboriginal stakeholders	<i>Minor revision (Rev1) to be prepared to include comments from Registered Aboriginal Parties (RAPs) and address comments from Heritage NSW.</i>
Public Safety Management Plan for CLZ (ML1814) EP	DPE / IEP, Resources Regulator, BCD, NPWS	No comments / issues raised. <i>Minor revision (Rev1) to be prepared to align with any edits in the Extraction Plan Main Report.</i>
Subsidence Monitoring Program for CLZ (ML1814) EP	DPE / IEP, Resources Regulator, BCD, NPWS	BCS / NPWS recommended that Centennial identify and implement a robust and demonstrably adequate subsidence monitoring program pre-approval. Current monitoring program considered adequate and commensurate with subsidence levels / effects expected from this type of mining. <i>Minor revision (Rev1) to be prepared to align with any edits in the Extraction Plan Main Report.</i>

Appendix J: Letter from Wellington Valley Wiradjuri Aboriginal Corporation providing response to draft (Rev 1) ACHMP CLZ EP (ML1814) (dated 9/3/24)



WELLINGTON VALLEY WIRADJURI
ABORIGINAL CORPORATION

P.O. Box 1583
Orange NSW 2800
ABN: 77 548 143 187
ICN: 7398

WVWAC@hotmail.com

09 March 2024

Sam Price
Environment and Community Superintendent
Centennial Coal - Airly Mine

Re: Proposed Aboriginal Cultural Heritage Management Plan: Cliff Line Zone of First Workings Extraction Plan (ML1814)

Dear Sam,

Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) would like to thank you for your invitation to provide a response for This Aboriginal Cultural Heritage issue relevant to obligations to protect our Heritage within our Traditional Lands. Wellington Valley Wiradjuri represent traditional families with identified apical ancestry pre European occupation with our known Traditional Lands. We know our culture, country and continue with our association with our traditional lands (Ngurangbang).

Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) have through consultation with other Traditional Elders and Traditional Community with cultural knowledge have the following comments and or recommendations:

- WVWAC agree to the proposed Aboriginal Cultural Heritage Management Plan: Cliff Line Zone of First Workings Extraction Plan (ML1814).

WVWAC make further comment on the following section:

4.1.1 Aboriginal Heritage Site (AHIMS 45-1-0167)

- WVWAC refer to the proposed **Phase 1**: Baseline archival recording including a detailed plan of the site, archival-quality photographic records and a record of the surface conditions of the site (prior to site being undermined).
 - We request as part of this that the Shelter is 3D photographed/scanned – this can be as simple as the Archaeologist using an iPhone and the Polycam App or similar that uses a combination Hi-resolution images and 3D scanning.

- We feel that regardless of their being negligible impacts through to the unthinkable partial or complete subsidence to this site, the imagery can be used by all Aboriginal People to have connection and knowledge of this site without the physical need to attend this site. This also would add to our collective Anthropological knowledge base and enhance our understanding of how the local and regional sites were used over a prolonged time period. It also assists in the preserving the site and countering the expedited Intergenerational Loss of Cultural and Heritage Sites within the wider region due to various development be that from Renewables, Mining, Industrial Land use or other development,

WWAC look forward to further participating in the above project, sharing our knowledge of county and to ensure our Heritage is protected. We trust our response meets your requirements. Please contact WWAC Directors should you require our assistance to address any Aboriginal issues to support your future plans.

Regards,

A handwritten signature in dark ink, appearing to read 'BRB', with a stylized flourish extending from the end.

Bradley R. Bliss J.P.
WWAC CEO and Contact Officer
Senior Aboriginal Cultural Heritage Field Officer
Senior Aboriginal Cultural Mentor and Educator
Mobile: 0427321016

Appendix K: Letter from Warrabinga – Wiradjuri #7 Native title Claimants group providing response to draft (Rev 1) ACHMP CLZ EP (ML1814) (dated 12/3/24)

Warrabinga- Wiradjuri #7 Native Title Claimants
-c/o Warrabinga Native Title Claimants Aboriginal Corporation
66 Dangar Street
Kandos Nsw 2848
Admin@warrabinga.com.au

Sam Price

Environment and community Superintendent

Airly mine

Sam.price@centennialcoal.com.au

Hi Sam

Warrabinga – Wiradjuri #7 Native title Claimants have reviewed the Aboriginal Cultural heritage Management Plan ML 1814 Regarding cliff line zone of first workings, We are writing to express majority Agreement with the Aboriginal Cultural Heritage Management Plan ML1814 regarding the Cliff line zone of first workings at Airly Centennial mine. This plan demonstrates a comprehensive understanding and respect for the cultural heritage of the Aboriginal community and outlines appropriate strategies for its preservation and management.

The methodology employed in the plan reflects a collaborative approach, involving consultation with local Aboriginal stakeholders, Extraction plan Guidelines, managing risks of subsidence guidelines and experts to ensure that their perspectives and knowledge are integrated into the management process. There were a couple of concerns primarily regarding the proximity to the ridge line and subsidence effects and we were unable to find ant reference to the Broad Headed snake in previous EIS's. A Collaborative effort is essential for achieving meaningful and effective cultural heritage management outcomes.

Furthermore, the plan incorporates a holistic approach to cultural heritage management, taking into account not only physical artifacts but also intangible cultural values and practices. This recognizes the interconnectedness of cultural heritage and biodiversity with the landscape and the importance of preserving these connections for future generations.

We appreciate the attention to detail and the thoroughness of the methodologies outlined in the Heritage management plan. From the identification and assessment of cultural heritage sites to the development of appropriate management strategies.

In conclusion, We support the Aboriginal Cultural Heritage Management Plan ML1814 for the Cliff line zone of first workings at Airly centennial Coal Mine, We look forward to seeing the positive impact of these efforts on the conservation of Aboriginal cultural heritage for years to come.

Regards

Kylie Manson

Warrabinga- Wiradjuri #7 Claimants group

Admin@warrabinga.com.au

**Appendix L: Letter from NSW Planning requesting response to agency advice on CLZ EP (ML1814) (Rev 1)
(dated 24/5/24)**

Our ref: SSD-5581-PA-86

Jacqueline Cooke

Compliance Manager, Centennial Airly Pty Limited

Sent via NSW Major Projects Planning Portal only

24/05/2024

Subject: Airly Mine Cliff Line Zone of First Workings Extraction Plan – Request for Information

Dear Ms Cooke

I refer to the Airly Mine Cliff Line Zone of First Workings Extraction Plan, submitted as required by Schedule 3, Condition 7 of SSD-5581 to the NSW Department of Planning, Housing and Infrastructure (NSW Planning) on 26 March 2024.

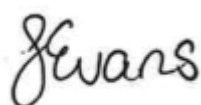
NSW Planning has received advice on the plan from:

- Airly Mine Independent Expert Panel;
- Department of Regional NSW - Mining, Exploration and Geoscience;
- NSW Resources Regulator;
- Heritage NSW;
- Department of Climate Change, Energy, the Environment and Water – Biodiversity, Conservation and Science; and
- NSW National Parks and Wildlife Service.

A copy of this advice is provided as an attachment to this letter.

NSW Planning requests you provide a response to all agency advice by 5 July 2024 (or as otherwise agreed by the Planning Secretary). Should you wish to discuss the matter further, please contact Gabrielle Allan 9585 6078.

Yours sincerely

A handwritten signature in black ink that reads "Evans".

Jessie Evans

Department of Planning, Housing and Infrastructure



Director, Resource Assessments
Resource Assessments

As nominee of the Planning Secretary



Strata Control Technology

CENTENNIAL COAL

Pillar Geometry Assessment for Cliff Line Zone
Extraction Plan

AIRLY5535



RESEARCH



CONSULTING



FIELD SERVICES



INSTRUMENTATION



REPORT TO Jacqueline Cook
Compliance Manager
Centennial Coal
Airly Mine
319 Glen Davis Road
Capertee NSW 2846

TITLE Pillar Geometry Assessment for Cliff Line
Zone Extraction Plan

REPORT NO AIRLY5535

PREPARED BY Rhys Pitchers
Adrian Rippon

DATE 15 May 2023

Rhys Pitchers
Geotechnical Engineer

Adrian Rippon
Principal Geotechnical Engineer

Report No	Version	Date	Revisions
AIRLY5535	Draft	23 December 2022	
AIRLY5535	Final	20 January 2023	
AIRLY5535	Rev 1	1 February 2023	
AIRLY5535	Rev 2	27 April 2023	
AIRLY5535	Rev 3	15 May 2023	

EXECUTIVE SUMMARY

Centennial Coal (Centennial) engaged SCT Operations Pty Ltd (SCT) to provide a first workings geometry assessment for input into the Cliff Line Zone (CLZ) Extraction Plan (EP). First workings incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features. Centennial are working under the Airly Mine CLZ First Workings Extraction Plan, developed in 2017, which incorporates the CLZ located within the existing Mining Lease ML1331. Centennial plan to develop a CLZ EP that covers both the existing mining lease and the adjacent Mining Lease ML1814. This new CLZ EP is the focus of this assessment.

The deliverables for this assessment included pillar geometries for input into the CLZ EP as well as a review of the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP. These outcomes were incorporated into a subsidence assessment, including a high-level surface impacts assessment. SCT also completed a site visit to observe loading effects in previously mined panels due to cliff geometry, depth of cover and secondary extraction. SCT have not defined the CLZ or the adequacy of the standoff of extraction panels to the CLZ.

The pillar review for first workings within the current CLZ EP at Airly Mine has resulted in the following pillar geometry assessment. The review presents the FoS using the UNSW pillar strength formula. Minimum pillar widths are limited to a width to height (W/H) ratio of greater than 8, minimum pillar dimensions 1/10 depth of cover, and a minimum pillar system FoS greater than 2.11 for underground workings beneath critical surface structures and/or features i.e., CLZ.

- 35m pillar centres are deemed to be adequate for depths less than 290m for first workings only. To obtain a FoS greater than 2.11 for DOC > 290m up to 320m DOC, 39m square centre pillars would be required. The pillar centres and FoS are presented in Table ES1.

Table ES1. Pillar system requirements (pillar centres) for first workings.

First Workings Pillar Centres (m)	Depth of Cover (m)	Pillar FoS (UNSW)
35	<290	2.11
39	>290 to 320	2.47*

*FoS at 320m DOC

- For first workings adjacent to secondary extraction, minimum pillar sizes for the CLZ EP need to be increased due to additional abutment load. A summary of increased pillar size are presented in Appendix 5.

The maximum subsidence, including tilt and strain for the pillar design requirements presented above have been calculated for the first workings in the CLZ and are presented in Table ES2. The subsidence predictions presented in this report are consistent with the EIS subsidence predictions.

Table ES2. Maximum predicted subsidence including tilt and strain for theoretical minimum pillar system size.

Scenario	Max Subsidence	Max Tilt (mm/m)	Max Strain	
			Tensile (mm/m)	Compressive (mm/m)
Typical first workings	≤37mm	<0.61	<0.18	<0.25

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1. INTRODUCTION

Centennial Coal Pty Ltd (Centennial) owns and operates Airly Mine, an existing underground coal mine located 40km northwest of Lithgow in the Western Coalfield of NSW. Airly Mine uses first workings, pillar extraction and miniwall mining methods to extract the Lithgow Seam and is currently operating under Mt Genowlan.

Centennial engaged SCT Operations Pty Ltd (SCT) to provide first workings pillar geometries for input into the Cliff Line Zone (CLZ) Extraction Plan (EP). First workings incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features. Cliff lines are defined as being at least 20m in height and having slope angles greater than 2:1 (Golder, 2014). The CLZ has been defined in the development consent (SSD_5581) as 30m from the toe and crest of each cliff. SCT have not defined the CLZ or the adequacy of the standoff of extraction panels to the CLZ. The adequacy of the standoff of extraction panels to the CLZ is assessed separately on a case by case basis in Extraction Plans for secondary extraction.

Centennial are working under the Airly Mine CLZ First Workings EP, developed in 2017, which incorporates the CLZ located within existing Mining Lease ML1331. Centennial aim to develop a CLZ EP that covers both the existing mining lease and the adjacent Mining Lease ML1814. The first workings CLZ, existing and proposed workings and mining leases are shown in Figure 1.

This report presents the review of relevant subsidence monitoring data, the potential loading effects from secondary extraction and the adequacy of coal pillar sizes in the current CLZ EP. Subsidence estimates and an impact assessment on surface features is also presented.

This work package builds on previous SCT assessments of the subsidence mechanism at Mt Airly, and pillar width recommendations for proposed miniwall extraction in the Mt Airly and Mt Genowlan mining areas.

2. SCOPE AND DELIVERABLES

A scope of work was provided by Centennial in a PowerPoint presentation on 15 September 2022 outlining the following scope.

- *Review relevant subsidence monitoring data*
- *Review/discussion of potential loading effects from secondary extraction in adjacent mining zones (i.e., splitting & quartering or miniwall mining)*
- *Review the adequacy of coal pillar sizes and confirm long term-stable*
- *Provide subsidence estimates associated with first workings*
- *Assess potential for impact based on features present*
- *Provide recommendation if further studies/assessment is required.*

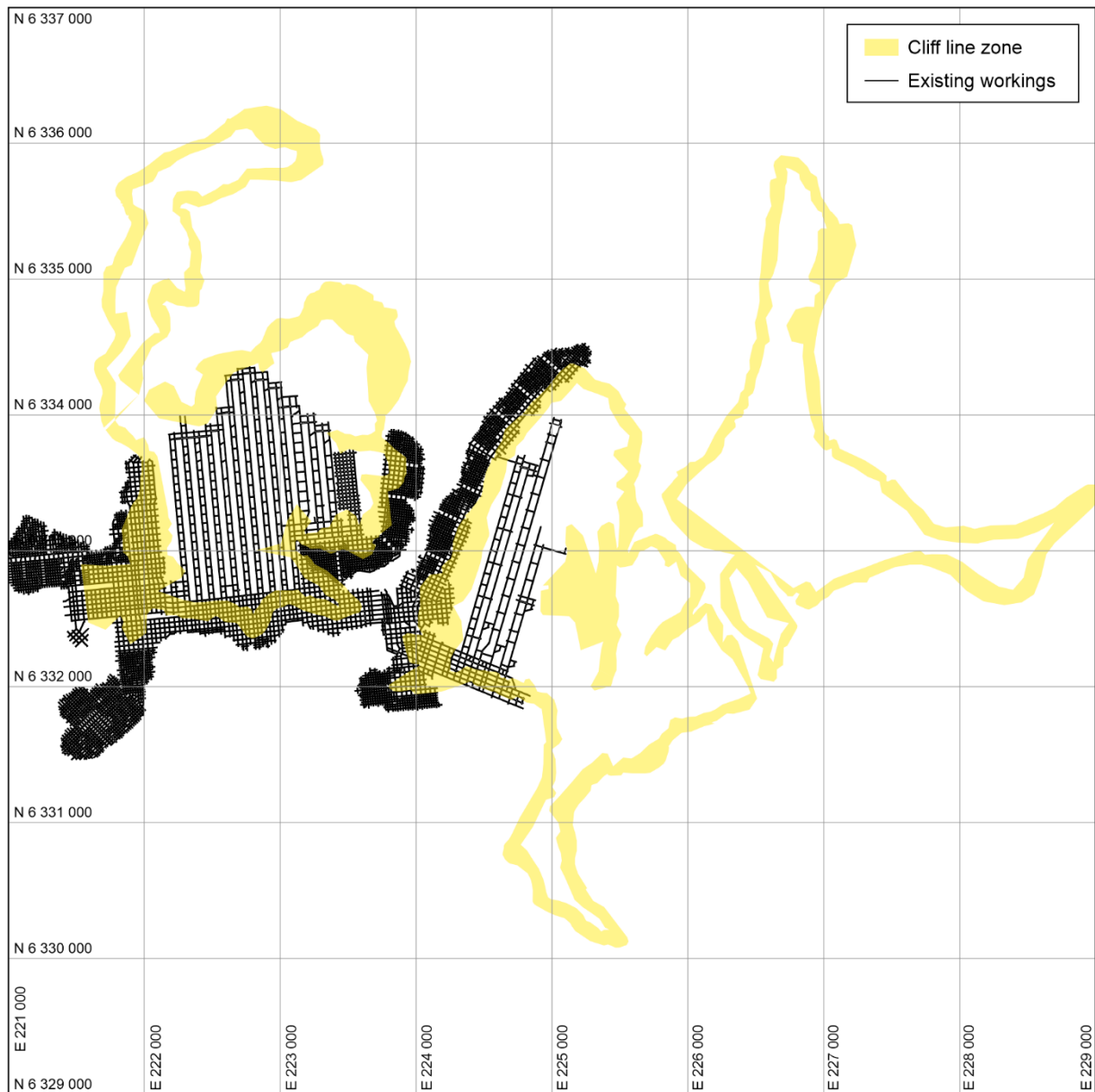


Figure 1: Cliff Line Zone of First Working at Airly Mine showing the mine plan and mining lease.

It was noted that some additional key aspects to determine long term stable pillars within the CLZ would need to be incorporated in the review and included:

- increased load from adjacent cliffs and high topography
- increased subsidence from adjacent secondary extraction.

The deliverables for this assessment included the review of subsidence data, overcore stress measurements and previous subsidence assessments to present potential loading effects and comment on the adequacy of proposed coal pillar sizes. This was incorporated into a subsidence assessment associated with first workings in the CLZ and high-level commentary on potential impacts to surface features. SCT also completed a site visit to observe loading effects in previously mined panels due to cliff geometry, depth of cover (DOC) and secondary extraction. The completed work program with associated chapter numbers is presented in Table 1.

Table 1. Scope and Deliverables

Item	Chapter	Scope	Deliverable
1	3	Conclusions and Recommendations.	- Provide first workings pillar geometries for input into the CLZ EP. - Comparison with current CLZ EP pillar and subsidence design specifications. - Provide recommendation if further studies/assessment is required.
2	4	Underground and surface site visit.	- Observe pillar loading effects from secondary extraction. - Investigate pillar loading effects adjacent to cliff lines and topographic variations. - Observe surface features for impacts assessment.
3	5	Review relevant subsidence monitoring data.	- Review of subsidence data and reports.
4	6	Review/discussion of potential loading effects from secondary extraction in adjacent mining zones (i.e., splitting & quartering or miniwall mining).	- Review/discussion of observed and model subsidence from adjacent secondary extraction.
5	7	Review the adequacy of coal pillar sizes and confirm long-term stable.	- Review of model cliff loads. Assessment of adequate pillar geometries for long term stable, taking into consideration load variations and adjacent workings. - Discussion of standoff to cliff lines for long term stable pillars.

6	8	Provide subsidence estimates associated with first workings.	- Provision of subsidence estimates based on proposed pillar geometries. - Additional estimates provided for adjacent secondary extraction.
7	9	Assess potential for impact based on features present.	- High level assessment of impact to cliffs, arch/heritage sites, groundwater/surface water. - Discussion on effects of structural features such as faults.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions

Using a combination of numerical modelling, field measurements, observations made during the site visit and pillar design experience, a robust methodology has been applied to estimate pillar loading and surface impacts in the CLZ at Airly Mine. This pillar design methodology has incorporated an additional 1MPa of CLZ vertical load and applied an effective pillar width reduction of 1m (6.5m effective roadway width) and an effective roadway height of 3m based on underground observations. The design method has endeavoured to not compound conservative input parameters but to integrate realistic design parameters to ensure long term stable and minimally subsiding pillars. The pillar design presented assumes all ribs are effectively supported with bolts and mesh.

Following the SCT pillar assessment, pillar geometries have been developed to optimise the CLZ EP. The pillar geometry assessment included.

- Minimum pillar widths are limited to a W/H ratio of greater than 8. This is based on the design criteria presented in the EIS and supported by Hill (2005) for underground workings beneath critical surface structures and/or features.
- Minimum pillar system FoS is greater than 2.11 for underground workings beneath critical surface structures and/or features.
- Minimum pillar dimensions required to maintain 1/10 depth of cover.
- For first workings adjacent to secondary extraction, minimum pillar sizes for the CLZ EP need to be increased due to additional abutment load.

Table 2 presents the adequacy of coal pillar sizes using the above design constraints and the minimum pillar system FoS of 2.11. The pillar assessment for first workings within the CLZ at Airly Mine has concluded:

- 35m pillar centres are deemed to be adequate for depths less than 290m for first workings only. To obtain a FoS greater than 2.11 for DOC > 290m up to 320m DOC, 39m square centre pillars would be required.
- For first workings adjacent to secondary miniwall extraction with a 61m void width, pillars within 100m from secondary extraction will attract additional vertical load, reducing the FoS. To maintain a FoS greater than 2.11 at depths greater than 250m and adjacent to secondary extraction, an increase in pillar size would be required. It is understood that there will be no (future) panel and pillar extraction voids within 40m of the first workings as noted in the EIS.
- For first workings adjacent to secondary splitting and quartering of pillars, to maintain a FoS greater than 2.11 at depths greater than 250m, an increase in pillar size would be required if the remnant pillars are not deemed to be long term stable.

Table 2. Pillar review summary showing FoS in reference to existing CLZ EP pillar design

Depth of Cover	Mining Sequence	Recommended Pillar Centres (m) for FoS > 2.11	Pillar FoS (UNSW)
<290m	First Workings No Adjacent Secondary	35	2.11
>290m to 320m	First Workings No Adjacent Secondary	39	2.47*

*FoS at 320m DOC

Subsidence estimates have been calculated assuming the strata above the pillar behaves elastically due to additional load introduced by first workings and have been calculated for the recommended pillar sizes. Table 3 provides a summary of the SCT subsidence predictions including tilt and strain. The subsidence prediction from the Airly Mine Extension Project Environmental Impacts Statement for the Cliff Line Zone of First Workings and revised predictions for the current Extraction Plan (Golder Associates, 2017) is also provided for comparison. The maximum subsidence, tilts, strains, and surface impacts are consistent with these previous studies.

Predicted subsidence magnitudes are presented as mining $\geq 40\text{m}$ from the CLZ first workings. The closer the pillars are to the potential secondary extraction, the larger the subsidence magnitudes are anticipated to be on first workings in the CLZ. Additionally, the greater the depth of cover the greater the additional loading caused by secondary extraction.

The natural sequence of erosion within the CLZ through both exposure to the elements and vegetation exploiting natural rock joints is expected to result in naturally occurring rock falls. It is important to note that these naturally occurring events cannot be eliminated through mine design. The design covered by this report relates to mining induced surface impacts only.

Table 3. Comparison of SCT subsidence predictions with current EP subsidence predictions

Predictions	Pillar Stability	Max Subsidence	Max. Tilt (mm/m)	Max. Strain		Surface Cracking	Surface Impacts
				Tensile (mm/m)	Compressive (mm/m)		
SCT Predictions	Long Term Stable with minimal subsidence	≤37mm	≤0.61	≤0.18	≤0.25	Mining induced surface cracking not expected	No mining induced surface cracking. Potential to produce downward flow through the fracture network, including through lineaments
EIS Predictions	Long Term Stable	65mm	0.6-1.1	0.2-0.3	0.2-0.5	Not Expected	Negligible impacts, no surface cracking
EP Revised Predictions	Long Term Stable, negligible settlement, effectively non-subsiding	<53mm Worst Case (long term flooded and additional pillar loading) Short to medium term <30mm and typically <20mm	0.4-0.9	0.1-0.3	0.1-0.3	Not Expected	No surface cracking, no surface impacts

3.2 Recommendations

Recommendations for further assessments including additional work required to refine design outcomes or to validate the work package include:

- Continued mapping of rib conditions during development within the CLZ noting locations of consistent rib deformation with respect to depth of cover and proximity to cliffs.
- Validate roof and floor rock properties with site specific database. Additional rock testing of cored samples to obtain Youngs Modulus and UCS from the roof and floor would assist in refining subsidence predictions.
- Subsidence monitoring of first workings to validate subsidence estimates. It is noted that the typical subsidence magnitudes reported, including tilts and strains are outside the limit of current survey monitoring accuracy. GNSS monitoring is more accurate and is recommended.
- Consideration needs to be taken for offset distances for future miniwall layouts adjacent to first workings in the cliff line zone.
- Consideration needs to be taken for remnant pillar stability when splitting and quartering pillars adjacent to first workings in the CLZ.

4. SITE VISIT

A site visit was undertaken by SCT Principal Geotechnical Engineer, Adrian Rippon and Geotechnical Engineer, Rhys Pitchers on Thursday 10 November 2022. The site visit included an underground inspection to observe pillar behaviour at a range of depths and a surface visit to observe the cliff lines and other natural features.

The location of these site visits relative to the Airly Mine plan are presented in Figure 2 along with the depth of cover. The CLZ of first workings within the ML1331 mining lease has a maximum depth of approximately 200m. Mining Lease ML1814 sees an increased depth of cover approaching 300m.

4.1 Underground Site Visit

The objective of the underground visit was to observe pillar loading effects from secondary extraction and pillar loading effects adjacent to cliff lines and topographic variations. Three locations were inspected during the underground site visit at Airly Mine and included:

- 401 panel 12ct through to MW-15 MG
- 400 panel 4ct through to 401 panel Z HDG
- 205 panel through MW-01 TG B heading.

Selected photographs of the observed roadway conditions are presented in Appendix 1, 2 and 3.

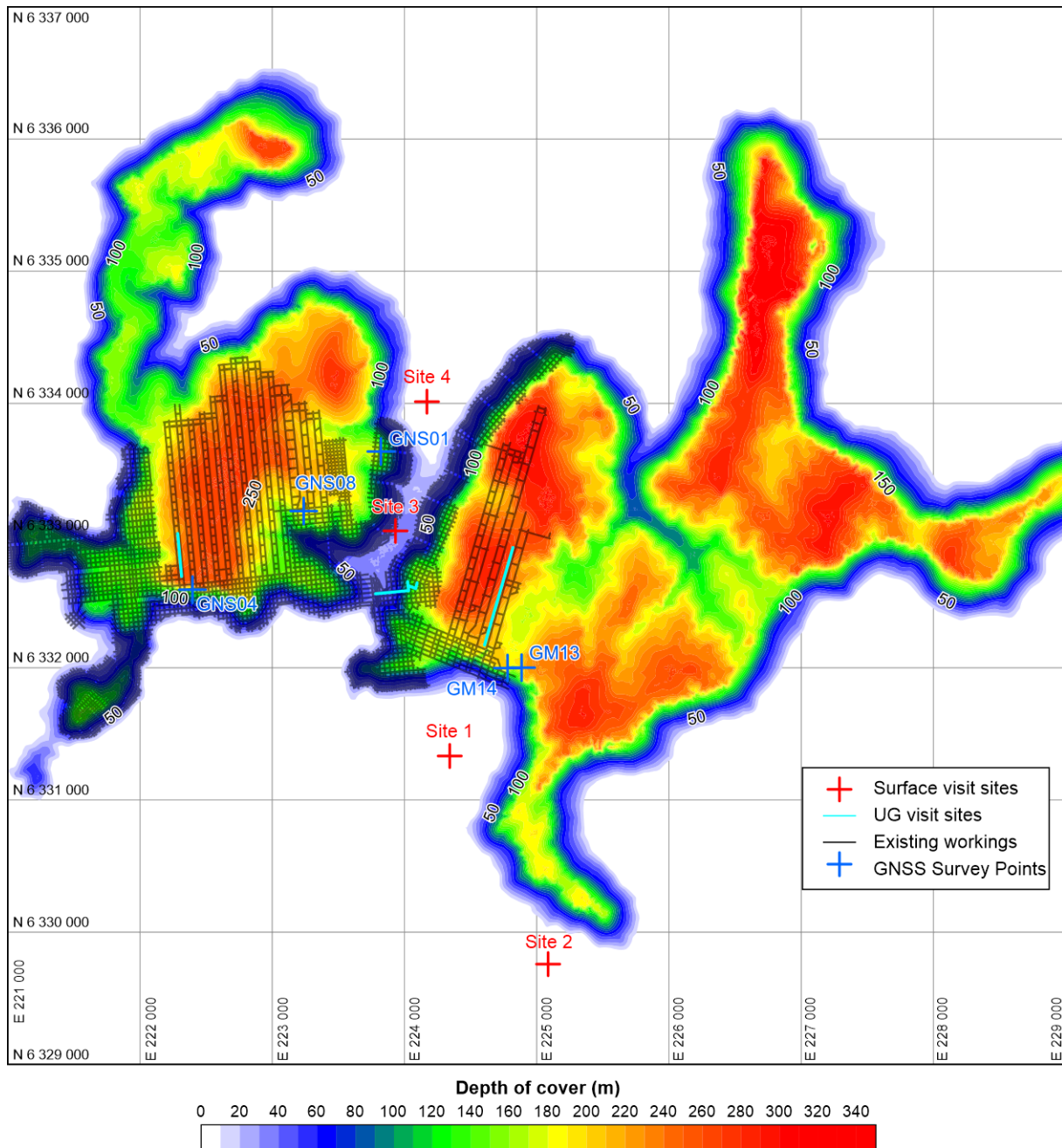


Figure 2: Location of site visits conducted by SCT relative to Airly Mine Plan.

The target horizon of the Lithgow Seam at Airly Mine consists of the LT1 to LT3 coal plies and averages 3.4m in thickness. The planned development height is 2.8m on average (with the upper limit of 3m). The Lithgow Seam is overlain by the Lidsdale Seam separated by the LW1 claystone band. The roof bolt horizon is typically comprised of 0.3m to 0.4m of coal overlain by 0.4m of the LW1 claystone and the Lidsdale Seam (Centennial Coal, 2017). Variability in the mining horizon and the corresponding location LW1 claystone was observed during the underground site visit. The immediate 1 to 2m of floor below the Lithgow Seam is comprised of a moderately strong sandstone with a UCS of approximately 40MPa.

Key observations from the underground visit included:

- An obvious increase in rib deformation was observed with increased DOC. Figure 3 shows the variation in rib behaviour from 40m to 240m DOC at 401 panel 12ct through to MW-15 MG.
- Solid and straight ribs were observed where depth of cover was 30m to 90m.
- Minor onset of rib spall and deterioration where DOC was 100m. This rib spall was typically below the LW2 clay band.
- Notable rib deterioration increased from approximately 130 - 150m DOC.
- Significant rib spall and deterioration was observed in MW-01 TG as shown in Figure 4, where depth of cover was in the order of 200m. No rib support or mesh was installed in this area.
- Rib support in 401 panel showed large areas of poor encapsulation and gloving around the rib bolts leaving effectively point anchored bolts in the rib. At these locations, additional rib deformation was observed (see Figure 5).
- Clay bands were identified close to the roof contact and through the sequence of the seam. The location of the LW1 clay band was horizon control dependant and has implications on the coal pillar strength.
- Generally, roof conditions were good across all depths. Additional deformation was observed around geological structure, wide drivage and overcast tunnels.
- Delamination of the roof was observed where up to 200mm of coal could delaminate and was horizon control dependant. If the mining horizon approached the LW1 clay band, delamination would occur. It was noted conditions would then stabilise at or above the LW1 clay band.
- Faults with minor throw are common at Airly Mine. In most cases, these faults do not cause significant operational issues.
- Faults regularly run through intersections. In cases where faults were located in the intersection there was increased roof deformation and remediation required.
- Where the faults intersected the headings, the rib conditions improved leading up to the faults and served as an indicator that the miner was approaching geological structure (Figure 6). This was accompanied by increased roof deformation and is the result of the altered stress environment around the structure.
- No major difference was observed in rib conditions between headings and cut throughs.
- Rib deformation was primarily identified as the result of increased depth of cover, reduced rib support and proximity to secondary extraction.



a) G HDG 12CT – 40m depth of cover, full plunge with no support (130m out from under the cliff line).



b) D-E HDG 12CT 120m DOC (20m out from under the cliff line).



c) MW-15 MG 3CT – 220m depth of cover.

Figure 3: Variation in rib conditions with increased depth of cover.



Figure 4: Rib deformation in 205 Panel X HDG, 9CT at 200m DOC.



Figure 5: Rib support in 401 panel showing gloving of resin and unencapsulated bolt.



Figure 6: Fault observed in 401 panel leading into intersection showing roof deformation with square ribs at 200m DOC.

A key outcome to the site visit was identifying realistic input parameters into the pillar design component of the study. The underground site visit identified implications on the designed vs actual pillar geometry based on over driveage, roof delamination, increased vertical load, rib support and proximity to secondary workings.

It is understood that some of the underground sites visited are historical locations with little to no rib/roof support. The design methodology used in this report did not apply this level of deformation to the input parameters. Only realistic geometry from the supported roadway was applied.

Observations of rib conditions provided a basis to estimate the vertical load acting on the coal and identify additional loading based on the proximity to the cliff line. The nature and scale of rib deterioration of the ribs can be used to refine vertical load estimates once loading exceeds the threshold for spalling (SCT, 2019). This is further discussed in Section 7.

4.2 Surface Site Visit

The objective of the surface site visit was to observe surface features for the high-level impacts assessment and included observations from the base of Mt Airly, Mt Genowlan and along Gap Creek to Point Hatteras.

A summary of observed natural features from the surface visit included:

- Sandstone features such as major and minor cliffs lines of Mt Airly and Mt Genowlan.
- Pagodas and balancing rock features.
- Existing natural cliff erosion and fallen rock slabs and boulders.
- 4WD roads, fire trails and walking tracks.
- Property fences and gates.
- Flowing creeks and waterways.

Extensive aeromagnetic surveys and reports have been conducted and compiled on the cliff lines of Mt Airly, Mt Genowlan and Point Hatteras and surface features. These cliff lines were observed during the site visit and are presented in Figure 7. In addition, Gap Creek was investigated and is presented in Figure 8.

5. SUBSIDENCE MONITORING DATA REVIEW

Subsidence monitoring in the form of survey pegs has been conducted for miniwall (MW) extraction in the Mt Airly mining area and the splitting and quartering of pillars in 200 panel and 121 panel. The results of these subsidence monitoring programs are presented herein. The review of the available subsidence data is important for creating a subsidence baseline and to identify potential mechanisms that may cause variations to subsidence predictions and support the design methodologies.

This is the totality of subsidence monitoring – using survey pegs – that has been supplied as part of this assessment.

5.1 Global Navigation Satellite System Monitoring

Global Navigation Satellite System (GNSS) monitoring has been conducted at Airly Mine over both miniwall and first workings extraction. It is noted that GNSS monitoring of cliffs has been conducted and is currently ongoing. The results for five GNSS units was supplied and included GNS01, GNS04, GNS08, GM14 and GM13. The location for each unit is presented in Figure 2.

Both GNS01 and GNS04 were installed after the completion of first workings so have not measured relevant subsidence data to be used to calibrate predictions. GNS08 was installed prior to the first workings over a larger pillar at the south end of the Mt Airly miniwall. Subsidence prediction using the methodology outlined in Section 8, estimate a total subsidence of 11mm with 6mm measured by the GNS08 GNSS unit. With a 5mm tolerance of the GNSS system, the prediction is within the measured subsidence.

GM13 and GM14 were installed prior to the first workings being completed. Although adjacent to similar sized pillars proposed in the EIS, the GM13 and GM14 monitoring units are located over significantly larger coal pillars and have not measured representative subsidence results for first workings proposed in the CLZ.



a) Looking north towards Mt Genowlan from Site 1.



b) Looking north towards Mt Genowlan from Site 2.



c) Looking east towards Point Hatteras Site 3.

Figure 7: Photographs of various cliff lines and exposed sandstone cliff faces.



Figure 8: Photographs of Gap Creek (looking south) Site 4.

5.2 Splitting and Quartering of 200 Panel First Workings

Subsidence monitoring was reported by Golder Associates over the pillars between 9 and 10 cut through in 200 panel (Golder Associates, 2016). The subsidence pegs were installed in December 2014 following first workings where 35m centre pillars were developed. Subsidence results relate to the splitting and quartering of pillars where the new geometry was 17.5m centre pillars. A maximum vertical subsidence of 7mm was measured with a representative maximum of 5mm. The subsidence measurement results are presented in Figure 9.

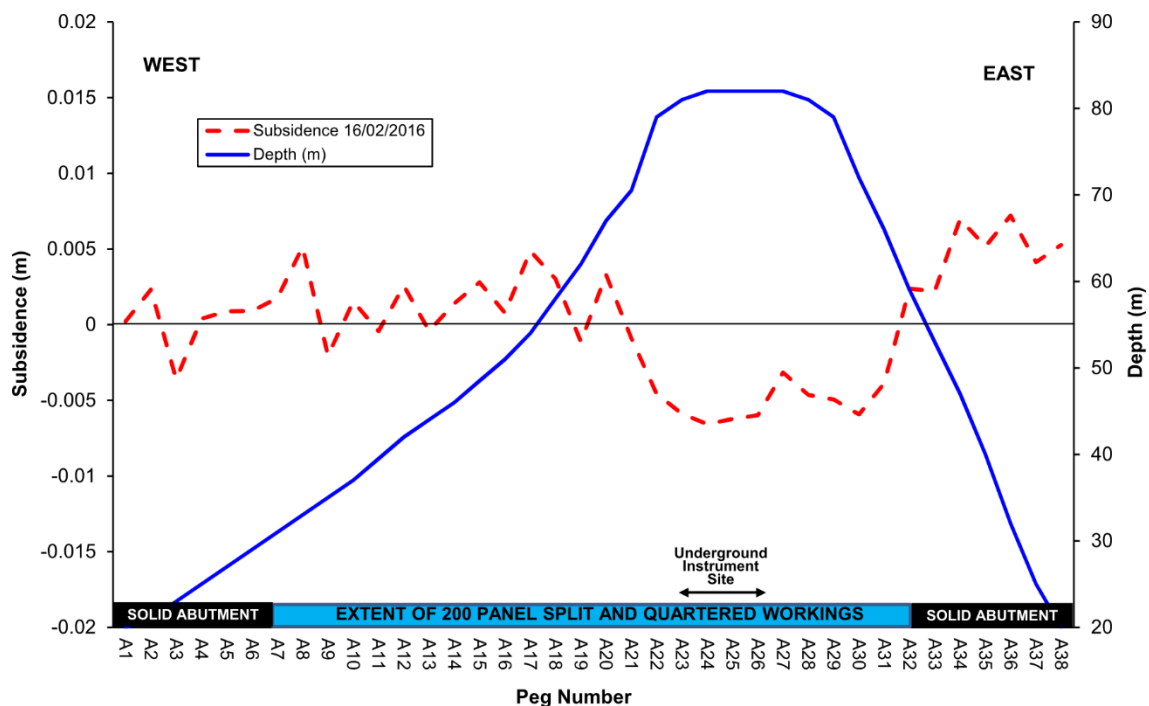


Figure 9: Subsidence measurements in 200 panel following splitting and quartering of pillars (Golder 2016).

5.3 Splitting and Quartering of 121 Panel First Workings

The subsidence monitoring over 121 panel measured subsidence due to splitting and quartering at 100m depths, noting cliff faces to the immediate north are 30m to 50m high. Results suggest between 11mm of subsidence and 7mm of upsidence. Subsidence measurements conducted over 121 panel are presented in Figure 10. The subsidence results were not indicative of significant ongoing movements. During an underground visit in December 2018, David King observed:

- rib spall was typically <0.3m
- negligible post-extraction roof deterioration
- ~6m wide pillar core "remnants" showed negligible signs of deterioration.

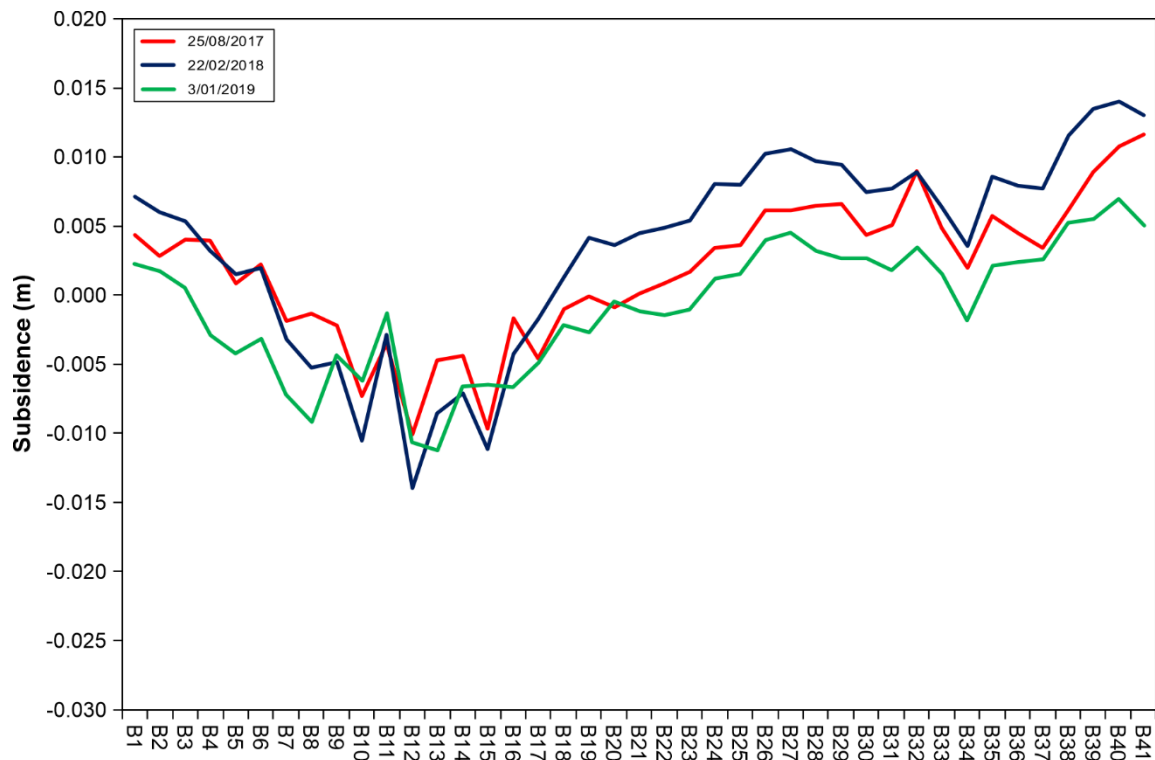


Figure 10: Subsidence results from splitting and quartering 121 panel workings (Strata 2019).

6. POTENTIAL LOADING EFFECTS FROM SECONDARY EXTRACTION

SCT conducted a numerical modelling assessment to estimate the surface subsidence associated with developing ten roadways adjacent to MW12 under the Mt Airly mining area. The full details of this report can be found in SCT Report: AIRLY5392 (2022).

The depth of cover was in the order of 170m over the proposed roadways. Roadway geometry was modelled as 5m roadways with 20m pillars and a 2.8m extraction height. A comparison between MW12 survey subsidence, modelled subsidence for MW2-12 extraction and then 12a panel development subsidence is presented in Figure 11. The assessments found that due to 12a panel development:

- Surface subsidence change was greatest over MW11-12 increasing 12mm.
- Surface subsidence of MG12 was modelled to increase 10mm. Surface subsidence over first workings <10mm.
- Surface subsidence due to first workings increased 7mm over the first roadway. This was the greatest surface subsidence magnitude increase over all roadways.

Further review of the AIRLY5392 numerical models were completed for this study to refine the subsidence predictions by investigating the vertical stress concentrations in the roof and floor of the pillars during development. The height above the pillar to which this additional vertical stress increase occurs can indicate the extent of strata that is being compressed, which drives surface subsidence. The same phenomenon occurs below the pillar. The total distance of stress increase into the roof or floor is termed the “bulb height”.

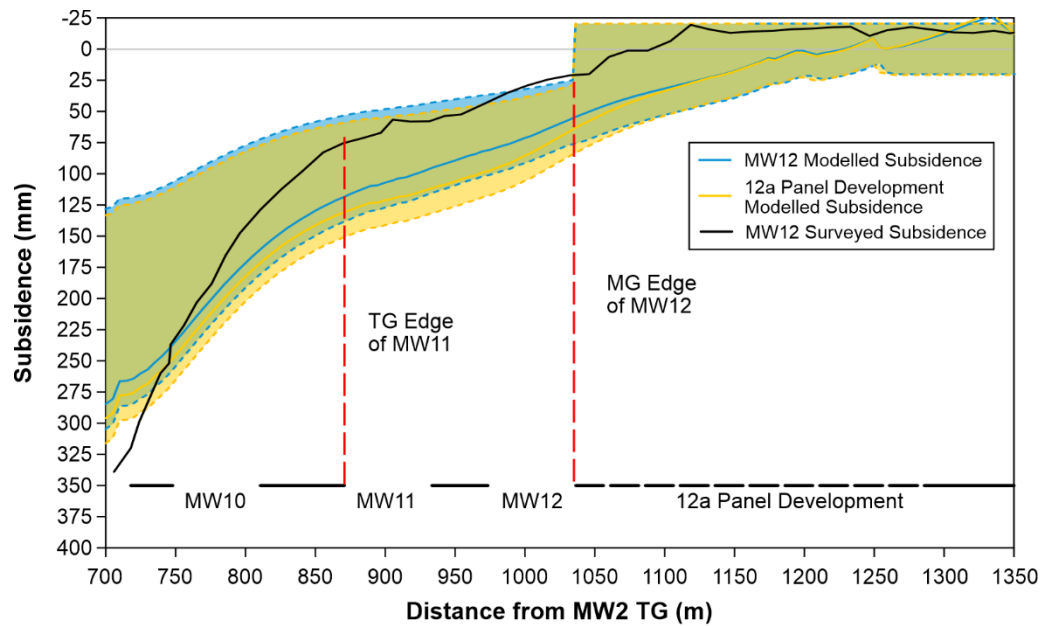


Figure 11: Modelled subsidence over MW10-12 and development of 12a panel including error based on current Airly Mine survey data (SCT, 2022).

The height to which additional vertical stress increases in the pillar causing compression was typically 1 x pillar width or in the order of 20m. Pillars offset less than 60m from the secondary workings had a vertical stress increase that extended 3 x pillar width into the roof, or in the order of 60m. These model results have been used as the basis for the subsidence assessment presented in Chapter 8, where 2 x pillar width has been used as a conservative and realistic bulb height for pillar compression calculations. Adjacent to secondary extraction, a 3 x pillar width has been used as the bulb height for pillar compression.

7. PILLAR DESIGN REVIEW

To create a long-term stable pillar geometry, an appropriate balance between pillar strength and vertical load on the remnant pillars needs to be established with enough margin to accommodate uncertainties (IEP, 2019). In areas of flat topography, the vertical load can be calculated with a high degree of confidence. In the CLZ at Airly Mine, the vertical load is not as easily estimated as the load from high topography can be redistributed to areas of shallower depth below the cliffs, increasing pillar load.

In 2019, SCT conducted a numerical modelling assessment to determine pillar loading below cliff lines at Airly Mine. This numerical modelling assessment followed an overcore stress measurement campaign conducted in 207 panel above 35m centre pillars. The details of this campaign can be found in SCT Report: AIRLY4889A (2018). The overcore stress measurement results were used to validate the pillar loading estimated by the numerical modelling assessment.

SCT Letter Report AIRLY5014 (2019) highlighted that in terrain where there are sharp variations in the topography, such as below high cliffs, the vertical load cannot be easily estimated. Below the cliffs, the weight of overburden strata is not uniform and is not necessarily equal to the weight of the overburden above each pillar. Overburden load is redistributed from high ground onto areas of shallower depth, thereby increasing the load on pillars on the low side of any sudden changes in overburden depth.

The overcore stress measurement results are presented in Figure 12. The modelled vertical stress results and vertical stress based purely on the weight of the overburden is also presented. The difference in vertical stress, shown by the grey line, represents the load surcharge from the cliff (SCT, 2019b).

The vertical stress in the model is determined from the weight of overburden strata and the lateral distribution of this weight from areas of greater depth to areas of lower depth. There is a strong correlation between the model stress and stress measurements taken at approximately 68m and 103m from the toe of the cliff. The stress measurement taken 33m from the toe of the cliff was interpreted to have a lower than representative magnitude and was not consistent with the observations of rib spall underground. As a result, the measurement has been excluded from the comparison – this is discussed in detail in SCT Report: AIRLY4971 (2019).

The modelling showed that close to the cliff, calculating pillar stability based purely on the direct weight of overburden strata is likely to underestimate pillar load. Figure 12 indicates the pre mining vertical stress at seam level to be 1MPa above the direct vertical stress approximately in line with the toe of the cliff. The pillar assessment presented in this report has incorporated the additional 1MPa of vertical load when calculating the adequacy of the CLZ coal pillar sizes for first workings at Airly Mine.

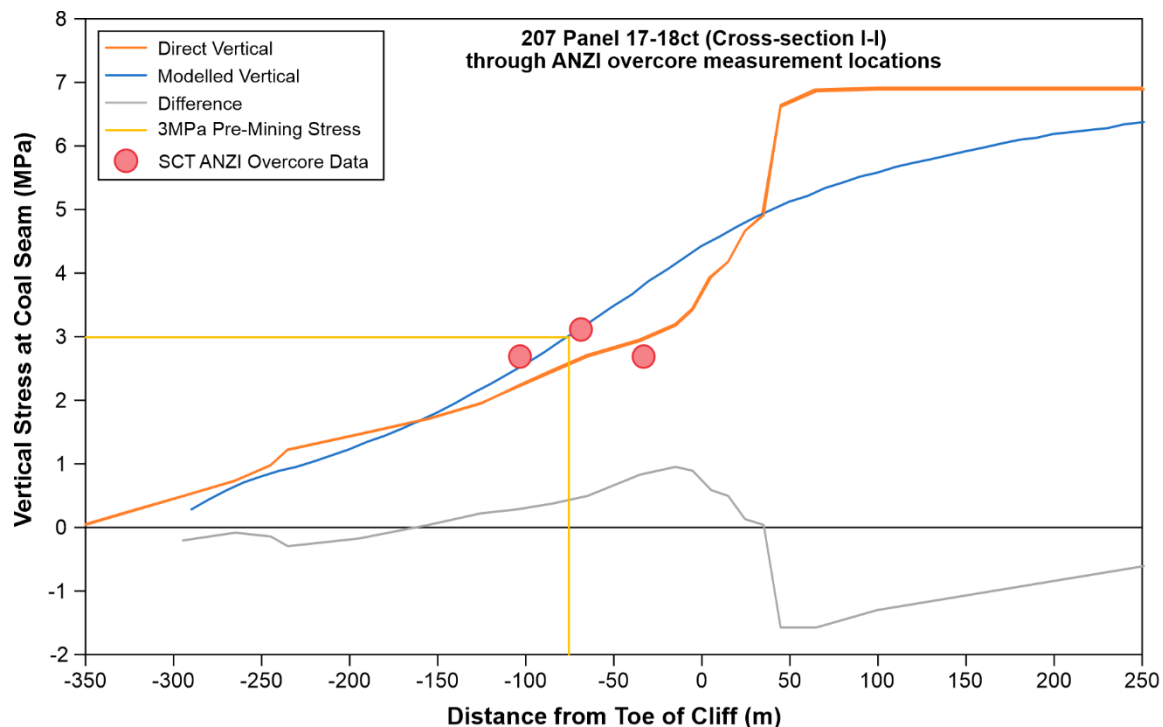


Figure 12: Vertical stress comparison between modelling, overcore measurements and estimates based on overburden weight (SCT 2019b).

7.1 Pillar Assessment for First Workings in the CLZ

An assessment of adequate pillar geometries for first workings in the CLZ has been conducted as part of this review. The UNSW method was applied to maintain a consistent representative approach to the previous design work presented in the CLZ EP 2017 report.

Schedule 2 Condition 2 of the conditions of the SSD_5581 consent requires the Applicant to carry out the development:

- (a) generally in accordance with the EIS and the Mining schedule; and
- (b) in accordance with the IPRP's Report and the conditions of this consent.

Note, the IPRP Report (July 2016) considered long term stable to be a factor of safety of 2.11 or a probability of infinite stability of greater than 75% - this assessment was based on methodology developed by UNSW.

The UNSW coal pillar design formula is used extensively in Australia and assigns a probability of stability associated with the FoS. The probability of stability cannot be compared for likeness to the FoS derived from other pillar strength formulas such as the Bieniawski pillar strength formula.

The strength of the designed CLZ EP pillars were calculated using the UNSW pillar strength formula as shown below in Equation 1:

$$1. \text{ UNSW} \quad Sp = 27.63\Theta^{0.51}/w_m^{0.22}h^{0.11}\{0.290[(w_m/5h)^{2.5}-1] + 1\} \text{ (MPa)}$$

where:

w_m = minimum pillar width

h = pillar height

Θ = effective width = $2w/(w_1 + w_2)$ for $w/h > 6$

For a given W/H ratio, a pillar's strength varies depending on the lithology of the roof and floor contacts. A strong contact allows a pillar to readily generate confinement by providing shear resistance to the coal that moves horizontally into the roadway due to Poisson's effect (and the increase in vertical load). A lower strength contact reduces the ability for the roof and floor to generate confinement as the weak contact provides less shear resistance to the horizontal movement.

A coal/sandstone contact generates more confinement within the pillar than a coal/clay contact. The pillar strength is therefore proportionate to the strength of the roof and floor contacts, or any other feature or structure that acts to reduce the pillar's ability to generate confinement such as geological structure. Figure 13 shows the ability for a pillar to generate strength in relation to W/H ratio and roof and floor lithology from Gale (1999).

First workings in the CLZ EP indicate 35m square centre pillars, with a nominal maximum roadway width of 5.5m and a nominal roadway height of 2.8m (Golder Associates, 2017). In addition to roof and floor contact lithology, there are several factors that can reduce the pillar strength. These commonly include:

- Off plan drivage.
- Rib spall – with vertical stress >5-6MPa.
- Increase in effective pillar height – due to spall and increased extraction of interbedded coal strata in the immediate roof.

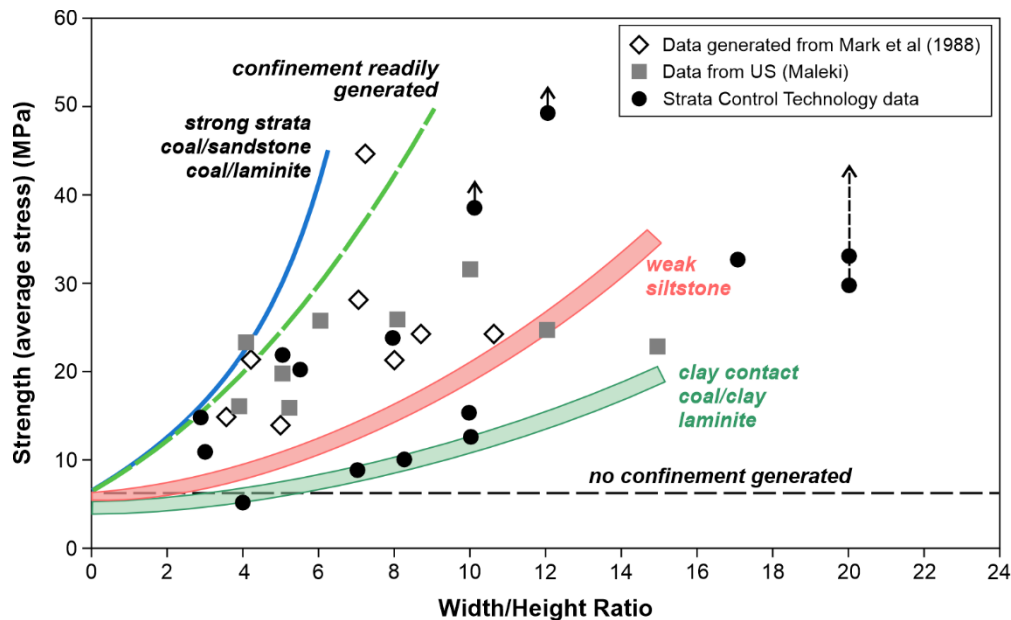


Figure 13: Strength in relation to W/H and lithology - computer model results and data (recreated from Gale, 1999).

With the above factors considered, an effective pillar width reduction of 1m and an effective roadway height of 3m has been used by SCT in the pillar stability assessment.

The increase in roadway width amounts to a 0.5m increase into the pillars either side of the roadway and a 0.2m increase in roadway height. This is considered a realistic approach which factors in operator variation, offline drivage, rib spall, reduced capacity of rib support and roof delamination, all of which was observed during the site visit. Rib spall was observed at depths greater than 100m which decreased the solid coal pillar width and therefore the strength of the pillar. This applied to the supported roadway. The historical locations investigated showed significantly greater deformation with no rib support installed. The design does not incorporate the geometry of the historical locations of the mine.

A Factor of Safety (FOS) of 2.11 is considered long term stable in the UNSW pillar design guidelines, equating to a 1:1,000,000 probability of pillar failure. Any pillars that are required to be long term stable, such as barrier pillars or pillars protecting specific surface features, are required to have a FOS at a minimum of 2.11.

Theoretical minimum pillar widths have been limited to a W/H ratio of greater than 8. This is based on the design criteria presented in the EIS and is supported by Hill (2005) for underground workings beneath critical surface structures and/or features as shown in Figure 14.

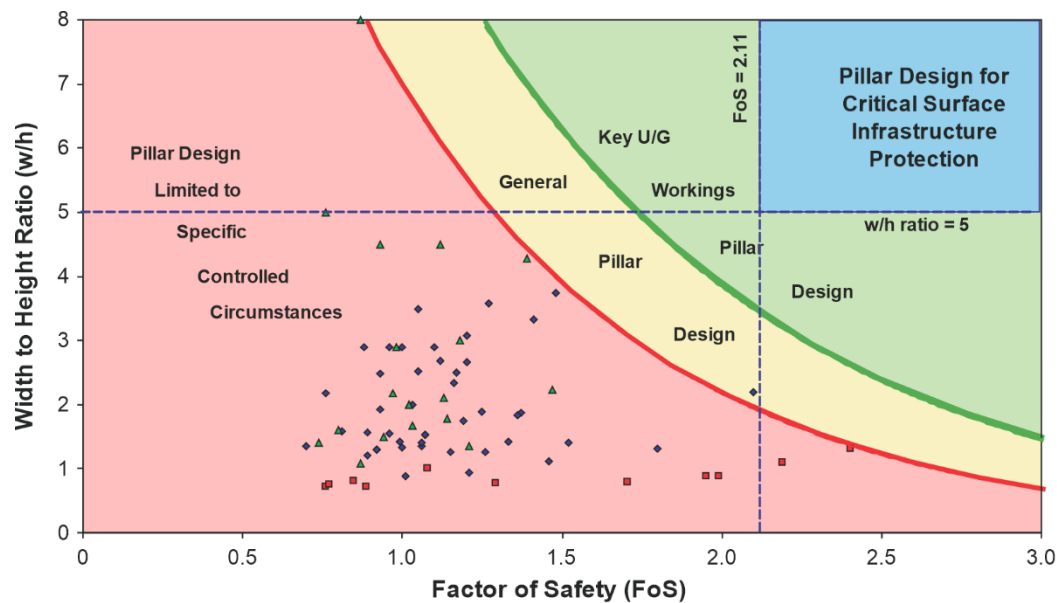


Figure 14: Design criteria for bord and pillar workings based on factor of safety and pillar w/h ratio (Hill, 2005).

Table 4 presents the results of the CLZ EP pillar geometry review of 35m square centres for varying depths of cover, noted as "Planned Geometry A" in the CLZ EP. Applying the same geometry as the minimum theoretical pillars by assuming a roadway width of 6.5m, the effective solid pillar width becomes 28.5m (for 35m square centre pillars). The pillar width to height ratio is 9.5 based on an effective roadway height of 3m.

Table 4. Pillar Factor of Safety for current CLZ of first workings EP-35m pillar centres

Depth of Cover (m)	Pillar Centres (m)	Solid pillar width (m)	Effective Pillar Width (m)	Pillar w/h ratio	Pillar FoS (UNSW)
80	35	29.5	28.5	9.5	6.28
100	35	29.5	28.5	9.5	5.29
150	35	29.5	28.5	9.5	3.79
200	35	29.5	28.5	9.5	2.95
230	35	29.5	28.5	9.5	2.61
250	35	29.5	28.5	9.5	2.42
290	35	29.5	28.5	9.5	2.11
300	37*	31.5	30.5	10.2	2.32
320	39*	33.5	32.5	10.8	2.47

*Minimum pillar dimensions required to maintain geometry >1/10 depth of cover.

Using the UNSW pillar strength formula and pillar sizes presented in Table 4, the FoS for all depths in the CLZ for ML1331 and ML1814 are > 2.11 and would be considered long term stable.

The Bieniawski (1992) pillar strength formula was also used to assess the pillar strength. This formula allows variation of roof and floor contacts to be considered in the estimation of pillar strength. For this reason, the Bieniawski pillar strength formula is the SCT preferred approach for pillar design and has been used to create the pillar FoS presented in Appendix 4.

Secondary extraction in the form of miniwall mining and partial pillar extraction is proposed adjacent to the CLZ first workings in some areas of the mining lease. Secondary extraction near the CLZ will result in additional vertical stress on the CLZ pillars from additional abutment load therefore impacting designed pillar stability and predicted subsidence. Additional pillar loading has been assessed at various depths of cover for future potential secondary extraction and is presented in Appendix 5.

8. SUBSIDENCE ASSESSMENT

8.1 Subsidence Assessment for First Workings in the CLZ

Subsidence estimates have been calculated assuming the strata above the pillar will behave elastically due to additional load introduced by first workings. Subsidence estimates have been calculated for 35m square centre pillars for first workings and are provided in Table 5. The impacts of secondary extraction are further discussed in Chapter 8.2. The subsidence estimates have been calculated assuming an effective roadway width of 6.5m and cut height of 3.0m. This is considered a realistic approach which factors in operator variation, offline driveage, rib spall, reduced capacity rib support and roof delamination, all of which were observed during the site visit.

Pillar compression has been calculated by multiplying the pillar width by a bulb factor of 2. This bulb factor is derived from numerical model results which show that vertical stress increase due to pillar extraction is observed $\sim 1 \times$ pillar width above the pillar. A stress bulb based on $2 \times$ the pillar width has been used in this approach to estimate surface subsidence, as subsidence estimates need to be at the range of anticipated subsidence. A stress bulb of $1 \times$ pillar width, may produce average subsidence, where an upper limit is required for assessment of surface impacts and approvals.

Table 5. First workings subsidence estimates for the current CLZ of first workings EP for varying depths of cover

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	Stress change (MPa)	Subsidence (mm)	Max. tensile strain (mm/m)	Max. compressive strain (mm/m)	Max. tilt (mm/m)
80	3.00	4.02	1.02	10	0.18	0.25	0.61
100	4.50	5.77	1.27	12	0.18	0.25	0.61
150	10.75	12.66	1.91	18	0.18	0.25	0.61
200	13.00	15.54	2.54	25	0.18	0.25	0.61
250	7.25	10.43	3.18	31	0.18	0.25	0.61
290	8.25	11.93	3.68	36	0.18	0.25	0.61
300	8.50	12.04	3.54	36	0.18	0.24	0.60
320	9.00	12.52	3.52	37	0.17	0.23	0.58

Pillar compression subsidence estimates have assumed a Young's Modulus of 7GPa in the roof and floor of the seam. Noting that the immediate roof is comprised of coal of the Lidsdale Seam and tuffaceous clay bands of the LW1. Roof material up to a height of ~30m is expected to comprise of mudstone, siltstone and sandstone having an average UCS of 40MPa.

A Young's Modulus of 7GPa also assumes the strata in the roof and floor of the pillar is intact and has not fractured under the load. A coal modulus of 2GPa was used. These modulus inputs are estimates that have not been validated with site specific data, where it is recommended to refine in further assessments. Maximum surface subsidence is estimated to be 37mm at 320m depth of cover and provides an upper bound to the surface subsidence estimations due to first workings in the CLZ. Maximum surface subsidence at 80m depth of cover is predicted to be approximately 10mm – this is approaching the shallow end of depths expected in the cliff line zone.

Maximum tilt and compressive/tensile strains have been calculated for first workings in the CLZ based on estimated subsidence and are presented in Table 5. Strains (E) and tilts (G) were estimated using the relationship in Holla (1991), where K is a function of maximum subsidence (Smax) and depth (H):

- Tensile strain: $E+ = 1000 \cdot K1 \cdot S_{max} / H$
- Compressive Strain: $E- = 1000 \cdot K2 \cdot S_{max} / H$
- Tilt: $G = 1000 \cdot K3 \cdot S_{max} / H$

K values are based on Holla (1991) data and SCT experience. For single seam extraction values of $K1=1.5$, $K2=2$ and $K3=5$ from the Holla (1991) dataset are considered representative.

Subsidence estimates have previously been provided by Golder Associates in the Cliff Line Zone extraction plan (2017). These subsidence estimates incorporated additional load associated with adjacent future partial extraction. All Golder Associates subsidence equations and subsidence estimates for different scenarios in the Cliff Line Zone can be found in Golder Associates (2017).

It is important to note that the tilts and strains presented in Table 5 are maximum values as they have been calculated using the maximum subsidence magnitude. Tilts and strains are also dynamic, changing as development progresses. Tilts and strains relate to important measures of surface changes relative to impacts on surface features.

Estimated additional subsidence driven by secondary extraction adjacent to the CLZ first workings is presented in Appendix 6

9. SURFACE IMPACTS ASSESSMENT

The impact on surface features due to first workings has been assessed under the current Airly CLZ EP which included subsidence predictions, environmental risk assessments and management plans. The EP found that at predicted subsidence magnitudes, no surface impacts were anticipated (Centennial Coal, 2017).

The pillars reviewed in this report for first workings are expected to be stable and minimally subsiding both in the short-term and longer-term. Subsidence effects, impacts and consequences are consistent with the Airly CLZ EP which expects minimal surface impacts.

The CLZ first workings undermines numerous surface features including:

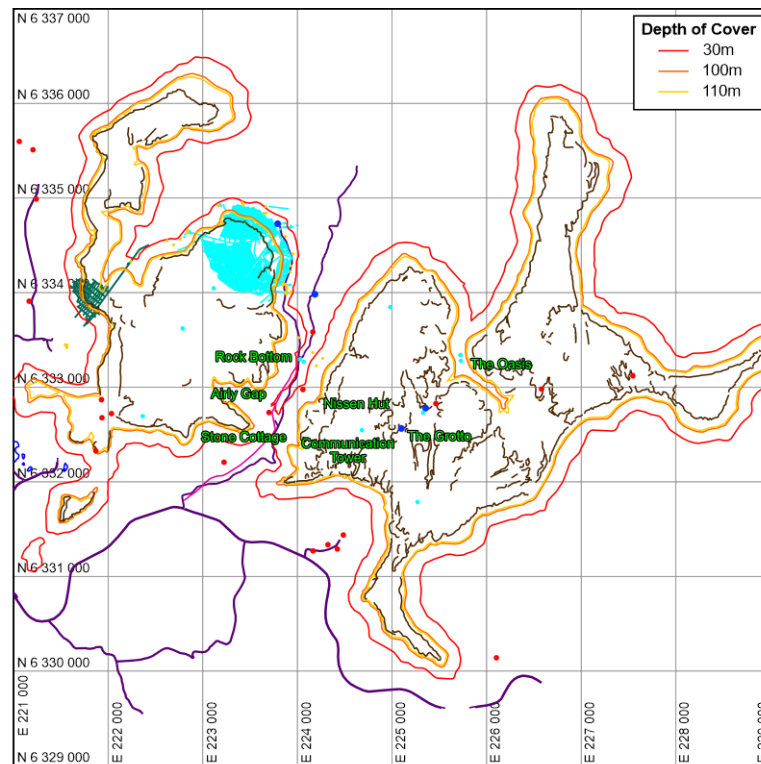
- mesas incorporating cliffs, cliff lines and steep slopes
- exposed sandstone and sandstone overhangs
- rock pagodas and rock outcrops
- ephemeral headwaters (Gap Creek)
- groundwater and aquifers
- unsealed access tracks
- gates and fences
- aquatic and terrestrial fauna and flora
- heritage sites (ML1331)
- Aboriginal heritage sites (ML1881).

Surface features as well as cliff and toe mapping provided by Catalyst Environmental are presented in Figure 15. In addition, cliff tops have been mapped in ML1331 and are shown in Figure 15 in yellow. Figure 15b presents the current and proposed mine plan overlaying the surface features introduced in Figure 15a.

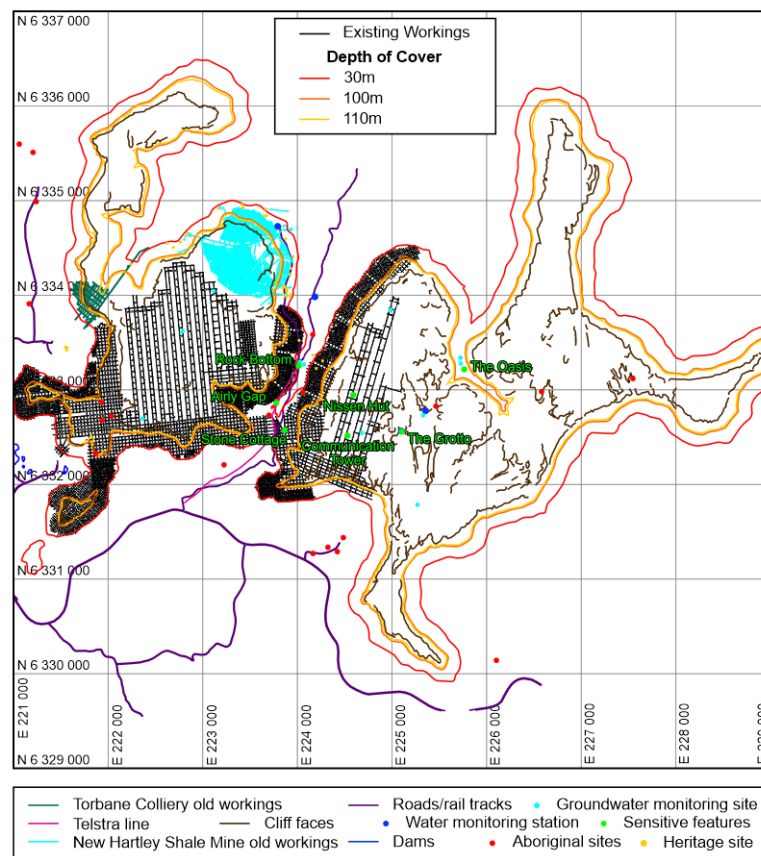
The Independent Expert Panel (IEP) considered the various environmental management plans for proposed first working in the CLZ suitable to manage the unlikely event of surface impacts to cliffs pagodas, steep slopes, and other surface features (Mills K. and Canbulat I., 2017).

In addition to subsidence magnitude, tilt and strain (compressive and tensile) are important factors to consider in assessing surface impacts. Tilts and strain have the potential to induce small-scale movement of the surface. The surface within the CLZ is expected to subside relatively uniformly as pillars are developed. However, the roadway face constantly changes during development and is dependent on sequencing. Therefore, the boundary of mining and the corresponding position of maximum tilts and strains is expected to be dynamic until mining in the CLZ is complete.

Natural joints and faults have the potential to be impacted by mining. These planes of weakness are the least resistant to surface movement and have the potential to move in response to stress changes caused by mining as the surface moves to re-equilibrate.



a) Surface features and cliff and toe mapping over Airly Mine.



b) Airly Mine plan with current and proposed workings overlaying surface features and cliff and toe mapping.

Figure 15: Surface features, cliff and toe mapping and current and proposed Airly Mine Plan.

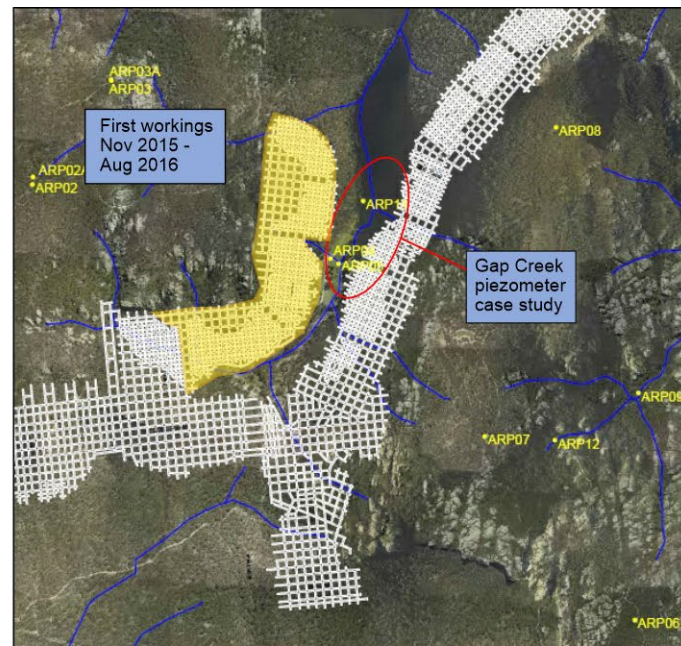
Previous experience at Airly has shown that if the mining horizon water head level is connected to the surface water source, depressurisation of the mining horizon has the potential to produce downwards flow through the fracture network, and more likely through lineaments. The Gap Creek lineament may also aid in the inability to maintain head pressure in the alluvials with its likely higher conductivity providing higher flow rates down to the lowered water table than the surrounding strata (ANP5448, 2022).

A review of potential mining impacts in the Gap Creek lineament at Airly Mine was conducted as first workings were mined adjacent to the lineament. The Lithgow Seam is 25m under Gap Creek and the first workings are approximately 50m from the Gap Creek piezometers. Figure 16 shows the location of the Gap Creek Study in relation to adjacent workings and the mining impact of first workings in the Lithgow Seam and underlying Marrangaroo Formation. With first workings extractions in the Lithgow Seam adjacent to Gap Creek, the Gap Creek piezometers showed a 7m head drop in Lithgow Seam pressure from 744mAHD to 737mAHD. At a high-level, the ephemeral and local nature of the creeks and drainage lines do not appear to be an inrush hazard.

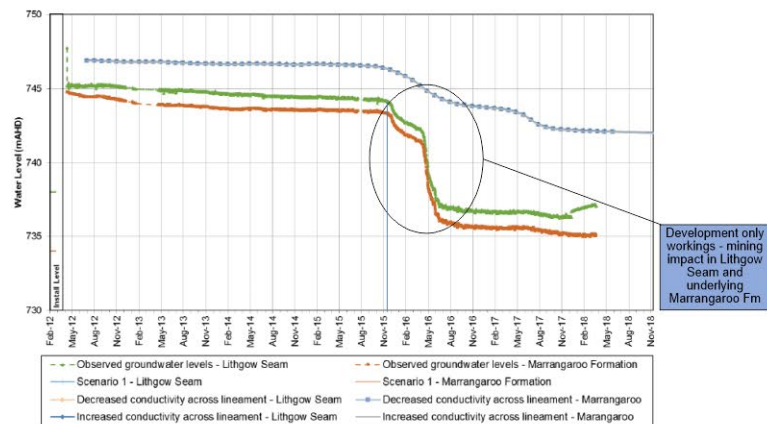
Table 6 presents a high level qualitative risk assessment on the predicted subsidence impacts to the natural features outlined above. The risk level incorporates the current performance measures outlined in the CLZ EP 2017 and the design assessment outcomes of this report. Natural erosion and degradation are not included in the below assessment.

Table 6. High level qualitative risk assessment

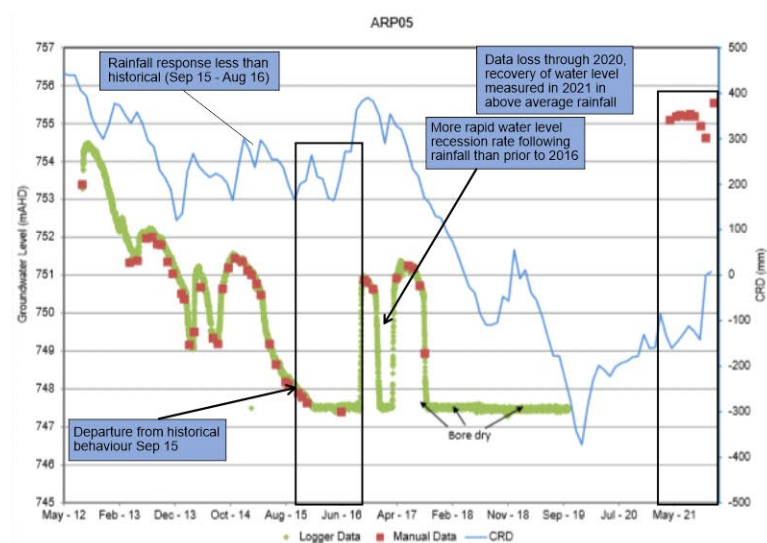
Hazard	Potential Impacts	Current Risk
Mesas incorporating cliffs, cliff lines and steep slopes	Surface cracking, fracturing of surface rocks and structures, collapse, or landslides/displaced rocks.	Low
Exposed sandstone and sandstone overhangs	Surface cracking, fracturing of surface rocks and structures, collapse or landslides/displaced rocks.	Low
Rock pagodas and rock outcrops	Surface cracking, fracturing of surface rocks and structures, destabilising balancing rocks.	Low
4WD roads, fire trails and walking tracks	Closure of tracks due to landslides/displaced rocks or collapse.	Low
Property fences and gates	Destabilising and collapse of fences and gates.	Low
Ephemeral headwaters, flowing creeks and waterways	Downward flow through fracture network and lineaments. Reduction in head level of creek alluvials.	Low Moderate (Lineaments)



a) Location of Gap Creek piezometer study and first workings.



b) Lithgow Seam head pressure during adjacent first workings mining.



c) Alluvial ground water levels in Gap Creek.

Figure 16: Airly Mine first workings to alluvials connectivity example.
Source: Centennial 2021 (SCT 2022b).

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SCT, 2022b. Angus Place West Project Overburden Conductivity and Connectivity Review. Report No. ANP5448. Dated 27 June 2022.

Strata, 2019. 121 and 200 Panel Subsidence Monitoring Outcomes. Report No. AIR-007-Rev0. 29 May 2019.

APPENDIX 1 – 401 PANEL 12CT THROUGH TO MW-15 MG PHOTOGRAPHS



Appendix 1.1: 401 Panel G HDG 12CT 40m DOC.



Appendix 1.2: 401 Panel E HDG 15CT Overcast.



Appendix 1.3: 401 Panel D-E HDG 12CT 120m DOC.



Appendix 1.4: 401 Panel C HDG 13-14 CT 200m DOC.



Appendix 1.5: 401 Panel C HDG 12CT 200m DOC.



Appendix 1.6: 401 Panel A_B HDG 12CT 150m DOC.



Appendix 1.7: 401 Panel MW-15 MG 3CT 200m DOC.



Appendix 1.8: 401 Panel MW-15 MG 5CT 240m DOC.

APPENDIX 2 – 400 PANEL 4CT PHOTOGRAPHS



Appendix 2.1: 400 Panel G HDG 4CT 50m DOC.



Appendix 2.2: 400 Panel E HDG 4 CT 100m DOC.



Appendix 2.3: 400 Panel B HDG 4 CT 130m DOC.



Appendix 2.4: 401 Panel A HDG 1CT 110m DOC.

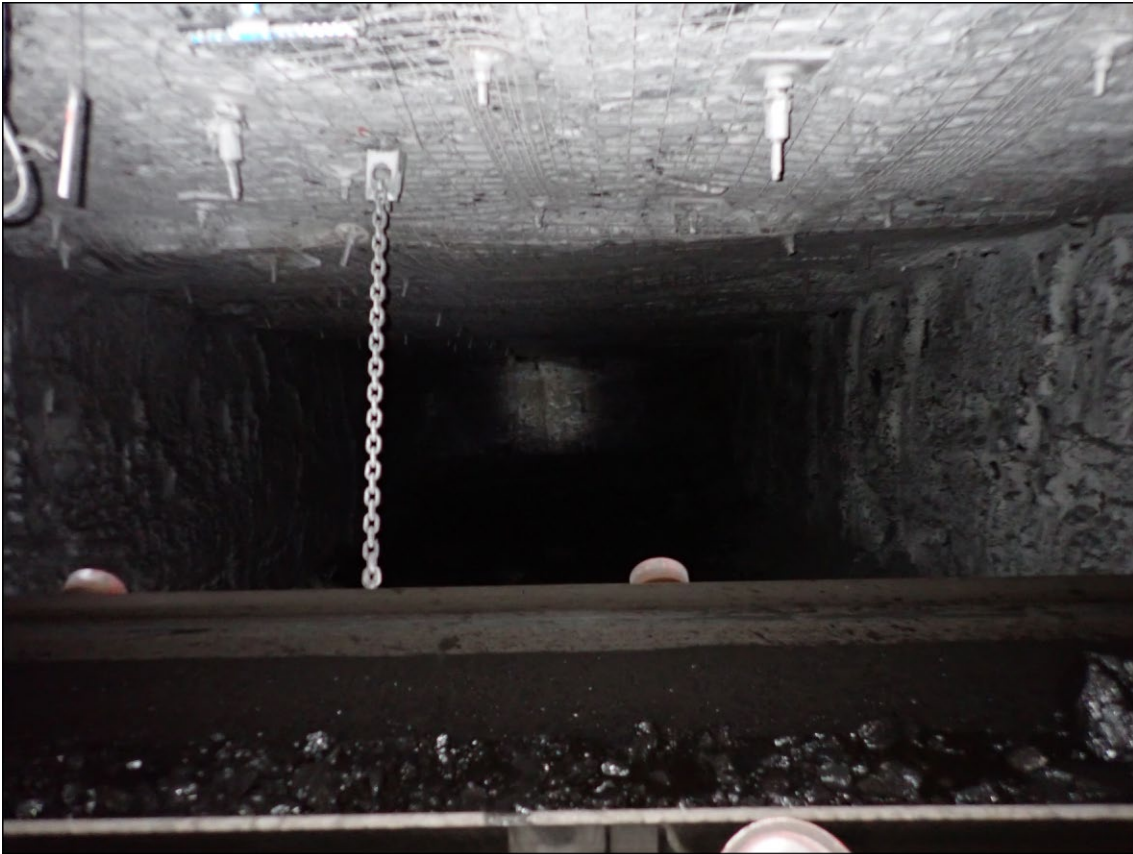


Appendix 2.5: 401 Panel A HDG 1CT 120m DOC.



Appendix 2.6: 401 Panel Z HDG 1CT 130m DOC.

APPENDIX 3 – 205 PANEL THROUGH MW-01 TG B HEADING PHOTOGRAPHS



Appendix 3.1: 205 Panel E HDG 9CT 30m DOC.



Appendix 3.2: 205 Panel C HDG 9 CT 60m DOC.



Appendix 3.3: 205 Panel A HDG 9CT 90m DOC.



Appendix 3.4: 205 Panel Z HDG 9CT 120m DOC.



Appendix 3.5: 205 Panel Y HDG 9 CT 150m DOC.



Appendix 3.6: 205 Panel X HDG 9 CT 200m DOC.



Appendix 3.7: 100 Panel A HDG 26CT 250m DOC.

APPENDIX 4 – PILLAR FOS USING THE BIENIAWSKI PILLAR STRENGTH FORMULA

The Bieniawski (1992) pillar strength formula was also used for pillar strength. This formula allows variation of roof and floor contacts to be considered in the estimation of pillar strength. For this reason, the Bieniawski pillar strength formula is the SCT preferred approach for pillar design.

The strength of the designed CLZ EP pillars were calculated using the UNSW and Bieniawski pillar strength formula as shown below in Equation 1 and Equation 2:

$$1. \text{ Bieniawski } Sp = S1(0.64+0.36*w/h)$$

where:

$$S1 = \text{coal strength}$$

A coal strength of 5MPa was used for the Bieniawski calculations, which is a representative estimation of the coal mass strength at Airly Mine, including roof and floor contacts. Joint SCT and UNSW ACARP C9018 found that the use of an in-situ coal strength of 6MPa for moderate strength (siltstone, laminite) competent roof and floor, and the use of 4MPa for weak materials, provided a good first pass on the implication of variation in host strata strength properties, when using the Bieniawski-based linear formulae (Gale W.J. and Hebblewhite B., 2005).

It is understood that the Lithgow Seam coal strength at Airly Mine ranges from 5MPa to 10MPa (Golder Associates, 2014). The application of 5MPa coal strength has taken into consideration pillar observation during the site visit noting rib failure at less than 150m depth of cover and the potential occurrence of the LW1 claystone band in the pillar roof contact.

Table A4-1. Minimum Pillar Sizes using UNSW FoS for first workings with Bieniawski FoS.

Depth of Cover (m)	Pillar Centres (m)	Solid pillar width (m)	Effective Pillar Width (m)	Pillar w/h ratio	Pillar FoS (UNSW)	Pillar FoS (Bieniawski)
80	35	29.5	28.5	9.5	6.28	5.05
100	35	29.5	28.5	9.5	5.29	4.26
150	35	29.5	28.5	9.5	3.79	3.05
200	35	29.5	28.5	9.5	2.95	2.38
230	35	29.5	28.5	9.5	2.61	2.10
250	35	29.5	28.5	9.5	2.42	1.95
280	35*	29.5	28.5	9.5	2.18	1.76
300	37*	31.5	30.5	10.2	2.32	1.79
320	39*	33.5	32.5	10.8	2.47	1.81

*Minimum pillar dimensions required to maintain 1/10 depth of cover. Pillar sizes at depths greater than 230m DoC have a Bieniawski factor of safety of less than 2.11

APPENDIX 5 – ADDITIONAL PILLAR LOADING DUE SECONDARY EXTRACTION

Secondary extraction in the form of miniwall mining and partial pillar extraction is proposed adjacent to the CLZ first workings in some areas of the mining lease. Secondary extraction in close proximity to the CLZ will result in additional vertical stress on the CLZ pillars from additional abutment load therefore impacting designed pillar stability and predicted subsidence.

A 40m barrier has been adopted between first workings pillars in the CLZ and the (future) secondary extraction voids of the panel and pillar mining zone as recommended by the Independent Review Panel (IRP). Additional stipulation also states that the offset between first workings and splitting and quartering is determined by the greater of the following:

- Beyond a 26.5-degree angle of draw (AOD) of cliffs in the CLZ;
- In areas where in-situ pre-mining/pre-development vertical stress loads are <3Mpa or post-development/prior to secondary extraction vertical stress loads are <4Mpa;
- At depth of cover >30m and <110m; and
- An offset >30m from the identified base of the cliff (in the CLZ).

The above 26.5-degree AOD will typically result in offset distance >40m. For completeness of this design review, offsets ranging from 0m to 100m have been assessed with 40m, 50m and 60m specifically presented.

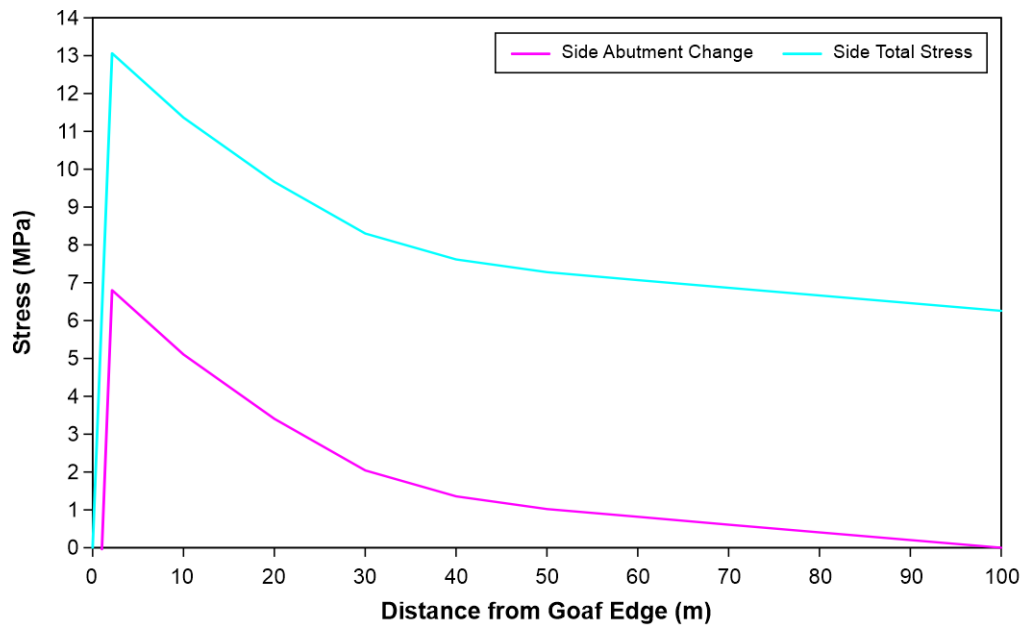
Additional pillar loading has been assessed at various depths of cover for future potential secondary extraction. Side abutment loading profiles have been calculated using side abutment load distributions inferred from SCT stress measurements. SCT stress measurements have also been cross referenced with ALPS calculations. The side abutment loading profiles have included miniwall widths of 61m and pillar geometries aligned with those used in the pillar design review:

- Pillar width (centre to centre) (m): 35m
- Effective roadway width: 6.5m (pillar width reduction of 1m)
- Effective extraction height: 3.0m.

The roadway width and extraction heights refer to effective dimensions. These are considered realistic as previously discussed. The side abutment load and total side abutment load are presented in Figure A5-1 for 250m depth of cover. This is considered the highest additional pillar loading due to future potential secondary extraction adjacent to the CLZ.

Immediately adjacent to the miniwall goaf the stress increase is estimated to be in the order of 6MPa. This stress increase reduces to no additional abutment stress 100m from the miniwall goaf. Shallower depths of cover will result in lower magnitudes of abutment loading and regress to no additional load over shorter distances.

The pillar FoS for the current CLZ EP 35m pillar centres relative to offset distance are presented in Table A5-1.



Appendix 5.1: Side abutment loading on pillar at 250m depth of cover.

Table A5-1. Pillar Factor of Safety for current CLZ of first workings EP adjacent to secondary extraction – 35m pillar centres

Depth (m)	Pillar centres (m)	Effective solid pillar width (m)	Pillar w/h ratio	Pillar FoS (UNSW)	UNSW Fos with Offset (m)			Bien. Fos with Offset (m)		
					40	50	60	40	50	60
80	35	28.50	9.5	6.28	6.28	6.28	6.28	5.05	5.05	5.05
100	35	28.50	9.5	5.29	5.29	5.29	5.29	4.26	4.26	4.26
150	35	28.50	9.5	3.79	3.46	3.62	3.79	2.79	2.91	3.05
200	35	28.50	9.5	2.95	2.65	2.72	2.79	2.13	2.19	2.25
250	35	28.50	9.5	2.42	2.14	2.20	2.24	1.72	1.77	1.81
250-290	37.5	31.00*	10.3	2.47	2.14	2.23	2.27	1.63	1.69	1.73
300	38	31.5*	10.5	2.47	2.14	2.22	2.27	1.61	1.67	1.71
320	39	32.5*	10.8	2.47	2.13	2.21	2.26	1.56	1.62	1.66

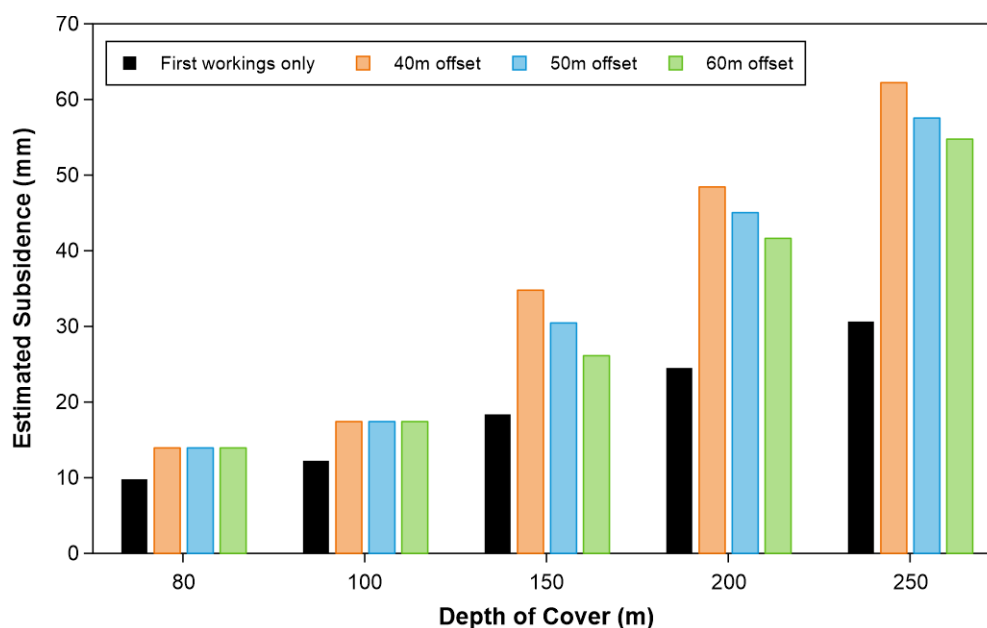
*Pillar Centres required to achieve >2.11 FoS at 290m, 300m and 320m DOC and 40m offset

APPENDIX 6 – ADDITIONAL SUBSIDENCE DUE SECONDARY EXTRACTION

Estimated additional subsidence driven by secondary extraction is presented in Figure A6-1 alongside estimated subsidence from first workings only. This assessment follows the additional loading assessment conducted in Chapter 7.2 which assumes miniwall extraction as the secondary extraction method.

Modelling indicated that vertical stress increase above the pillar adjacent to secondary extraction extended $\sim 3 \times$ the pillar width. A bulb factor of 3 has been used for pillar subsidence estimates adjacent to secondary extraction. The result is that surface subsidence estimates are increased.

There are two key takeaways to consider with additional subsidence from secondary extraction. Firstly, the closer the pillars are to the potential secondary extraction the larger the subsidence magnitude increase is expected to be on first workings in the CLZ. Secondly, the greater the depth of cover the greater the additional loading caused by secondary extraction. As a result, the increase in surface subsidence is proportionally higher than at relatively shallower depths. These trends can be observed in Figure A6-1.



Appendix 6.1: Estimated subsidence from first workings and additional subsidence from potential secondary extraction at varying depths of cover.

Table A6-1 presents the estimated subsidence, tilts and strains above first workings in the CLZ where secondary extraction has occurred with an offset of 40m. The areas potentially impacted by abutment loading are expected to show greater subsidence than the typical workings of the CLZ. In the case of 320m depth of cover the surface subsidence is expected to increase from 37mm to 69mm due to secondary extraction at 40m.

Table A6-1. Estimated subsidence, tilt and strains driven by a 40m offset between first workings and secondary extraction for the proposed pillar design.

Depth (m)	Vertical stress (MPa)	Ave. pillar stress (MPa)	Stress change (MPa)	Subsidence (mm)	Maxi. tensile strain (mm/m)	Max. compressive strain (mm/m)	Max. Tilt (mm/m)
80	3.00	4.02	1.02	14	0.26	0.35	0.87
100	3.50	4.77	1.27	17	0.26	0.35	0.87
150	4.75	6.61	1.86	26	0.26	0.34	0.85
200	6.00	9.53	3.53	48	0.36	0.48	1.21
250	7.25	11.79	4.54	62	0.37	0.50	1.24
290	8.25	13.60	5.35	73	0.38	0.51	1.27
300	8.50	13.88	5.38	78	0.39	0.52	1.31
320	9.00	14.53	5.53	85	0.40	0.53	1.33

16 November 2023

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Dear Jacqueline

CLIFF LINE ZONE PILLAR DESIGN REVIEW FOR AN INCREASED EXTRACTION HEIGHT

Airly Mine requested SCT Operations Pty Ltd (SCT) to provide a review of the first workings pillar geometries completed by SCT in May 2023 for input into the Cliff Line Zone (CLZ) Extraction Plan (EP). The pillar stability review was requested to account for an increase in roadway height from 3.0 m to 3.2 m. The initial work package is presented in SCT report AIRLY5535_Rev3: Pillar Geometry Guidelines for Cliff Line Zone Extraction Plan, dated 15 May 2023.

First workings at Airly Mine incorporate mine development of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features. At the time of the AIRLY5535 report, the CLZ first workings pillar design was assessed based on the range of geometries, including depth of cover, that spanned the CLZ area of mining lease ML1814. Subsequent mine design following the AIRLY5535 report refined the pillar geometries and locations allowing for a more detailed pillar review, incorporate the 3.2 m roadway height.

Centennial Coal (Centennial) are currently working under the Airly Mine CLZ First Workings EP, developed in 2017, which incorporates the CLZ located within existing Mining Lease ML1331. Centennial aim to develop a CLZ EP that covers the adjacent Mining Lease ML1814. The first workings CLZ, existing and proposed workings and mining leases are shown in Figure 1.

This letter report presents the review of the adequacy of coal pillar sizes for the first workings in the CLZ EP for a 3.2 m extraction height. Subsidence estimates are also presented.

1. SCOPE OF WORK

A scope of work was provided by Centennial via email on 10 November 2023. The scope included the requirement to conduct a review of the AIRLY5535_Rev3 report involving the pillar geometry assessment for the CLZ EP for ML1814 for an increased roadway height of 3.2 m.

Pillar geometries have been developed to optimise the CLZ EP using the CLZ first workings design guidelines including.

- Minimum pillar widths are limited to a W/H ratio of greater than 8. This is based on the design criteria presented in the EIS and supported by Hill (2005) for underground workings beneath critical surface structures and/or features.
- Minimum pillar system Factor of Safety (FoS) is > 2.11 for underground workings beneath critical surface structures and/or features.
- Minimum pillar dimensions required to maintain 1/10 depth of cover.
- For first workings adjacent to secondary extraction, minimum pillar sizes for the CLZ EP need to be increased due to additional abutment load.

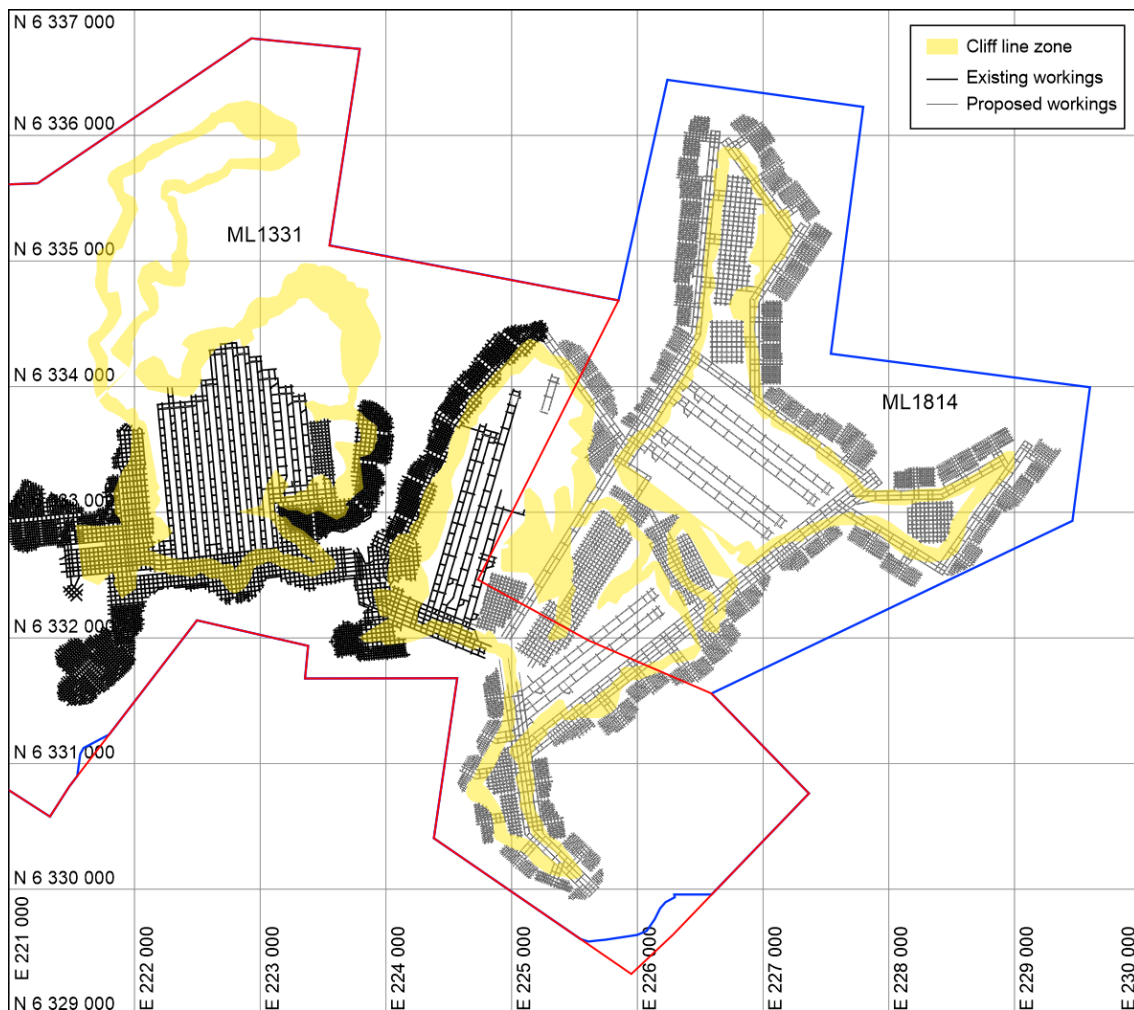


Figure 1: Cliff Line Zone of First Working at Airly Mine showing the mine plan and mining lease.

2. CONCLUSION

A robust methodology has been applied to estimate pillar loading and surface impacts in the CLZ at Airly Mine with an increased roadway height of 3.2 m.

The mine plan for the first workings in the CLZ for ML1814 is consistent with the designing of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features.

The design review identified that a 3.2 m roadway height for 35 m pillar centres at a depth of cover greater than 260 m would have a FOS < 2.11 and would not be considered long term stable. However, the proposed mine plan does not contain any full 35 m square pillars under the CLZ at a depth greater than 260 m.

Barrier pillar dimensions between CLZ first workings and secondary extraction are sufficient to maintain a pillar FOS > 2.11.

Predicted subsidence magnitudes have not been significantly impacted by the increased roadway height to 3.2 m. A maximum subsidence of 37 mm is predicted for first workings within the CLZ. A maximum subsidence of 55 mm would be expected at a DOC 260 m, using 35 m square pillar centres within 60 m of secondary miniwall extraction.

The natural sequence of erosion within the CLZ through both exposure to the elements and vegetation exploiting natural rock joints is expected to result in naturally occurring rock falls. It is important to note that these naturally occurring events cannot be eliminated through mine design. The design covered by this report relates to mining induced surface impacts only.

3. PILLAR ASSESSMENT FOR FIRST WORKINGS IN THE CLZ

The full methodology for the CLZ first workings pillar design assessment can be found in the SCT report AIRLY5535. A summary of the main design parameters include.

- In the CLZ at Airly Mine, the vertical load is not as easily estimated as the load from high topography can be redistributed to areas of shallower depth below the cliffs, increasing pillar load. An additional 1 MPa of vertical load has been incorporated when calculating the adequacy of the CLZ coal pillar sizes for first workings at Airly Mine.
- The UNSW method was applied to maintain a consistent representative approach to the previous design work presented in the CLZ EP 2017 report.
- A FOS of 2.11 is considered long term stable in the UNSW pillar design guidelines, equating to a 1:1,000,000 probability of pillar failure. Any pillars that are required to be long term stable, such as barrier pillars or pillars protecting specific surface features, are required to have a FOS at a minimum of 2.11.
- Theoretical minimum pillar widths have been limited to a W/H ratio of greater than 8. This is based on the design criteria presented in the EIS and is supported by Hill (2005) for underground workings beneath critical surface structures and/or features.
- For a given W/H ratio, a pillar's strength varies depending on the lithology of the roof and floor contacts. In addition to roof and floor contact lithology, there are several factors that can reduce the pillar strength. These commonly include:
 - Off plan drivage.
 - Rib spall – with vertical stress >5-6 MPa.
 - Increase in effective pillar height – due to spall and increased extraction of interbedded coal strata in the immediate roof.
- With the above factors considered, an effective pillar width reduction of 1mm was applied by SCT in the pillar stability assessment.

- As requested, the assessment has been reviewed using an increased roadway height to 3.2 m using the planned pillar locations as supplied by Airly Mine in Design –P36-LOM-SCT.dwg.

Table 1 presents the results of the CLZ EP pillar geometry review of 35 m square centres for varying depths of cover. Applying the same geometry as the minimum theoretical pillars by assuming a roadway width of 6.5 m, the effective solid pillar width becomes 28.5 m (for 35 m square centre pillars). The pillar width to height ratio is 8.9 based on an effective roadway height of 3.2 m.

Using the UNSW pillar strength formula and pillar sizes presented in Table 1, the FoS for depths greater than 260 m using square 35 m pillar centres are < 2.11 and would not be considered long term stable.

A review of the CLZ first workings mine plan indicates:

- There are no full 35 m pillar centres at depths greater than 260 m.
- Two pillars with 35 m centres were identified with partial depth of cover greater than 260 m. Both pillars are adjacent to solid coal barriers and maintain more than 78 % of total area at a depth less than 260 m and would be considered long term stable.
- All pillars at depths greater than 260 m have been designed with a larger pillar length, therefore increasing the effective pillar width and associated FOS.

Table 1: Pillar Factor of Safety for current CLZ of first workings EP-35 m pillar centres

Depth of Cover (m)	Pillar Centres (m)	Effective Pillar Width (m)	3.0 m Roadway Height		3.2 m Roadway Height	
			Pillar w/h ratio	Pillar FoS (UNSW)	Pillar w/h ratio	Pillar FoS (UNSW)
80	35	28.5	9.5	6.28	8.9	5.61
100	35	28.5	9.5	5.29	8.9	4.73
150	35	28.5	9.5	3.79	8.9	3.39
200	35	28.5	9.5	2.95	8.9	2.64
230	35	28.5	9.5	2.61	8.9	2.33
260	35	28.5	9.5	2.42	8.9	2.09
290	35	28.5	9.5	2.11	8.9	1.89
300	37*	30.5	10.2	2.32	9.8	2.18
320	39*	32.5	10.8	2.47	10.2	2.18

*Minimum pillar dimensions required to maintain geometry >1/10 depth of cover.

The mine plan for the first workings in the CLZ for ML1814 is consistent with the designing of roadways and cut throughs to form long term stable pillars, to reduce subsidence and protect surface features. Figure 2 shows the planned first workings in the CLZ with the 260 m DOC contour highlighted.

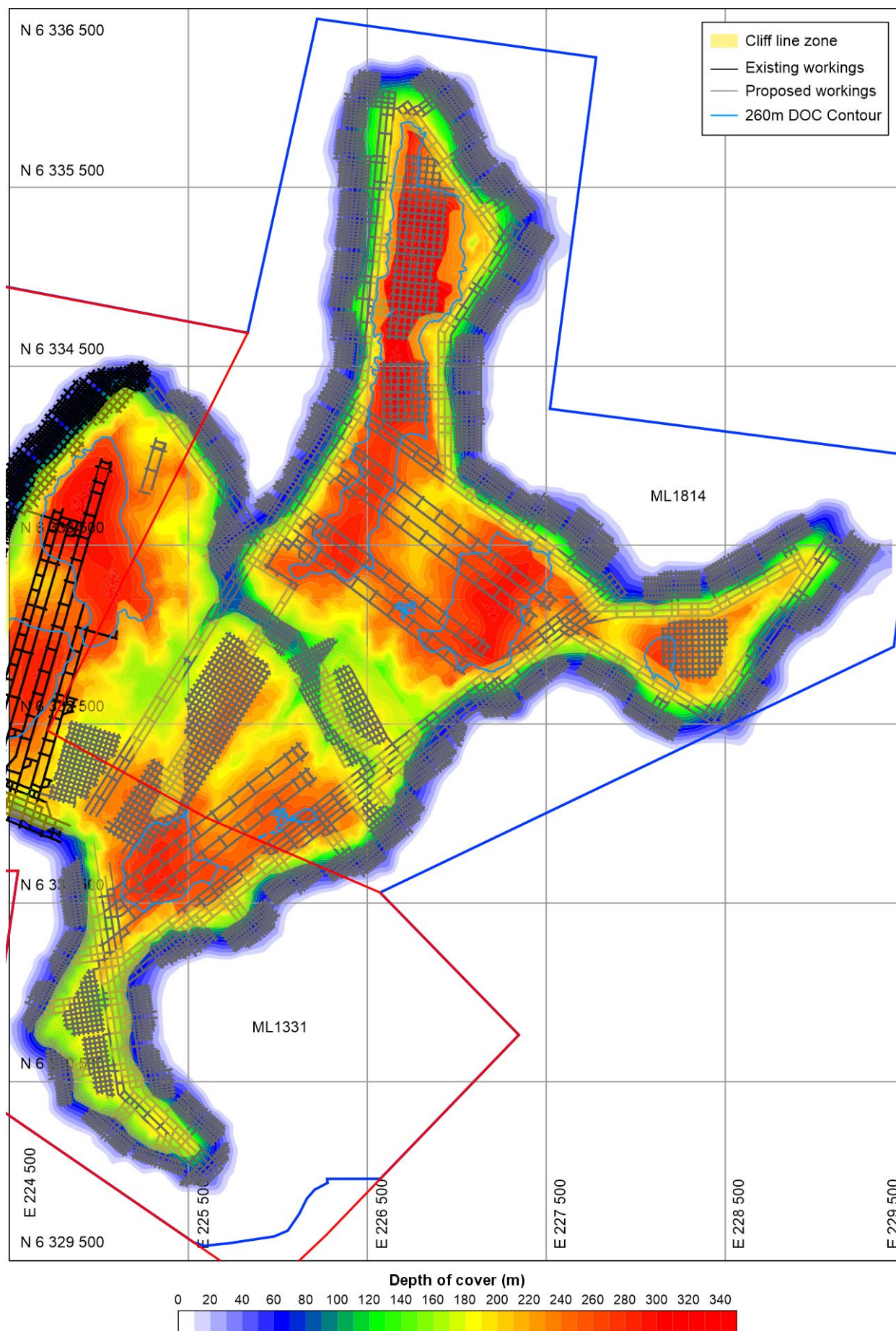


Figure 2: Planned CLZ first workings pillar geometry.

Secondary extraction in the form of miniwall mining and partial pillar extraction is proposed adjacent to the CLZ first workings in some areas of the mining lease. Secondary extraction near the CLZ will result in additional vertical stress on the CLZ pillars from additional abutment load therefore impacting designed pillar stability and predicted subsidence. Appropriate barriers have been implemented in the design to reduce the additional abutment load with no pillars falling below a FOS of 2.11.

4. SUBSIDENCE ASSESSMENT

Subsidence estimates have been calculated assuming the strata above the pillar will behave elastically due to additional load introduced by first workings. Subsidence estimates have been calculated for 35 m square centre pillars for first workings and are provided in Table 2. The subsidence estimates have been calculated assuming an effective roadway width of 6.5 m and cut height of 3.2 m. This is considered a realistic approach which factors in operator variation, offline driveage, rib spall, and reduced capacity rib support, all of which were observed during the site visit in November 2022.

Table 2: First workings subsidence estimates for the CLZ of first workings EP for a 3.2 m roadway height

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	Stress change (MPa)	Subsidence (mm)	Max. tensile strain (mm/m)	Max. compressive strain (mm/m)	Max. tilt (mm/m)
80	3.00	4.02	1.02	10	0.19	0.25	0.62
100	3.50	4.77	1.27	12	0.19	0.25	0.62
150	4.75	6.66	1.91	19	0.19	0.25	0.62
200	6.00	8.54	2.54	25	0.19	0.25	0.62
250	7.25	10.43	3.18	31	0.19	0.25	0.62
290	8.25	11.93	3.68	36	0.19	0.25	0.62
300	8.50	12.04	3.54	36	0.18	0.24	0.61
320	9.00	12.52	3.52	38	0.18	0.24	0.60

Pillar compression has been calculated by multiplying the pillar width by a bulb factor of 2. This bulb factor is derived from numerical model results which show that vertical stress increase due to pillar extraction is observed $\sim 1 \times$ pillar width above the pillar. A stress bulb based on $2 \times$ the pillar width has been used in this approach to estimate surface subsidence, as subsidence estimates need to be at the range of anticipated subsidence. A stress bulb of $1 \times$ pillar width, may produce average subsidence, where an upper limit is required for assessment of surface impacts and approvals.

Pillar compression subsidence estimates have assumed a Young's Modulus of 7GPa in the roof and floor of the seam. Noting that the immediate roof is comprised of coal of the Lidsdale Seam and tuffaceous clay bands of the LW1. Roof material up to a height of ~ 30 m is expected to comprise of mudstone, siltstone and sandstone having an average UCS of 40MPa.

A Young's Modulus of 7GPa also assumes the strata in the roof and floor of the pillar is intact and has not fractured under the load. A coal modulus of 2GPa was used. These modulus inputs are estimates that have not been validated with site specific data, where it is recommended to refine in further assessments. Maximum surface subsidence is estimated to be 37 mm at 320 m depth of cover and provides an upper bound to the surface subsidence estimations due to first workings in the CLZ. Maximum surface subsidence at 80 m depth of cover is predicted to be approximately 10 mm – this is approaching the shallow end of depths expected in the cliff line zone.

Maximum tilt and compressive/tensile strains have been calculated for first workings in the CLZ based on estimated subsidence and are presented in Table 2. Strains (E) and tilts (G) were estimated using the relationship in Holla (1991), where K is a function of maximum subsidence (Smax) and depth (H):

- Tensile strain: $E+ = 1000 \cdot K1 \cdot S_{max} / H$
- Compressive Strain: $E- = 1000 \cdot K2 \cdot S_{max} / H$
- Tilt: $G = 1000 \cdot K3 \cdot S_{max} / H$

K values are based on Holla (1991) data and SCT experience. For single seam extraction values of $K1=1.5$, $K2=2$ and $K3=5$ from the Holla (1991) dataset are considered representative.

It is important to note that the tilts and strains presented in Table 2 are maximum values as they have been calculated using the maximum subsidence magnitude. Tilts and strains are also dynamic, changing as development progresses. Tilts and strains relate to important measures of surface changes relative to impacts on surface features.

Estimated additional subsidence driven by secondary extraction is presented in Figure 3 alongside estimated subsidence from first workings only. This assessment assumes miniwall extraction as the secondary extraction method.

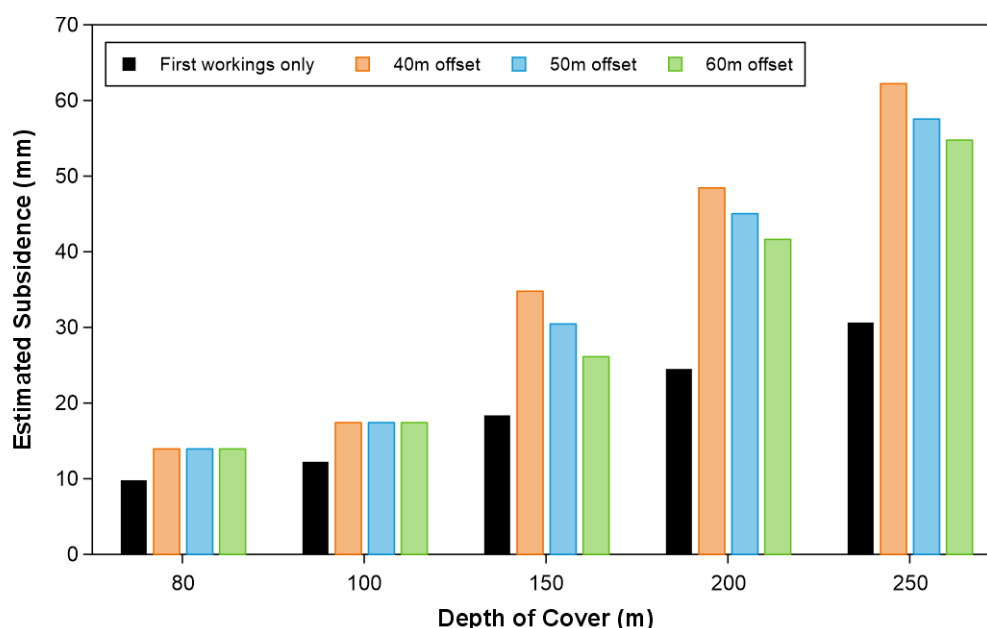


Figure 3: Estimated subsidence from first workings and additional subsidence from potential secondary extraction at varying depths of cover.

Modelling indicated that vertical stress increase above the pillar adjacent to secondary extraction extended $\sim 3 \times$ the pillar width. A bulb factor of 3 has been used for pillar subsidence estimates adjacent to secondary extraction. The result is that surface subsidence estimates are increased.

There are two key takeaways to consider with additional subsidence from secondary extraction. Firstly, the closer the pillars are to the potential secondary extraction the larger the subsidence magnitude increase is expected to be on first workings in the CLZ. Secondly, the greater the depth of cover the greater the additional loading caused by secondary extraction. As a result, the increase in surface subsidence is proportionally higher at greater depths.

Appropriate barriers (> 60 m) have been implemented in the design to reduce the additional subsidence. A maximum subsidence of 55 mm would be expected at a DOC 260 m, using 35 m square pillar centres within 60 m of secondary miniwall extraction.

The natural sequence of erosion within the CLZ through both exposure to the elements and vegetation exploiting natural rock joints is expected to result in naturally occurring rock falls. It is important to note that these naturally occurring events cannot be eliminated through mine design. The design covered by this report relates to mining induced surface impacts only.

Yours sincerely



Adrian Rippon
Principal Geotechnical Engineer

5. REFERENCES

SCT 2023. Pillar Geometry Guidelines for Cliff Line Zone Extraction Plan. SCT Report AIRLY5535_Rev3, dated 15 May 2023.

BASELINE BIODIVERSITY REPORT

MW17-19 EP Area and CLZ (ML1814) EP Area



152229

2

01 February 2023

REPORT

Document status

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Approval for issue

Mark Aitkens



26 September 2022

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EXECUTIVE SUMMARY

This Baseline Biodiversity Report characterises the existing biodiversity values within areas subject to future underground coal mining, these being the MW17-19 Extraction Plan (EP) area and the Cliff Line Zone (CLZ) EP area within Mining Lease (ML) 1331 and 1814. Emphasis is placed on the presence or likelihood of threatened species, populations, and ecological communities (or their habitats) occurring within the EP areas as listed under the NSW *Biodiversity Conservation Act 2016* (BC Act), *Fisheries Management Act 1994* (FM Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This baseline assessment has informed the subsidence and environmental risk assessment for these EP areas, as well as the relevant management and monitoring measures to be included in the EP and associated Biodiversity Monitoring Plans (BMPs). Potential mining induced impacts and management measures will be addressed in each EP and associated BMP.

Landscape context

The EP areas are within the Capertee Uplands of the South Eastern Highlands Interim Biogeographic Regionalisation for Australia, and is within the Mugii Murum-ban State Conservation Area. Connectivity through the Greater Blue Mountains World Heritage Area is provided through the Gardens of Stone National Park to the south and Capertee National Park to the north. The study area contains diverse geological and geomorphological features, such as pagoda rock formations and precipitous sandstone escarpments with elevations of above 1000m.

The underlying geology of the study area comprises Narrabeen Group—fine-grained lithic sandstone occasionally interbedded with thin shale lenses. The EP areas span four soil landscapes with ridgetops predominately ‘Warragamba’ and ‘Wollangambe’ soil landscapes, with isolated patches of basalt influence within ‘Mount Tomah’ soil landscape. Lower elevations consist of ‘Hassans Walls’ soil landscape. The EP area forms a part of the Capertee River sub-catchment with several first, second and third order drainage lines which flow into the main tributary of Genowlan Creek which is predominately fed by rainfall based flows. However, rainfall is held in the Quaternary strata and released slowly into the reaches of Genowlan Creek above the Grotto and the Oasis areas. Flows through the Oasis are constant and are considered a component of baseflow (GHD 2014).

Biodiversity values

Broad-scale vegetation types occurring in the EP areas include dry sclerophyll forest, wet sclerophyll forest and heath with finer scale mapping identifying the presence of at least 12 plant community types (PCTs). Sensitive biodiversity features within the EP areas include:

- Sensitive landscape features;
- Threatened Ecological Communities (TECs);
- Facultative Ecosystems;
- Threatened flora; and
- Threatened fauna.

Vegetation by EP area is further described as follows.

MW17-19 EP area

The vegetation predominately consists of PCTs 3865, 3686 and 3695 which are heath communities and open forests typical of ridgetops. No TECs occur within this EP area.

No GDEs have been identified within the EP Area (GHD 2014). One facultative ecosystem may occur within the gullies on the edges of the EP area, this being vegetation described as Western Blue Mountains Monkey Gum Gully Forest (PCT 3495), which occurs along moist gullies. This vegetation is identified as a ‘Facultative Ecosystem’ as it is unlikely to be entirely dependent on groundwater resources, and may rely on groundwater on a seasonal basis or only during extended drought periods (Serov et al 2012; RPS 2014).

One threatened flora species is known to occur within this EP area. *Prostanthera stricta* (Mount Vincent Mint Bush; BC Act: Vulnerable; EPBC Act: Vulnerable).

One threatened fauna species is persistent within the EP area. The Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable), frequents the area feeding on abundant stands of *Allocasuarina* species.

Other mobile threatened fauna species particularly woodland birds, microbats, reptiles and arboreal mammals would utilise the habitat features within the area. Key habitat features include:

- Sandstone habitats: pagodas, steep cliffs and escarpments, rocky outcrops or piles of sandstone boulders, caves, crevices and ledges for microbats and reptiles such as the Broad-headed Snake (*Hoplocephalus bungaroides*; BC Act: Endangered; EPBC Act: Vulnerable) and Rosenberg's Goanna (*Varanus rosenbergi*; BC Act: Vulnerable);
- Flowering and fruiting plants: utilised as foraging habitat for woodland birds and mammals such as the Flame Robin (*Petroica phoenicea*; BC Act: Vulnerable), the Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable; EPBC Act: Endangered) and the Greater Glider (*Petauroides volans*; EPBC Act: Endangered);
- *Allocasuarina* species: for foraging Glossy Black-Cockatoos (*Calyptorhynchus lathami*; BC Act: Vulnerable); and
- Koala feed trees: within woodland vegetation including *Eucalyptus cypellocarpa*, *Eucalyptus piperita* and *E. punctata*.

Implications for mining and recommendations

Approvals for Panel and Pillar Mining within MW17-19 EP area are based on predicted surface subsidence levels of up to 100-125mm (Centennial 2021). Based on this mine design, the proposed MW17-19 EP area is unlikely to have negative implications on the aforementioned key biodiversity feature.

During the 2022 monitoring programme across the Mining Lease Area, the following baseline monitoring was conducted:

- Continued monitoring of threatened species and their habitats;
- Additional *Prostanthera stricta* monitoring transects established within the EP Area; and
- Additional glossy black-cockatoo monitoring be established within the EP area.

CLZ EP area

The CLZ EP area contains sensitive landscape features including the deeply incised gorges named the Grotto and Oasis which forms a tributary of the Genowlan Creek.

Vegetation communities

The vegetation varies from PCT 3686, 3695 and 3865 along ridgetop cliff edges, to PCT 3226 and 3495 within the gullies. One TEC occurs within this EP area. PCT 3859 within the study area forms a part of the Genowlan Point *Allocasuarina nana* Heathland EEC listed under the BC Act.

No high priority GDEs have been identified within the study area, although there is potential for facultative ecosystems existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017). PCTs association with facultative ecosystems include the following:

- 3226: Western Blue Mountains Montane Wet Fern Forest;
- 3495: Western Blue Mountains Monkey Gum Gully Forest; and
- 3731: Capertee Conglomerate Grey Gum-Stringybark Forest.

Threatened flora

Two threatened flora species are known to occur within the CLZ EP area (**Figure 3-8**):

- *Prostanthera stricta* (Mount Vincent Mint Bush; BC Act: Vulnerable; EPBC Act: Vulnerable); and
- *Pultenaea* sp. Genowlan Point (BC Act: Critically Endangered; EPBC Act: Critically Endangered).

Threatened fauna

Threatened fauna utilise the diverse habitats of the CLZ EP area including diurnal bird species, forest owls, mammals, microbats and reptiles. Key habitats for threatened fauna within the CLZ EP area include:

- Sandstone habitats: pagodas, steep cliffs and escarpments, rocky outcrops or piles of sandstone boulders, caves, crevices and ledges for microbats and reptiles such as the Broad-headed Snake (*Hoplocephalus bungaroides*; BC Act: Endangered; EPBC Act: Vulnerable) and Rosenberg's Goanna (*Varanus rosenbergi*; BC Act: Vulnerable);
- Hollow-bearing trees: are known to be common within the EP area and surrounds and include a diversity of eucalypt species of various ages. Smaller trees of woodland communities typically support smaller trunk and branch hollows whereas forest communities in sheltered gullies around the Grotto, support large trees and large branch hollows.
- Aquatic habitats: in the form of ephemeral first, second and third order creek lines which flow into the main tributary of Genowlan Creek then on into the Capertee River. These habitats may offer habitat to frogs such as the threatened *Heleioporus australiacus* (Giant Burrowing Frog), *Mixophyes iteratus* (Giant Barred Frog) and *Pseudophryne australis* (Red-crowned Toadlet).
- Flowering and fruiting plants: utilised as foraging habitat for woodland birds and mammals such as the Flame Robin (*Petroica phoenicea*; BC Act: Vulnerable), the Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable; EPBC Act: Endangered) and the Greater Gliders (*Petauroides Volans*; EPBC Act: Endangered);
- *Allocasuarina* species: for foraging Glossy Black-Cockatoos (*Calyptorhynchus lathami*; BC Act: Vulnerable); and
- Koala feed trees: within woodland vegetation including *Eucalyptus cypellocarpa*, *Eucalyptus piperita* and *E. punctata*.

Implications for mining and recommendations

The CLZ EP area intersects with many sensitive landscape features restricted to the Genowlan Point area including:

- *Pultenaea* sp. Genowlan Point (BC Act: Critically Endangered; EPBC Act: Critically Endangered);
- Genowlan Point *Allocasuarina nana* Heathland EEC; and
- The Grotto;
- Facultative ecosystems (GDEs).

The CLZ EP area is restricted to first workings only. The subsidence assessment of the CLZ ML1331 Extraction Plan (Centennial 2017) states that "no surface impacts would be expected at these levels of subsidence. Specifically, no surface impacts would be expected to cliff lines, pagodas and steep slopes at these negligible levels of subsidence". However, repeatable and measurable monitoring should continue, or be established. It is to note that monitoring of *Pultenaea* sp. Genowlan Point and Genowlan Point *Allocasuarina nana* Heathland EEC is carried out by NPWS.

During the 2022 monitoring programme across the Mining Lease Area, the following baseline monitoring was conducted:

- Continued monitoring of threatened species and their habitats;
- Biodiversity monitoring within facultative ecosystems, with a focus on the Grotto habitat following a Before After Control Impact design where feasible; and
- Additional *Prostanthera stricta* monitoring transects established within the EP Area.

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Appendix B EPBC Act MNES Search

Appendix C Floristic Plots - Woodland

Appendix D Floristic Plots - GDE

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1 INTRODUCTION

1.1 Background

RPS was engaged by Centennial Airly Pty Ltd (Centennial Airly) to provide a Baseline Biodiversity Report to accompany the Extraction Plan (EP) and Biodiversity Management Plan (BMP) for two EP areas; the Cliff Line Zone (CLZ) within Mining Lease (ML)1814 and the MW17-19 EP areas (hereafter referred to as the study area).

Airly Mine operates an approved coal mining lease (SSD_5581) to extract thermal coal at Mount Airly, Point Hatteras and Genowlan Mountains, which form part of the Mugii Murum-ban State Conservation Area (SCA). Centennial Airly is the operator of the mine and is a wholly owned subsidiary of Centennial Pty Limited. Airly Mine currently holds two leases (Mining Lease ML1331 and ML1814), which together covers about 3,980 ha (**Figure 1-1**).

1.2 Objectives and scope

The aim of this Baseline Biodiversity Report is to characterise the biodiversity values within CLZ EP area and the MW17-19 EP area (see **Figure 1-1**), with emphasis on identifying entities that may be sensitive to mining induced change. The findings of this Baseline Biodiversity Report would inform the subsidence and environmental risk assessment for the study area, as well as the relevant management and monitoring measures to be included in the corresponding EPs and BMPs.

The scope of this report is to:

- Undertake a desktop review of databases, reports, aerial imagery, vegetation and habitat mapping relevant to the study area;
- Identify and map existing vegetation communities including any threatened ecological communities (TECs);
- Describe key fauna habitat values of the EP area;
- Determine the presence or likely occurrence of threatened entities [species, populations and ecological communities (or their habitats)] occurring within the study area, as listed under the NSW *Biodiversity Conservation Act 2016* (BC Act);
- Determine the presence or likely occurrence of threatened entities [species, populations and ecological communities (or their habitats)] occurring within the study area, as listed under the *Fisheries Management Act 1994* (FM Act); and
- Determine the presence or likely occurrence of threatened entities and other matters of national environmental significance [i.e. species, migratory species, ecological communities (or their habitats)] as listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); Matters of National Environmental Significance (MNES)].

1.3 Study area

The study area consists of the two proposed EP areas (see **Table 1-1**) located on Genowlan Mountain and Genowlan Point situated on the northern fringe of the Western Coalfields. It is about 40 km north-west of Lithgow and 4 km north-east of Capertee township; within the Lithgow City Local Government Area (LGA). See **Figure 1-1** for the study area context. The land is zoned as E1: National Parks and Nature Reserves under the Lithgow City Local Environment Plan (LEP).

Table 1-1 The study area

EP area	Mining Lease	Area (ha)
CLZ	ML1814	211.41
MW17-19	ML1331 and ML1814	121.62
Total		

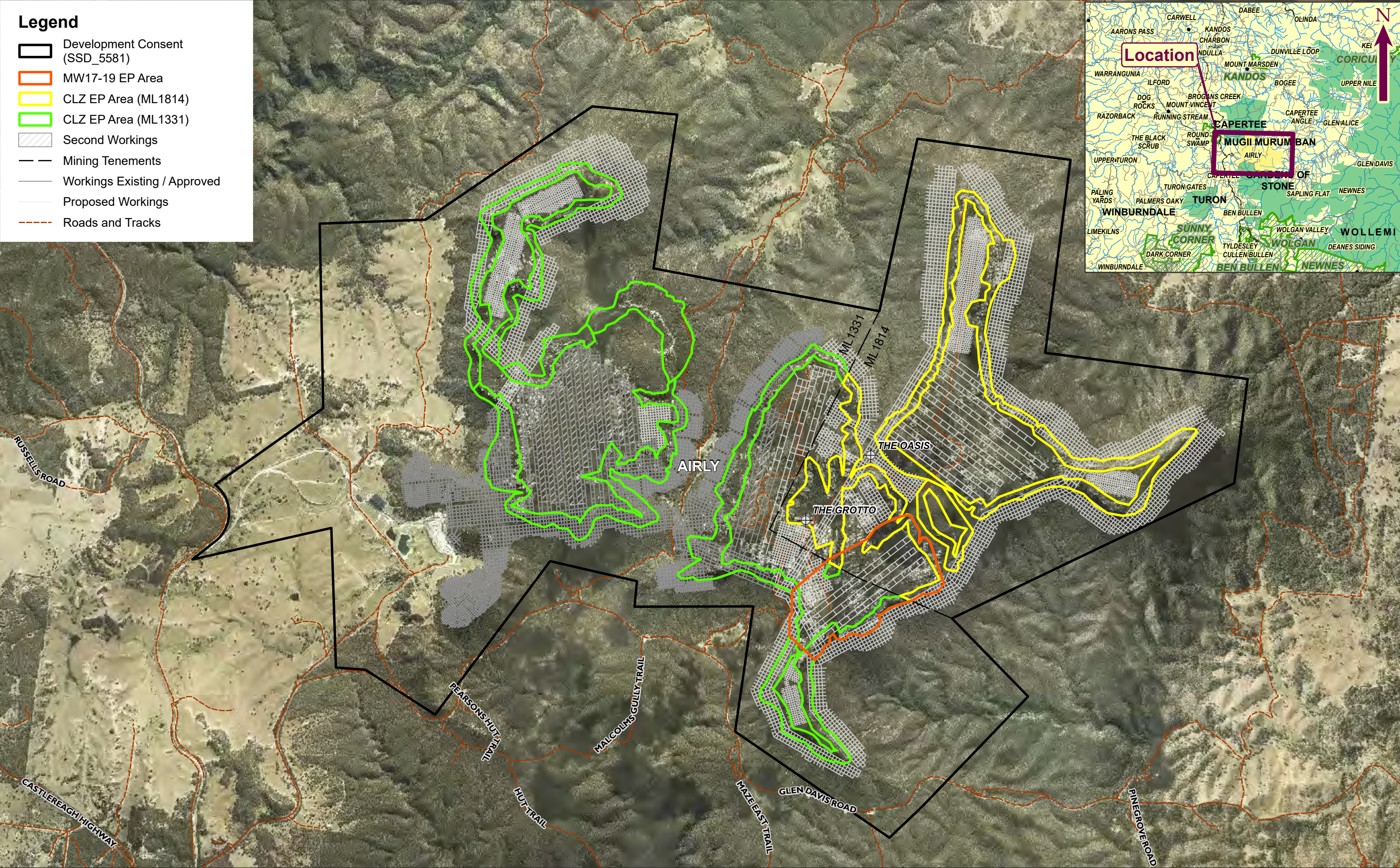


FIGURE 1-1:
PROJECT AREA LOCATION

LOCATION: AIRLY

VERSION: A
DATE EXPORTED: 26/09/2022
TECHNICIAN: Natalie.Wood

DATA SOURCES
Centennial, RPS, NSWSS,

500 0 500 1,000 1,500 2,000
m
SCALE 1:35,000 AT A3 SIZE / Projection: GDA 1994 MGA Zone 56

CLIENT: Centennial Airly
PROJ: PR152229
PURPOSE: Baseline Assessment

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REPORT

The study area is located entirely within the Muggi Murum-ban State Conservation Area (SCA). The Gardens of Stone National Park is located to the south and Capertee National Park to the north. The study area is typified by steep and rugged areas of pagodas, cliffs and valleys with topography ranging from 770 to 1040 m Above Sea Level (ASL). Broad habitat types within the study area include dry sclerophyll forest, wet sclerophyll forest, grassy woodlands, heath and cleared and cleared areas (DEC 2006; RPS 2014).

1.4 Regulatory Context

Legislation and policies relevant to the proposal is outlined in **Table 1-2**.

Table 1-2 Relevant Legislation, Policy and Guidelines

Legislation, Policy and Guidelines	Comment
Local Policy and Legislative Guidelines	
<i>Lithgow Local Environmental Plan 2014</i>	The study area has been identified as an 'Environmentally Sensitive Areas - Biodiversity' area under the <i>Lithgow Local Environmental Plan 2014</i> (LEP). The following are to be considered: - any adverse impact on the condition, ecological value and significance of the fauna and flora on the land; - any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna; - any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land; and - any adverse impact on the habitat elements providing connectivity on the land. The study area has additionally been identified as 'Environmentally Sensitive Areas – Watercourses', 'Environmentally Sensitive Areas – Groundwater'. The following are to be considered: - the water quality and flows within the watercourse; - aquatic and riparian species, habitats and ecosystems of the watercourse; - the stability of the bed and banks of the watercourse; - the free passage of fish and other aquatic organisms within or along the watercourse; - the likelihood of groundwater contamination from the development (including from any on-site storage or disposal of solid or liquid waste and chemicals); - any adverse impacts the development may have on groundwater dependent ecosystems; - the cumulative impact the development may have on groundwater (including impacts on nearby groundwater extraction for a potable water supply or stock water supply); and - any appropriate measures proposed to avoid, minimise, or mitigate the impacts of the development.
State Policy and Legislative Guidelines	
<i>Environmental Planning and Assessment Act 1979</i>	The project is a State Significant Development in accordance with Clause 8 and Schedule 1 (Item 5) of <i>State Environmental Planning Policy (State and Regional Development)</i> 2011. The Airly Mine operates under existing consent SSD_5581.
<i>Biodiversity Conservation Act 2016</i>	The BC Act is administered by Department of Planning, Industry and Environment (DPE). The BC Act gives provisions to declare and protect threatened species, populations, and ecological communities with a legal threatened status in NSW. Threatened species (and populations) and ecological communities are listed in Schedules 1 and 2 of the BC Act, respectively. The BC Act also lists Key Threatening Process's (KTPs) that may threaten the survival of these threatened entities. The BC Act also introduces the Biodiversity Offsets Scheme (BOS) and Biodiversity Assessment Method (BAM).
<i>Biosecurity Act 2015</i>	Prescribes the statutory requirements for managing pests, diseases, weeds and contaminants in NSW. Applies to construction activities and occupation of the Activity area.

REPORT

Legislation, Policy and Guidelines	Comment
<i>Fisheries Management Act 1994</i>	The FM Act provides for the identification, conservation and recovery of threatened fish, aquatic invertebrates and marine vegetation. The Act also covers the identification and management of KTPs which affect threatened species or could cause other species to become threatened.
<i>State Environmental Planning Policy (Resources and Energy) 2021</i>	Airly Mine operates under the existing Development Consent Section 89E of the Environmental Planning & Assessment Act 1979, SSD_5581. As such, activities outlined in Part 2.2 of the SEPP are permissible.
Commonwealth Policy and Legislative Guidelines	
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (MNES). The MNES protected under national environment law include: • listed threatened species and communities; • listed migratory species; • Ramsar wetlands of international importance; • Commonwealth marine environment; • world heritage properties; • national heritage places; • the Great Barrier Reef Marine Park; • nuclear actions; and • a water resource, in relation to coal seam gas development and large coal mining development. Under the EPBC Act, actions that have, or are likely to have, a significant impact on a MNES require approval from the Commonwealth Department of the Agriculture, Water and Environment (DAWE).
<i>Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DoE 2013)</i>	These significant impact guidelines aid in determining if a proposed action is likely to have a significant impact on a MNES. Consideration of survey methods for specific MNES required where potential impacts are identified.

1.5 Terms and definitions

Abbreviation	Definition
Airly Mine	Current mining lease area, Mining Lease ML1331 and ML1814, which together covers about 3,980 hectares
API	Aerial photo interpretations
ASL	Above sea level
BACI	Before-After-Control-Impact
BC Act	<i>Biodiversity Conservation Act 2016</i>
Centennial Airly	Centennial Airly Pty Limited
CMA	Catchment Management Authority
CMLR	Centre for Mine Land Rehabilitation
DCCEEW	Department of Climate Change Energy, the Environment and Water
DPE	Department of Primary Industries and the Environment
EEC	Endangered Ecological Community
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	<i>Fisheries Management Act 1994</i>
GBMWA	Greater Blue Mountains World Heritage Area
IBRA	Interim Biogeographic Regionalisation for Australia

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Abbreviation	Definition
KTP	Key Threatening Process
LEP	Local Environmental Plan
Locality	10 kilometre radius of the study area
LoOA	Likelihood of Occurrence Analysis
MNES	Matters of National Environmental Significance
NPWS	National Parks and Wildlife Service
Study area	The areas encompassing the CLZ and MW17-19 EP areas. See Figure 1-1 .
MW	Mini Wall
RDP	Rapid Data Point
SB	Sydney Basin
SCA	State Conservation Area
TEC	Threatened Ecological Community
VIS	Vegetation information system

1.6 Report structure

This report is divided into four sections as follows:

1. Introduction: providing project context, objective and scope, introducing the study area and regulatory framework.
2. Methods: outline the steps methods taken to conduct both the literature review and ground truthing assessment.
3. Results: detailing the outcomes of the assessment as follows:
 - Literature review consisting of
 - Landscape context (i.e. location and topography; connectivity; climate; NSW (Mitchell) Landscape; geology and soils; and hydrology); and
 - Likelihood of Occurrence Analysis (LoOA) for threatened flora, fauna and ecological communities;
 - Vegetation communities (including plant community types (PCTs) and associated TECs);
 - Threatened flora;
 - Threatened fauna; and
 - BC and EPBC Act listed KTPs identifies key threats to biodiversity relevant to the study area.
4. Summary of findings, implications for mining and recommendations.

2 METHODS

2.1 Literature review

A literature review is initially undertaken to gather available data and understand the context of the study area prior to field surveys. RPS has previously conducted extensive field surveys within and adjacent to the study area. These surveys were undertaken in compliance with the Airly Biodiversity Management Plan (required by consent condition 15, Schedule 4 of SSD-5581; delivered by RPS since 2015). Surveys undertaken include threatened flora and fauna surveys, vegetation mapping and ongoing seasonal monitoring of sensitive ecological receivers.

Monitoring within the Airly Development Consent Area was developed by the Centre for Mine Land Rehabilitation (CMLR) and was commenced in 2012 by the University of Queensland (UQ). The monitoring methods were based on a Before-After-Control-Impact (BACI) approach and have been varied by RPS where necessary to reflect operational circumstances.

To inform this report, a desktop assessment was undertaken considering the biodiversity dataset collected within the Project as part of the ongoing monitoring by RPS. Internal RPS documents reviewed, informing all aspects of the study include:

- 2012-2013 Flora and Fauna Baseline Survey Report (RPS 2013);
- 2012-2014 Flora and Fauna Baseline Survey Report (RPS 2014a);
- Airly Mine Extension Project Flora and Fauna Assessment, March 2014, RPS Australia East (RPS 2014b);
- Seasonal Flora and Fauna Monitoring Report 2015/2016 (RPS 2016);
- Biodiversity Management Plan Extraction Plan Airly Mine (Centennial 2016);
- Airly Mine Splitting and Quartering Extraction Plan (ML1331) - Biodiversity Management Plan - Report to Centennial Coal (RPS 2018);
- Airly Mine Flora and Fauna Monitoring Report 2016/2017. Report to Centennial Coal (RPS 2017a);
- Airly Mine Seasonal Flora and Fauna Monitoring Report 2015/2016. Report to Centennial Coal (RPS 2017b);
- Annual Flora and Fauna Monitoring Report 2016-2017 (RPS 2017c);
- Final Biodiversity Management Plan for Cliff Line Zone of First Workings within ML1331 Airly Mine (Centennial 2018);
- Annual Flora and Fauna Monitoring Report 2017-2018 (RPS 2019);
- Annual Flora and Fauna Monitoring Report 2019-2020 (RPS 2020);
- Annual Flora and Fauna Monitoring Report 2020-2021 (RPS 2021a); and
- Ecology Baseline Assessment Report – Point Hatteras (RPS 2021b).

2.1.1 Landscape context

A biogeographic overview of the study area was obtained from the published descriptions of the Mitchell landscapes (NPWS 2003), Interim Biogeographic Regionalisation for Australia (IBRA) subregions and Soil Landscapes of Central and Eastern NSW - V2.1 (DPE 2020a). Other published and unpublished resources of relevance to the study area were also evaluated and incorporated where appropriate.

Information sources were reviewed for a 10 km radius of the study area (hereafter referred to as the 'locality') to inform the landscape context description include:

- Vegetation of the Western Blue Mountains including the Capertee, Coxs and Jenolan-Gurnang Areas (DEC, 2006) Vegetation Information System (VIS)_ID 2231
- Mitchell Landscapes (NPWS 2003);

REPORT

- eSPADE Soil Landscapes of Central and Eastern NSW - v2.1 (DPE 2020a);
- IBRA Region and subregion mapping (IBRA7); and
- Recent aerial imagery of the study area.

2.1.2 Likelihood of Occurrence Analysis

The Likelihood of Occurrence Analysis (LoOA) has been informed by the results of the biogeographic overview for the study area. In addition, the following datasets have informed the LoOA:

- Flora and fauna records contained the BioNet database (DPE 2022);
- Threatened biodiversity records contained in the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search tool (DCCEEW 2021);
- Habitat descriptions as provided by the online Threatened Species Profile Database (TSPD) (DPE 2021c);
- Biodiversity Assessment Method Calculator (BAM-C);
- Vegetation community, flora and fauna data from RPS's database;
- DPE VIS database; and
- Fisheries NSW Spatial Data Portal (DPI 2021).

Threatened species, populations and communities previously recorded within the locality, or with potential habitat within the locality inform the subject species list for consideration.

Five 'likelihood of occurrence' categories have been attributed to identify the chance of threatened biodiversity within the study area. The attribution of a likelihood of occurrence category has had regard for:

- The recency of threatened species observations;
- Proximity to the study area (i.e. application of landscape factors such as patch size and connectivity);
- Habitat descriptions as provided in the TSPD (DPE 2021c);
- Habitat values and condition as determined through the study area specific literature review; and
- The effect of existing KTPs.

The five likelihood of occurrence ratings are described in **Table 2-1**.

Table 2-1 Likelihood of Occurrence Analysis criteria

Likelihood Rating	Description
None	Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the study area. The study area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2 km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient Activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
Low	Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The study area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2 km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species Activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs.
Moderate	Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the study area. The study area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as

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Likelihood Rating	Description
	connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Council SAI indicative habitat mapping indicates potential for the species to occur. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy.
High	Habitat values within the study area are generally consistent with descriptions provided in the BCS TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Council SAI indicative habitat mapping indicates potential for the species to occur. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy.
Known	Species observed or previous reliable record exists and/or habitat values within the study area are generally consistent with research or descriptions provided in the BCS TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Habitat occupancy is likely to be associated with important life cycle processes; however, the reliance on this habitat would depend on additional factors (e.g. size and extent of local population, effect of KTPs).

2.2 Vegetation Communities

Vegetation communities were typified using the State Vegetation Type Map (SVTM) is a regional-scale map of NSW Plant Community Types. This map represents the current extent of each Plant Community Type, Vegetation Class and Vegetation Formation, across all tenures in NSW (DPE 2022d). The SVTM maps the distribution of each Plant Community Type (PCT), Vegetation Class and Vegetation Formation with data input from the NSW BioNet Flora Survey Plots – PCT Reference Sites (DPE 2022e).

Subsequent flora surveys were undertaken that involved ground-truthing of vegetation communities through rapid data points (RDPs) which document the most dominant flora species of the canopy, midstorey and ground stratum within a 10 m radius of the point and 20 x 20 m flora quadrats which document all species as well as cover and abundance within the quadrant (RPS 2014; Figure 2-1 **Figure 2-1.**).

Previous and current quadrat and RDP data was compiled into GIS and overlain on a range of aforementioned data sets. These data layers and the floristic data were then used to predict the vegetation type present within polygons. Fine-scale (a scale of approximately 1:5000) alterations using aerial photo interpretations (API) were subsequently undertaken to improve polygon accuracy. This was undertaken digitally (i.e. on screen) using API techniques, involving the delineation of polygons based on similarities and differences between patterns observed in the vegetation as seen in the air photo.

The following data sources were utilised to provide the most up to date vegetation mapping for the study area:

- Vegetation community, flora and fauna data from RPS's database;
- DPE SVTM (DPE 2022);
- DPE vegetation information system (VIS) database (DPE 2021a);
- Vegetation of the Western Blue Mountains including the Capertee, Coxs and Jenolan-Gurnang Areas (DEC, 2006) VIS_ID 2231;
- Mitchell Landscapes (NPWS 2003);
- eSPADE Soil Landscapes of Central and Eastern NSW - v2.1 (DPE 2020a); and
- IBRA Region and subregion mapping (IBRA7).

2.2.1 Threatened Ecological Communities

TECs were ground thuthed by 20 x 20 m flora quadrats which document all species as well as cover and abundance within the quadrant. Two flora quadrants were undertaken within the Genowlan Point *Allocasuarina nana* Heathland EEC (**Figure 2-2**).

2.2.2 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems were determined utilising a desktop assessment of:

- Relevant documents (e.g. Environmental Impact Statement, Groundwater Assessment (GHD 2014), Flora and Fauna Assessment (RPS 2014);
- Groundwater Dependent Ecosystems Atlas (BOM 2022);
- Vegetation community, flora and fauna data from RPS's database;
- DPE SVTM (DPE 2022);
- DPE vegetation information system (VIS) database (DPE 2021a).

Surveys of relevant PCTs were undertaken that involved ground-truthing of potential GDEs through RDPs which document the most dominant flora species of the canopy, midstorey and ground stratum within a 10 m radius of the point and photography.

Vegetation surveys were undertaken from the 20 to 24 July 2022 (**Figure 2-2**).

2.2.2.1 Monitoring

Baseline monitoring was established on 12 to 16 December 2022.

GDE plots were monitored using plots both BAM plots (i.e. measuring flora composition, vegetation structure and ecological function as defined by the BAM) and a rapid aquatic assessment modified from the Australian River Assessment System (AUSRIVAS) methodology. Ten GDE BAM plots and five rapid aquatic assessments have been established at the base of Pt Hatteras and the Grotto for the Pt Hatteras BMP and CLZ ML1814 BMP to establish baseline and gather repeated monitoring data. The location and method applied at these plots are summarised in **Table 2-2**.

Table 2-2: Location, PCT and monitoring method of GDE plots

Plot	BMP Location	PCT	Monitoring method
1	Pt Hatteras	941	• BAM plot
2	Pt Hatteras	941	• BAM plot
3	Control	941	• BAM plot
4	Control	941	• BAM plot
5	Grotto (CLZ ML1814 BMP)	1615	• BAM plot • Rapid aquatic assessment
6	Grotto (CLZ ML1814 BMP)	1615	• BAM plot • Rapid aquatic assessment
7	Grotto (CLZ ML1814 BMP)	1615	• BAM plot • Rapid aquatic assessment
8	Grotto (CLZ ML1814 BMP)	1615	• BAM plot • Rapid aquatic assessment
9	Grotto (CLZ ML1814 BMP)	941	• BAM plot
10	Grotto (CLZ ML1814 BMP)	941	• BAM plot • Rapid aquatic assessment

A rapid aquatic assessment modified from the AUSRIVAS methodology. The start and end points of each 50 m GDE plot are marked with wooden stakes and labelled. Location data for each of these points was recorded using a differential GPS. Photographs were taken of each GDE plot from a standardised point at an approximate height of 1.5 m. A horizontal field of view of approximately 40 degrees is achieved, which is within the central angle of view for human vision (i.e. 40-60 degrees).

The following assessments are conducted during each monitoring period:

- a. Stream condition:

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- i. Flow width (m) averaged from set distance along the stream (5 m, 15 m, 25 m, 35 m, 45 m);
 - ii. Max flow width (m);
 - iii. Min flow width (m);
 - iv. Soil moisture $\pm 3\%$ VWC averaged from set distance along the stream (5 m, 15 m, 25 m, 35 m, 45 m);
 - v. Clarity/sediment load (0 [no clarity] – 5 [clearest]);
 - vi. Erosion (0 [no signs of erosion] - 5 [severe]).
- b. Stream type:**
- i. Stream flow type:
 1. Pooling;
 2. Flowing;
 3. Continuous;
 4. Discontinuous;
 5. Riffles.
 - ii. Aquatic vegetation type:
 1. Submerged;
 2. Floating;
 3. Emergent.
 - iii. Substrate type:
 1. Bedrock;
 2. Boulder (>256mm);
 3. Cobble (64-256mm);
 4. Pebble (16-64mm);
 5. Gravel (2-16mm);
 6. Sand (0.06-2mm);
 7. Clay/Silt (<0.06mm).
 - iv. Bank slope:
 1. Flat <10°;
 2. Low 10 - 30°;
 3. Moderate 30 - 60°;
 4. Steep 60 - 80°;
 5. Vertical 80 – 90.

2.3 Threatened flora

Threatened flora within the study area have been characterised from the following database searches:

- BioNet database (DPE 2022b);
- RPS database (RPS 2021); and
- UQ Monitoring Program, Sustainable Minerals Institute Centre for Mined Land Rehabilitation (SMI CMLR) (UQ 2013).

Threatened flora records were then cross-checked with vegetation community mapping and previous flora records and monitoring efforts within the RPS database (RPS 2021; **Figure 2-1.**). Additional threatened flora

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surveys were conducted at Mount Genowlan by means of 'random meander' from the 20 to 24 July 2022 (Figure 2-2).

2.3.1 Threatened flora monitoring

Previous flora monitoring work has occurred for Mount Vincent's Mint-bush (*Prostanthera stricta*) and Capertee Stringybark (*Eucalyptus cannonii*). See Figure 2-1. Detailed monitoring methodology are outlined in *Airly Mine 2012-2014 Flora and Fauna Baseline Survey Report* (RPS 2014a) and summarised in Table 2-3.

Table 2-3: Threatened flora monitoring

Target Species	Monitoring Methods
<i>Prostanthera stricta</i>	Point intercept method and floristic density plots in permanent survey sites
<i>Eucalyptus cannonii</i>	Eighteen individual trees assessed for condition, crown extent and growth changes

Results relevant to the study areas were compiled from previous monitoring years to display population trends.

2.4 Threatened fauna

2.4.1 Habitat for threatened fauna

A literature review of past documents relating to the study area was carried out to identify potential habitat niches for threatened fauna within the study area. This assessment included consideration habitat condition and complexity, including the occurrence of microhabitats. Such habitat niches include tree hollows, fallen logs, bush rock, caves and crevices, manmade structures, riparian areas, wetlands and water bodies, taking into consideration for past land uses, connectivity and underlying geology of the study area.

2.4.2 Threatened fauna records

Threatened flora within the study area have been characterised from the following database searches:

- BioNet database (DPE 2021b);
- RPS database (RPS 2021); and
- UQ Monitoring Program, Sustainable Minerals Institute Centre for Mined Land Rehabilitation (SMI CMLR) (UQ 2013).

Threatened fauna records were then cross-checked for consistency between data sources and relevant reports.

Additional field fauna surveys were conducted by means of 'opportunistic sightings' from 20 to 24 July 2022 (Figure 2-2).

2.4.3 Threatened fauna monitoring

Fauna surveys have previously been conducted by RPS yearly in spring/summer under the current Biodiversity Monitoring Programs (RPS 2017; RPS 2018; RPS 2019; RPS 2020, RPS 2021) across the entire Airly Mine lease area. Detailed monitoring methodology are outlined in *Airly Mine 2012-2014 Flora and Fauna Baseline Survey Report* (RPS 2014a) and summarised in Table 2-4.

Table 2-4: Threatened fauna monitoring methods

Target Species	Monitoring Methods
Glossy Black-Cockatoos	Percent cover of <i>Allocasuarina</i> species present at permanent survey sites and the presence of chewed orts was recorded
Large Forest Owls	Targeted call-playback, spotlighting and surveys near previously identified roost trees/habitat

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Target Species	Monitoring Methods
Diurnal Birds	30-minute surveys across permanent transects and opportunistic surveys
Cave Dwelling Micro-bats	Anabat units to detect presence of microbat species
Other Targeted Species (Spotted-tailed Quoll (<i>Dasyurus maculatus</i>), Broad-headed Snakes (<i>Hoplocephalus bungaroides</i>) and Rosenberg's Goanna (<i>Varanus rosenbergi</i>)	Suitable habitat for these species was targeted via camera trapping/ opportunistic sightings
Feral Species	Camera trapping/ opportunistic sightings

Results relevant to the study area were compiled from previous monitoring years to display population trends.

2.5 Key Threatening Processes

Potential KTPs relevant to the study area were explored amongst those currently list under the BC Act, FM Act and EPBC Act. A literature review of previous documents relating to the study area and any relevant databases (see **Section 2.1**) helped identification of KTPs likely to be relevant to the study area (at least to some degree).

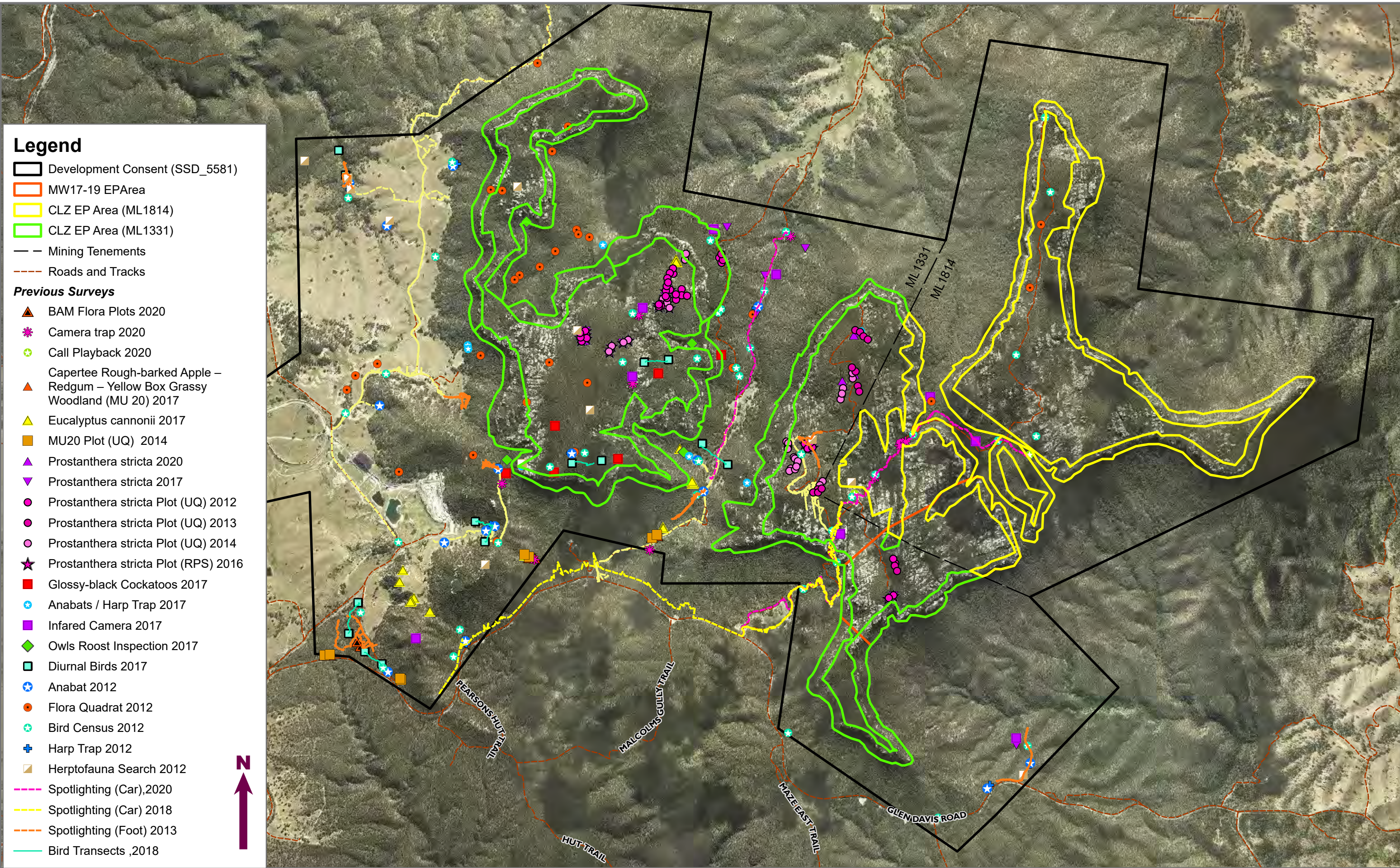


FIGURE 2-1 :
PREVIOUS SURVEY RESULTS

LOCATION: AIRLY

VERSION: A
DATE EXPORTED: 26/09/2022
TECHNICIAN: Natalie.Wood

DATA SOURCES
Centennial, RPS, NSWSS,

500 0 500 1,000 1,500 2,000
m
SCALE 1:30,000 AT A3 SIZE / Projection: GDA 1994 MGA Zone 56

CLIENT: Centennial Airly
PROJ: PR152229
PURPOSE: Baseline Assessment

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PROJECT PATH: S:\Centennial\All Jobs\5568 - 152229 - Airly Cliff Line Zone EP BMP Update\10 - Drafting\ECO_BMPGeneralFigures_aprx

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3 RESULTS

3.1 Literature review

3.1.1 Landscape context

3.1.1.1 Location and topography

The study area lies within the Mugii Murum-ban SCA, with the Gardens of Stone National Park to the south and Capertee National Park to the north (see **Figure 3-2**). The landscape is characterised by steep sandstone escarpments and pagoda rock formations. The study area is mostly within the Capertee Uplands of the South Eastern Highlands Bioregion (IBRA7) with some eastern slopes falling within the Capertee Valley of the NSW Western Slopes IBRA (see **Figure 3-1**). The South Eastern Highlands bioregion is situated inland from the coastal bioregions of the South East Corner and the Sydney Basin. It is bounded by the Australian Alps and South Western Slopes bioregions to the south and west, and spans about 8,375,961 ha into the ACT and Victoria (DPE 2021). The narrow, deeply incised gorges or canyons are quite common throughout the Blue Mountains region and are typified at within the study area by features such as the Grotto which forms a tributary of the Genowlan Creek.



Plate 3-1 Example of pagoda rock formations

2.6 Limitations

The results of the baseline assessment adopted a desktop approach only, consisting of existing data compiled from previous surveys within and adjacent to the study area. No further on ground assessment were included here.

Vegetation mapping has not been ground-truthed within the study area. Vegetation mapping is reliant on vegetation surveys conducted in vegetation contiguous with the study area in 2014 and from correspondence with existing broadscale mapping. Previous vegetation surveys within the study area were limited in spatial extent.

Some plant species that occur in the local area, such as cryptic species, are annuals and are present only in the seed bank for much of the year. Moreover, some perennial plant species can be inconspicuous or difficult to identify unless flowering.

Fauna species that have been recorded in the local area may occur on a seasonal or migratory basis, and so may be absent for much of the year. Fauna behaviours may have also affected detectability during past surveys, with some easily disturbed or cryptic species difficult to detect.

2.6.1 Data Availability and Accuracy

The collated threatened flora and fauna species records obtained from the BioNet Database (DPE 2021b) for the locality are known to vary in accuracy and reliability. Traditionally, this is due to the reliability of information provided to BCS for collation and/or the need to protect specific threatened species locations. For the purposes of this report this information has been considered to have an accuracy of ± 1 km, however for some threatened species, records may be denatured by up to 2 km.

These potential limitations have been addressed by a thorough literature research and review and through identification of potential habitats for flora and fauna species and assessment of the potential for targeted species to occur within the study area based on:

- Known records from previous surveys conducted by RPS;
- The type and condition of habitats present;
- The land use throughout the study area and surrounds; and
- The landscape context.

Spatial data during previous surveys by RPS were recorded with a Trimble Differential GPS unit, which is capable of sub-metre accuracy following post processing.



Plate 3-2 **Example of incised gorges**

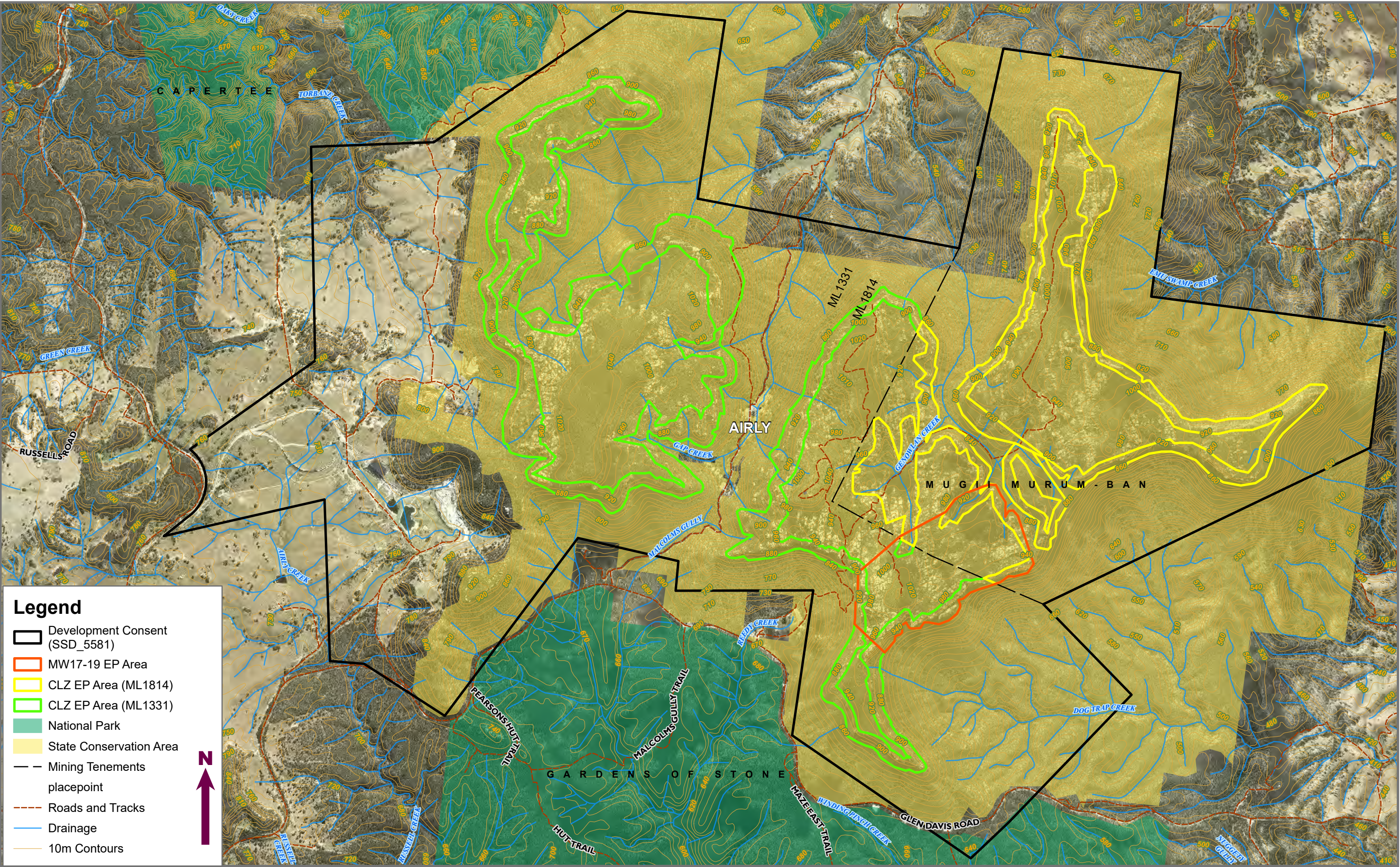


FIGURE 3-2: CONSERVATION AREAS

LOCATION: AIRLY

VERSION: A
DATE EXPORTED: 26/09/2022
TECHNICIAN: Natalie.Wood

DATA SOURCES
Centennial, RPS, NSWSS,

500 0 500 1,000 1,500 2,000
m

SCALE 1:30,000 AT A3 SIZE / Projection: GDA 1994 MGA Zone 56

CLIENT: Centennial
PROJ: PR152229
PURPOSE: Baseline Assessment

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3.1.1.2 Connectivity

The study area is located on the western margin of the Greater Blue Mountains World Heritage Area that surrounds the western rim of the Sydney Basin, preserving the sandstone-based links between the Sydney, Hunter and Central West regions of New South Wales (DECC 2008a). This vast expanse of continuous habitat facilitates the movement of many fauna species across the landscape. Animals move through habitats to obtain food, shelter and breeding resources in response to seasonal resource ability and habitat conditions. Large tracts of habitat are generally required for successful dispersal away from natal areas or seasonal migrations (Van der Ree et al 2007).

There are no significant barriers to fauna movement surrounding the study area, however in the wider locality, the landscape to the west of the study area is characterised by a mosaic of cleared agricultural land and large patches of remnant vegetation. Many of these remnants are linked by riparian vegetation that has been retained in association with drainage lines; others are linked by narrow corridors of native vegetation. Some remnants do not maintain connectivity with any other patches of vegetation in the landscape and are completely isolated amongst cleared land.

3.1.1.2.1 Conservation areas

The study area is located within the Mugii Murum-ban SCA. Several other conservation reserves are in the surrounding locality (see **Figure 3-2** and **Table 3-1**). These areas protect a diversity of significant habitats such as basalt caps, sandstone escarpments, pagoda rock formations, gorges and canyons, alluvial gullies, heaths, rainforest, hanging swamps and wet sclerophyll forests. These variations in topography, altitude, aspect and microclimates support a diversity of native plants and animals, including rare and threatened species and ecological communities.

Table 3-1 Conservation Reserves in the Surrounding Locality

Conservation area	Area (ha)	Location	Features
Mugii Murum-ban SCA	3,650	Within the study area	Vegetation and habitat of the national park are continuous with those of the study area
Capertee National Park	2,839	Directly North-west of the study area	Vegetation and habitat of the national park are continuous with those of the study area
Gardens of Stone National Park	15, 010	Directly south of the Study area	Contains pagoda formations. Supports poorly represented Yellow- Box / Ironbark Woodland communities and rare White Box / Grassy Woodland and White Box / Grass Tree / Spinifex Woodland communities. Six threatened flora species and several threatened fauna species are known to occur in park (NPWS 2009a).
Turon National Park	3,103	About 10 km south-west of the study area	Does not maintain connectivity with the study area
Wollemi National Park	488,620	About 15 km east of the study area	Contains pagoda formations, deep gorges, river valleys, canyons, hanging swamps, waterfalls and sandstone escarpments; the varied topography and vegetation provides a diversity of habitats for plants and animals. Conserves significant areas of warm temperate rainforest, Mellong swamps communities and white box and yellow box woodlands. Contains 25 rare or threatened flora species and numerous threatened fauna species known to occur. Wollemi pine <i>Wollemia nobilis</i> occurs in a remote section of the park (NPWS 2001).
Greater Blue Mountains World Heritage Area	1,032,649	Encompasses all surrounding conservation areas	Both the Gardens of Stone and Wollemi National Park contribute to the Greater Blue Mountains World Heritage Area (GBMWH). The GBMWH was inscribed in the World Heritage List in 2000, on the basis of its outstanding natural values. These natural values are listed in the Greater Blue Mountains World Heritage Area Strategic Plan.

3.1.1.3 Climate

The South Eastern Highlands IBRA bioregion is dominated by a temperate climate with significant areas in the north and south at higher elevations having a montane climate with milder summers. Rainfall and temperature vary seasonally with the heaviest rainfalls and highest temperatures experienced in summer months, and the lowest temperatures and rainfalls generally occurring in winter months. Frosts and fogs are common in winter (RPS 2014).

3.1.1.4 NSW (Mitchell) landscape

The study area is characterised by the Newnes Plateau (Mitchell) landscape with Capertee Plateau, Capertee landscape occurring along the eastern boundary of the study area (see **Figure 3-3**). Small inlier patches of the Sydney Basin Diatremes landscape occur in the north (Mitchell 2002; DECC 2008b). See **Table 3-2** for the NSW (Mitchell) Landscape description and **Figure 3-3** for the locations within the study area.

Table 3-2 Descriptions for relevant NSW (Mitchell) Landscapes

NSW (Mitchell) landscape	Description	EP Area
Newnes Plateau Sydney Basin (SB) Wollemi	Undulating high level plateau with shallowly incised swampy streams and occasional relics and dunes on horizontal Triassic quartz sandstones and shale, general elevation 1000 m ASL, local relief <100 m. Thin stony yellow red sands, deep yellow earths, podsols on dunes and yellow or grey texture-contrast soils on shale units. Woodland of stunted Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Snow Gum (<i>Eucalyptus pauciflora</i>), Blue Mountains Ash (<i>Eucalyptus oreades</i>), Silvertop Ash (<i>Eucalyptus sieberi</i>), Grey Ironbark (<i>Eucalyptus paniculata</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Grass Trees (<i>Xanthorrhoea</i> sp.) with numerous other shrubs. Patches of Dwarf Casuarina (<i>Allocasuarina nana</i>) heath on very exposed and eroded aspects, sedge swamps with marginal heath form linear patterns in open valleys.	MW17-19 CLZ
Sydney Basin Diatremes SB Volcanics	Widely distributed across the Sydney Basin and distinguished as a landscape because they always contain locally different landform, soil and vegetation. Diatremes are circular volcanic vents filled with layered, brecciated country rock cemented by a fine-grained basaltic matrix. Some contain a core of basalt. In sandstone country the volcanic breccia weathers and erodes more rapidly than the sandstone and the landform is a deep circular with the appearance of a crater. Soils in the crater are dominated by sandstone detritus from the surrounding slopes but the subsoils is a fertile well, structured clay derived from the breccia and these protected sites carry more mesic variants of the local vegetation. In shale country the breccia is more resistant than the shale and the diatremes form a low rounded hill with red-brown gradational profiles of clay loam and structured clay with moderate to high fertility. General elevation varies considerably across the basin, local relief of positive landforms up to 25 m, negative landforms ('craters') 180 m.	CLZ
Capertee Plateau SB Capertee	Wide valleys, low rolling hills below sandstone cliffs on Permian conglomerates, sandstones, and shales with coal at the base of the Sydney Basin and exposure of underlying Devonian shale, siltstone or quartzite. Small areas of Tertiary basalt. General elevation 800 to 1000 m ASL, local relief 100-120 m. Isolated flat top mountains in the valleys formed as pinnacles or remnant pieces of plateau. Shoulder slopes with stone pillars or 'pagodas' above steep canyons on tributary streams falling into gorges. Low gradient swampy streamlines. Shallow stony texture-contrast profiles, usually with gritty well drained A-horizons, over tough yellow or grey poorly drained clays.	CLZ

3.1.1.5 Geology and soils

The underlying geology of the study area comprises Narrabeen Group—fine-grained lithic sandstone occasionally interbedded with thin shale lenses. The study area contains a diversity of geological and geomorphological features such as pagoda rock formations and precipitous sandstone escarpments (see **Figure 3-4**).

The MW17-19 EP area spans three mapped soil landscapes, whilst the CLZ EP area spans four mapped soil landscapes. Ridgetops are predominantly occurring on the 'Warragamba' and 'Wollangambe' soil landscape.

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The higher elevation points of the study area, typically above 1000 m ASL transition into 'Mount Tomah' soil landscape, whilst as the terrain drops into lower elevation, the soil landscape transitions into 'Hassans Walls' soil landscape (DPE 2020a). See **Table 3-3** for the soil landscape descriptions and **Figure 3-4** for the locations within the study area.

Table 3-3 Soil Landscapes of Central and Eastern NSW

Soil Landscape	Description	EP Area
Warragamba 8931wb	The Warragamba landscape comprises narrow convex crests and ridges and steep colluvial sideslopes on Narrabeen Group sandstones with minor cliffs and scarps on steeper slopes. Local relief is typically between 80 – 130 m ASL at elevations mostly less than 700 m ASL. Soils are shallow to deep Lithosols on crests and ridges; Brown Earths, Red Podzolic Soils on upper slopes and Yellow Podzolic Soils on lower slopes. This soil landscape is typified by mass movement hazard as plant root development is limited by shallow soils and steep slopes, severe water erosion hazard, rock fall hazard and acid stony soils of low fertility. The vegetation on Warragamba soil landscape generally consists of open-forest communities with a variety of tree species including Smooth-barked apple (<i>Angophora costata</i>), Blue-leaved stringybark (<i>Eucalyptus agglomerata</i>), Sydney peppermint (<i>Eucalyptus piperita</i> ssp. <i>piperita</i>), Cedar wattle (<i>Acacia elata</i>), Grey gum (<i>Eucalyptus punctata</i>), Turpentine (<i>Syncarpia glomulifera</i>), Red Bloodwood (<i>Eucalyptus gummifera</i>), Brown Barrel (<i>Eucalyptus fastigata</i>) and Mountain Gum (<i>Eucalyptus dalrympleana</i> ssp. <i>dalrympleana</i>). Understoreys contain species from the Mimosaceae, Epacridaceae, Myrtaceae, Proteaceae and Fabaceae families.	MW17-19 CLZ
Wollangambe 8931wo	The Wollangambe landscape comprises of rounded narrow crests and moderately to steeply inclined sideslopes. Localised rock outcrop are in the form of small benches, cliffs and low broken scarp. The local relief is typically less than 100 m and evaluation is generally above 600 m ASL. The underlying geology is Narrabeen Group—quartz sandstone and quartz-lithic sandstone interbedded with thin red, grey and green claystone, shale and occasional conglomerate and ironstone lenses. Thin outliers of Hawkesbury Sandstone in the north-eastern corner of the map sheet may occur. The shallow soil landscape consists of Siliceous Sands/Lithosols, Earthy Sands and Yellow Earths on crests. The soil landscape is typified by high to severe water erosion hazard, steep slopes, shallow soils, localised rock fall hazard, localised rock outcrop and low soil fertility. The vegetation of the Wollangambe soil landscape generally consists of open-woodland with low open-forest in more sheltered valleys. Tree species include black ash (<i>Eucalyptus sieberi</i>), narrow-leaved stringy bark (<i>Eucalyptus oblonga</i> ssp. <i>oblonga</i>), red bloodwood (<i>Eucalyptus gummifera</i>), blue mountains ash (<i>Eucalyptus oreades</i>), broad-leaved peppermint (<i>Eucalyptus dives</i>), grey gum (<i>Eucalyptus punctata</i>), Sydney peppermint (<i>Eucalyptus piperita</i> ssp. <i>piperita</i>), and narrow leaved peppermint (<i>Eucalyptus radiata</i> ssp. <i>radiata</i>). Shrub dominated understoreys with broad-leaved hakea (<i>Hakea dactyloides</i>), sunshine wattle (<i>Acacia terminalis</i>), hill banksia (<i>Banksia spinulosa</i> var. <i>collina</i>), waratah (<i>Telopea speciosissima</i>), small-leaved boronia (<i>Boronia microphylla</i>), laurel geebung (<i>Persoonia laurina</i>), broad-leaf geebung (<i>Persoonia levis</i>), dorothy's wattle (<i>Acacia dorothera</i>), phyllota (<i>Phyllota</i> spp.) and mat-rush (<i>Lomandra</i> spp.) are characteristic.	MW17-19 CLZ
Hassans Walls 8931hw	Hassans Walls soil landscape is widespread on the steep colluvial slopes and cliffs which enclose the Wolgan, Capertee and Coxs river valleys. The landscape consists of cliffs derived from Narrabeen Group sandstones and steep colluvial talus sideslopes developed over the Illawarra Coal Measures and the Shoalhaven Group. Local relief is generally greater than 100 meters at elevations of 280 to 1,000 m ASL. Soils are typically shallow discontinuous Lithosols/Siliceous Sands on small rocky ledges on cliffs; moderately deep stony Lithosols/Siliceous Sands on upper slopes and recently deposited talus; moderately deep Yellow Podzolic Soils and Brown Podzolic Soils on lower slopes; shallow Sands/Lithosols along narrow steep deeply incised drainage lines and moderately deep Sands/Lithosols along narrow drainage flats. This soil landscape has severe risk of sheet erosion and rock fall which currently occurs throughout the landscape, risk of extreme water erosion hazard, mass movement hazard, severe foundation hazard, rock outcrop and localised shallow soils, high run-on, localised non-cohesive soils and is typically within mine subsidence district. The Vegetation is largely uncleared open-woodland and some open-forest on the more sheltered slopes. Tree species include Scribbly Gum (<i>Eucalyptus rossii</i>), Red Stringybark	MW17-19 CLZ

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Soil Landscape	Description	EP Area
	<i>(Eucalyptus macrorhyncha ssp. macrorhyncha)</i> , Broad-leaved Ironbark (<i>Eucalyptus fibrosa ssp. fibrosa</i>), Red Box (<i>Eucalyptus polyanthemos</i>), Mountain Grey Gum (<i>Eucalyptus cypellocarpa</i>), Thin-leaved Stringybark (<i>Eucalyptus eugenioides</i>), Grey Gum (<i>Eucalyptus punctata</i>) and Yellow Box (<i>Eucalyptus melliodora</i>). An open understorey with shrubs from the families Mimosaceae, Proteaceae, Fabaceae and Myrtaceae is characteristic. Along narrow drainage flats Tea-tree (<i>Leptospermum spp.</i>) is often conspicuous.	
Mount Tomah 8931to	The Mount Tomah landscape is restricted to small basalt caps. The landscape is typified by rounded crests and rolling hills on Tertiary basalt. The local relief is generally 40 to 100 m at elevation of greater than 700 m ASL. Soil are shallow stony Red Krasnozems, Structured Loams and Lithosols on crests and localised steep slopes; moderately deep to deep Red Krasnozems on upper and midslopes; moderately deep to deep Chocolate Soils and Structured Loams on lower slopes associated with the basalt, shale, sandstone transition. This landscape contains localised steep slopes, localised mass movement hazard, localised shallow soil and localised rock outcrop. Mass movement including minor earth slumps is evident near and along some drainage lines. The vegetation of this landscape is generally extensively cleared particularly on the more accessible larger basalt caps. The vegetation is typified by tall open-forest communities with closed-forest in sheltered valleys and woodland on some of the more north-western occurrences (Benson and Keith 1990). Blaxland's Stringybark (<i>Eucalyptus blaxlandii</i>) and Ribbon Gum (<i>Eucalyptus viminalis</i>) are the main tree species of the tall open-forest communities. Other trees include Brown Barrel (<i>Eucalyptus fastigata</i>), blue mountains ash (<i>Eucalyptus oreades</i>), Blackwood (<i>Acacia melanoxylon</i>) and Narrow-leaved Peppermint (<i>Eucalyptus radiata ssp. radiata</i>). Understorey species include Blackthorn (<i>Bursaria spinosa</i>), Fireweed Groundsel (<i>Senecio linearifolius</i>), Ivy-leaved violet (<i>Viola hederacea ssp. hederacea</i>), Bidgee-widgee (<i>Acaena novae-zelandiae</i>), Kidney Weed (<i>Dichondra repens</i>), Common Bracken (<i>Pteridium esculentum</i>), Stinging Pennywort (<i>Hydrocotyle laxiflora</i>) and Old man's Beard (<i>Clematis aristata</i>). A dry basalt cap woodland community (Benson and Keith 1990) occurs on caps around Mount Airly and includes Red Box (<i>Eucalyptus polyanthemos</i>) and Red Stringybark (<i>Eucalyptus macrorhyncha ssp. macrorhyncha</i>).	CLZ

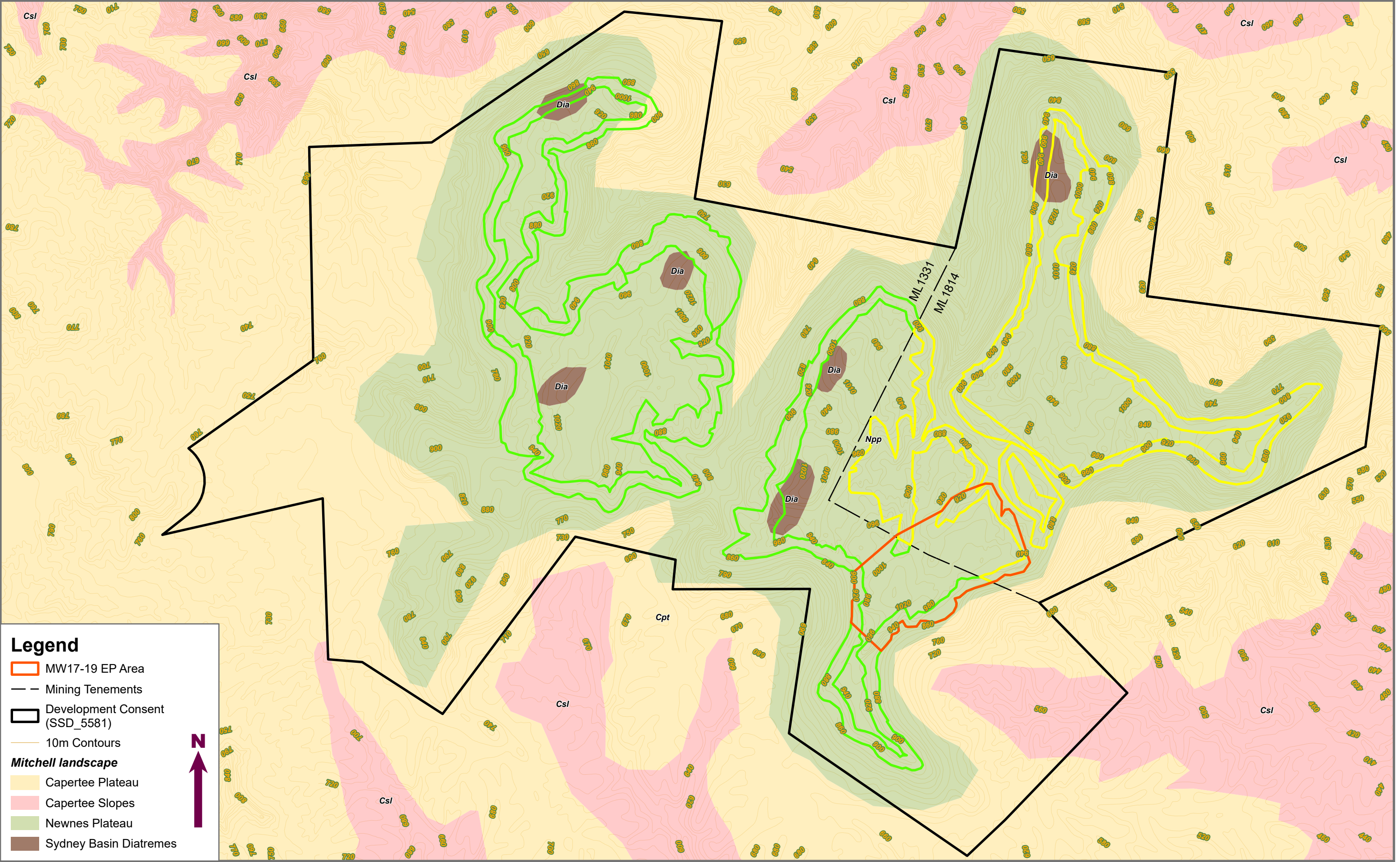
3.1.1.6 Hydrology

The study area occurs within the Capertee River sub-catchment, in the north-west of the Hawkesbury Nepean Catchment Management Authority (CMA). Surface hydrology of the project comprises a dendritic drainage network of ephemeral streams joining tributaries, and ultimately a main river, at acute angles. In general, flow rates fluctuate in response to rainfall patterns (RPS 2014).

The MW17-19 EP area intersects with two mapped first order drainages lines which feed into Genowlan Creek (see **Figure 3-2**). The CLZ EP area intersects with about 22 mapped first and second order drainage lines which feed into Torbane Creek in the west, Gap Creek in the centre and Genowlan Creek in the north east. All creeks are ephemeral and flow into the Capertee River. The Capertee River is a tributary of the Colo River, which ultimately flows into the Hawkesbury River and Broken Bay (RPS 2014).



Plate 3-3 **Second order stream flowering into Genowlan Creek**



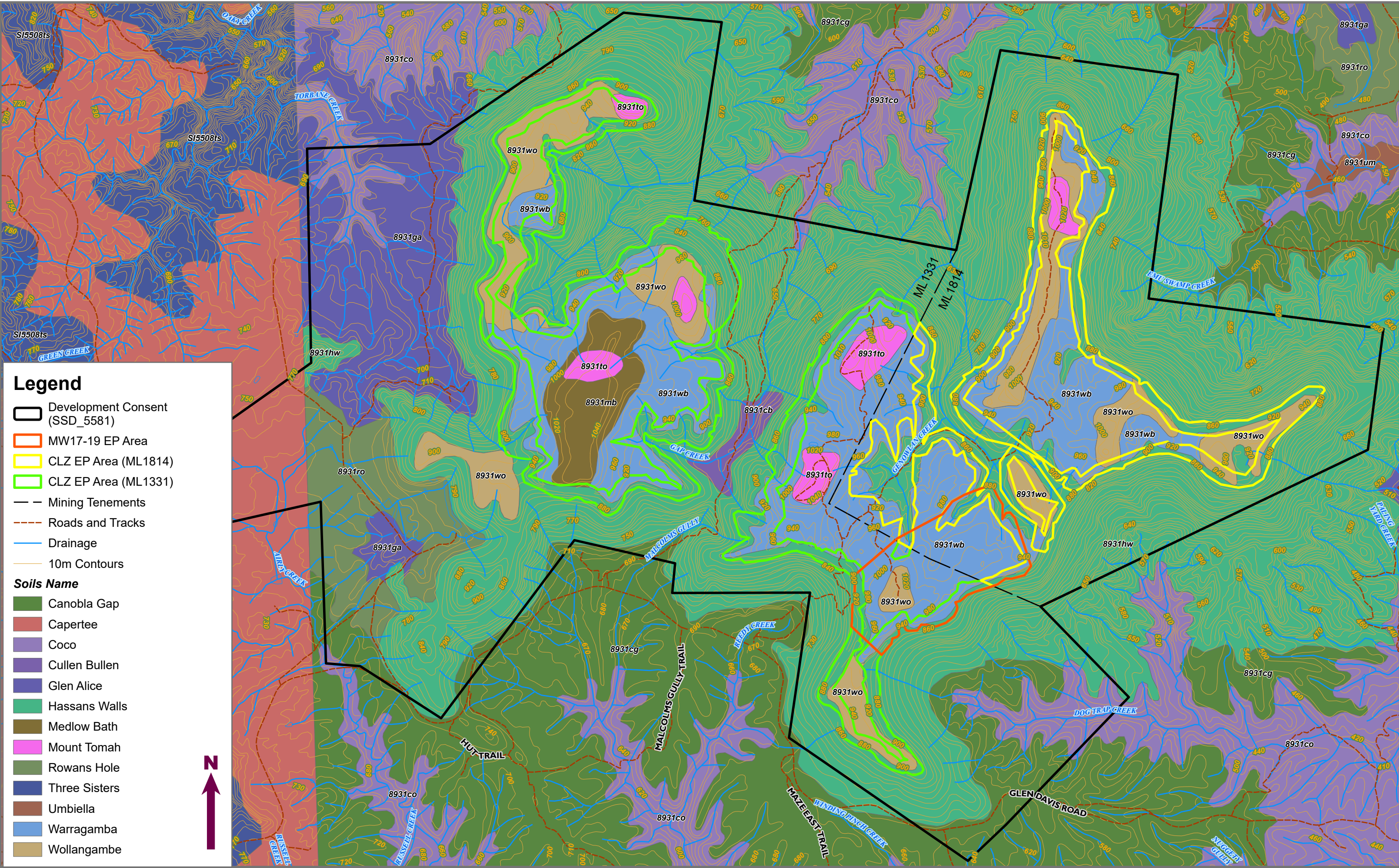


FIGURE 3-4 : SOLIS

LOCATION: AIRLY

VERSION: A
DATE EXPORTED: 26/09/2022
TECHNICIAN: Natalie.Wood

DATA SOURCES
Centennial, RPS, NSWSS,

500 0 500 1,000 1,500 2,000 m

SCALE 1:30,000 AT A3 SIZE / Projection: GDA 1994 MGA Zone 56

3.1.2 Likelihood of Occurrence Analysis

A total of 127 threatened flora and fauna species were previously recorded in the locality, or associations with habitat features or vegetation communities within the locality. Flora and fauna records contained the BioNet database (DPE 2021b) identified 59 previously recorded listed threatened flora and fauna species in the locality. The Protected Matters Search Tool (PMST; DCCEEW 2021) identified 53 listed threatened flora and fauna species as well as 12 listed migratory species and two listed TECs. The BAM-C identified 60 predicted species and 38 candidate species associated with the Plant Community Types (PCTs) and habitat types within the study areas.

Of these species, 24 threatened flora, 59 threatened fauna and one threatened insect were deemed to have a 'moderate', 'high' or 'known' likelihood to occur within the study area due to habitat suitability, consideration for connectivity and previous data collected by RPS. This is summarised in **Table 3-4**. The full LoOA and habitat descriptions are located in **Appendix A**

Table 3-4: Results of the Likelihood of Occurrence Analysis – moderate to high LoO

Class	Scientific Name	Common Name	BC Act	EPBC Act	Recent Record (Y/N)	LoO
Amphibia	<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	N	Moderate
Amphibia	<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	N	Moderate
Amphibia	<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	N	Moderate
Amphibia	<i>Mixophyes balbus</i>	Stuttering Frog	E	V	N	Moderate
Amphibia	<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	N	Moderate
Amphibia	<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		N	Moderate
Aves	<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	Y	High
Aves	<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V		Y	High
Aves	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V	E	Y	Known
Aves	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	E		Y	Known
Aves	<i>Chthonicola sagittata</i>	Speckled Warbler	V		Y	High
Aves	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V		Y	High
Aves	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Y	High
Aves	<i>Falco subniger</i>	Black Falcon	V		Y	High
Aves	<i>Glossopsitta pusilla</i>	Little Lorikeet	V		Y	High
Aves	<i>Grantiella picta</i>	Painted Honeyeater	V	V	N	Moderate
Aves	<i>Hieraaetus morphnoides</i>	Little Eagle	V		N	Moderate
Aves	<i>Lathamus discolor</i>	Swift Parrot	E	CE, MAR	N	High
Aves	<i>Lophoictinia isura</i>	Square-tailed Kite	V		N	Moderate
Aves	<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V		Y	High
Aves	<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V		Y	High
Aves	<i>Merops ornatus</i>	Rainbow bee-eater		MAR	N	Moderate
Aves	<i>Monarcha melanopsis</i>	Black-faced Monarch		M, MAR	N	Moderate
Aves	<i>Myiagra cyanoleuca</i>	Satin Flycatcher		M, MAR	N	High
Aves	<i>Neophema pulchella</i>	Turquoise Parrot	V		Y	High
Aves	<i>Ninox connivens</i>	Barking Owl	V		N	Moderate
Aves	<i>Ninox strenua</i>	Powerful Owl	V		N	High

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Class	Scientific Name	Common Name	BC Act	EPBC Act	Recent Record (Y/N)	LoO
Aves	<i>Pachycephala inornata</i>	Gilbert's Whistler	V		N	High
Aves	<i>Petroica boodang</i>	Scarlet Robin	V		Y	High
Aves	<i>Petroica phoenicea</i>	Flame Robin	V	MAR	N	High
Aves	<i>Polytelis swainsonii</i>	Superb Parrot	V	V	N	Moderate
Aves	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V		Y	Moderate
Aves	<i>Pycnoptilus floccosus</i>	Pilotbird		V	N	Moderate
Aves	<i>Rhipidura rufifrons</i>	Rufous Fantail		M,MA R	N	High
Aves	<i>Stagonopleura guttata</i>	Diamond Firetail	V		Y	High
Aves	<i>Tyto novaehollandiae</i>	Masked Owl	V		N	High
Aves	<i>Tyto tenebricosa</i>	Sooty Owl	V		N	Known
Flora	<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	N	Moderate
Flora	<i>Acacia flocktoniae</i>	Flockton Wattle	V	V	N	Moderate
Flora	<i>Acacia meiantha</i>		E	E	N	Moderate
Flora	<i>Astrotricha crassifolia</i>	Thick-leaf Star-hair	V	V	N	Moderate
Flora	<i>Eucalyptus cannonii</i>	Capertee Stringybark	V		Y	Known
Flora	<i>Grevillea evansiana</i>	Evans Grevillea	V	V	N	Moderate
Flora	<i>Grevillea obtusiflora</i>		E	E	N	Moderate
Flora	<i>Haloragodendron lucasii</i>		E	E	N	Moderate
Flora	<i>Homoranthus darwinioides</i>	Fairy Bells	V	V	N	Moderate
Flora	<i>Leionema lachnaeoides</i>		E	E	N	Moderate
Flora	<i>Leionema sympetalum</i>	Rylstone Bell	V	V	N	Moderate
Flora	<i>Olearia cordata</i>		V	V	N	Moderate
Flora	<i>Persoonia marginata</i>	Clandulla Geebung	V	V	Y	Moderate
Flora	<i>Phebalium bifidum</i>		E		Y	Moderate
Flora	<i>Pomaderris cotoneaster</i>	Cotoneaster Pomaderris	E	E	N	High
Flora	<i>Prostanthera cryptandroides subsp. cryptandroides</i>	Wollemi Mint-bush	V	V	N	High
Flora	<i>Prostanthera stricta</i>	Mount Vincent Mint-bush	V	V	Y	Known
Flora	<i>Pultenaea glabra</i>	Smooth Bush-Pea	V	V	N	High
Flora	<i>Pultenaea sp. Genowlan Point</i>		CE	CE	N	Known
Flora	<i>Pultenaea sp. Olinda</i>		E		N	High
Flora	<i>Rhodamnia rubescens</i>	Scrub Turpentine	CE	CE	N	Moderate
Flora	<i>Swainsona recta</i>	Small Purple-pea	E	E	N	Moderate
Flora	<i>Xanthosia scopulicola</i>		V		N	Moderate
Flora	<i>Zieria murphyi</i>	Velvet Zieria	V	V	N	High
Insect	<i>Paralucia spinifera</i>	Purple Copper Butterfly, Bathurst Copper Butterfly	E	V	N	Moderate
Mammalia	<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V		N	High
Mammalia	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	N	Known
Mammalia	<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	N	High
Mammalia	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		N	Moderate
Mammalia	<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V		N	Moderate
Mammalia	<i>Miniopterus australis</i>	Little Bent-winged Bat	V		N	Moderate

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Class	Scientific Name	Common Name	BC Act	EPBC Act	Recent Record (Y/N)	LoO
Mammalia	<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V		N	High
Mammalia	<i>Myotis macropus</i>	Southern Myotis	V		N	Moderate
Mammalia	<i>Petauroides volans</i>	Greater Glider		E	N	Known
Mammalia	<i>Petaurus australis</i>	Yellow-bellied Glider	V		N	Moderate
Mammalia	<i>Petaurus norfolcensis</i>	Squirrel Glider	V		N	High
Mammalia	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	N	High
Mammalia	<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V		N	Moderate
Mammalia	<i>Phascolarctos cinereus</i>	Koala	E	E	Y	Known
Mammalia	<i>Pseudomys novaehollandiae</i>	New Holland Mouse		V	N	Moderate
Mammalia	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	N	High
Mammalia	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V		N	High
Mammalia	<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V		N	High
Reptilia	<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	V	V	N	Moderate
Reptilia	<i>Delma impar</i>	Striped Legless Lizard	V	V	N	Moderate
Reptilia	<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	N	High
Reptilia	<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V		N	Known

Note: V – Vulnerable; E – Endangered; CE – Critically Endangered; M – Migratory; MAR - Marine.

3.2 Vegetation types

Broadscale vegetation types include dry sclerophyll forest, wet sclerophyll forest and heathlands. Dry sclerophyll habitats dominate about half of study area, wet sclerophyll habitats are much more patchily distributed occurring in the gullies surrounding the study area, and heathlands are generally restricted to patches of sandstone rock outcrops.

3.2.1 Plant Community Types

The MW17-19 EP area comprises eight PCTs and the CLZ (ML1814) comprises 12 PCTs (see **Table 3-5**).

Table 3-5 PCTs within the MW17-19 EP area

PCT Code	PCT Description	CLZ (ML1814) Area (ha)	MW17-19 EP Area (ha)
0	Not native vegetation	0.03	0.08
3210	Blue Mountains Cool Wet Eucalypt Forest	0.13	0.01
3226	Western Blue Mountains Montane Wet Fern Forest	15.19	1.68
3480	Capertee-Wolgan Escarpment Dry Forest	0.19	-
3495	Western Blue Mountains Monkey Gum Gully Forest	29.21	11.55
3686	Mount Airly Sandstone Forest	89.99	42.21
3687	Newnes Plateau Peppermint-Ash Tall Forest	2.16	0.50
3694	Upper Blue Mountains Ridgetop Woodland	1.55	-
3695	Western Blue Mountains Peppermint Sheltered Forest	12.79	13.97
3731	Capertee Conglomerate Grey Gum-Stringybark Forest	2.31	-
3859	Genowlan Point Heath	2.21	-
3862	Newnes Plateau Rockplate Heath	1.29	3.49
3865	Western Blue Mountains Pagoda Scrub	54.36	48.15
Grand Total		211.41	121.62

Further descriptions of the PCTs are provided below.

3.2.1.1 Blue Mountains Cool Wet Eucalypt Forest (PCT 3210)

Vegetation Community Details

Description: A very tall to extremely tall sclerophyll open forest with a layered mid-stratum of mesophyll small trees and tree ferns, with a ground layer of ferns and climbers. This PCT occurs in deeply incised elevated gullies in Kanangra Boyd National Park and sheltered slopes on basalt peaks in the Blue Mountains. The tree canopy is variable in composition and is characterised by a suite of cool-climate species that individually occur no more than occasionally. *Eucalyptus fastigata* is most frequently recorded with other species including *Eucalyptus viminalis*, *Eucalyptus smithii*, *Eucalyptus oreades* are all rare though locally dominant. Very localised stands of *Eucalyptus bicostata* occur in the Coxs catchment and very protected creeks in the Kowmung Gorge are dominated by *Casuarina cunninghamiana* subsp. *cunninghamiana*. The mid-stratum is very frequently layered with a mid-dense layer of smaller trees, very frequently dominated by a high cover of *Doryphora sassafras* commonly with *Acacia melanoxylon* and rarely with *Toona ciliata*. A lower layer of tall shrubs includes *Meliccytus dentatus* and *Hedycarya angustifolia*, with tree ferns *Cyathea australis* or *Dicksonia antarctica*, common. The ground layer very frequently includes *Urtica incisa*, particularly near canopy openings along with small ferns such as *Pellaea falcata*. Small climbers are also common including *Pandorea pandorana* subsp. *pandorana*, *Hackelia latifolia*, *Smilax australis* and *Tylophora barbata*.

The distribution of this PCT is partitioned by substrate. In the Blue Mountains it is localised around the sheltered slopes of the large basalt peaks of Mount Wilson and Mount Tomah, generally at elevations of above 800 metres asl. In Kanangra Boyd National Park it occupies drier climates, however in very protected, steep and incised gullies on a range of metasediments with elevations that fall to around 500 metres asl. Collectively however, these environments are amongst the coolest in the Sydney

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Vegetation Community Details

Basin region. This community shares a moderate floristic overlap with rainforest PCT 3047, however in Kanangra Boyd National Park it receives less than two thirds of the annual rainfall of that PCT and includes a simpler assemblage of rainforest species.

Vegetation formation: Wet Sclerophyll Forests (Shrubby sub-formation)

PCT lineage: Previously PCT 706

Percent cleared: 3.06%

Associated TEC: Relates to the NSW Blue Mountains Basalt Forest TEC where it occurs in the Sydney Basin Bioregion and on basalt influenced substrates consistent with the Final Determination paragraph 2.2.
Relates to the Commonwealth Upland Basalt Eucalypt Forests TEC where it occurs on soils derived from basalt or basalt like substrates within or adjoining the Sydney Basin bioregion (IBRA Version 6.1) and satisfies the condition thresholds as per section 5 of the Listing Advice.

3.2.1.2 Western Blue Mountains Montane Wet Fern Forest (PCT 3226)

Vegetation Community Details

Description: A very tall wet sclerophyll open forest of intermediate elevations on moderately fertile, moist sheltered slopes of the moderately high, cool western Blue Mountains and outlying ranges. Distributed from Charbon and the slopes of Nullo Mountain south to Springvale and Hartley Vale and through the western Burragorang catchment to Mares Forest and Joadja. Samples are from elevations of 650-1150 metres asl, with means of 700-1100 mm rainfall and 4-19 frost days annually, commonly associated with sheltered slopes derived from shales and enriched sandstones (Illawarra Coal Measures, Narrabeen Group sandstones below remnant basalt, Lambie Group metasediments) and occasionally ignimbrite and granitic rocks.

A very tall, mid-dense to closed canopy commonly contains *Eucalyptus fastigata*, accompanied by *Eucalyptus radiata* and occasionally *Eucalyptus cypellocarpa*. A scattered small tree layer commonly includes *Acacia falciformis* and occasionally *Elaeocarpus reticulatus*. The shrub layer is sparse and very frequently includes scattered *Leucopogon lanceolatus* and occasionally *Coprosma quadrifida* or *Persoonia linearis*. The ground layer is mid-dense to closed and is commonly dominated by ferns including *Pteridium esculentum*, *Blechnum cartilagineum* and *Calochlaena dubia*, interspersed with tall clumps of *Lomandra longifolia* and *Dianella caerulea*. Other ground layer species include tufted grasses *Microlaena stipoides* and *Poa sieberiana*, small forbs *Viola hederacea*, *Poranthera microphylla* and *Hydrocotyle laxiflora*, and small vines including *Clematis aristata* and occasional *Geitonoplesium cymosum*, *Billardiera scandens*, *Desmodium varians* or *Eustrephus latifolius*.

This community tends to occupy deep gullies in the north of its range and moist, sheltered south-facing slopes at higher elevations further south, and may be replaced by PCT 3650 on exposed rocky crests. On more fertile soils on remnant basalt caps it may be replaced by PCT 3305.

Vegetation formation: Wet Sclerophyll Forests (Shrubby sub-formation)

PCT lineage: Complex split from PCT 1107 and 1615

Percent cleared: 6.74%

Associated TEC: No associated TEC

3.2.1.3 Capertee-Wolgan Escarpment Dry Forest (PCT 3480)

Vegetation Community Details

Description: This placeholder PCT describes a tall to very tall sclerophyll open forest with a mid-stratum of dry shrubs and a ground layer of grasses, graminoids and small climbers. Caution is required with the assignment of plots to this PCT as it is defined by a pool of standard survey plots collected across a range of seasonal extremes by different observers, each with alternate though related taxonomic interpretations. Additional fieldwork is required to resolve data in the area. Based on current data however, this PCT occurs on Permian siltstone and shale escarpment slopes, below the residual sandstone mesas and plateaus above the Capertee Valley, western Blue Mountains.

Vegetation Community Details

The tree canopy very frequently includes a high cover of *Eucalyptus fibrosa* commonly with *Eucalyptus punctata*, and occasionally one or more species from the stringybark eucalypt group, of which *Eucalyptus macrorhyncha* and *Eucalyptus cannonii* are most frequent. These may be occasionally accompanied or replaced by *Eucalyptus polyanthemos*, rarely *Eucalyptus cypellocarpa* or *Eucalyptus rossii*. The mid-stratum occasionally includes a sparse layer of small trees including eucalypt saplings or *Acacia obtusifolia*. A lower layer of dry shrubs is sparse to mid-dense and almost always includes *Acrotriche rigida*, very frequently with *Bursaria spinosa* and *Persoonia linearis*, commonly with *Astroloma humifusum*, *Hibbertia obtusifolia*, *Correa reflexa* and *Indigofera australis*. The ground layer is also sparse to mid-dense, very frequently including *Glycine clandestina*, and commonly tussock grasses including *Poa sieberiana* and *Rytidosperma pallidum*, *Dianella prunina* and small climbers *Clematis glycinoides* and *Hardenbergia violacea*.

This PCT occurs at mid-elevations across all the escarpment aspects that fall below Mount Airly and is likely to extend to unsampled parts of the eastern escarpment below the Wollemi Plateau. It grades into taller forest PCT 3510 on sheltered escarpment aspects or on deeper shale soils.

Vegetation formation:	Dry Sclerophyll Forests (Shrubby sub-formation)
PCT lineage:	New vegetation type
Percent cleared:	1.96%
Associated TEC:	No associated TEC

3.2.1.4 Western Blue Mountains Monkey Gum Gully Forest (PCT 3495)

Vegetation Community Details

Description:	A tall to very tall sheltered sclerophyll open forest with dry shrubs and a ground cover of ferns, climbers and graminoids found, in gullies and on steep sheltered escarpment slopes that trace the margins of the sandstone plateau along the western Blue Mountains. The tree canopy is very frequently dominated by <i>Eucalyptus cypellocarpa</i>, often with one or more stringybark eucalypts of which <i>Eucalyptus blaxlandii</i> and <i>Eucalyptus globoidea</i> are most frequent. Other species occasionally include <i>Eucalyptus punctata</i> and rarely <i>Eucalyptus piperita</i>. The mid-stratum is sometimes layered, with a sparse cover of smaller trees that include eucalypts, taller <i>Acacia</i> species, which commonly includes <i>Acacia obtusifolia</i> or a sparse cover of <i>Melaleuca linariifolia</i> in creek lines. The lower layer of dry shrubs commonly includes <i>Leucopogon lanceolatus</i>, <i>Leptospermum polygalifolium</i>, <i>Acacia obtusifolia</i> and <i>Bursaria spinosa</i>. The ground layer is a mid-dense to dense cover of ferns, climbers, forbs and graminoids. <i>Lomandra longifolia</i> is almost always present, very frequently with <i>Pteridium esculentum</i>, <i>Adiantum aethiopicum</i>, <i>Clematis aristata</i>, <i>Geitonoplesium cymosum</i>, <i>Desmodium varians</i> and <i>Dichondra repens</i>. This PCT is closely associated with sheltered Permian Berry Siltstones on mid to high elevations between Mount Airly in the Capertee Valley and the Megalong and Jamison valleys below the townships of the Upper Blue Mountains. Southern outliers occur in the ranges and valleys around Yerranderie, where Permian sediments are exposed along and below Scotts Main Range. Grades into a wide range of dry and sheltered forest PCTs across its range. It is largely encompassed within the reserve system of the Greater Blue Mountains World Heritage Area.
Vegetation formation:	Dry Sclerophyll Forests (Shrubby sub-formation)
PCT lineage:	Previously PCT 941
Percent cleared:	1.73%
Associated TEC:	No associated TEC

3.2.1.5 Mount Airly Sandstone Forest (PCT 3686)

Vegetation Community Details

Description:	A tall, rarely very tall sclerophyll open forest with a dry shrub layer and very sparse ground layer associated with exposed, rocky high elevation Narrabeen sandstone mesas and ranges on the western rim of the Capertee Valley, Central Tablelands.
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Vegetation Community Details

The tree canopy very frequently includes *Eucalyptus sparsifolia*, commonly *Eucalyptus punctata* and/or *Eucalyptus piperita* or occasionally *Eucalyptus mannifera*. The mid-stratum occasionally includes a taller layer of small trees, dominated by *Allocasuarina littoralis*. The lower layer of dry shrubs almost always includes *Acacia obtusifolia*, very frequently with *Persoonia linearis* and commonly with *Leucopogon muticus* and *Podolobium ilicifolium*. The ground layer is dominated by litter and loose stones, and only a very sparse cover of native vegetation, characterised by isolated individuals of graminoids and grasses. Species commonly include *Lomandra filicifolia*, *Entolasia stricta*, *Microlaena stipoides* and *Dianella caerulea*, occasionally with *Poa sieberiana*.

This PCT is found mainly on the ridgetops of Mount Airly, however occurs patchily on residual sandstones east of Ilford in areas disconnected from the main sandstone ranges to the south and east. It is replaced on the main Ben Bullen range by dry shrub forest PCT 3749 which includes a different set of canopy species, has a lower frequency of *Acacia obtusifolia* and a higher grass cover.

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

PCT lineage: Previously PCT 1248

Percent cleared: 10.01%

Associated TEC: No associated TEC

3.2.1.6 Newnes Plateau Peppermint-Ash Tall Forest (PCT 3687)

Vegetation Community Details

Description: A very tall moist shrubby sclerophyll open forest found on high cool parts of Newnes Plateau in the eastern central tablelands. This PCT is associated with areas of moderately deep or enriched soil, (possibly shale lenses) on Banks Wall Sandstone on the plateau and at its margins with underlying Illawarra Coal Measures sediments. It occurs at elevations of 950-1200 metres asl, with means of 900-1100 mm precipitation and 7-14 frost days annually.

A mid-dense tree canopy almost always includes *Eucalyptus radiata*, commonly with *Eucalyptus dalrympleana* and occasionally *Eucalyptus oreades*, *Eucalyptus blaxlandii*, *Eucalyptus fastigata* or *Eucalyptus cypellocarpa*. A complex mid-stratum includes sparse small trees such as occasional *Polyscias sambucifolia* or *Acacia falciformis*, and a mid-dense smaller shrub layer that commonly includes *Leucopogon lanceolatus*, *Lomatia silaifolia*, *Amperea xiphoclada*, *Monotoca scoparia* and *Olearia myrsinoides*, and occasional patchy *Leptospermum polygalifolium*, *Banksia spinulosa*, *Callicoma serratifolia* or *Lomatia myricoides*. The ground layer is mid-dense to sparse and commonly includes tall *Pteridium esculentum*, *Lomandra longifolia*, *Dianella caerulea*, *Dianella tasmanica* and *Senecio pinnatifolius*, twining *Billardiera scandens* and *Clematis aristata*, grasses *Microlaena stipoides* and *Poa sieberiana*, and small forbs *Viola sieberiana*, *Poranthera microphylla*, *Hydrocotyle laxiflora*, *Gonocarpus teucrioides*, *Lomandra filiformis* and *Solenogyne bellioides*. This community commonly grades into PCT 3688 on nearby shallow sandstone soils.

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

PCT lineage: Previously PCT 1247

Percent cleared: 3.11%

Associated TEC: No associated TEC

3.2.1.7 Upper Blue Mountains Ridgetop Woodland (PCT 3694)

Vegetation Community Details

Description: A mid-high to tall, rarely very tall, heathy sclerophyll open forest or woodland found on exposed Narrabeen sandstone ridges and slopes across the upper Blue Mountains. The tree canopy very frequently includes a high cover of *Eucalyptus sieberi* and *Eucalyptus piperita*, occasionally accompanied or replaced by *Eucalyptus sclerophylla*, *Eucalyptus sparsifolia* or *Eucalyptus oreades*. The mid-dense to dense mid-stratum is characterised by shrubs from the Proteaceae family, very frequently *Banksia spinulosa*, *Isopogon anemonifolius*, *Monotoca scoparia* and *Persoonia levis*. Other shrub species frequently include *Leptospermum trinervium* and *Hakea*

Vegetation Community Details

dactyloides with the smaller *Platysace linearifolia* almost always present. The ground layer is commonly an open cover of grasses, graminoids, sedges and ferns that very frequently includes *Entolasia stricta*, *Caustis flexuosa*, *Lomandra glauca* and commonly *Pteridium esculentum*.

This PCT is widespread across sandstone plateaus at elevations above 600 metres asl and within a rainfall range of 920 mm in the western Blue Mountains to 1400 mm per annum in the wettest parts near Katoomba. It extends from the eastern Newnes Plateau to Kings Tableland with outlying examples on elevated parts of Lacys Tableland above Lake Burragorang.

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

PCT lineage: Complex split from PCTs 1248 and 1249

Percent cleared: 6.72%

Associated TEC: No associated TEC

3.2.1.8 Western Blue Mountains Peppermint Sheltered Forest (PCT 3695)

Vegetation Community Details

Description: A tall to very tall dry shrubby sclerophyll open forest found on sheltered Narrabeen sandstone slopes and gullies on the western ranges of Wollemi National Park.

The tree canopy almost always includes a high cover of *Eucalyptus piperita* occasionally with *Eucalyptus punctata* or rarely *Eucalyptus cypellocarpa* and stringybarks (*Eucalyptus sparsifolia*, *Eucalyptus agglomerata*, *Eucalyptus blaxlandii*). The sparse shrub layer very frequently includes *Leucopogon lanceolatus*, *Persoonia linearis* and *Acacia obtusifolia* with the latter the most abundant and *Podolobium ilicifolium* is also common. The ground layer consists of a sparse cover of *Pteridium esculentum*, *Dianella caerulea* and *Entolasia stricta*.

This sheltered forest is widespread across the sandstone plateau of the northern Wollangambe and Newnes plateaus north to the Nullo Mountain area. This region marks an area of declining rainfall as the sandstone ranges fall in elevation from high points in the Upper Blue Mountains towards the western flowing Cudgegong River. This community grades into exposed ridgetop woodlands PCT 3623 in the northern extent of the distribution near Nullo Mountain and dry forests PCT 3627 and PCT 3857 elsewhere.

Vegetation formation: Dry Sclerophyll Forests (Shrubby sub-formation)

PCT lineage: Previously PCT 1630

Percent cleared: 1.86%

Associated TEC: No associated TEC

3.2.1.9 Capertee Conglomerate Grey Gum-Stringybark Forest (PCT 3731)

Vegetation Community Details

Description: A tall, occasionally very tall, sclerophyll open forest with a mid-stratum of dry shrubs and a ground layer of grasses and graminoids. This PCT occurs on dry quartz-rich Permian sediments exposed on foothill ranges of the Capertee and Wolgan valleys, western Blue Mountains.

The tree canopy very frequently includes a high cover of *Eucalyptus punctata* and one or more species from the stringybark eucalypt group, of which *Eucalyptus sparsifolia* and *Eucalyptus cannonii* are most frequent. Other eucalypts commonly include *Eucalyptus rossii*, and rarely *Eucalyptus fibrosa*, *Eucalyptus crebra*, or very localised patches of *Eucalyptus polyanthemus* or *Eucalyptus mannifera*. The sparse to mid-dense shrub layer commonly includes *Persoonia linearis*, *Podolobium ilicifolium*, *Hibbertia obtusifolia*, *Platysace ericoides*, *Astroloma humifusum* and *Brachyloma daphnoides*, occasionally with a patchy cover of *Leucopogon muticus* and *Acacia decora*. The sparse to mid-dense ground layer is dominated by grasses, very frequently including *Rytidosperma pallidum*, commonly or occasionally with *Dichelachne micrantha*, *Microlaena stipoides* or *Poa sieberiana*. Small forbs almost always include *Goodenia hederacea*, very frequently with graminoids such as *Dianella revoluta* and *Lomandra filiformis*.

Vegetation Community Details

This PCT occurs across a topographically diverse landscape, depending on where the underlying Permian substrate is exposed. This varies from steep, dry and rocky escarpment talus slopes, or on gently sloping crests on plateaus or lower-elevation valley floors. Such areas receive a relatively low mean annual rainfall as they fall in the rain shadow of the Blue Mountains plateau. It occurs at mid to high elevations which experience cool tableland temperatures. This community is replaced by forest PCTs 3480 or 3770 on finer-grained Permian sediments exposed on escarpments and foothills. It has only weak floristic overlap with other PCTs in NSW, and is extensively distributed throughout Gardens of Stone National Park.

Vegetation formation:	Dry Sclerophyll Forests (Shrubby sub-formation)
PCT lineage:	Complex split from 889 and 863
Percent cleared:	27.07%
Associated TEC:	No associated TEC

3.2.1.10 Genowlan Point Heath (PCT 3859)

Vegetation Community Details

Description:	A closed heathland found on rocky Narrabeen sandstone at Genowlan Point on the isolated Mount Airly mesa in the Capertee Valley and surrounding escarpments, western Blue Mountains. Mid-high eucalypts are rarely recorded as emergents, mainly <i>Eucalyptus blaxlandii</i> or <i>Eucalyptus sparsifolia</i> along with, occasionally, just a few individuals of <i>Callitris muelleri</i>. A dense even shrub canopy almost always includes <i>Allocasuarina nana</i> and <i>Leptospermum trinervium</i> and very frequently a sparse cover of <i>Acacia obtusifolia</i>, commonly <i>Brachyloma daphnoides</i> and occasionally <i>Banksia penicillata</i>. The ground layer consists of a patchy and sparse cover of graminoids, very frequently including <i>Lepidosperma viscidum</i> and <i>Lomandra glauca</i> and rarely the larger <i>Xanthorrhoea johnsonii</i>. This PCT has a naturally restricted distribution and represents the driest end of the rainfall gradient among all the Sydney Montane Heaths dominated by <i>Allocasuarina nana</i>. This community occurs where mean annual rainfall covers a narrow band of 800-860 mm, although the elevation range of 990-1030 metres asl overlaps with other upper Blue Mountains heath PCTs 3862 and 3863. The species richness of these more easterly wetter heaths is almost twice that recorded in this PCT.
Vegetation formation:	Heathlands
PCT lineage:	Previously PCT 636
Percent cleared:	32.74%
Associated TEC:	Relates to the NSW <i>Genowlan Point Allocasuarina nana</i> Heathland TEC only where it occurs on Genowlan Point as per paragraph 1 of the Final Determination.

3.2.1.11 Newnes Plateau Rockplate Heath (PCT 3862)

Vegetation Community Details

Description:	A tall heathland or closed heathland, occasionally with eucalypt emergents, found on rocky Narrabeen sandstone on the margins of the Newnes Plateau and headwaters of the Wollangambe catchment, upper Blue Mountains. Low growing eucalypts including the rare mallee <i>Eucalyptus gregsoniana</i> are occasionally recorded as an emergent layer. The shrub canopy almost always includes a high cover of <i>Allocasuarina nana</i> broken only by exposed rock plates or pagodas. The shrub layer also very frequently includes <i>Banksia ericifolia</i>, <i>Petrophile pulchella</i>, <i>Calytrix tetragona</i> and <i>Leptospermum arachnoides</i>. The ground layer is a sparse patchy cover on the skeletal soils however almost always includes <i>Stylidium lineare</i> and commonly <i>Lepidosperma laterale</i> and <i>Lomandra glauca</i>. This PCT is prominent on the rocky ridges that lead to cliffs and escarpments overlooking incised gorges, and forms a continuous even cover or tessellated pattern where the heath grows over extensive areas amongst open exposed pagodas and outcrops. It is restricted to higher elevations, usually exceeding 900 metres asl that receive 900-1160 mm mean annual rainfall. This community
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REPORT

Vegetation Community Details

occurs in colder and drier environments than those that support the similar heath PCT 3863 found in the wetter parts of the upper Blue Mountains near Blackheath and Katoomba.

Vegetation formation: Heathlands

PCT lineage: Previously PCT 708

Percent cleared: 0.95%

Associated TEC: No associated TEC

3.2.1.12 Western Blue Mountains Pagoda Scrub (PCT 3865)

Vegetation Community Details

Description: A tall open shrubland found on massive residual sandstone outcrops known as pagodas, on clifftops and escarpment edges of the Newnes Plateau and adjoining ranges, western Blue Mountains. The shrub canopy almost always includes *Leptospermum parvifolium* with a high cover and *Leucopogon muticus*, very frequently with *Calytrix tetragona* and *Leptospermum arachnoides*. There is a diverse however inconsistent combination of other heath shrubs that are typically sparse in cover, commonly including *Acacia obtusifolia*, rarely with *Isopogon anethifolius* and *Banksia penicillata*. The shrubland occasionally has a sparse taller layer of small trees that include combinations of pine, most frequently *Callitris rhomboidea*, low stunted eucalypts, most frequently *Eucalyptus rossii* and mallee eucalypts such as *Eucalyptus stricta*. A range of *Allocasuarina* species are also sometimes present, most frequently *Allocasuarina distyla*, either in the small tree layer or as stunted forms in the shrubland. Exposed rock makes up a large proportion of the ground cover and as a result, the mix of ground layer species and their cover is highly variable. An example of the ground layer includes small clumps of sedges such as *Lepidosperma viscidum* that cling to damp skeletal soils in rock crevices. This PCT is common although patchy across the mid to high-elevations between Lithgow and the Wolgan Valley, occurring within Wollemi and Gardens of Stone national parks. It forms part of a mosaic of shrubland, heath and rocky woodland communities in the western Blue Mountains. This PCT is replaced by a floristically related shrubland PCT 3866, found below 750 metres asl in lower annual rainfall zones. Some of the characteristic shrub canopy are shared between the two shrublands, however PCT 3866 includes species common to dry rock plates of the western Hunter region.

Vegetation formation: Heathlands

PCT lineage: New vegetation type

Percent cleared: 0.50%

Associated TEC: No associated TEC

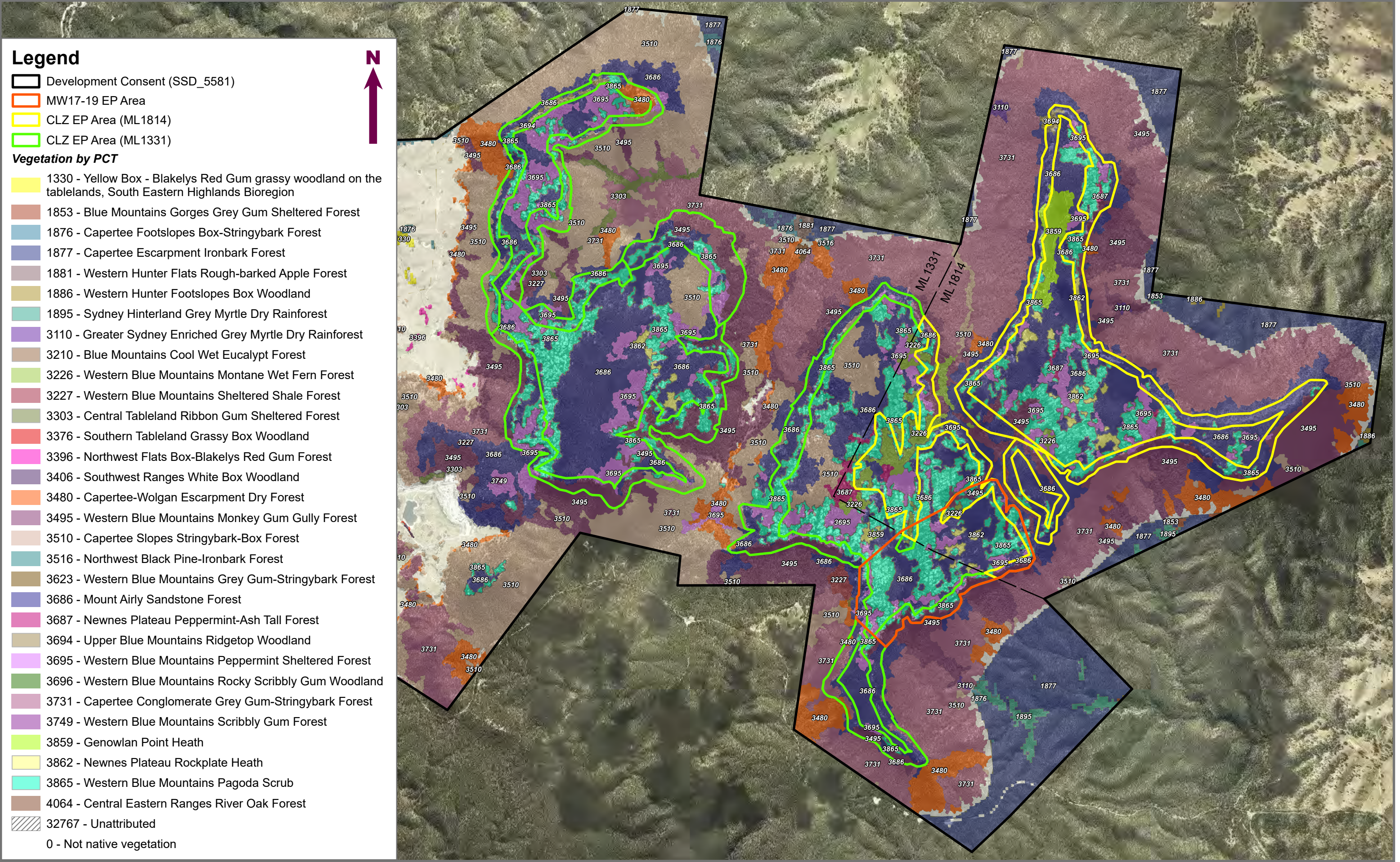


FIGURE 3-5:
VEGETATION COMMUNITIES

LOCATION: AIRLY

VERSION: A
DATE EXPORTED: 26/09/2022
TECHNICIAN: Natalie.Wood

DATA SOURCES
Centennial, RPS, NSWSS,

500 0 500 1,000 1,500 2,000
m
SCALE 1:30,000 AT A3 SIZE / Projection: GDA 1994 MGA Zone 56

CLIENT: Centennial
PROJ: PR152229
PURPOSE: Baseline Assessment

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PROJECT PATH: S:\Centennial\All Jobs\5568 - 152229 - Airly Cliff Line Zone EP BMP Update\10 - Drafting\ECO_BMPGeneralFigures_aprx

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3.2.2 Threatened Ecological Communities

PCT 3210 and PCT 3859 may form a part of BC Act listed TECs.

It was concluded that one TEC occurs within the CLZ EP area (see **Table 3-6**).

Table 3-6: TECs within the EP areas

TEC	Listing	Associated PCT	Area (ha)	EP Area
Genowlan Point <i>Allocasuarina nana</i> Heathland EEC	BC Act	3895	2.21	CLZ

Details of these listings and justification of their presence or absence within the study area are provided in the following section.

3.2.2.1 Genowlan Point *Allocasuarina nana* Heathland EEC

PCT 3859 within the study area forms a part of the Genowlan Point *Allocasuarina nana* Heathland EEC listed under the BC Act. PCT 3859 within the study area is consistent with the EEC listing as:

- It occurs on the Genowlan Point, Capertee Valley; and
- It contains *Allocasuarina nana*, as confirmed in floristic plots recently undertaken (**Table 3-7**). These plots also confirmed the presence of *Xanthorrhoea johnsonii*, *Micromyrtus sessilis*, *Pseudanthus divaricatissimus* and *Callitris muelleri*, which form a unique combination that typically composes this community (DPE 2019b).

This EEC is geographically restricted to Genowlan Point with the total extent of its occurrence limited to an estimated 15.2 ha area. This TEC is monitored annually by the NPWS.

Two floristic plots were surveyed as part of this Baseline Assessment (**Figure 2-2**). Results are detailed below in **Table 3-7**. Both plots displayed a species diversity of 27 and contained no exotic species.

Table 3-7: Flora composition and Structure of BAM plots for Genowlan Point *Allocasuarina nana* Heathland EEC

BAM Growth Form Group	Scientific Name	Common Name	GEN_PT_0 2 C	GEN_PT_0 1 A	GEN_PT_0 2 C	GEN_PT_0 2 A
Forb (FG)	<i>Dampiera stricta</i>		1	100	0.5	50
Forb (FG)	<i>Goodenia bellidifolia</i>		0.1	50	0.2	30
Forb (FG)	<i>Patersonia sericea</i>	Silky Purple-Flag	0.1	1		
Grass & grasslike (GG)	<i>Austrostipa pubescens</i>		0.1	25		
Grass & grasslike (GG)	<i>Lepidosperma viscidum</i>		15	25	0.1	2
Grass & grasslike (GG)	<i>Lomandra glauca</i>	Pale Mat-rush	0.2	50	1	50
Grass & grasslike (GG)	<i>Rytidosperma spp.</i>				0.1	2
Grass & grasslike (GG)	<i>Rytidosperma tenuius</i>		0.1	25		
Grass & grasslike (GG)	<i>Schoenus spp.</i>		1	100	0.1	5
Grass & grasslike (GG)	<i>Schoenus villosus</i>				1	40
Other (OG)	<i>Marsdenia spp.</i>		0.1	1		
Other (OG)	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree			1	3
Shrub (SG)	<i>Acacia obtusifolia</i>		0.1	1	1	1
Shrub (SG)	<i>Allocasuarina nana</i>	Dwarf She-oak	75	100	70	200
Shrub (SG)	<i>Babingtonia densifolia</i>		0.2	25		

REPORT

BAM Growth Form Group	Scientific Name	Common Name	GEN_PT_0 2 C	GEN_PT_0 1 A	GEN_PT_0 2 C	GEN_PT_0 2 A
Shrub (SG)	<i>Baeckea brevifolia</i>		0.1	10		
Shrub (SG)	<i>Boronia microphylla</i>	Small-leaved Boronia			0.2	20
Shrub (SG)	<i>Boronia rigens</i>	Stiff Boronia	0.1	25	0.4	20
Shrub (SG)	<i>Bossiaea heterophylla</i>	Variable Bossiaea			0.6	20
Shrub (SG)	<i>Brachyloma daphnoides</i>	Daphne Heath	0.1	5	1	10
Shrub (SG)	<i>Cryptandra amara</i>	Bitter Cryptandra	0.1	20	0.5	20
Shrub (SG)	<i>Harmogia densifolia</i>				0.2	20
Shrub (SG)	<i>Hibbertia serpyllifolia</i>	Hairy Guinea Flower	0.1	5		
Shrub (SG)	<i>Isopogon anethifolius</i>	Narrow-leaf Drumsticks	0.1	1	0.1	1
Shrub (SG)	<i>Kunzea parvifolia</i>	Violet Kunzea	5	25		
Shrub (SG)	<i>Leptospermum parvifolium</i>		5	25		
Shrub (SG)	<i>Leptospermum polyanthum</i>				2	10
Shrub (SG)	<i>Leptospermum trinervium</i>	Slender Tea-tree	1	25	0.2	1
Shrub (SG)	<i>Leucopogon muticus</i>	Blunt Beard-heath	0.1	5	1	8
Shrub (SG)	<i>Micrantheum ericoides</i>		0.1	25		
Shrub (SG)	<i>Micromyrtus ciliata</i>	Fringed Heath-myrtle			0.3	30
Shrub (SG)	<i>Micromyrtus sessilis</i>		1	40	0.4	5
Shrub (SG)	<i>Persoonia spp.</i>				0.1	6
Shrub (SG)	<i>Phyllota phyllicoides</i>	Heath Phyllota			1	20
Shrub (SG)	<i>Platysace lanceolata</i>	Shrubby Platysace	0.1	5		
Shrub (SG)	<i>Pseudanthus divaricatissimus</i>		0.1	10	1	20
Shrub (SG)	<i>Rhytidosporum procumbens</i>				0.1	2
Tree (TG)	<i>Callitris muelleri</i>				15	25
Tree (TG)	<i>Eucalyptus piperita</i>	Sydney Peppermint	0.1	5		
Total				27		27

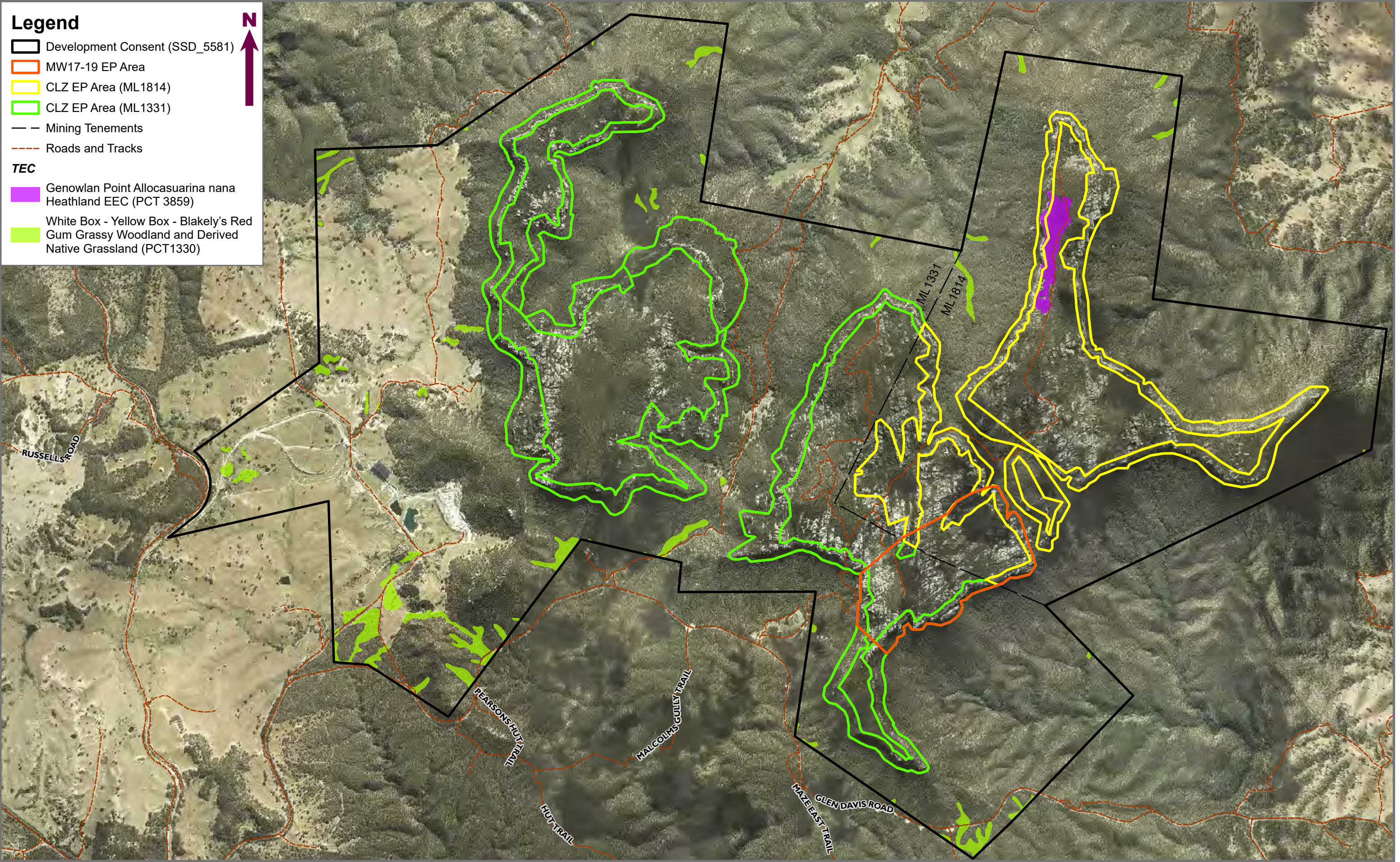


FIGURE 3-6:
THREATENED ECOLOGICAL COMMUNITIES

LOCATION: AIRLY

VERSION: A
DATE EXPORTED: 26/09/2022
TECHNICIAN: Natalie.Wood

DATA SOURCES
Centennial, RPS, NSWSS,

500 0 500 1,000 1,500 2,000
m
SCALE 1:30,000 AT A3 SIZE / Projection: GDA 1994 MGA Zone 56

CLIENT: Centennial
PROJ: PR152229
PURPOSE: Baseline Assessment

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3.2.3 Groundwater Dependent Ecosystems

No high priority GDEs have been identified within the study area, although there is potential for 'Facultative Ecosystems' existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017).

3.2.3.1 Facultative Ecosystems

Monitoring has shown the water flow in 'The Grotto' to be ephemeral and rainfall dependent. The sheltered environment along with moisture from surface water and seepage of water from the surrounding sandstones promotes the growth of water loving plants such as tree ferns. In general, groundwater flows were considered too deep to have much interaction with potentially occurring GDEs, however, there were areas of alluvium that contain shallow aquifers within surrounding Airly Mine lease area (see **Figure 3-7**). Vegetation communities which occurred within the 'shallow aquifer zone', and hence may have interaction with groundwater, include:

- PCT 3226: Western Blue Mountains Montane Wet Fern Forest;
- PCT 3495: Western Blue Mountains Monkey Gum Gully Forest; and
- PCT 3731: Capertee Conglomerate Grey Gum-Stringybark Forest.

The aforementioned communities were ultimately considered to be 'Facultative Ecosystems' as opposed to GDEs (RPS 2014). These communities are likely to be utilising shallow aquifers and are therefore considered unlikely to be entirely groundwater dependent. This assumption is supported by the fact that the flora species within these vegetation communities are not restricted to alluvial drainage lines; they can occur along moist sheltered gully areas, creek lines, as well as dry slopes. Therefore, they can be termed as Facultative Ecosystems as defined below:

Facultative Ecosystems – 'A GDE that is not entirely dependent on groundwater, and may rely on groundwater on a seasonal basis or only during extended drought periods. At other times, water requirements may be met by soil or surface water' (Serov et al 2012).

Table 3-8 below outlines the extent of these Facultative Ecosystems present within each EP Area.

Table 3-8: Facultative Ecosystems within the EP Areas

Old PCT Code	PCT Code	PCT Description	CLZ (ML1814) Area (ha) [% within EP area) ¹	MW17-19 EP Area (ha) ² [% within EP area) ¹
1615	3226	Western Blue Mountains Montane Wet Fern Forest	15.19 [7.18 %]	1.68 [1.38%]
941	3495	Western Blue Mountains Monkey Gum Gully Forest	29.21 [13.82%]	11.55 [9.50%]
-	3731	Capertee Conglomerate Grey Gum-Stringybark Forest	2.31 [1.09%]	-

1. CLZ EP area and MW17-19 EP areas overlap. Percentage is the proportion of this community within the specified EP area.
2. Facultative ecosystems occur only within the 'extended monitoring and management area' and not within the 'principal subsidence management area'.

3.2.3.1.1 Monitoring

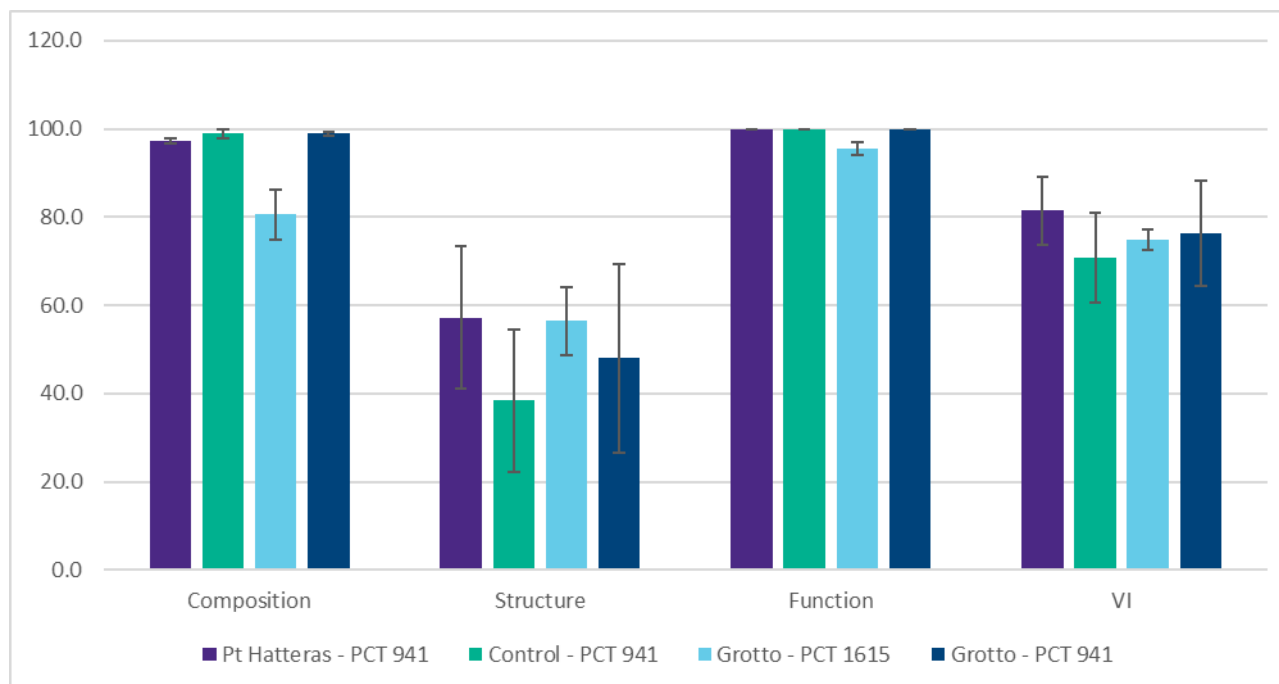
Ten GDE plots were established utilising BAM in the summer 2022 monitoring period around the base of Pt Hatteras and within the Grotto across two of the PCTs.

Table 3-9 and **Graph 3-1** displays the 2022 composition, structure, function and vegetation integrity (VI) scores within the GDE plots across monitoring locations. This data will be used for comparison in future monitoring periods.

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Table 3-9: 2022 GDE plots - mean BAM scores across monitoring locations

Location - PCT	Composition	Structure	Function	VI
Pt Hatteras - PCT 942	97.3	57.2	100.0	81.5
Control - PCT 941	98.9	38.4	100.0	70.9
Grotto - PCT 1615	80.6	56.4	95.5	74.9
Grotto - PCT 941	98.9	48.1	100.0	76.2



Graph 3-1: Histogram displaying mean BAM scores (composition, structure, function, VI) and SE across monitoring locations

RDP analysis for this Baseline Assessment found that PCT 3226/3495 was always dominated by moisture dependant ferns such as *Adiantum aethiopicum*, *Blechnum spp.*, *Calochlaena dubia*, *Cyathea australis* and *Pteridium esculentum*. Furthermore, *Calochlaena dubia* was always present, thus could be used as an indicator species of Facultative Ecosystem health.

PCT 3731 commonly exhibited a groundcover of more generalist species such as *Lomandra longifolia* and *Pteridium esculentum* which are generally indicative of variable soil moisture. *Doodia aspera* was almost always present. Sometimes drier woodland grasses were present (*Echinopogon spp.*, *Aristida spp.*) and sprawling shrub *Pimelea latifolia*. See **Apex Table 3** for the full floristics.

3.2.3.1.1.1 Rapid aquatic assessment

Rapid aquatic assessment occurred along 50 m transects within the Grotto at five locations adjacent streams. **Table 3-10** provide a summary of the stream condition within the Grotto whilst

Table 3-11 provide a summary of the stream types. This data forms a part of the baseline condition of these monitoring locations.

Table 3-10: 2022 stream condition

Parameter	Score
Average flow width (m)	1.1
Max flow width (m)	2.0
Min flow width (m)	0.4
Average soil moisture $\pm 3\%$ VWC	20.84

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Clarity/sediment load (0 poor - 5 clear)	4.2
Erosion (0 absent - 5 severe)	1

Table 3-11: 2022 GDE stream type parameters

Parameter	Ratio across locations
Stream flow type	
Pooling	1
Flowing	1
Continuous	0.4
Discontinuous	0.6
Riffles	1
Aquatic vegetation type	
Submerged	0.4
Floating	0
Emergent	0
Substrate type	
Bedrock	0.04
Boulder (>256mm)	0.06
Cobble (64-256mm)	0.08
Pebble (16-64mm)	0.082
Gravel (2-16mm)	0.144
Sand (0.06-2mm)	0.41
Clay/Silt (<0.06mm)	0.184
Bank slope	
Flat <10°	0
Low 10 - 30°	0
Moderate 30 - 60°	0.4
Steep 60 - 80°	0.6
Vertical 80 - 90°	0



Plate 3-4 The Grotto surface flow (PCT 3226)



Plate 3-5 PCT 3731

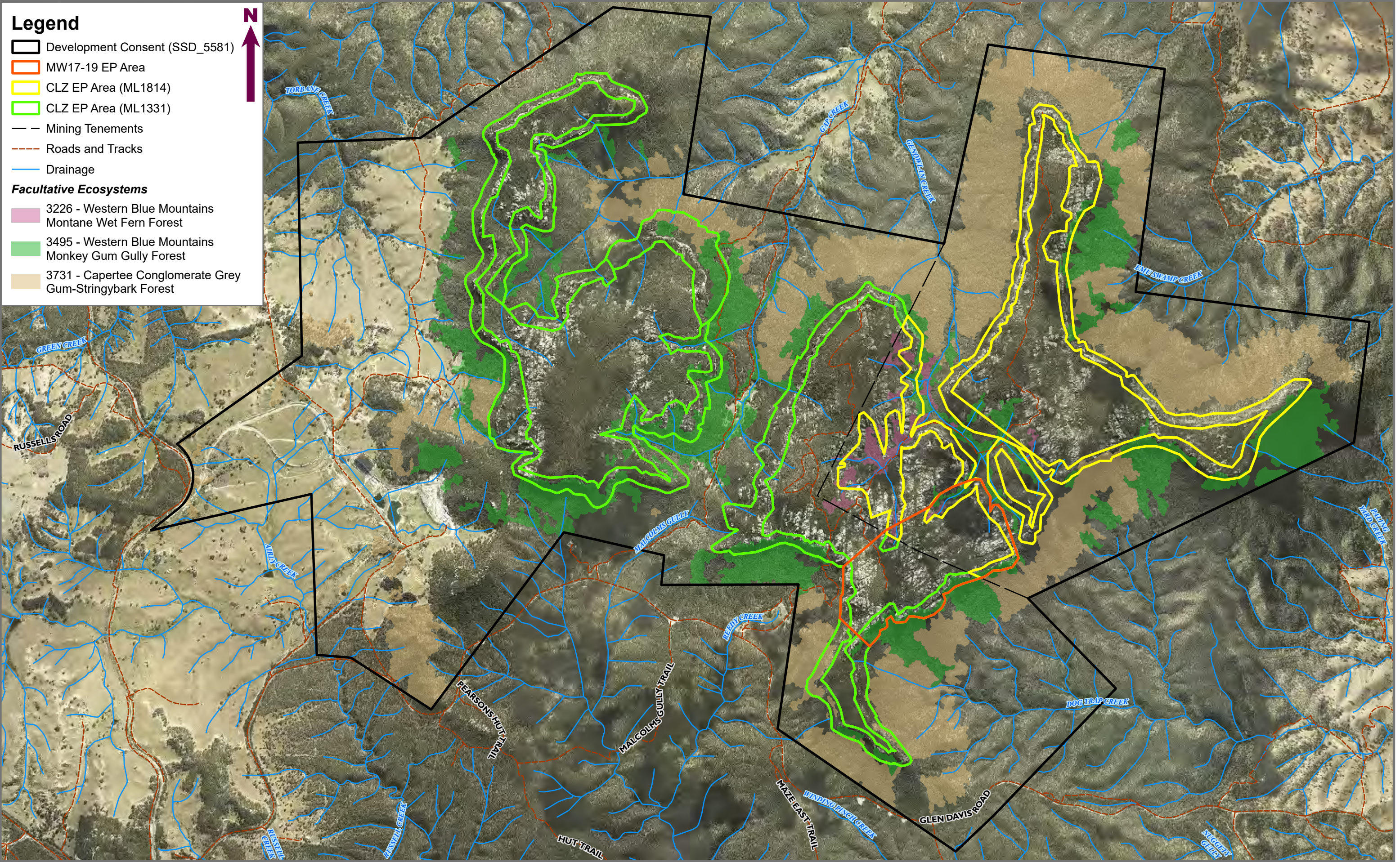


FIGURE 3-7:
GROUNDWATER DEPENDENT ECOSYSTEMS AND HYDROLOGY

LOCATION: AIRLY

VERSION: A
DATE EXPORTED: 26/09/2022
TECHNICIAN: Natalie.Wood

DATA SOURCES
Centennial, RPS, NSWSS,

500 0 500 1,000 1,500 2,000
m
SCALE 1:30,000 AT A3 SIZE / Projection: GDA 1994 MGA Zone 56

CLIENT: Centennial
PROJ: PR152229
PURPOSE: Baseline Assessment

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3.3 Flora

3.3.1 Threatened flora species

Seven threatened flora species have been recorded within the locality, of these, two threatened flora species occur within the EP areas as summarised in **Table 3-12** and shown in **Figure 3-8**.

Table 3-12 Threatened flora species

Common Name	Scientific	BC Act	EPBC Act	Count	Source	EP Area
<i>Eucalyptus cannonii</i>	Capertee Stringybark	V		158	BioNet (DPE 2022b) (RPS 2021)	
<i>Grevillea obtusiflora</i>		E	E	19	BioNet (DPE 2022b)	
<i>Persoonia marginata</i>	Clandulla Geebung	V	V	48	BioNet (DPE 2022b)	
<i>Phebalium bifidum</i>		E		248	BioNet (DPE 2022b)	
<i>Pomaderris brunnea</i>	Brown Pomaderris	E	V	1	BioNet (DPE 2022b)	
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	Wollemi Mint-bush	V	V	2	BioNet (DPE 2022b)	
<i>Prostanthera stricta</i>	Mount Vincent Mint-bush	V	V	1000+	RPS 2022	MW17-19, CLZ
<i>Pultenaea</i> sp. Genowlan Point		CE	CE	35	NPWS 2021	CLZ
<i>Zieria murphyi</i>	Velvet Zieria	V	V	1	BioNet (DPE 2021b)	

Note: V – Vulnerable; E – Endangered; CE – Critically Endangered; M – Migratory

3.3.1.1 *Prostanthera stricta* (Mount Vincent Mint Bush)

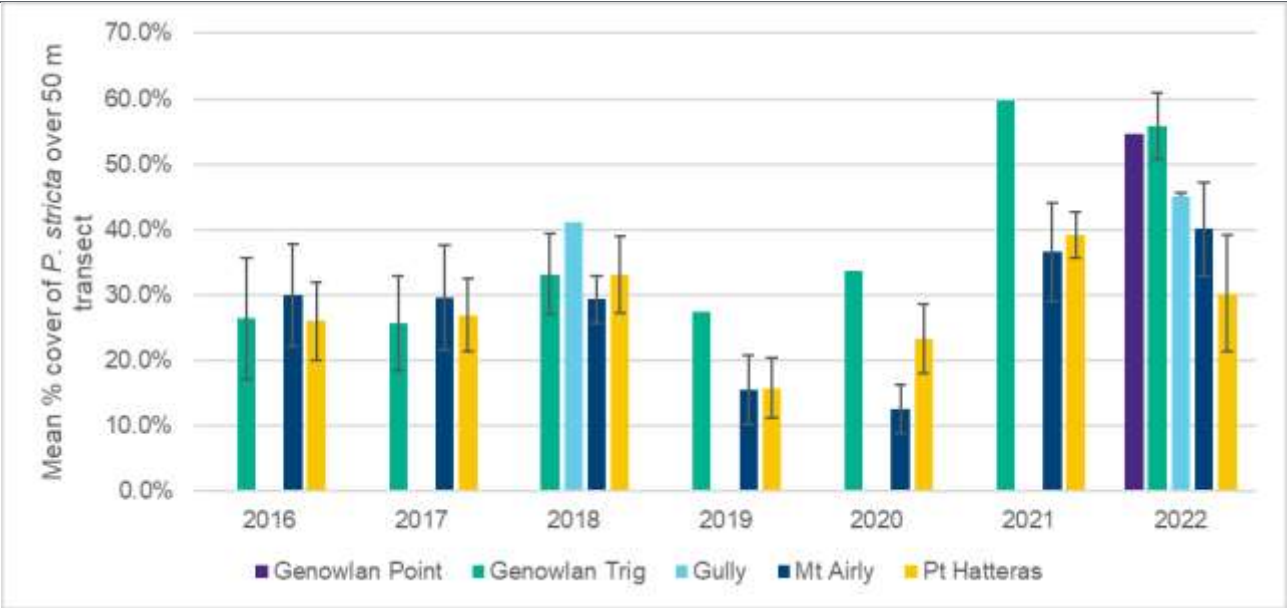
Prostanthera stricta occurs from Mt Vincent to Genowlan Mountain in the Central Tablelands. *Prostanthera stricta* is often a locally dominant understory shrub species found within heath or scrub communities along cliff edges, or as an understorey species within a range of open forest or tall open forest types and/or adjacent transitional communities. Associated vegetation includes *Eucalyptus blaxlandii*, *Eucalyptus cannonii* and *Eucalyptus viminalis* with *Acacia implexa* and *Goodenia ovata*. *Prostanthera stricta* grows in areas of both skeletal soil and on deeper, well-drained soil profiles in areas characterised by steep rocky side slopes, cliff lines, sandstone platforms, or gentle slopes with exposed sandstone outcroppings. It has been found that the habitat at Mount Airly, Point Hatteras and Genowlan Point is typically restricted to the gradation from basalt to sandstone, which is frequently abrupt, occupying a narrow band of 5 - 50 m (RPS 2014a).

Within the study area *Prostanthera stricta* is common within areas of the 'Mount Tomah' soil landscape associated with basalt capping on Genowlan Point, however can occur elsewhere in the study area with basalt influence. Some stands of *Prostanthera stricta* are also located near Genowlan Trig (see **Figure 3-8**).

3.3.1.1.1 Monitoring

Eighteen transects were monitored across the 2022 monitoring program, including four plots that were established, and two that were re-established to provide additional baseline and control replication. Monitoring results display an increase in cover of *Prostanthera stricta* across the transects linked to rainfall patterns which were above the historical average for 9 months of the year and population recovery since the controlled burn across Mount Airly in 2018.

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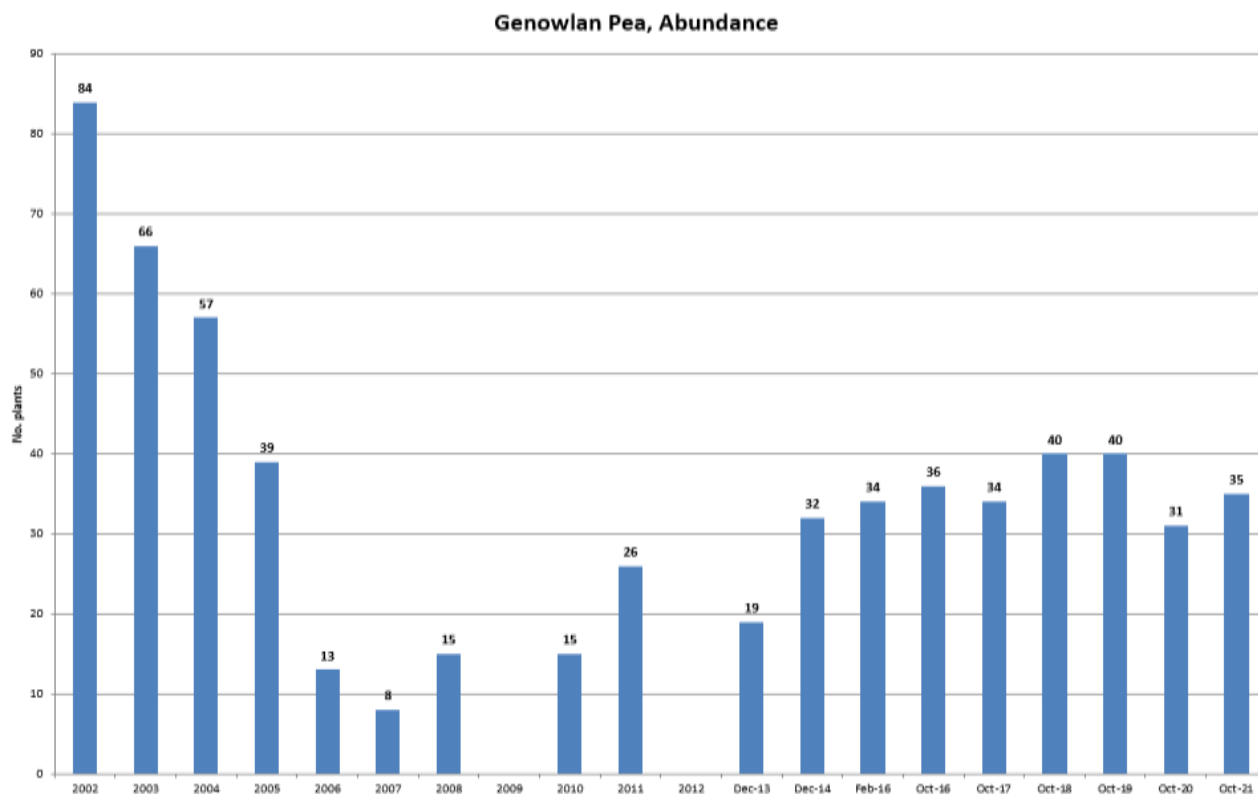
Graph 3-2: Proportional percent cover of *Prostanthera stricta* over the 50 m plot (RPS 2021)



Plate 3-6 Population of *Prostanthera stricta* (Mount Vincent Mint Bush)

3.3.1.2 *Pultenaea* sp. Genowlan Point

Pultenaea sp. Genowlan Point is known from a single population in the Mugii Murum-ban State Conservation Area in the Capertee Valley, which is a site-managed species within the Saving Our Species (SOS) program. This population is restricted to a small area of 0.15ha on an exposed rocky area adjacent to a cliff edge within the CLZ EP area (see **Figure 3-8**). All individuals within this population occupy north-westerly aspects on skeletal soils, in some cases on narrow ledges beneath the cliff edge. Associated vegetation includes open *Eucalyptus sparsifolia* forest with an open shrubby understorey including *Persoonia longifolia*, *Isopogon dawsonii* and *Leucopogon muticus* (DPE 2021c). Monitoring of this species is currently conducted by NPWS.



Graph 3-3: *Pultenaea* sp. Genowlan Point abundance (NPWS 2021)

Currently there are 35 individuals of *Pultenaea* sp. Genowlan Point in the population (NPWS 2021; see **Graph 3-3** and **Figure 3-8**) and the population has been deemed 'stable' (NPWS 2020).



Plate 3-7 *Pultenaea* sp. Genowlan Point

3.3.2 Exotic flora

The MW17-19 and CLZ EP areas are predominately weed free due to their isolation, and reduced vehicle access. No weeds were recorded within the Genowlan Point plots, however seven exotic species were recorded within the woodland plot, in relatively low abundance. See **Table 3-13** for a summary of the exotic flora species.

Table 3-13: Exotic flora species recorded within the EP areas

Scientific Name	Common Name	Abundance within plots
<i>Cirsium vulgare</i>	Spear Thistle	1
<i>Conyza</i> spp.		3
<i>Galium divaricatum</i>	Slender Bedstraw	100
<i>Hypochaeris glabra</i>	Smooth Catsear	1
<i>Hypochaeris radicata</i>	Catsear	2
<i>Modiola</i> spp.		2
<i>Senecio jacobaea</i>	Ragwort	2

Under the *Biosecurity Act* 2015, plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

3.4 Fauna

3.4.1 Threatened fauna records

3.4.1.1 Birds

A total of 24 threatened birds have been previously recorded within the locality; however, due to the mobility of these species and availability of niche habitat features within the EP areas it is presumed that all threatened bird species may periodically utilise resources in the study area (See **Table 3-14** and **Figure 3-9**). Evidence of Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable) feeding was present within the EP areas.

Table 3-14 Threatened bird species

Common Name	Scientific Name	BC Act	EPBC Act	Count	Source
Barking Owl	<i>Ninox connivens</i>	V	-	8	BioNet (DPE 2022b)
Black Falcon	<i>Falco subniger</i>	V	-	1	BioNet (DPE 2022b)
Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V	-	17	BioNet (DPE 2022b) (UQ 2014)
Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V	-	94	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Diamond Firetail	<i>Stagonopleura guttata</i>	V	-	61	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V	-	52	BioNet (DPE 2022b) (RPS 2021)
Flame Robin	<i>Petroica phoenicea</i>	V	-	3	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V	E	48	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Gilbert's Whistler	<i>Pachycephala inornata</i>	V	-	1	BioNet (DPE 2022b)
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V	-	55	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis temporalis</i>	V	-	5	BioNet (DPE 2022b) (RPS 2021)
Hooded Robin (south-eastern form)	<i>Melanodryas cucullata cucullata</i>	V	-	25	BioNet (DPE 2022b) (RPS 2021)
Little Eagle	<i>Hieraaetus morphnoides</i>	V	-	15	BioNet (DPE 2022b)
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	-	55	BioNet (DPE 2022b) (UQ 2017) (RPS 2021)
Masked Owl	<i>Tyto novaehollandiae</i>	V	-	1	BioNet (DPE 2022b) (RPS 2021)
Painted Honeyeater	<i>Grantiella picta</i>	V	V	1	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Powerful Owl	<i>Ninox strenua</i>	V	-	9	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	CE	136	BioNet (DPE 2022b) (UQ 2017)
Scarlet Robin	<i>Petroica boodang</i>	V	-	19	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Sooty Owl	<i>Tyto tenebricosa</i>	V	-	5	BioNet (DPE 2022b) (RPS 2021)
Speckled Warbler	<i>Chthonicola sagittata</i>	V	-	17	BioNet (DPE 2022b)
Square-tailed Kite	<i>Lophoictinia isura</i>	V	-	2	BioNet (DPE 2022b)
Swift Parrot	<i>Lathamus discolor</i>	E	CE	27	BioNet (DPE 2022b)

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Common Name	Scientific Name	BC Act	EPBC Act	Count	Source
Turquoise Parrot	<i>Neophema pulchella</i>	V	-	21	BioNet (DPE 2022b)
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	-	14	BioNet (DPE 2022b)
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V	-	2	BioNet (DPE 2022b)
White-fronted Chat	<i>Epthianura albifrons</i>	V	-	1	BioNet (DPE 2022b)

Note: V – Vulnerable; E – Endangered; CE – Critically Endangered; M – Migratory.



Plate 3-8 Glossy Black-Cockatoo (*Calyptorhynchus lathami*) feeding on *Allocasuarina* sp.

3.4.1.2 Microbats

Eight threatened microbat species have been previously recorded within the locality (see **Figure 3-9**), due to the mobility of these species and availability of niche habitat features (see **Table 3-18**). It is presumed that all threatened microbat species may periodically utilise resources within the EP areas. See **Table 3-15** for threatened microbats recorded nearby the study area.

Other non-threatened microbat species previously observed in the locality include, Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Eastern Horseshoe Bat (*Rhinolophus megaphyllus*), White-striped Free-tailed Bat (*Austronomus australis*), Large Forest Bat (*Vespadelus darlingtoni*), Eastern Free-tailed Bat (*Mormopterus ridei*), South-eastern Free-tailed Bat (*Mormopterus planiceps*), Southern Forest Bat (*Vespadelus regulus*) and Little Forest Bat (*Vespadelus vulturinus*) (RPS 2016).

Table 3-15 Threatened microbat species

Common Name	Scientific	BC Act	EPBC Act	Count	Source
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V		3	BioNet (DPE 2022b)
Eastern Coastal Free-tailed Bat	<i>Mormopterus norfolkensis</i>	V		0	BioNet (DPE 2022b) (RPS 2018)

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Common Name	Scientific	BC Act	EPBC Act	Count	Source
Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V		15	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V	V	15	BioNet (DPE 2022b) (UQ 2014) (RPS 2021)
Little Bent-winged Bat	<i>Miniopterus australis</i>	V		1	BioNet (DPE 2022b)
Little Pied Bat	<i>Chalinolobus picatus</i>	V		0	BioNet (DPE 2022b) (RPS 2018)
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V		1	BioNet (DPE 2022b)
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V		1	BioNet (DPE 2022b)

Note: V – Vulnerable; E – Endangered; CE – Critically Endangered; M – Migratory.

3.4.1.3 Mammals

Five threatened mammal species (excluding microbat species) have been previously recorded in the locality (see **Figure 3-9**). Of significance, the Spotted-tail Quoll (*Dasyurus maculatus maculatus*; BC Act: Vulnerable; EPBC Act: Endangered) was captured on a camera trap in 2013 (RPS 2013) and a Koala (*Phascolarctos cinereus*; BC Act: Vulnerable; EPBC Act: Vulnerable) has recently been observed on the Diamond Mine Trail (DPE 2022b) and calls recorded on songmeters (RPS 2021). The Greater Glider (*Petauroides volans*; EPBC Act: Vulnerable) were also observed during spotlighting in recent surveys (RPS 2020). See **Table 3-16** for a summary of the threatened mammals found within or nearby the study area.

Table 3-16 Threatened fauna species

Common Name	Scientific	BC Act	EPBC Act	Count	Source
Greater Glider	<i>Petauroides volans</i>		V	4	BioNet (DPE 2022b), (RPS 2021)
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	V	2	BioNet (DPE 2022b)
Koala	<i>Phascolarctos cinereus</i>	E	E	2	BioNet (DPE 2022b)
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V	E	4	BioNet (DPE 2022b) (RPS 2013)
Squirrel Glider	<i>Petaurus norfolcensis</i>	V		2	BioNet (DPE 2022b) (RPS 2021)

Note: V – Vulnerable; E – Endangered; CE – Critically Endangered; M – Migratory.



Plate 3-9 Spotted-tail Quoll (*Dasyurus maculatus*) captured on a camera trap in 2013, within the Airly Mine lease area (RPS 2013)

3.4.1.4 Amphibians

No threatened frog species have been previously recorded within the locality, however this may be due to a lack of survey effort, cryptic nature and seasonality of many frog species. Six threatened frog species returned a 'moderate' LoO (see **Table 3-4**) based on habitat suitability. Non-threatened frog species previously recorded in the locality include the Common Eastern Froglet (*Crinia signifera*), Eastern Banjo Frog (*Limnodynastes dumerilii*), Brown-striped Frog (*Limnodynastes peronii*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), Smooth Toadlet (*Uperoleia laevis*), Green Tree Frog (*Litoria caerulea*), Broad-palmed Frog (*Litoria latopalmata*), Rocket Frog (*Litoria nasuta*) and Peron's Tree Frog (*Litoria peronii*) (RPS 2013a).

Where suitable, frogs should be considered within the existing fauna monitoring survey effort.

3.4.1.5 Reptiles

Two threatened reptile species have been previously recorded within the locality (DPE 2022b) (see **Figure 3-9**). The Broad-headed Snake (*Hoplocephalus bungaroides*; BC Act: Endangered; EPBC Act: Vulnerable) has been recorded within the study area, while Rosenberg's Goanna (*Varanus rosenbergi*; BC Act: Vulnerable; EPBC Act: Not Listed) has been recorded on multiple occasions (opportunistically and on camera trap) during previous survey efforts (RPS 2016) within the Airly Mine lease area. See **Table 3-17**.

Table 3-17 Threatened reptile species

Common Name	Scientific	BC Act	EPBC Act	Count	Source	Within EP Area
Broad-headed Snake	<i>Hoplocephalus bungaroides</i>	E	V	1	BioNet (DPE 2022b)	Neither
Rosenberg's Goanna	<i>Varanus rosenbergi</i>	V		3	BioNet (DPE 2022b) (RPS 2021)	Neither

Note: V – Vulnerable; E – Endangered; CE – Critically Endangered; M – Migratory.



Plate 3-10 Rosenberg's Goanna (*Varanus rosenbergi*) recorded on a camera trap (RPS 2020)

3.4.2 Habitat for threatened fauna

Five broad habitat types occur in the study area; dry sclerophyll forest, wet sclerophyll forest, grassy woodlands, heath and cleared and cleared areas. Specific habitat features particularly associated with threatened fauna within the locality area described in **Table 3-18**.

Table 3-18 Habitat features for threatened fauna

Key habitat feature	Description
Sandstone habitats	Rugged sandstone habitats are a characteristic feature of the study area, and include the distinctive pagodas, steep cliffs and escarpments, rocky outcrops or piles of sandstone boulders, caves, crevices and ledges. Several fauna species recorded in the study area are sandstone habitat specialists. The study area supports an abundance and complexity of sandstone caves and overhangs that offer roosting habitat to obligate cave-roosting microbat species recorded in the study area, such as Eastern Horseshoe-bat (<i>Rhinolophus megaphyllus</i>) and Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>; BC Act: Vulnerable; EPBC Act: Vulnerable). The Common Wallaroo (<i>Macropus robustus</i>) may be more abundant than the number of sightings suggests, due to its shy nature and scats not being readily identifiable. Steep escarpments, sandstone outcrops and rocky hills comprise preferred habitat of the species, and such features are common throughout the study area (DEC 2007a). Sandstone outcrops, overhangs, crevices and ledges provide good habitat opportunities for reptile species; many species of lizards and snakes rely heavily on sandstone cracks and crevices for shelter. Lesueur's Velvet Gecko (<i>Oedura lesueurii</i>) is a small nocturnal gecko that may shelter beneath sandstone boulders and slabs during the day in the study area, preferring rocks in full sun rather than partial or full shade. (Downes and Shine 1998). The Broad-tailed Gecko (<i>Phyllurus platurus</i>) also typically seeks shelter in sandstone crevices. The Broad-headed Snake (<i>Hoplocephalus bungaroides</i>; BC Act: Endangered; EPBC Act: Vulnerable) is also likely to associate with rock crevices and under flat sandstone rocks on exposed cliff edges locally.



Plate 3-11 Sandstone habitat in the form of sandstone escarpments and pagoda formations typical of the study area

Hollow-bearing Trees

Hollow-bearing trees are known to be common within the study area and surrounds and include a diversity of eucalypt species of various ages. Smaller trees of woodland communities typically support smaller trunk and branch hollows whereas forest communities in sheltered gullies, support large trees and large branch hollows.

Characteristics of hollows dictate the suitability of hollows for different fauna groups or species. The abundance and variations in hollows are reflected by the high diversity and abundance of hollow-dependent fauna species previously recorded in the locality. Hollow-dependent fauna are defined as species that rely on tree hollows for shelter, roosting, or nesting at some stage in their life cycle. Several threatened hollow-dependent species occur in the study area, including Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable), Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable), Little Lorikeet (*Glossopsitta pusilla*; BC Act: Vulnerable), Powerful Owl (*Ninox strenua*; BC Act: Vulnerable), and Brown Treecreeper (*Climacteris picumnus victoriarum*; BC Act: Vulnerable).

Broad hollow size and examples of fauna species may include:

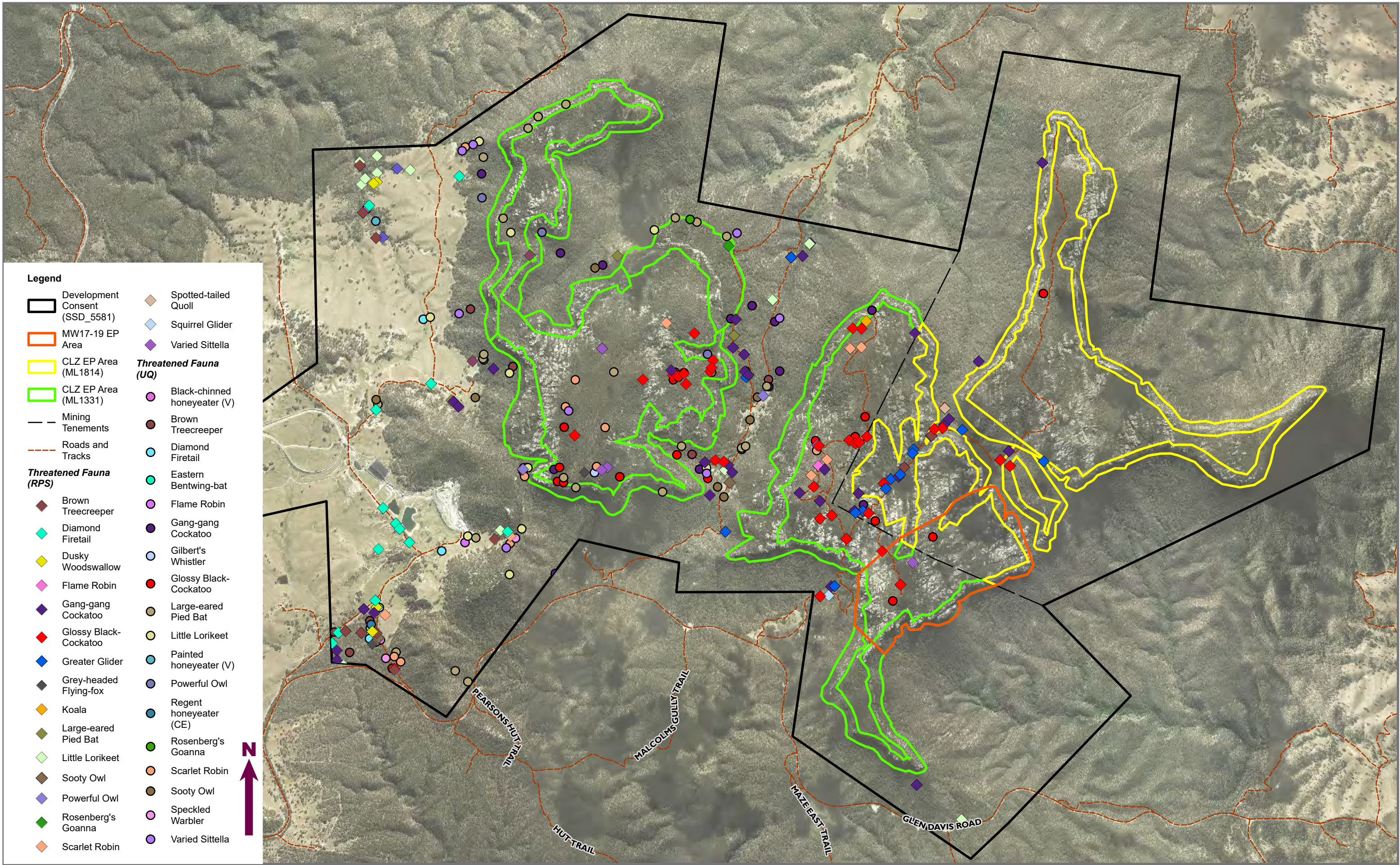
- Small hollow (1-5 cm minimum diameter): Little Forest Bat (*Vespadelus vulturnus*);
- Medium hollow (5-10 cm minimum diameter): Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Large Forest Bat (*Vespadelus darlingtoni*), Southern Myotis (*Myosotis macropus*; BC Act: Vulnerable), Sugar glider (*Petaurus breviceps*), Striated Pardalote (*Pardalotus striatus*);
- Large hollow (10-20 cm minimum diameter): Australian owllet-nightjar (*Aegotheles cristatus*), Australian King-Parrot (*Alisterus scapularis*), Crimson Rosella (*Platycercus elegans*), Eastern Rosella (*Platycercus eximius*), Little Lorikeet (*Glossopsitta pusilla*; BC Act: Vulnerable), Red-rumped Parrot (*Psephotus haematonotus*), Red-browed Treecreeper (*Climacteris erythrops*), Brown Treecreeper (*Climacteris picumnus victoriarum*; BC Act: Vulnerable), White-throated Treecreeper (*Cormobates leucophaea*); and
- Very large hollow (>20 cm minimum diameter): Sulphur-crested Cockatoo (*Cacatua galerita*), Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable), Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable), Yellow-tailed Black-Cockatoo (*Calyptorhynchus funereus*), Laughing Kookaburra (*Dacelo novaeguineae*), Powerful Owl (*Ninox strenua*; BC Act: Vulnerable), Southern Boobook (*Ninox novaeseelandiae*), Common Brushtail possum (*Trichosurus vulpecular*), Greater Glider (*Petauroides Volans*; EPBC Act: Vulnerable).

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Key habitat feature	Description
Flowering and fruiting plants	The study area supports an abundance of flowering plants including a diversity of myrtaceous species, such as eucalypts, and other flowering species such as banksias and acacias. These species offer foraging resources including nectar, pollen, Eucalypt sap and Acacia gum to arboreal mammals. The study area also supports a diversity of highly mobile nectar-feeding birds including and may provide foraging resources for threatened birds such as Black-chinned Honeyeater (eastern subspecies) (<i>Melithreptus gularis gularis</i> BC Act: Vulnerable), Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>; BC Act: Vulnerable), Little Lorikeet (<i>Glossopsitta pusilla</i>; BC Act: Vulnerable), Painted Honeyeater (<i>Grantiella picta</i>; BC Act: Vulnerable; EPBC Act: Vulnerable) and Regent Honeyeater (<i>Anthochaera phrygia</i>; BC Act: Critically Endangered; EPBC Act: Critically Endangered). Mistletoe was common throughout the study area; the fruits of many mistletoe species show a range of attributes that are attractive to many animals, as they are large, sweet and conspicuous. Species that may utilise mistletoes include Silvereye (<i>Zosterops lateralis</i>), Ringtail possum (<i>Pseudocheirus peregrines</i>) and thornbills (RPS 2014).
Logs and ground timber	Large woody debris was common across the study area. The abundance of hollow logs offers potential sheltering and breeding habitat for small terrestrial mammals, reptiles and birds.
Aquatic habitats	There are several mapped first, second and third order creek lines within the study area. All creeks are ephemeral and flow into the main tributary of Genowlan Creek then on into the Capertee River. These habitats may offer habitat to frogs such as the threatened <i>Heleioporus australiacus</i> (Giant Burrowing Frog), <i>Mixophyes iteratus</i> (Giant Barred Frog) and <i>Pseudophryne australis</i> (Red-crowned Toadlet).
Key Fish Habitat and habitat for threatened fish	Permanent aquatic habitats are uncommon in the study area and are limited to ephemeral drainage lines. Genowlan Creek has not been deemed as critical habitat under the BC Act or FM Act (Centennial 2016), however is mapped as Key Fish Habitat under the FM Act (DPI 2021). The Capertee River is also mapped as Key Fish Habitat under the FM Act (DPI 2021) and the Capertee River downstream from the study area are mapped as habitat for the Macquarie Perch (<i>Macquaria australasica</i>; Threatened species under the FM Act). The closest mapped habitat for the Macquarie Perch is located 25 km east of the study area in Glen Davis.
<i>Allocasuarina</i> spp.	Glossy Black-Cockatoo (BC Act: Vulnerable) have a restrictive diet and feed only on the seeds in cones of She-oak [i.e. <i>Casuarina</i> and <i>Allocasuarina</i> sp., but specifically <i>Allocasuarina littoralis</i> (Black She-oak) within the Airly mining lease] and during foraging, discard chewed cones to the ground. It is these discarded cones (termed 'orts') that can be used to quantify the amount of time that glossy black-cockatoo spend foraging in stands of She-oaks and estimate foraging periods (RPS 2018).
Koala feed trees	The EP Area is located within the Central and Southern Tablelands Koala management area (DECC 2008). Several key Koala feed trees for this management area occur within the study area across all the PCTs present, with the exception of PCT 3865 heath community. Koala feed trees present on site include: • <i>E. agglomerata</i> (Blue-leaved Stringybark); • <i>E. cypellocarpa</i> (Monkey Gum); • <i>E. dalrympleana</i> (Mountain Gum); • <i>E. macrorhyncha</i> (Red Stringybark); • <i>E. melliodora</i> (Yellow Box); • <i>E. piperita</i> (Sydney Peppermint); • <i>E. polyanthemos</i> (Red Box); • <i>E. punctata</i> (Grey Gum); • <i>E. viminalis</i> (Ribbon Gum).

3.4.3 Feral Species

Four feral fauna species were recorded on camera traps during the 2022 monitoring period including cats on two occasions, feral pigs on two occasions, and foxes on six occasions. Feral species activity has increased since the 2021 monitoring year, however no feral dogs were recorded this year (RPS 2022)



3.5 Key Threatening Processes

Existing KTPs are listed under the BC Act, FM Act and EPBC Act within the study area are summarised below in **Table 3-19**.

Table 3-19 Summary of current KTPs

KTP	Status	Impact	Reasons
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands	BC Act	Existing, Low impact	Alteration to the flow regimes and water quality of Genowlan Creek from previous Returns Workings within and adjacent the study area.
Competition and grazing by the feral European rabbit	BC Act, EPBC Act	Existing, Low impact	Exotic animals have been previously recorded within or adjacent the study area, however, were more frequently observed within cleared areas to the west of the study area (RPS 2014). Pest management has occurred since, with significant reduction in pest species.
Competition and habitat degradation by Feral Goats, <i>Capra hircus</i> Linnaeus 1758	BC Act, EPBC Act	Existing, Low impact	Exotic animals have been previously recorded within or adjacent the study area, however, were more frequently observed within cleared areas to the west of the study area. Small groups of Feral Goats (<i>Capra hircus</i>) were frequently found on Mt Airly (RPS 2014). Pest management has occurred since, with significant reduction in pest species.
Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>	BC Act	Existing, Low impact	Exotic animals have been previously recorded within or adjacent the study area, however, were more frequently observed within cleared areas to the west of the study area. Feral Dogs were seen on several occasions, in cleared areas in proximity to the pit top. Rabbits (<i>Oryctolagus cuniculus</i>) were common in cleared, low-lying areas (RPS 2014). Pest management has occurred since, with significant reduction in pest species.
Invasion of native plant communities by exotic perennial grasses	BC Act, EPBC Act	Existing, Low impact	The areas of vegetation within the study area are predominantly weed free. Minor infestations along 4WD tracks due to spread of seeds via vehicle movement may be present.
Human-caused Climate Change	BC Act, EPBC Act, FM Act	Existing, Moderate impact	The study area currently is at risk to the rapidly changing climates which disturbs the intricate balance of ecosystems. Whilst the ecosystem is not at the extremes of the climate (i.e. alpine areas) which are highly sensitive to climate change, the study area is at severe risk to extreme weather events, such as frequent wildfires.

4 SUMMARY OF FINDINGS, IMPLICATION FOR MINING AND RECOMMENDATIONS

The EP areas are within the Capertee Uplands of the South Eastern Highlands Interim Biogeographic Regionalisation for Australia, and is within the Muggi Murum-ban State Conservation Area. The underlying geology of the study area comprises Narrabeen Group—fine-grained lithic sandstone occasionally interbedded with thin shale lenses. The EP areas encompasses 12 Plant Community Types (PCTs). Broad-scale vegetation types include dry sclerophyll forest, wet sclerophyll forest and heath. Sensitive biodiversity features within the EP areas include:

- Sensitive landscape features;
- Threatened Ecological Communities (TECs);
- Facultative Ecosystems;
- Threatened flora; and
- Threatened fauna.

Each of these sensitive biodiversity features is discussed by EP area in the following sections.

4.1 MW17-19 EP area

4.1.1 Sensitive landscape features

No sensitive landscape features as per the Environmental Impact Statement (EIS; Centennial 2014) occur within the EP area. The EP area is characterised by steep sandstone escarpments and pagoda rock formations.

4.1.2 Vegetation communities

The MW17-19 EP area encompasses eight PCTs with none forming part of a listed TEC. The vegetation predominately consists of PCTs 3865, 3686 and 3695 which are heath communities and open forests typical of ridgetops. **Table 3-5** provides a breakdown of these PCTs.

No high priority GDEs have been identified within the study area, although there is potential for Facultative Ecosystems existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017). The MW17-19 EP area supports small areas of PCT 3495 Western Blue Mountains Monkey Gum Gully Forest and PCT 3226 Western Blue Mountains Montane Wet Fern Forest, which are considered to be Facultative Ecosystems. These communities are considered unlikely to be entirely groundwater dependent. This assumption is supported by the fact that the flora species within these vegetation communities are not restricted to alluvial drainage lines; they can occur along moist sheltered gully areas, creek lines, as well as dry slopes.

4.1.3 Threatened flora

One threatened flora species is known to occur within this EP area (see **Figure 3-8**). *Prostanthera stricta* (Mount Vincent Mint Bush; BC Act: Vulnerable; EPBC Act: Vulnerable). There are currently 18 monitoring transects for *Prostanthera stricta* within the Lease Area with additional transects established in the 2022 monitoring period directly within the EP area, and to provide additional control locations. Monitoring results display an increase in cover of *Prostanthera stricta* across the transects linked to rainfall patterns which were above the historical average for 9 months of the year and population recovery since the controlled burn across Mount Airly in 2018. (RPS 2022; **Graph 3-2**).

4.1.4 Threatened fauna

One threatened fauna species is persistent within the EP area (see **Figure 3-9**). The Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable), frequents the area feeding on abundant stands of *Allocasuarina* species. A glossy black-cockatoo monitoring was established in this EP area.

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Other mobile threatened fauna species particularly woodland birds, microbats, reptiles and arboreal mammals would utilise the habitat features within the area. Key habitat features include:

- Sandstone habitats: pagodas, steep cliffs and escarpments, rocky outcrops or piles of sandstone boulders, caves, crevices and ledges for microbats and reptiles such as the Broad-headed Snake (*Hoplocephalus bungaroides*; BC Act: Endangered; EPBC Act: Vulnerable) and Rosenberg's Goanna (*Veranus rosenbergi*; BC Act: Vulnerable);
- Flowering and fruiting plants: utilised as foraging habitat for woodland birds and mammals such as the Flame Robin (*Petroica phoenicea*; BC Act: Vulnerable), the Gang-gang Cockatoo (*Callocephalon fimbriatum*; BC Act: Vulnerable; EPBC Act: Endangered) and the Greater Gliders (*Petauroides Volans*; EPBC Act: Endangered);
- *Allocasuarina* species: for foraging glossy black-cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable); and
- Koala feed trees: within woodland vegetation including *Eucalyptus cypellocarpa*, *Eucalyptus piperita* and *E. punctata*.

Fauna species diversity will continue to be monitored across the EP areas as part of the collective monitoring programme across the Mining Lease Area.

4.1.5 Implications for mining and recommendations

Approvals for Panel and Pillar Mining within MW17-19 EP area are based on predicted surface subsidence levels of up to 100-125mm (Centennial 2021). Void and pillar widths have been specifically designed to support the overburden with minimal subsidence effects at the surface. The final pillars left following panel extraction are specifically designed to provide long term stable support to the surface with no expected surface cracking and minimal ground movement (Centennial 2014). Based on this mine design, the proposed MW17-19 EP area is unlikely to have negative implications on the aforementioned key biodiversity feature.

4.2 CLZ EP area

4.2.1 Sensitive landscape features

The CLZ EP area contains sensitive landscape features including the deeply incised gorges named the Grotto and Oasis which forms a tributary of the Genowlan Creek.

4.2.2 Vegetation communities

The CLZ EP area encompasses 12 PCTs. The vegetation varies from PCT 3686, 3695 and 3865 along ridgetop cliff edges, to PCT 3226 and 3495 within the gullies. **Table 3-5** provides a breakdown of these PCTs. One TEC occurs within this EP area. PCT 3859 within the study area forms a part of the Genowlan Point *Allocasuarina nana* Heathland EEC listed under the BC Act. There is about 2.21 ha of the 15.2 ha extant occurring with the CLZ EP area.

No high priority GDEs have been identified within the study area, although there is potential for Facultative Ecosystems existing as moist sheltered gully forests or along creek lines (RPS 2014; GHD 2017).

The CLZ EP area supports areas of PCT 3226 Western Blue Mountains Montane Wet Fern Forest, PCT 3495 Western Blue Mountains Monkey Gum Gully Forest and PCT 3731 Capertee Conglomerate Grey Gum-Stringybark Forest within gullies and escarpments. During the 2022 monitoring programme across the Mining Lease Area ten GDE plots were established utilising BAM around the base of Pt Hatteras and within the Grotto across two of the PCTs. Composition, structure, function and vegetation integrity (VI) scores were calculated which establish baseline data for this ecosystem. Additionally rapid aquatic assessment occurred along 50 m transects within the Grotto at five locations adjacent streams which provide baseline condition and stream type data.

4.2.3 Threatened flora

Two threatened flora species are known to occur within this EP area (**Figure 3-8**):

- *Prostanthera stricta* (Mount Vincent Mint Bush; BC Act: Vulnerable; EPBC Act: Vulnerable); and
- *Pultenaea* sp. Genowlan Point (BC Act: Critically Endangered; EPBC Act: Critically Endangered).

Eighteen transects for *Prostanthera stricta* occur within the Lease Area with additional transects established in the 2022 monitoring period to provide additional control locations. Monitoring results display an increase in cover of *Prostanthera stricta* across the transects linked to rainfall patterns which were above the historical average for 9 months of the year and population recovery since the controlled burn across Mount Airly in 2018. (RPS 2022; **Graph 3-2**).

Pultenaea sp. Genowlan Point is known from a single population that occurs within the CLZ EP area. Monitoring of *Pultenaea* sp. Genowlan Point is currently conducted by NPWS. Currently there are 35 individuals of *Pultenaea* sp. Genowlan Point in the population (NPWS 2021; see **Graph 3-3**) and the population has been deemed 'stable' (NPWS 2020).

4.2.4 Threatened fauna

Threatened fauna utilise the diverse habitats of the CLZ EP area including (**Figure 3-9**):

- Diurnal birds;
- Forest owls;
- Mammals;
- Microbats; and
- Reptiles.

Greater Gliders and Large forest owls such as the Sooty Owl (*Tyto tenebricosa*; BC Act: Vulnerable) are common to gully habitats likely due to abundant hollows, tall timber and coverage. A historical record of the Spotted-tailed Quoll (*Dasyurus maculatus*; BC Act: Vulnerable; EPBC Act: Endangered) is located within the Grotto. The incised gorges and gullies also provide key foraging habitat for microbat species, whilst cliffs and overhangs provide roosting habitat. Diurnal bird species such as the Glossy Black-Cockatoo (*Calyptorhynchus lathami*; BC Act: Vulnerable) frequent the woodland and heath communities.

Whilst no threatened amphibians have been detected within the Mining Lease Area, no formal surveys have been undertaken. Amphibian species are cryptic and can only be heard at specific times of the year and in suitable high rainfall conditions, therefore often avoid detection. Amphibian species are especially vulnerable to environmental disturbances and can be used as models of studying environmental change (Hopkins 2007). It is recommended that amphibian surveys are considered within the collective monitoring programme across the Mining Lease Area.

Key habitats for threatened fauna within the CLZ EP area include:

- Sandstone habitats: pagodas, steep cliffs and escarpments, rocky outcrops or piles of sandstone boulders, caves, crevices and ledges for microbats and reptiles such as the Broad-headed Snake (*Hoplocephalus bungaroides*; BC Act: Endangered; EPBC Act: Vulnerable) and Rosenberg's Goanna (*Veranus rosenbergi*; BC Act: Vulnerable);
- Hollow-bearing Trees: are known to be common within the EP area and surrounds and include a diversity of eucalypt species of various ages. Smaller trees of woodland communities typically support smaller trunk and branch hollows whereas forest communities in sheltered gullies around the Grotto, support large trees and large branch hollows.
- Aquatic habitats: in the form of ephemeral first, second and third order creek lines which flow into the main tributary of Genowlan Creek then on into the Capertee River. These habitats may offer habitat to frogs such as the threatened *Heleioporus australiacus* (Giant Burrowing Frog), *Mixophyes iteratus* (Giant Barred Frog) and *Pseudophryne australis* (Red-crowned Toadlet).
- Flowering and fruiting plants: utilised as foraging habitat for woodland birds and mammals such as the Flame Robin (*Petroica phoenicea*; BC Act: Vulnerable), the Gang-gang Cockatoo (*Callocephalon*

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fimbriatum; BC Act Vulnerable; EPBC Act: Endangered) and the Greater Gliders (*Petauroides Volans*; EPBC Act: Endangered);

- *Allocasuarina* species: for foraging Glossy Black-Cockatoos (*Calyptorhynchus lathami*; BC Act: Vulnerable); and
- Koala feed trees: within woodland vegetation including *Eucalyptus cypellocarpa*, *Eucalyptus piperita* and *Eucalyptus punctata*.

4.2.5 Implications for mining and recommendations

The CLZ EP area is restricted to first workings only. The subsidence assessment of the CLZ ML1331 Extraction Plan (Centennial 2017) states that “no surface impacts would be expected at these levels of subsidence. Specifically, no surface impacts would be expected to cliff lines, pagodas and steep slopes at these negligible levels of subsidence”. However, repeatable and measurable monitoring should continue, or be established. It is to note that monitoring of *Pultenaea* sp. Genowlan Point and Genowlan Point *Allocasuarina* nana Heathland EEC is carried out by NPWS.

During the 2022 monitoring programme across the Mining Lease Area, the following baseline monitoring was conducted:

- Continued monitoring of threatened species and their habitats;
- Biodiversity monitoring within facultative ecosystems, with a focus on the Grotto habitat following a Before After Control Impact design where feasible; and
- Additional *Prostanthera stricta* monitoring transects established within the EP Area.

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Appendix A

Likelihood of Occurrence Analysis

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ApX Table 1 Likelihood of Occurrence Analysis

Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
<i>Acacia bynoeana</i> (Bynoe's Wattle)	E	V	Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Acacia flocktoniae</i> (Flockton Wattle)	V	V	Grows in dry sclerophyll forest on sandstone.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Acacia meiantha</i>	E	E	The Clarence population occurs in open eucalypt forest in association with <i>E. dives</i> and <i>E. sieberi</i> and in an adjacent area of mostly shrubs where the tree overstorey was cleared for powerlines; it is found on sandy soil over sandstone at approx. 1000 m elevation.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
<i>Actitis hypoleucos</i> (Common Sandpiper)		M	Utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Anthochaera phrygia</i> (Regent Honeyeater)	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. The distribution of the species has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and	30	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.		
<i>Aprasia parapulchella</i> (Pink-tailed Legless Lizard)	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by kangaroo grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Apus pacificus</i> (Fork-tailed Swift)		M,MAR	The Fork-tailed Swift is almost exclusively aerial, flying from less than one metre to at least 300 metres above ground and probably much higher.		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Ardea ibis</i> (Cattle egret)		MAR	0		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
<i>Artamus cyanopterus</i> (Dusky Woodswallow)	V		The Dusky Woodswallow is widespread in eastern, southern and southwestern Australia. In New South Wales it is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region. The Dusky Woodswallow is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, including heath. The ground cover may consist of grasses, sedges or open ground, often with coarse woody debris (Higgins and Peter 2002). Birds are also often observed in farm land, usually at the edges of forest or woodland or in	8	occupancy involving important lifecycle processes. High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			roadside remnants or wind breaks with dead timber.		
<i>Astrotricha crassifolia</i> (Thick-leaf Star-hair)	V	V	Occurs near Patonga (Gosford LGA), and in Royal NP and on the Woronora Plateau (Sutherland and Campbelltown LGAs). There is also a record from near Glen Davis (Lithgow LGA). Also in Victoria. Occurs in dry sclerophyll woodland on sandstone.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Botaurus poiciloptilus</i> (Australasian Bittern)	E	E	The Australasian Bitterns is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Burhinus grallarius</i> (Bush Stone-curlew)	E		The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.		active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Calidris acuminata</i> (Sharp-tailed Sandpiper)		M	Freshwater or saltwater wetlands- the muddy edges of lagoons, swamps, lakes, dams, soaks, sewage dams or temporary floodwaters.		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Calidris ferruginea</i> (Curlew Sandpiper)	E	CE,M,M AR	The Curlew Sandpiper is distributed around most of the coastline of Australia. It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Calidris melanotos</i> (Pectoral Sandpiper)		M,MAR	Tends to live and feed over shallow coastal waters- the estuaries, lagoons and channels around river and harbour entrances and along the		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			shallows close in shore.		2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Callocephalon fimbriatum</i> (Gang-gang Cockatoo)	V	E	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	6	Known. Species observed and habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Habitat occupancy is likely to be associated with important life cycle processes; however, the reliance on this habitat would depend on additional factors (e.g. size and extent of local population, effect of KTPs). Species recently observed in the locality (NSW BioNet records).
<i>Calyptorhynchus lathamii</i> (Glossy Black-Cockatoo, Riverina population)	EP		Inhabits forest with low nutrients, characteristically with key <i>Allocasuarina</i> spp. Tends to prefer drier forest types with a middle stratum of <i>Allocasuarina</i> below <i>Eucalyptus</i> or <i>Angophora</i> . Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	2	Known. Species observed and habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Habitat occupancy is likely to be associated with important life cycle processes; however, the reliance on this habitat would depend on additional factors (e.g. size and extent of local population, effect of KTPs). Species recently observed in the locality (NSW BioNet records).
<i>Cercartetus nanus</i> (Eastern Pygmy-possum)	V		Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			favoured food source. Will often nest in tree hollows, but can also construct its own nest . Because of its small size it is able to utilise a range of hollow sizes including very small hollows. Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period .		2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Chalinolobus dwyeri</i> (Large-eared Pied Bat)	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Chrysococcyx osculans</i> (Black-eared cuckoo)		MAR	0		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
					recently observed in the locality (NSW BioNet records).
<i>Chthonicola sagittata</i> (Speckled Warbler)	V		The Speckled Warbler lives in a wide range of eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	3	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Climacteris picumnus victoriae</i> (Brown Treecreeper (eastern subspecies))	V		Found in eucalypt woodlands (including box-gum woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and river red gum forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	10	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
<i>Cynanchum elegans</i> (White-flowered Wax Plant)	E	E	Recorded from rainforest gullies scrub and scree slopes from the Gloucester district to the Wollongong area and inland to Mt Dangar.		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Daphoenositta chrysoptera</i> (Varied Sittella)	V		Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	3	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Darwinia peduncularis</i>	V		Occurs as local disjunct populations in coastal NSW with a couple of isolated populations in the Blue Mountains. It has been recorded from Brooklyn, Berowra, Galston Gorge, Hornsby, Bargo River, Glen Davis, Mount Boonbourwa and Kings Tableland. Usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).

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<i>Dasyurus maculatus</i> (Spotted-tailed Quoll)	V	E	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Delma impar</i> (Striped Legless Lizard)	V	V	Found mainly in natural temperate grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near natural temperate grassland and occasionally in open box-gum woodland. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Dichanthium setosum</i> (Bluegrass)	V	V	Occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Queensland and Western Australia. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not

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			and highly disturbed pasture.		recently observed in the locality (NSW BioNet records).
<i>Eucalyptus aggregata</i> (Black Gum)	V	V	Found in the NSW Central and Southern Tablelands, with small isolated populations in Victoria and the ACT. Has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands in the lowest parts of the landscape, on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Also occurs as isolated paddock trees in modified native or exotic pastures.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Eucalyptus cannonii</i> (Capertee Stringybark)	V		Restricted to an area of about 100 by 60 km in the central tablelands of NSW. The western border is approximately marked by a line between Bathurst and Mudgee, while the eastern locations occur approximately on a line between Lithgow and the town of Bylong. Within this area the species is often locally frequent. Recorded from Tablelands Grassy woodland Complex communities and Talus Slope woodland, and in Winburndale Nature Reserve within woodland dominated by <i>Eucalyptus macrorhyncha</i> and	28	Known. Species observed and habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Habitat occupancy is likely to be associated with important life cycle processes; however, the reliance on this habitat would depend on additional factors (e.g. size and extent of local population, effect of KTPs). Species recently observed in the locality (NSW BioNet records).

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			Eucalyptus goniocalyx.		
<i>Eucalyptus pulverulenta</i> (Silver-leafed Gum)	V	V	Found in two quite separate areas, the Lithgow to Bathurst area and the Monaro (Bredbo to Bombala). Grows in shallow soils as an understorey plant in open forest, typically dominated by brittle gum, red stringybark, broad-leaved peppermint, silvertop ash and apple box.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Euphrasia arguta</i>	CE	CE	Occur in eucalypt forest with a mixed grass and shrub understorey within Nundle State forest. Sites have either been logged in the last few decades, or appear to have regrown from past clearing.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Falco subniger</i> (Black Falcon)	V		The Black Falcon is found along tree-lined watercourses and in isolated woodlands, mainly in arid and semi-arid areas. It roosts in trees at night and	1	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or

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			often on power poles by day.		quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Falco hypoleucos</i> (Grey Falcon)	E		Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Falsistrellus tasmaniensis</i> (Eastern False Pipistrelle)	V		Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Gallinago hardwickii</i>		M	Latham's Snipe is a non-breeding migrant to the south east of		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation

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<i>(Latham's Snipe)</i>			Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.		formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Glossopsitta pusilla</i> (Little Lorikeet)	V		Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	3	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Grantiella picta</i> (Painted Honeyeater)	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e.

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			all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.		standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Grevillea divaricata</i>	E		Known only from the type collection made in 1823 by Allan Cunningham, from "north of Bathurst". Specimen notes describe the plant as occurring frequently in dry open forest lands and as possibly growing on rocky river margins.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Grevillea evansiana</i> (Evans Grevillea)	V	V	Grows in dry sclerophyll forest or woodland, occasionally in swampy heath, in sandy soils, usually over Hawkesbury sandstone.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).

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<i>Grevillea obtusiflora</i>	E	E	Occurs as scattered groups in the understorey of low open eucalypt forest at an altitude of 730 metres above sea level. Subspecies <i>fecunda</i> occurs in clusters within low, open scrub beneath open, dry sclerophyll forest, on orange, sandy loam soils with sandstone boulders, at an altitude of 570 metres.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)	V		Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Haloragodendron lucasii</i>	E	E	Occurs on Hawkesbury Sandstone in moist sandy loam soil. The species prefers sheltered aspects and inhabits gentle slopes below cliff lines near creeks in low open woodland or open forest. Its distribution is correlated with high soil moisture and phosphorus levels.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently

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					observed in the locality (NSW BioNet records).
<i>Heleioporus australiacus</i> (Giant Burrowing Frog)	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Hieraaetus morphnoides</i> (Little Eagle)	V		Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Hirundapus caudacutus</i> (White-throated Needletail)		V,M,MA R	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat

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					occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Homoranthus darwinioides</i> (Fairy Bells)	V	V	Grows in various woodland habitats with shrubby understoreys, usually in gravelly sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Hoplocephalus bungaroides</i> (Broad-headed Snake)	E	V	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows to find shelter during hotter parts of summer.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Hygrocybe anomala</i> var. <i>ianthinomarginata</i>	V		Occurs in gallery warm temperate forests dominated by lilly pilly, grey myrtle, cheese tree and sweet		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a

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			pittosporum. Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Occur as individuals or in groups, terrestrial rarely on wood and only if extremely rotten; substrates include soil, humus, or moss.		disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Hygrocybe aurantipes</i>	V		Occurs in gallery warm temperate forests dominated by lilly pilly, grey myrtle, cheese tree and sweet pittosporum. Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Occur as individuals or in groups, terrestrial rarely on wood and only if extremely rotten; substrates include soil, humus, or moss.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Hygrocybe reesiaae</i>	V		Occurs in gallery warm temperate forests dominated by lilly pilly, grey myrtle, cheese tree and sweet pittosporum. Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Occur as individuals or in groups, terrestrial rarely on wood and only if extremely rotten; substrates		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher

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			include soil, humus, or moss.		value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Lathamus discolor</i> (Swift Parrot)	E	CE,MAR	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects . The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW . This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Leionema lachnaeoides</i>	E	E	Occurs at 10 sites in the upper Blue Mountains, within a 12 km range between Katoomba and Blackheath. Potential habitat occurs in the Megalong and Jamison Valleys. Populations occur on exposed sandstone cliff tops and terraces, at 960 - 1000m altitude and with aspects from south-east to south-west. Habitat vegetation is montane heath and commonly includes Eucalyptus stricta, Allocasuarina nana, Dillwynia retorta, Epacris microphylla and Caustis flexuosa.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Leionema sympetalum</i>	V	V	Restricted to exposed rocky sandstone formations known		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
<i>(Rylstone Bell)</i>			as pagodas. The species occurs in dry sclerophyll forest and probably also occurs in open or closed heathland communities.		formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Leipoa ocellata</i> (Malleefowl)	E	V	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Utilises mallee with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other eucalypt woodlands, such as inland grey box, ironbark or bimbie box woodlands with thick understorey, or in other woodlands such dominated by mulga or native cypress pine species.		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Leucochrysa albicans</i> var. <i>tricolor</i> (Hoary Sunray)		E	Hoary Sunray occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. Plants can be found in natural or semi-natural vegetation and grazed or ungrazed habitat. Bare ground is required		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			for germination. In NSW, the species is often found in association with yellow box, Blakely's red gum and red box.		occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Litoria aurea</i> (Green and Golden Bell Frog)	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Litoria booroolongensis</i> (Booroolong Frog)	E	E	The Booroolong Frog is found along permanent western flowing streams of the Great Dividing Range through most of NSW and down into northern Victoria. Streams range from small slow-flowing creeks to large rivers and the adults are found on or near cobble banks and other rock structures within stream margins and shelter under rocks or amongst vegetation near the ground on the stream edge. The species occurs along streams in		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			both forested areas and open pasture, but has been affected by the presence of the introduced willow tree. Booroolong Frogs sometimes basks in the sun on exposed rocks near flowing water during summer.		
Litoria littlejohni (Littlejohn's Tree Frog)	V	V	Occurs in wet and dry sclerophyll forests and heathland associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range from the Central Coast down into Victoria. Individuals have been collected from a wide range of water bodies that includes semi-permanent dams, permanent ponds, temporary pools and permanent streams, with calling occurring from fringing vegetation or on the banks. Individuals have been observed sheltering under rocks on high exposed ridges during summer and within deep leaf litter adjacent to the breeding site. Calling occurs in all months of the year, often in association with heavy rains. The tadpoles are distinctive, being large and very dark in colouration.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Lophoictinia isura (Square-tailed Kite)	V		Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may

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			is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata or E. smithii. Individuals appear to occupy large hunting ranges of more than 100km ² . They require large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.		not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Macquaria australasica (Macquarie Perch)		E	Macquarie perch are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
Melanodryas cucullata (Hooded Robin (south-eastern form))	V		Occupy a wide range of eucalypt woodlands, Acacia shrublands and open forests.	3	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat

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					occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Melithreptus gularis gularis</i> (Black-chinned Honeyeater (eastern subspecies))	V		Eucalypt woodlands within an approximate annual rainfall range of 400-700mm	1	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Merops ornatus</i> (Rainbow bee-eater)		MAR	0		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Micronomus norfolkensis</i> (Eastern Coastal Free-tailed Bat)	V		Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).

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<i>Miniopterus australis</i> (Little Bent-winged Bat)	V		Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Miniopterus orianae oceanensis</i> (Large Bent-winged Bat)	V		Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Mixophyes balbus</i> (Stuttering Frog)	E	V	Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity

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			permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of breeding, individuals range widely across the forest floor and can be found hundreds of metres from water		for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Mixophyes iteratus</i> (Giant Barred Frog)	E	E	This species is found along larger streams of the coast and adjacent ranges of NSW and SE QLD. It inhabits rainforest and wet sclerophyll forest, but is also found within cleared farmland where fringing vegetation is retained, including lantana beds. Many sites where the Giant Barred Frog is known to occur are the lower reaches of streams which have been affected by major disturbances such as clearing, timber harvesting and urban development in their headwaters.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Monarcha melanopsis</i> (Black-faced Monarch)		M,MAR	0		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently

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					observed in the locality (NSW BioNet records).
Motacilla flava (Yellow Wagtail)		M,MAR	Often seen near water. Listen for high-pitched, piercing call note. Common breeder on Arctic tundra from Alaska to Russia; found in grassy and waterside habitats in Southeast Asian wintering grounds and in migration.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
Myiagra cyanoleuca (Satin Flycatcher)		M,MAR	0		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Myotis macropus (Southern Myotis)	V		The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings,		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently

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			under bridges and in dense foliage.		observed in the locality (NSW BioNet records).
Neophema chrysostoma (Blue-winged parrot)		MAR	0		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
Neophema pulchella (Turquoise Parrot)	V		The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	2	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Ninox connivens (Barking Owl)	V		Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e.

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			in otherwise open country.		standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Ninox strenua</i> V (Powerful Owl)			Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Numenius madagascariensis</i> (Eastern Curlew)		CE,M,MA	The Eastern curlew spends its breeding season in northeastern Asia, including Siberia to Kamchatka, and Mongolia. Its breeding habitat is composed of marshy and swampy wetlands and lakeshores.		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would

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			Most individuals winter in coastal Australia, with a few heading to South Korea, Thailand, Philippines and New Zealand, where they stay at estuaries, beaches, and salt marshes. It uses its long, decurved bill to probe for invertebrates in the mud. It may feed in solitary but it generally congregates in large flocks to migrate or roost. Its call is a sharp, clear whistle, cuuue-reee, often repeated.		likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
Nyctophilus corbeni (Corben's Long-eared Bat)	V	V	The South-eastern Long-eared Bat has a limited distribution that is restricted around the Murray-Darling Basin in south-eastern Australia. Even in this region its distribution is scattered and it is rarely recorded. It occurs in far eastern South Australia, in areas north of the Murray River, east of Canegrass Station and south of the Barrier Highway. These areas include the Riverland Biosphere Reserve, Danggali Conservation Park and the Birds Australia Gluepot Reserve. It is distributed throughout inland NSW except in the north-west area which is dominated by treeless plains. It can be found in		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.

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			the Hunter Valley, extending from central NSW to the eastern Hunter Valley coast. Considered <i>Nyctophilus timorensis</i> south eastern form under TSC Act.		
<i>Olearia cordata</i>	V	V	Grows in dry open sclerophyll forest and open shrubland, on sandstone ridges.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Pachycephala inornata</i> (Gilbert's Whistler)	V		Recorded in mallee shrublands, but also occurs in box-ironbark woodlands, cypress pine and belah woodlands and river red gum forests, though at this stage it is only known to use this habitat along the Murray, Edwards and Wakool Rivers. Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including wattles, hakeas, sennas and hop-bushes.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Paralucia spinifera</i> (Purple Copper Butterfly, Bathurst)	E	V	The Copper Butterfly is only found in the Central Tablelands of NSW. Its habitat is restricted to elevations above 900 m where it		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the

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Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
Copper Butterfly)			feeds exclusively on a form of blackthorn. The butterfly's life cycle relies on a 'mutualistic' relationship with the ant <i>Anonychomyrma itinerans</i> , and on the presence of blackthorn (<i>Bursaria spinosa</i> subsp. <i>lasiophylla</i>).		known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Persoonia marginata (Clandulla Geebung)	V	V	Grows in dry sclerophyll forest and woodland communities on sandstone. Appears to respond well to disturbance, with greater densities found along the edges of tracks and in areas disturbed by forestry activities.	38	Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Petauroides volans (Greater Glider)		V	The Greater Glider occurs in eucalypt forests and woodlands. Utilise tree hollows		Known. Species observed and habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Habitat occupancy is likely to be associated with important life cycle processes; however, the reliance on this habitat would depend on additional factors (e.g. size and extent of local population, effect of KTPs). Species recently observed in the locality (NSW BioNet records).
Petaurus australis (Yellow-bellied Glider)	V		Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity

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			gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.		for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Petaurus norfolcensis (Squirrel Glider)	V		Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range . Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias . There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Petrogale penicillata (Brush-tailed Rock-wallaby)	E	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat

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					occupancy. Species recently observed in the locality (NSW BioNet records).
Petroica boodang (Scarlet Robin)	V		The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	1	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Petroica phoenicea (Flame Robin)	V	MAR	Flame Robins are found in a broad coastal band from southern Queensland to just west of the South Australian border. The species is also found in Tasmania. The preferred habitat in summer includes eucalyptus forests and woodland, whilst in winter prefers open woodlands and farmlands. It is considered migratory. The Flame Robin breeds from about August to January.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Phascogale tapoatafa (Brush-tailed Phascogale)	V		The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath,		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently

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			swamps, rainforest and wet sclerophyll forest.		observed in the locality (NSW BioNet records).
Phascolarctos cinereus (Koala)	V	E	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall .	2	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Phebalium bifidum	E		Phebalium bifidum is restricted to the Capertee Valley, south east of Kandos in the South Eastern Highlands bioregion in NSW. The species is extremely rare, in being known from only four disjunct sites from within the Valley. Phebalium bifidum is not known from any conservation reserve. Occurs in dry sclerophyll woodland or heath on structured loam soil; in most instances plants have been found on relatively flat ground on broad ridges and hill crests.	514	Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Polytelis swainsonii (Superb Parrot)	V	V	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity

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			Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. Inhabits box-gum, box-cypress-pine and boree woodlands and river red gum forest.		for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Pomaderris brunnea (Brown Pomaderris)	E	V	The species is expected to live for 10 - 20 years, while the minimum time to produce seed is estimated to be 4 - 6 years. Found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area. It also occurs at Walcha on the New England Tableland and in far eastern Gippsland in Victoria.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
Pomaderris cotoneaster (Cotoneaster Pomaderris)	E	E	Has been recorded in a range of habitats in predominantly forested country. The habitats include forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Pomatostomus temporalis (Grey-crowned Babbler)	V		In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western	1	Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known

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(eastern subspecies))			plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. Inhabits open box-gum woodlands on the slopes, and box-cypress-pine and open box woodlands on alluvial plains.		'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Prasophyllum petilum (Tarengo Leek Orchid)	E	E	Grows in open sites within Natural Temperate Grassland at the Boorowa and Delegate sites and in grassy woodland in association with River Tussock Poa labillardieri, Black Gum Eucalyptus aggregata and tea-trees Leptospermum spp. near Queanbeyan and within the grassy groundlayer dominated by Kanagaroo Grass under Box-Gum Woodland at Ilford (and Hall, ACT)		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
Prasophyllum sp. Wybong		CE	Endemic to NSW. It is known from seven populations in eastern NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with

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					landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
Prostanthera cryptandroide s subsp. cryptandroide s (Wollemi Mint-bush)	V	V	At Glen Davis, occurs in open forest dominated by Eucalyptus fibrosa. Other eucalypt species may be present as sub-dominants. In the Denman-Gungal and Widden-Baerami Valley areas, occurs on rocky ridgelines on Narrabeen Group Sandstones in association with a range of communities.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Prostanthera stricta (Mount Vincent Mint-bush)	V	V	A locally dominant undershrub in heath or scrub communities along cliff edges, or as an understory species within a range of open forest or tall open forest types, or in adjacent transitional communities. Grows in areas of both skeletal soil and on deeper, well-drained soil profiles in areas characterised by steep rocky sideslopes, cliff lines, sandstone platforms, or gentle slopes with exposed sandstone outcroppings.	5	Known. Species observed and habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Habitat occupancy is likely to be associated with important life cycle processes; however, the reliance on this habitat would depend on additional factors (e.g. size and extent of local population, effect of KTPs). Species recently observed in the locality (NSW BioNet records).
Prototroctes maraena (Australian Grayling)		V	Historically, this species occurred in coastal streams from the Grose River Valley, southwards through NSW, Vic. and Tas. It also occasionally occurred high upstream in the		None. Species specific habitat types (i.e. important habitat features) and known vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are absent from the investigation area. The investigation area is also likely located outside the species known 'area of occurrence' and may also occur outside the species 'extent of occurrence' [i.e. standard grid size of

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			Snowy R. A single juvenile specimen was collected from Lake Macquarie in 1974 . This species spends only part of its lifecycle in freshwater. The Tambo River population inhabits a clear, gravel-bottomed stream with alternating pools and riffles, and granite outcrops. It has also been associated with clear, gravel-bottomed habitats in the Mitchell & Wonnangatta Rivers but was present in a muddy-bottomed, heavily silted habitat in the Tarwin R.		2x2km (IUCN 2017)]. Species incidence is not expected and, if detected, would likely represent atypical occurrence (e.g. incidence linked with transient activity). Presence unlikely associated with habitat occupancy involving important lifecycle processes.
<i>Pseudomys novaehollandiae</i> (New Holland Mouse)		V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
<i>Pseudophryne australis</i> (Red-crowned Toadlet)	V		Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and

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			semi-perennial streams. After rain these creeks are characterised by a series of shallow pools lined by dense grasses, ferns and low shrubs and usually contain leaf litter for shelter. Eggs are terrestrial and laid under litter, vegetation or rocks where the tadpoles inside will reach a relatively late stage of development before waiting for flooding waters before hatching will occur.		active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Pultenaea glabra (Smooth Bush-Pea)	V	V	Grows in swamp margins, hillslopes, gullies and creekbanks and occurs within dry sclerophyll forest and tall damp heath on sandstone. Restricted to the higher Blue Mountains.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Pultenaea sp. Genowlan Point	CE	CE	Occurs on well drained stony soil near a cliff edge.		Known. Species observed and habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN

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					2017)]. Habitat occupancy is likely to be associated with important life cycle processes; however, the reliance on this habitat would depend on additional factors (e.g. size and extent of local population, effect of KTPs). Species recently observed in the locality (NSW BioNet records).
Pultenaea sp. Olinda	E		Has been found only in a very limited area of pagoda rock formation east of Rylstone.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Pycnoptilus floccosus (Pilotbird)		V	0		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Rhipidura rufifrons (Rufous Fantail)		M,MAR	0		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).

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Rhizanthella slateri (Rhizanthella slateri (Rupp) M.A. Clem. & Cribb in the Great Lakes local government area)	EP	E	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Rhodamnia rubescens (Scrub Turpentine)	CE	CE	Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils. This species is characterised as highly to extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Rostratula australis (Australian Painted Snipe)	E	E	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not

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					recently observed in the locality (NSW BioNet records).
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tail-bat)	V		Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Scoteanax rueppellii</i> (Greater Broad-nosed Bat)	V		Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Stagonopleura guttata</i> (Diamond Firetail)	V		Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including box-gum woodlands and snow gum	4	High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat

REPORT

Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities.		occupancy. Species recently observed in the locality (NSW BioNet records).
Swainsona recta (Small Purple-pea)	E	E	Before European settlement, this species occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's red gum, yellow box, candlebark gum and long-leaf box. Grows in association with understorey dominants that include kangaroo grass, poa tussocks and spear-grasses.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Tetratheca glandulosa	V		Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gynea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey-sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops. Vegetation structure varies from heaths and scrub to woodlands-open		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).

REPORT

Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			woodlands, and open forest.		
<i>Thesium australe</i> (Austral Toadflax)	V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
<i>Tyto novaehollandiae</i> (Masked Owl)	V		Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
<i>Tyto tenebricosa</i> (Sooty Owl)	V		Often found in tall old-growth forests, including temperate		High. Habitat values within the investigation area are generally consistent with descriptions provided in

REPORT

Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 metres. Nests and roosts in hollows of tall emergent trees, mainly eucalypts often located in gullies. Nests have been located in trees 125 to 161 centimetres in diameter.		the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Varanus rosenbergi (Rosenberg's Goanna)	V		This species is a Hawkesbury-Narrabeen sandstone outcrop specialist. Occurs in coastal heaths, humid woodlands and both wet and dry sclerophyll forests.		Known. Species observed and habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is located within known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Habitat occupancy is likely to be associated with important life cycle processes; however, the reliance on this habitat would depend on additional factors (e.g. size and extent of local population, effect of KTPs). Species recently observed in the locality (NSW BioNet records).
Velleia perfoliata	V	V	The species is only known from the Hawkesbury District and Upper Hunter Valley in the Central Coast botanical subdivision of NSW. Velleia perfoliata grows in heath on shallow sandy soil over Sandstone. It is currently known to exist in 9 populations. Five of these populations are reserved whilst a further population is partly reserved. Four of the reserved sites are situated adjacent to fire trails.		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
Veronica blakelyi	V		Restricted to the western Blue Mountains, near Clarence, near Mt Horrible, on Nullo Mountain and in the		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a

REPORT

Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			Coricudgy Range. Occurs at fewer than 20 locations, none of which is in a conservation reserve. Occurs in eucalypt forest, often in moist areas.		disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
Vespadelus trougtoni (Eastern Cave Bat)	V		The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).
Wollemia nobilis (Wollemi Pine)	CE	CE	Restricted to remote canyons in the Wollemi National Park, north-west of Sydney. Occurs in warm temperate rainforest and rain forest margins in		Low. Vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) are present; however, species specific habitat types (i.e. important habitat features) are either absent, in low abundance and/ or in a disturbed state. The investigation area is likely to be located outside the species known 'area of occurrence' but may be within the known 'extent of occurrence'

REPORT

Scientific Name (Common Name)	BC Act	EPBC Act	Habitat	Number of Recent Records (DPE 2022b)	LoO
			remote sandstone canyons.		[i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are likely to be negatively influencing the likelihood of habitat occupancy. If detected, species activity is most likely low and associated with landscape scale habitat use such as movement between areas of higher value habitat, the use of supplementary habitat or reflect the negative effects of active/ uncontrolled KTPs. Species not recently observed in the locality (NSW BioNet records).
Xanthosia scopulicola	V		Known only from scattered locations between Kings Tableland (Wentworth Falls) and Boars Head rock (west of Katoomba) in the Blue Mountains. Grows in cracks and crevices of sandstone cliff faces or on rocky outcrops above the cliffs.		Moderate. Species specific (i.e. important habitat features) and vegetation classification based habitat surrogates (i.e. PCT and/ or vegetation formations) occur within the investigation area. The investigation area may or may not be located within the species known 'area of occurrence' but is within the known 'extent of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality may be influencing the capacity for habitat occupancy. Pre-existing and active KTPs may potentially have a negative influence on species incidence and/ or habitat occupancy. Not recently observed in the locality (NSW BioNet records).
Zieria murphyi (Velvet Zieria)	V	V	The species grows in open, dry sclerophyll forest, on sandy soils on sandstone and in sheltered sites, often just below cliff lines		High. Habitat values within the investigation area are generally consistent with descriptions provided in the BCD TSPD. Habitat is likely to be located within the known 'extent of occurrence' and 'area of occurrence' [i.e. standard grid size of 2x2km (IUCN 2017)]. Factors such as connectivity, patch size, habitat quantum and/ or quality are unlikely to adversely influence the capacity of the species to occupy the habitat. Pre-existing and active KTPs are unlikely to be substantially influencing species incidence and/ or habitat occupancy. Species recently observed in the locality (NSW BioNet records).

Appendix B
EPBC Act MNES Search

Appendix C
Floristic Plots - Woodland

REPORT

ApX Table 2: Full floristic data from Genowlan Point Allocasuarina nana Heathland EEC and Woodland 20 x 20 m plots

Scientific Name	Common Name	BC Act	EP BC Act	Exot ic	GEN_PT_ 01		GEN_PT_ 02		Woodland _01		Woodland _02		Woodland _03*	
					Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.
<i>Acacia obtusifolia</i>					0.1	1	1	1	2	20			2	25
<i>Acacia terminalis</i>	Sunshine Wattle										0.1	3		
<i>Ajuga australis</i>	Austral Bugle												0.1	25
<i>Allocasuarina littoralis</i>	Black She-Oak								5	2	35	25		
<i>Allocasuarina nana</i>	Dwarf She-oak				75	100	70	200						
<i>Austrostipa pubescens</i>					0.1	25								
<i>Austrostipa spp.</i>													0.1	5
<i>Babingtonia densifolia</i>					0.2	25								
<i>Baeckea brevifolia</i>					0.1	10								
<i>Billardiera procumbens</i>											0.1	2		
<i>Boronia microphylla</i>	Small-leaved Boronia						0.2	20						
<i>Boronia rigens</i>	Stiff Boronia				0.1	25	0.4	20						
<i>Bossiaea heterophylla</i>	Variable Bossiaea						0.6	20						
<i>Brachyloma daphnoides</i>	Daphne Heath				0.1	5	1	10			0.1	1		
<i>Callitris muelleri</i>							15	25						
<i>Cheilanthes sieberi</i>	Rock Fern												0.1	20
<i>Chrysocephalum spp.</i>													0.1	1
<i>Cirsium vulgare</i>	Spear Thistle			YES									0.1	1
<i>Clematis aristata</i>	Old Man's Beard												0.2	50
<i>Conyza spp.</i>				YES									0.1	3
<i>Correa reflexa</i>	Native Fuschia												0.1	2
<i>Cryptandra amara</i>	Bitter Cryptandra				0.1	20	0.5	20						
<i>Dampiera stricta</i>					1	100	0.5	50						
<i>Desmodium varians</i>	Slender Tick-trefoil												0.1	10
<i>Deyeuxia spp.</i>													1	100
<i>Dianella caerulea</i>	Blue Flax-lily										0.2	20	0.1	4
<i>Dichondra repens</i>	Kidney Weed												2	500
<i>Dodonaea multijuga</i>									0.1	4				
<i>Echinopogon ovatus</i>	Forest Hedgehog Grass												0.2	50

REPORT

Scientific Name	Common Name	BC Act	EP BC Act	Exot ic	GEN_PT_ 01		GEN_PT_ 02		Woodland _01		Woodland _02		Woodland _03*	
					Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.
<i>Entolasia stricta</i>	Wiry Panic								0.1	3	0.1	10		
<i>Epacris spp.</i>											0.1	2		
<i>Eucalyptus cypellocarpa</i>	Monkey Gum												20	6
<i>Eucalyptus piperita</i>	Sydney Peppermint				0.1	5			5	1	10	4	3	5
<i>Eucalyptus punctata</i>	Grey Gum								2	1				
<i>Eucalyptus sparsifolia</i>	Narrow-leaved Stringybark								30	10	2	2	10	5
<i>Galium divaricatum</i>	Slender Bedstraw			YES									0.2	100
<i>Galium leiocarpum</i>													1	500
<i>Geranium homeanum</i>													0.2	200
<i>Glycine microphylla</i>	Small-leaf Glycine												0.1	10
<i>Glycine tabacina</i>	Variable Glycine												0.1	25
<i>Gonocarpus elatus</i>											0.2	20		
<i>Gonocarpus teucrioides</i>	Germander Raspwort												0.2	50
<i>Goodenia bellidifolia</i>					0.1	50	0.2	30						
<i>Goodenia hederacea</i>	Ivy Goodenia										0.1	10		
<i>Haloragis spp.</i>											0.1	1		
<i>Harmogia densifolia</i>							0.2	20						
<i>Hibbertia serpyllifolia</i>	Hairy Guinea Flower				0.1	5								
<i>Hydrocotyle sibthorpioides</i>													0.5	200
<i>Hypericum gramineum</i>	Small St John's Wort												0.1	5
<i>Hypochaeris glabra</i>	Smooth Catsear			YES					0.1	2			0.1	1
<i>Hypochaeris radicata</i>	Catsear			YES									0.1	2
<i>Isopogon anethifolius</i>	Narrow-leaf Drumsticks				0.1	1	0.1	1						
<i>Juncus spp.</i>													0.3	30
<i>Kunzea parvifolia</i>	Violet Kunzea				5	25								
<i>Lepidosperma gunnii</i>											0.2	20		
<i>Lepidosperma laterale</i>	Variable Sword-sedge										0.1	2		

REPORT

Scientific Name	Common Name	BC Act	EP BC Act	Exotic	GEN_PT_01		GEN_PT_02		Woodland_01		Woodland_02		Woodland_03*	
					Cover	Abund.	Cover	Abund.	Cover	Abund.	Cover	Abund.	Cover	Abund.
<i>Lepidosperma urophorum</i>									3	10	15	30	0.2	1
<i>Lepidosperma viscidum</i>					15	25	0.1	2						
<i>Leptospermum parvifolium</i>					5	25								
<i>Leptospermum polyanthum</i>							2	10	4	5	0.1	2		
<i>Leptospermum trinervium</i>	Slender Tea-tree				1	25	0.2	1						
<i>Leucopogon muticus</i>	Blunt Beard-heath				0.1	5	1	8	0.1	2				
<i>Lomandra filiformis</i>	Wattle Matt-rush								0.1	2				
<i>Lomandra glauca</i>	Pale Mat-rush				0.2	50	1	50			0.2	30		
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush												8	60
<i>Lomandra micrantha</i>	Small-flowered Mat-rush								0.3	10	0.1	3		
<i>Marsdenia spp.</i>					0.1	1								
<i>Micrantheum ericoides</i>					0.1	25								
<i>Microlaena stipoides</i>	Weeping Grass								1	40	0.1	5	5	2,000
<i>Micromyrtus ciliata</i>	Fringed Heath-myrtle						0.3	30						
<i>Micromyrtus sessilis</i>					1	40	0.4	5						
<i>Modiola spp.</i>				YES									0.1	2
<i>Monotoca scoparia</i>													0.1	5
<i>Opercularia hispida</i>	Hairy Stinkweed												0.1	5
<i>Patersonia sericea</i>	Silky Purple-Flag				0.1	1					0.1	1		
<i>Persoonia linearis</i>	Narrow-leaved Geebung								2.0	3	0.1	1	0.1	2
<i>Persoonia spp.</i>							0.1	6						
<i>Phyllanthus hirtellus</i>	Thyme Spurge										0.1	1		
<i>Phyllota phyllicoides</i>	Heath Phyllota						1	20						
<i>Platysace lanceolata</i>	Shrubby Platysace				0.1	5					0.2	20		
<i>Poa sieberiana</i>	Snowgrass								0.1	5				
<i>Pomaderris andromedifolia</i>											0.1	3		
<i>Pomax umbellata</i>	Pomax								0.1	2	0.1	10	0.1	25

REPORT

Scientific Name	Common Name	BC Act	EP BC Act	Exot ic	GEN_PT_ 01		GEN_PT_ 02		Woodland _01		Woodland _02		Woodland _03*	
					Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.	Cove r	Abun d.
<i>Poranthera microphylla</i>	Small Poranthera								0.1	5	0.1	20		
<i>Pseudanthus divaricatissimus</i>					0.1	10	1	20						
<i>Pteridium esculentum</i>	Bracken												0.2	10
<i>Rhytidosporum procumbens</i>							0.1	2						
<i>Rytidosperma spp.</i>							0.1	2						
<i>Rytidosperma tenuius</i>					0.1	25								
<i>Schoenus spp.</i>					1	100	0.1	5						
<i>Schoenus villosus</i>							1	40						
<i>Senecio jacobaea</i>	Ragwort			YES									0.1	2
<i>Solanum spp.</i>													0.1	3
<i>Stellaria pungens</i>	Prickly Starwort												0.1	25
<i>Stypandra glauca</i>	Nodding Blue Lily								1	20	0.1	2		
<i>Veronica plebeia</i>	Trailing Speedwell												0.5	100
<i>Viola hederacea</i>	Ivy-leaved Violet												10	1,000
<i>Wahlenbergia spp.</i>	Bluebell												0.1	5
<i>Wahlenbergia stricta</i>	Tall Bluebell												0.1	2
<i>Xanthorrhoea arborea</i>									0.2	2				
<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree						1	3						

Appendix D

Floristic Plots - GDE

REPORT

Apx Table 3: Dominant floristics of the Facultative Ecosystems PCT 3731 (EX plots) and PCT 3495 (GDE plots).

Scientific Name	Common Name	BC Act	EPBC Act	EX01	EX02	EX03	EX04	EX05	GDE0 1	GDE0 2	GDE0 3	GDE0 4	GDE0 5	GDE0 6	GDE0 7
Fern															
<i>Adiantum aethiopicum</i>	Common Maidenhair										X				
<i>Blechnum ambiguum</i>										X					
<i>Blechnum cartilagineum</i>	Gristle Fern										X	X		X	X
<i>Calochlaena dubia</i>	Rainbow Fern								XX	XX	X	XX	X	X	X
<i>Cyathea australis</i>	Rough Treefern								X	X	X	X	X	X	
<i>Doodia aspera</i>				X	X		X	X							
<i>Pteridium esculentum</i>	Bracken			X	X		X	X	XX	XX	X	X	X	X	X
Forb															
<i>Calomeria amaranthoides</i>	Incense Plant										X				X
<i>Dichondra repens</i>	Kidney Weed				X			X							
<i>Galium leiocarpum</i>				X						X	X	X			
<i>Geranium spp.</i>				X							X				
<i>Hydrocotyle peduncularis</i>					X		X								
<i>Hydrocotyle sibthorpioides</i>								X			X				
<i>Veronica plebeia</i>	Trailing Speedwell			X											
<i>Viola hederacea</i>	Ivy-leaved Violet				X		X			X	X	X			
Grass & Grass-like															
<i>Aristida ramosa</i>	Purple Wiregrass					X									
<i>Aristida spp.</i>				X											
<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass			X				X							
<i>Echinopogon ovatus</i>	Forest Hedgehog Grass				X										
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush			XX	X		XX	X	XX				X		

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Scientific Name	Common Name	BC Act	EPBC Act	EX01	EX02	EX03	EX04	EX05	GDE0 1	GDE0 2	GDE0 3	GDE0 4	GDE0 5	GDE0 6	GDE0 7
<i>Microlaena stipoides</i>	Weeping Grass			X	X			X		X	X	X			
<i>Oplismenus aemulus</i>				X	X			X							
<i>Rytidosperma spp.</i>						X	X								
Shrub															
<i>Acacia falcata</i>				X											
<i>Acacia longifolia</i>						X	X								
<i>Acacia obtusifolia</i>									X			X		X	
<i>Acacia penninervis</i>	Mountain Hickory						XX								
<i>Acacia terminalis</i>	Sunshine Wattle					X									
<i>Bursaria longisepala</i>						X	X								
<i>Elaeocarpus reticulatus</i>	Blueberry Ash				X				X			X		X	X
<i>Hibbertia aspera</i>	Rough Guinea Flower						X								
<i>Indigofera australis</i>	Australian Indigo			X	X	X						X			
<i>Leptospermum polyanthum</i>									X	X					
<i>Leptospermum polygalifolium</i>	Tantoon							X					X	X	X
<i>Lomatia myricoides</i>	River Lomatia									X					
<i>Pimelea latifolia subsp. hirsuta</i>				X	X	XX	X								
Tree															
<i>Brachychiton populneus</i>	Kurrajong			X											
<i>Eucalyptus cypellocarpa</i>	Monkey Gum			X	X		X	XX	XX		X	XX	X	X	
<i>Eucalyptus fastigata</i>	Brown Barrel							X			XX		X	X	X
<i>Eucalyptus macrorhyncha</i>	Red Stringybark					XX									
<i>Eucalyptus melliodora</i>	Yellow Box					X									
<i>Eucalyptus piperita</i>	Sydney Peppermint							X	X		XX	X	X	X	
<i>Eucalyptus polyanthemos</i>	Red Box					XX									

REPORT

Apx Table 4: GDE BAM plot flora list

Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Acacia melanoxylon</i>		Blackwood	4	7	8	4	1	3														
<i>Acacia obtusifolia</i>			4	10	3	3	6	20	2	5	4	10	0.5	10	0.1	1		0.5	1			
<i>Acaena novae-zelandiae</i>		Bidgee-widgee			0.1	5	0.1	2	0.1	4										0.2	10	
<i>Acrotriche rigida</i>									0.2	1												
<i>Adiantum aethiopicum</i>		Common Maidenhair									0.3	30	0.3	20			0.5	100	0.2	20		
<i>Ajuga australis</i>		Austral Bugle			0.1	6	1	30									0.2	40	0.3	10		
<i>Allocasuarina littoralis</i>		Black She-Oak					0.5	1														
<i>Amperea xiphoclada</i>										0.3	20											
<i>Amyema spp.</i>		Mistletoe						0.1	2								0.1	1				
<i>Asplenium flabellifolium</i>		Necklace Fern								0.2	20								0.1	5		
<i>Asplenium flaccidum</i>		Weeping Spleenwort									0.1	2	0.1	10								
<i>Billardiera scandens</i>		Hairy Apple Berry	0.2	20		0.1	5	0.1	5				0.1	2								
<i>Blechnum cartilagineum</i>		Gristle Fern							15	50	0.1	4	40.5	310			25	75	8	30		
<i>Blechnum nudum</i>		Fishbone Water Fern											0.1	2								
<i>Brachychiton populneus</i>		Kurrajong	0.1	1																		
<i>Bursaria spinosa</i>		Native Blackthorn			7	20	6	20	1	5									0.2	2		
<i>Calochlaena dubia</i>		Rainbow Fern							25	100	4	20	60	500					2	20		
<i>Calotis hispidula</i>		Bogan Flea					0.1	20														
<i>Cassinia spp.</i>			0.1	2			0.1	2			0.1	2										

REPORT

Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance	
Cassinia uncata		Sticky Cassinia																		0.1	1		
Centaurium spp.	*				0.1	4											0.1		2				
Cheilanthes sieberi		Rock Fern	0.1	4	0.1	6	0.1	2		0.1	10												
Cirsium vulgare	*	Spear Thistle			0.1	6	0.1	3		0.1	1		0.1	1						0.1	3		
Clematis aristata		Old Man's Beard	7	50	8	60	2	30		2	50	0.1	5	0.1	5		2.1	65		0.2	30	0.5	20
Clematis glycinoides		Headache Vine								0.2	10							2		50			
Conyza bonariensis	*	Flaxleaf Fleabane								0.1	2												
Conyza spp.	*		0.1	1	0.1	5	0.2	10				0.1	2	0.1	2								
Coprosma quadrifida		Prickly Currant Bush																		2	9		
Coronidium spp.										0.1	1												
Correa reflexa		Native Fuschia								0.1	2							0.1		2			
Correa reflexa var. reflexa		Native Fuschia					0.2	3															
Crassula Sieberiana		Australian Stonecrop										0.1	4										
Cyathea australis		Rough Treefern								1	4			22	30					1	2		
Cynoglossum australe								2	50														
Cyperus spp.										0.1	1	0.1	1										
Dendrobium spp.										1	20												
Desmodium varians		Slender Tick-trefoil	0.3	40	0.2	30	0.2	20										0.1	50				
Dianella caerulea		Blue Flax-lily											0.3	10									

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<i>Dianella caerulea</i> var. <i>caerulea</i>								0.2	20			0.5	20									
<i>Dianella caerulea</i> var. <i>producta</i>			1	15	1	10	0.5	20	1	20	3	70	1	30	0.3	5		2	50	0.1	3	
<i>Dichelachne</i> spp.			7	60	1	10	10	100	1	40	0.5	20			0.1	3				0.1	7	
<i>Dichondra repens</i>		Kidney Weed	3	100	3	80	3	100	5	200				3	100		0.1	100	2	100		
<i>Doodia aspera</i>											0.5	50					0.2	40	0.5	20		
<i>Doodia</i> spp.													2	80								
<i>Echinopogon caespitosus</i>		Bushy Hedgehog-grass	0.1	4	1	30					0.1	10	1	40					0.2	30		
<i>Echinopogon ovatus</i>		Forest Hedgehog Grass						1	50								0.1	50	0.1	8		
<i>Echium plantagineum</i>	*	Patterson's Curse			0.1	1																
<i>Einadia hastata</i>		Berry Saltbush	0.1	2																		
<i>Elaeocarpus reticulatus</i>		Blueberry Ash				0.1	1			0.7	3	4	6	15.1	10		0.1	1	4	5		
<i>Entolasia marginata</i>		Bordered Panic	3	100	2	60		0.5	30		25	1000	2	90					0.1	10		
<i>Entolasia stricta</i>		Wiry Panic											0.2	10			0.1	30				
<i>Epacris microphylla</i>		Coral Heath							0.1	3												
<i>Epacris</i> spp.						0.1	1															
<i>Eucalyptus blaxlandii</i>		Blaxland's Stringybark									6	4										
<i>Eucalyptus cannonii</i>		Capertee Stringybark				15	3	7	2													
<i>Eucalyptus cypellocarpa</i>		Monkey Gum	25	10	50	11	10	3	25	5	15	4		25	4	10	1	35	5	10	3	

REPORT

Scientific Name	Exotic	Common Name	1 Cover	1 Abundance	2 Cover	2 Abundance	3 Cover	3 Abundance	4 Cover	4 Abundance	5 Cover	5 Abundance	6 Cover	6 Abundance	7 Cover	7 Abundance	8 Cover	8 Abundance	9 Cover	9 Abundance	10 Cover	10 Abundance
<i>Eucalyptus fastigata</i>		Brown Barrel											25	4								
<i>Eucalyptus macrorhyncha</i>		Red Stringybark	2	3			3	1	15	2												
<i>Eucalyptus piperita</i>		Sydney Peppermint							25	8	3	2					15		3		15	5
<i>Eucalyptus polyanthemos</i>		Red Box	2	2		15	7															
<i>Eucalyptus punctata</i>		Grey Gum											0.5	1			3		1			
<i>Eucalyptus spp.</i>					0.1	1							0.1	1								
<i>Euchiton involucratus</i>		Star Cudweed			0.2	20	0.2	50														
<i>Euchiton spp.</i>			0.1	3				0.1	5											0.1	10	
<i>Eustrephus latifolius</i>		Wombat Berry	0.1	10																		
<i>Gahnia spp.</i>									0.2	1												
<i>Galium gaudichaudii</i>		Rough Bedstraw									0.1	5		0.1	20		0.1	20				
<i>Galium leiocarpum</i>			0.1	20	4	10	0.3	40	1	100	0.4	50	0.1	10	0.5	50		1	400	0.1	20	
<i>Galium propinquum</i>		Maori Bedstraw												1	100				0.1	10		
<i>Galium spp.</i>								0.1	5													
<i>Geitonoplesium cymosum</i>		Scrambling Lily	1	40	0.2	20	0.1	3	0.1	2	0.1	2	0.3	10	0.5	40				0.1	10	
<i>Geranium homeanum</i>											0.1	10		0.1	5		0.1	20				
<i>Geranium solanderi</i>		Native Geranium	0.1	3	1	20	0.1	4						2	80							
<i>Geranium spp.</i>																	0.3	30	1	50		
<i>Glycine clandestina</i>		Twining glycine						0.3	30								0.2	50				
<i>Glycine microphylla</i>		Small-leaf Glycine						0.2	30													
<i>Glycine spp.</i>			0.1	10	0.1	3	0.1	30														

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Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Glycine tabacina</i>		Variable Glycine					0.1	20					0.1	30					0.2	40		
<i>Gonocarpus tetragynus</i>		Poverty Raspwort				0.3	30												0.1	20		
<i>Gonocarpus teucroides</i>		Germander Raspwort	0.3	2		0.1	3		0.1	2	1	25	0.1	2			0.3	15	0.2	10		
<i>Goodenia bellidifolia</i>						0.1	3															
<i>Goodenia ovata</i>		Hop Goodenia	7	50																		
<i>Grevillea speciosa</i>		Red Spider Flower							0.1	2												
<i>Hardenbergia violacea</i>		False Sarsaparilla				0.1	3															
<i>Hedycarya angustifolia</i>		Native Mulberry									2	20										
<i>Helichrysum elatum</i>																			0.2	1		
<i>Hibbertia empetrifolia</i>																	1	10	0.3	6		
<i>Hibbertia obtusifolia</i>		Hoary Guinea Flower				0.1	2															
<i>Hibbertia spp.</i>			0.1	4																		
<i>Hydrocotyle laxiflora</i>		Stinking Pennywort		5	10	1	50	3	200		0.2	20	3.3	220			1	200	2	100		
<i>Hydrocotyle sibthorpioides</i>											0.2	40										
<i>Hypericum gramineum</i>		Small St John's Wort		0.1	10	0.1	10												0.1	3		
<i>Hypericum spp.</i>								0.1	1													
<i>Hypochaeris glabra</i>	*	Smooth Catsear						0.1	5													
<i>Hypochaeris radicata</i>	*	Catsear		0.1	6	0.1	3			0.1	2			0.1	2							
<i>Indigofera australis</i>		Australian Indigo	1	10	0.1	1	3	10	0.1	2		0.1	2	1	4		0.5	5	0.2	5		

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Scientific Name	Exotic	Common Name	1 Cover	1 Abundance	2 Cover	2 Abundance	3 Cover	3 Abundance	4 Cover	4 Abundance	5 Cover	5 Abundance	6 Cover	6 Abundance	7 Cover	7 Abundance	8 Cover	8 Abundance	9 Cover	9 Abundance	10 Cover	10 Abundance
<i>Isolepis inundata</i>		Club-rush									4	200										
<i>Juncus spp.</i>									0.1	1												
<i>Lagenifera stipitata</i>		Blue Bottle-daisy			0.1	10	1	40	0.1	20		0.1	10	0.1	10			0.1	20	0.3	30	
<i>Lepidium spp.</i>			0.2	20	0.3	20	0.1	3														
<i>Lepidosperma laterale</i>		Variable Sword-sedge			0.1	1					0.2	3										
<i>Lepidosperma spp.</i>											0.4	15		0.2	10							
<i>Leptospermum morrisonii</i>									25	20								0.1	1	30	30	
<i>Leptospermum polygalifolium</i>		Tantoon									10	30		9	12							
<i>Leucopogon juniperinus</i>		Prickly Beard-heath												0.1	1							
<i>Leucopogon lanceolatus</i>									0.5	3				0.5	5			1	1	0.3	1	
<i>Lissanthe strigosa</i>		Peach Heath			0.2	5					0.1	1										
<i>Lomandra confertifolia</i>		Matrush					0.1	2				0.1	5									
<i>Lomandra longifolia</i>		Spiny-headed Mat-rush	4	30	10	20	20	90	4	30	1	6	2	15	4.2	20		4	100	3	30	
<i>Lomandra multiflora</i>		Many-flowered Mat-rush					0.2	10														
<i>Lomandra spp.</i>		Mat-rush									0.5	5										
<i>Marsdenia spp.</i>			0.1	1											0.1	2						
<i>Medicago spp.</i>	*				0.1	3																
<i>Microlaena stipoides</i>		Weeping Grass	10	200	30	20	1	50	2	100	0.2	10	2	100	5	140		7	1000	30	300	
<i>Notodanthonia longifolia</i>		Long-leaved									0.1	3					0.1	10				

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Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
		Wallaby Grass																				
<i>Opercularia hispida</i>		Hairy Stinkweed	0.1	2		0.1	3	0.3	20													
<i>Oplismenus aemulus</i>			0.1	4				0.1	10					3	100			5	750	5	200	
<i>Oplismenus imbecillis</i>											0.1	10										
<i>Oxalis spp.</i>																	0.1	20				
<i>Pandorea pandorana</i>		Wonga Wonga Vine	0.1	3																		
<i>Panicum spp.</i>		Panicum																		4	80	
<i>Persoonia linearis</i>		Narrow-leaved Geebung	0.1	2		0.1	2	1	2	0.7	2	0.1	4	0.1	2							
<i>Phyllanthus hirtellus</i>		Thyme Spurge	0.2	15																		
<i>Pimelea latifolia subsp. hirsuta</i>			0.1	1													1	15	0.2	2		
<i>Plantago debilis</i>		Shade Plantain			0.1	2	1	30														
<i>Platysace lanceolata</i>		Shrubby Platysace									0.1	1										
<i>Poa sieberiana</i>		Snowgrass						0.2	10								1	20				
<i>Poa spp.</i>				1	10	2	40															
<i>Poaceae indeterminate</i>	*	Grasses, reeds and bamboos								0.1	10											
<i>Podolobium ilicifolium</i>		Prickly Shaggy Pea				0.2	3															
<i>Polyscias sambucifolia</i>		Elderberry Panax									0.1	5	0.1	1								
<i>Pomaderris spp.</i>											25	30										
<i>Poranthera microphylla</i>		Small Poranthera		0.1	8	0.1	20	0.2	10		0.1	4	0.1	20								

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Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Prunella vulgaris</i>	*	Self-heal						0.1	5													
<i>Pteridium esculentum</i>		Bracken	3	60		1	10	999	999	1	10	3	20	1.1	22			2	30	3	20	
<i>Pyrrosia rupestris</i>		Rock Felt Fern									0.2	40										
<i>Rhytidosporum</i> spp.					0.2	20																
<i>Rosa rubiginosa</i>	*	Sweet Briar			0.1	1																
<i>Rubus fruticosus</i> sp. agg.	*	Blackberry complex			0.1	1																
<i>Rubus parvifolius</i>		Native Raspberry			0.1	2								0.7	30			0.1	3	0.1	8	
<i>Rytidosperma pallidum</i>		Redanther Wallaby Grass; Silvertop Wallaby Grass						0.2	5													
<i>Rytidosperma racemosum</i>		Wallaby Grass						0.1	5													
<i>Rytidosperma</i> spp.								0.5	20													
<i>Schoenus apogon</i>		Fluke Bogrush									0.1	15										
<i>Senecio diaschides</i>					0.1	10	0.1	4														
<i>Senecio jacobaea</i>	*	Ragwort			0.1	20	0.1	6	0.1	1												
<i>Senecio minimus</i>								1	25		0.1	5										
<i>Senecio quadridentatus</i>		Cotton Fireweed			0.1	2	0.1	6														
<i>Sigesbeckia orientalis</i>		Indian Weed	1	30	1	30																
<i>Solanum aviculare</i>		Kangaroo Apple			0.3	5																

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<i>Solanum brownii</i>		Violet Nightshade	0.5	8	0.2	20																
<i>Solanum nigrum</i>	*	Black-berry Nightshade			0.1	3																
<i>Solanum prinophyllum</i>		Forest Nightshade	0.1	10			0.1	3		0.1	5			0.1	5			0.1	20	0.1	3	
<i>Solanum stelligerum</i>		Devil's Needles						0.1	2													
<i>Sonchus spp.</i>		Sowthistle				0.1	1													0.1	1	
<i>Stellaria pungens</i>		Prickly Starwort				0.1	3						0.2	7			0.1	15				
<i>Stylidium graminifolium</i>		Grass Triggerplant							0.1	2												
<i>Styphelia triflora</i>		Pink Five-Corners				2	20	0.1	4	0.1	2											
<i>Teucrium spp.</i>																	1	50	0.1	8		
<i>Thysanotus juncifolius</i>						0.1	20															
<i>Todea barbara</i>		King Fern									0.4	5	1	6								
<i>Urtica incisa</i>		Stinging Nettle			0.1	3																
<i>Verbena bonariensis</i>	*	Purpletop			0.1	2																
<i>Vernonia cinerea</i>								0.1	5													
<i>Veronica plebeia</i>		Trailing Speedwell	0.2	20	0.1	10	0.1	3	0.1	5	0.1	1	0.1	5	0.1	8	0.1	50	0.1	7		
<i>Viola hederacea</i>		Ivy-leaved Violet	15	300		9	200	25	800	0.2	20			5	300					20	300	
<i>Viola sieberana</i>											0.2	40	1	60			5	1000				
<i>Vittadinia cuneata</i>						0.1	5															
<i>Wahlenbergia communis</i>		Tufted Bluebell						0.2	50											0.1	10	
<i>Wahlenbergia gracilis</i>		Sprawling Bluebell	0.1	4	0.1	3																

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Scientific Name	Exo tic	Common Name	1 Cover	1 Abun dance	2 Cover	2 Abun dance	3 Cover	3 Abun dance	4 Cover	4 Abun dance	5 Cover	5 Abun dance	6 Cover	6 Abun dance	7 Cover	7 Abun dance	8 Cover	8 Abun dance	9 Cover	9 Abun dance	10 Cover	10 Abun dance
<i>Wahlenbergia spp.</i>		Bluebell									0.1	2										
<i>Wahlenbergia stricta</i>		Tall Bluebell			0.1	20	0.2	30														
<i>Wilkiea spp.</i>															3	1				2		2
<i>Xylomelum pyriforme</i>		Woody Pear							0.3	999												

Appendix E

Photographs

Apx Table 5: Monitoring photographs for Facultative Ecosystems PCT 3731 (EX plots) and PCT 3495 (GDE plots)

EX01	
EX02	

EX03



EX04



EX05



GDE01



GDE02



GDE03



GDE04



GDE05



GDE06



GDE07



Apx Table 6: Baseline photographs of Genowlan Point *Allocasuarina nana* Heathland EEC and Woodland 20 x 20 m plots

GEN_PT_0
1



Start



End

GEN_PT_0
2



Start



End

Woodland_01



Start



End

Woodland_
02



Start



End

Woodland_03



Start



End

AIRLY EXTRACTION PLAN FOR THE CLIFF LINE ZONE ML1814 AND MW17-19 EXTRACTION PLAN AREA

Historical Heritage Management Plan Update & Phase 1 Baseline
Historical Heritage Assessment



PR152234-1
Version 1.0
14 December 2022

REPORT

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
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Approval for issue

S. Kennedy



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Glossary and Abbreviations

Term/Acronym	Definition
AA	Archaeological Assessment
AKO&M	Australian Kerosene Oil and Mineral Company
ASS	Australian Shale syndicate
CHL	Commonwealth Heritage List
COC	Commonwealth Oil Corporation
EP	Extraction Plan
GSC	Genowlan Shale Company
HHIMS	Historic Heritage Information Management System
HHMP	Historical heritage management plan
HLRV	Historical Land Records Viewer
LEP	Local Environment Plan
LithMer	Lithgow Mercury
ML	Mining Lease
NHL	National Heritage List
NSWS&O	New South Wales Shale and Oil
RNE	Register of the National Estate
SHR	State Heritage Register
SLNSW	State Library of New South Wales
SLV	State Library of Victoria
SydGaz	Sydney Gazette
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHL	World Heritage List

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1 INTRODUCTION

1.1 Background

RPS have been assisting Centennial Coal with the heritage management of the Airly Mine since 2013 and during this time have produced numerous documents regarding Aboriginal and Historical heritage and archaeology. In 2016 RPS produced an overarching Historical Heritage Management Plan (HHMP) for all of Centennial's Western Holdings which, in addition to Airly, includes Springvale Holdings, Western Coal Services, Lidsdale Siding, Angus Place Lease, Clarence Lease and Charbon (RPS, 2016). The purpose of the HHMP is to provide Centennial with a consistent approach to the identification, recording and management of historical heritage and ensure compliance with the *Heritage Act 1977 (NSW)*. Since its initial production in 2016, the HHMP has been updated once in November 2020.

In 2022 Centennial began planning for an extension to the Airly Mine to incorporate Cliff Line Zone ML1814 which was not assessed in the original HHMP, and the MW17-19 Extraction Plan, which was partially included. RPS were subsequently commissioned by Centennial to update the HHMP to incorporate these areas. This addendum to the HHMP has been written to record the process and results of the update to the HHMP for the new area. As part of this work, a Baseline Historical Heritage Assessment of the areas was also undertaken and is integrated in this document.

1.2 Study area

The study area is 5.5km long, 3.2km wide area located within the Lithgow LGA in the Central Tablelands of NSW on the western slopes of the Blue Mountains. It is largely within Muggi Murum-ban State Conservation Area on the north side of Glen Davis Road, around 8km east of Capertee. It is dominated by the mesa of Genowlan Mountain which is separated from the adjacent Mount Airly by Gap Creek. Genowlan Mountain is roughly 'Y' shaped with a central trunk measuring around 2.8 km long southwest to northeast. From the northeastern end, two arms branch off, a north to south ridge that runs for 3.1km and an east to west ridge which is around 3km long. The mesa is characterised by very steep cliffs on all sides. To the northeast of the Mountain is the headwaters of Emu Swamp Creek (Figure 1-1).

1.3 Methodology

This report documents the stages of work undertaken to update the HHMP for Airly Mine and a Historical Heritage Baseline Assessment of the areas.

For the HHMP to be updated to include the study area the following sections require additional information.

- Section 3 – Historic Heritage Context for Western Region
- Section 4 – Historic Heritage Sites within Western Region
- Section 5 – Historic Heritage Assessment

This document should be read as an addendum to the HHMP. Section 2 of this report provides further historical context for the study area and should be read in collaboration with Section 3 of the HHMP. Section 3 of this report is a Gap Analysis which seeks to identify if any historical heritage sites are within the study area. This analysis found no sites and as a result a field survey was undertaken to confirm these findings. This collectively address Section 4 of the HHMP. Section 4 of this report provides a Historical Heritage Baseline Assessment for the study area and updates Section 5 of the HHMP.

1.4 Authorship

This report was written by Dr Gary Marriner (Senior Heritage Consultant) who also undertook the field survey. Kristen Tola (Heritage Consultant) provided assistance with the background research and database searches, and Natalie Wood (Senior GIS Consultant) provided the figures. Susan Kennedy (Practice Leader, Heritage – NSW) has reviewed this report.

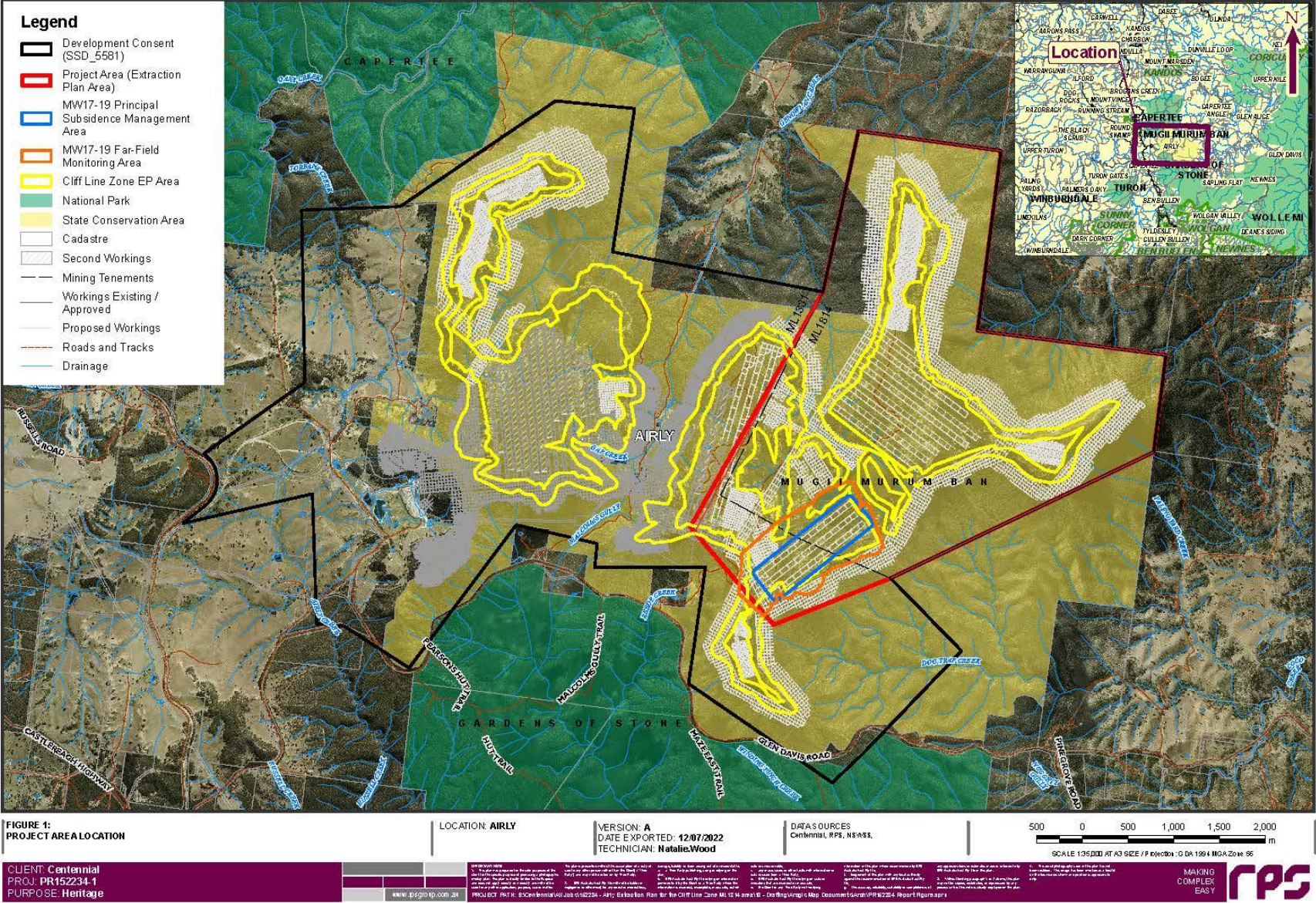


Figure 1-1: Location of the study area within the State Conservation area

2 HISTORICAL CONTEXT

2.1 Overview

A comprehensive historical context as already been produced for Airly (RPS, 2013). The following surmises that context with additional research salient to the specific study areas. The following summary is based on previously prepared histories.

The Aboriginal history of the area is extensive and complex and is not the focus of this document. The Aboriginal use and occupation of the Airly region is addressed in the broader 2013 report which should also be referred to.

2.2 Aboriginal history after 1788

The site is on the traditional lands of the Dharuk People who were known to be specialist toolmakers. the first recorded contact between the Dharuk people and British colonialists occurred in 1791 when Governor Philip led a part to the Hawksbury River. By the mid 1790s British settlement of the Hawksbury began to put pressure on the food supplies of the Dharuk people. Initial exploration into the Blue Mountains by Barrallier in 1802 observed Aboriginal people in the Wollondilly Valley (RPS 2013).

2.3 Early explorations

European presence in the region around Airly commenced in 1821 when James Blackman travelled from Wallerawang towards Mudgee. Blackman was one of ten farms selected by Governor Macquarie to settle the Bathurst area in 1818 where he was granted 50 acres of farmland and a town lot of two acres. His 1821 journey saw his team travel from Bathurst to Burrundulla Swamps, south of Mudgee via the Cudgegong River (Greaves, 1966). This route would have taken him in the vicinity of Capertee, west of Airly. Blackman continued to explore the area into 1822 along with William Lawson (Selkirk, 1920).

By the 1820s Sir John Jamison had amassed 18,000 acres of land in the area around Capertee which was one of his numerous estates (Lawrence and Davies, 2011 p. 122). Jamison came to NSW in 1814, having inherited land from his father, Thomas Jamison, the surgeon of the First Fleet. Over the ensuing decades Jamison became one of the largest landowners in the colony and was a well-known public figure, constitutional reformer, and member of the Legislative Council from 1837 to 1843 (Walsh, 1967). He was a two time, and inaugural, President of the Agricultural Society of New South Wales, and at one point considered to be the second wealthiest person in the colony (Connah, 1986). He used his land at Capertee, which he named Capita, as a horse farm (Binney, 2005 p.116). In 1829 Capertee was used as a named place for the demarcation of county boundaries, with it being included within the County of Roxburgh at this time (SydGaz 17 Oct 1829).

The discovery of gold in 1851 drastically changed the fortunes of Capertee and the surrounding area which by 1883 had a railway, school, and police station. This growth was further enhanced by the discover of coal, limestone, and oil shale in the 1870s. It was during the boom period in the late 19th century that Airly was established as a satellite settlement of Capertee (SMH 08 Feb 2004).

2.4 Mining

One of the earliest European settlers into the Airly region was James Galagher who took up a selection at Round Swamp in 1842 (Galagher, 2010). In 1854 he purchased 50 acres at Airly Flat, where he built a slab hut and in the ensuing years, he purchased land at Excelsior and also Meadow Flat. Once established, James Galagher built two substantial houses, Airly House and Wallah Tappee (Galagher, 2010 p.10).

In 1883 the first Oil shale seams at Airly were identified by S. Nicholson and J. Larkin who, along with J. Connel, P. Wallace and R. Fryer took out a lease on the southern portion of the area. They were unable to meet the labour conditions for the site however and the lease lapsed around 1888. The area was split into separate mines: Genowlan to the south, Airly/New Hartley to the north, and King's Mine. The village of Airly was nestled approximately between the mines.

Following the failure of the initial lease, the Genowlan mine was taken up by a German syndicate known as the Genowlan Shale Company (GSC) who began exporting immediately. It was during this lease, in 1884,

that a private railway line was built right across Galagher's Airly property connecting the newly discovered oil shale deposits with Torbane Rail Siding and on to the main Mudgee railway line (Galagher, 2010 p.12). Financial difficulties in 1894 led to the largest shareholder in GSC, Andrew Anderson, forming a new company, the Australian Shale syndicate (ASS) which subsequently purchased the mine. The ASS controlled the lease until 1896 when it was contracted out to the Australian Kerosene Oil and Mineral Company (AKO&M). AKO&M had extensive experience in mining shale having run the Joadja mine (Jack, 1995) and were offered purchase on the mine, however they declined indicating it may not have been sufficiently lucrative (Mills, 1998).

The King's mine lease was taken up by Francis William King, and his brother, R.J. King in 1893 who were able to produce a moderate output of shale for export. The continued to work the mine until 1896 at which time it was taken over by New South Wales Shale and Oil (NSWS&O). the NSWS&O also took over the Airly/New Hartley mine at this time having exhausted the resource at Hartley Vale (Rigby, 2004). They renamed the mine New Hartley and commenced production under manager William Hall. Accessibility issues led to significant infrastructure being constructed to link the mine to the government railway at Torbane Station. This consisted of a light rail that went through a tunnel which was completed in 1898. A telephone line was installed alongside the rail to facilitate communications (Mills, 1998). The mine was subsequently acquired by the Commonwealth Oil Corporation in 1906.

2.5 Airly Village

Airly Village was surveyed on 28th June 1897 by James Dawson and officially proclaimed On the 4th of September 1897. As demonstrated on parish maps of the time, the planned village consisted of a central street – Tramway Avenue – than ran north to south or around 500m with Hill Street running parallel to the west, and Genowlan Street and then Cliff Street parallel to the east. Short Street, Ilford Street and South Street linked these.

Although some buildings were constructed on the planned subdivision including the school, church and post office, many of the residents lived beyond the planned village closer to their work areas and wherever level ground could be found or created (Rigby, 2004). The propensity towards ignoring the formalised settlement was related to the cost of construction and the location of usable water supplies. In June 1898 it was commented, "...The people do not seem disposed to settle in the prescribed area...another drawback in the surveyed township is the absence of good water" (*LithMer* 24 Jun 1898)

Typical dwellings ranged from freestanding sandstone huts to cave houses which utilised the natural sandstone overhangs supplemented with dry stone walls and other materials. Many of the dwellings would have been very makeshift in nature with clay or dirt floors and constructed from materials which could be easily and cheaply obtained and reused. This included bark, galvanised iron, wattle and daub and brattice cloth. Building materials would have been carried into the remote mountain location, presumably in many cases reused from previous use on another mine site and in turn, everything that could be taken would have been moved on to the next site.

2.6 Decline of mining

The early 20th century saw numerous industrial disputes as prices for shale fluctuated and resources dwindled. The mine workers at both the New Hartley and Genowlan mines formed a combined union in August 1900 and affiliated it with the Federal Labour Association of Australia. This unionisation occurred during a period of sustained economic depression in Australia when the demand for oil shale fell, prices became unstable and the demands of mine managers upon the workforce became increasingly impractical (Rigby, 2004). The first major strike occurred in September 1900 with demand for an 8-hour day. The miners' demands were met reasonably easily; however, the subsequent reduction in working hours led to a reduction in wages such that the miners were forced to request that the manager increase the hewing rate (Mead, 1986). The request was declined by the A.K.O&M board, and during October 1900 at least a quarter of the workforce left because they were not earning a living wage. A new rate was finally agreed in mid-November 1900. Further strikes occurred over pay and working conditions through the early years of the 20th century including at New Hartley in July 1902 where a 21 week strike took place over hewing rates and another 5 week strike in 1906.

Disputes over pay and conditions continued at New Hartley mine from 1904 to 1907 with a five week strike in 1906 leading to an agreed increase in the hewing rate. Negotiations to reach this agreement were made

difficult by the fact that local managers now had to refer to the new London-based directors of the Commonwealth Oil Corporation (COC) for all major decisions.

In 1907, with a marked increase in share prices, the miners requested a 25% increase in the hewing rate, which was refused by COC, which again led to strike action. At least sixty men saw the strike through, receiving support from unionists throughout the state. The strike was eventually ended on the 16th of May 1908 by a specially established Arbitration Court that met at Torbane. The judgment favoured the miners and the strike eventually contribute to the implementation of the *Industrial Disputes Act 1908*. The settlement led to a three-year deal between miners and management which was honoured by both parties with no further action after 1908. It has been argued (Mead, 1986) that the continual process of strikes and concessions over the first decade of the 20th century was a deliberate management strategy by companies to prevent over mining of the resources. With Mead noting that rather than laying off staff to reduce production and risk skill workers leaving “A carefully created and orchestrated strike, such as the lockout of June to December, 1902 and the pay renegotiation of 1907, would have been a much more satisfactory way of running down reserves”. (Mead *ibid* p.393).

In June 1912 the COC announced their plan to close New Hartley and after it went into liquidation in 1913 its mining interests in the area were purchased by Commonwealth Oil Federation (COF) (Mills, 1998). COF ran the mines for a few years; apparent exhaustion of the resource led to the pit being closed entirely in 1918 (Simpson, 1982).

3 GAP ANALYSIS

3.1 Introduction

The aim of this gap analysis is to identify if any historical sites are known within the study area and indicate areas where historical sites and archaeological deposits may be located. It includes a search of all relevant Local, State, Federal and World registers and databases, an overview of previous heritage and archaeological research undertaken for the study area and surrounding environment, and an analysis of historical plans including maps and photographs.

3.2 Listed Sites

Multiple registers and lists exist for items of historical heritage in Australia. The following databases and registers were searched to identify statutory and non-statutory heritage items within and adjacent to the study area. In some instances, the same heritage item, place, or complex is registered on multiple registers. The listed sites in proximity to the study area are shown in Figure 3-1.

3.2.1 UNESCO World heritage list

The study area is not within any UNESCO World heritage listed site. It is adjacent to Greater Blue Mountains Area (WHL 917).

3.2.2 Environment Protection and Biodiversity Conservation Act (Cth) 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the principal environmental Act at a Commonwealth level. It provides for the protection and management of nine matters of national environmental significance as defined in the EPBC Act. Matters of national environmental significance include but are not limited to flora, fauna, ecological communities, and heritage places of national and international importance.

In addition, the EPBC Act applies to actions with a significant impact on the environment where the actions affect, or are taken on, Commonwealth land, or are carried out by a Commonwealth agency (even if that significant impact is not on one of the nine matters of 'national environmental significance').

The EPBC Act requires approval from the Minister for actions with a significant impact on places included on the National Heritage List (NHL) or Commonwealth Heritage List (CHL).

3.2.2.1 National Heritage List

The National Heritage List was established under the EPBC Act to protect places of outstanding significance to Australia.

The study area is within one area currently listed as being an 'Area under assessment' on the NHL (Table 3-1:).

Table 3-1: NHL listed sites that relate to the study area.

Name	Class	Legal Status	Place ID	Place File Number
<i>The Greater Blue Mountains Area – Additional Values</i>	Natural	Nominated Place	105696	1/14/006/0061

3.2.2.2 Commonwealth Heritage List

The Commonwealth Heritage List was established under the EPBC Act to protect places owned and managed by Commonwealth agencies.

There are no items on the CHL within or adjacent to the study area.

3.2.3 Register of the National Estate

The Register of the National Estate (RNE) was originally established under the *Australian Heritage Commission Act 1975* (repealed). In 1997 the Council of Australian Governments agreed that heritage listing, and protection should be the responsibility of the level of government best placed to deliver agreed outcomes. It was agreed that the Commonwealth's involvement in environmental matters should focus on matters of national environmental significance, including World Heritage properties and places of national significance. Each state, territory and local government has a similar responsibility for its own heritage.

The expiration or repeal of parts of the EPBC Act and the *Australian Heritage Council Act 2003* relating to the RNE does not diminish protection of Commonwealth heritage places. Places listed on the Commonwealth Heritage Register remain protected under the EPBC Act. The RNE is now an archive of information about more than 13,000 places throughout Australia.

The study area is within the items in Table 3-2. An indicative place is not considered to be on the RNE, but its details have been entered into the register. As the RNE is now a non-statutory archive of places, there is no process for the item to be added to the register.

Table 3-2: RNE listed sites that relate to the study area

Name	Class	Legal Status	Place ID	Place File Number
<i>The Pagoda Country</i>	<i>Natural</i>	Indicative Place	18258	1/07/232/0033

3.2.4 Heritage Act 1977 (NSW)

The NSW *Heritage Act 1977* (the Heritage Act) is the principal Act for the management of NSW's environmental heritage. It establishes the State Heritage Register (SHR) and includes provisions for Interim Heritage Orders, Orders to Stop Work and archaeological relics (both on land and underwater within the limits of the State). It also requires government agencies to maintain a Heritage and Conservation Register.

To assist management of NSW's environmental heritage, the Heritage Act distinguishes between assets of State and local significance:

- State significance refers to significance to the state in relation to the historical, archaeological, architectural, cultural, social, natural or aesthetic value of an item
- local significance refers to significance to an area in relation to the historical, archaeological, architectural, cultural, social, natural or aesthetic value of an item.

3.2.4.1 NSW State Heritage Register

Section 31 of the Heritage Act requires the Heritage Council to keep the SHR. The SHR identifies places and objects of importance to the whole of NSW.

There are no items on the SHR in or adjacent to the present study area.

3.2.4.2 HHIMS s170 register National Parks

Section 170 of the Heritage Act requires government agencies to establish a Heritage and Conservation Register that identifies all assets of environmental heritage that it owns or occupies. Government agencies are required to provide the NSW Heritage Council notice of any intention to remove an asset from a Section 170 Heritage and Conservation Register, transfer ownership of an asset included on a Section 170 Heritage and Conservation Register, cease to occupy an asset on a Section 170 Heritage and Conservation Register or demolish an item included on a Section 170 Heritage and Conservation Register and assets must be maintained with due diligence in accordance with the *State Agency Heritage Guide* (Heritage Council 2005).

REPORT

NSW National Parks & Wildlife Service maintains s170 Register information in the Historic Heritage Information Management System (HHIMS). This is a database that contains records for heritage sites and items that exist on the New South Wales national parks system. HHIMS replaced the previous NSW National Parks and Wildlife Service Historic Places Register in August 2002.

The items in Table 3-3 are adjacent to the study area. There are no items on the National Parks s170 register within the present study area.

Table 3-3: HHIMS s170 listed sites adjacent the study area

Item	State Heritage Inventory ID	Item name	Item type
12421	3917651	Airly Village Ruins	Complex
13455	3917573	Bakery; Airly Village	Element
13456	3917574	Site of Church; Airly Village	Element
13457	3917575	Spring Shaft and Stone House; Airly Village	Element
13458	3917576	Big Rock Cave Dwellings; Airly Village	Element
13459	3917577	Potts Point Dwelling Precinct; Airly Village	Element
13461	3917579	Magazine, Spring and Stone Cave Dwelling; Airly Village	Element
13462	3917580	Stone Dwelling Precinct; Airly Village	Element
13463	3917581	Gorrms House; Airly Village	Element
13464	3917582	Skipway, stone retaining wall; Airly Village	Element
13465	3917583	Martins Tunnel, ventilation tunnel and Chimney; Airly Village	Element
13466	3917584	Ventilation Chimney; Airly Village	Element
13467	3917585	Boiler and winding house; Airly Village	Element
13468	3917586	Flying Fox Ropeway; Airly Village	Element
13469	3917587	Ventilation shaft, dwelling, skipway; Airly Village	Element

3.2.5 Lithgow Local Environmental Plan 2014

The *Lithgow Local Environmental Plan (LEP) 2014* sets out various planning, development and environmental controls for the Local Government Area (LGA) of Lithgow. Schedule 5 of the LEP identifies heritage items important to the LGA. The LEP differentiates between Heritage Items, Heritage conservation areas and Archaeological sites (Table 3-4).

REPORT

There are no Heritage Items, Heritage conservation areas or Archaeological sites listed on the Lithgow LEP within the study area. The items in Table 3-4 are archaeological sites adjacent to the study area.

Table 3-4: Lithgow LEP 2014 listed sites that relate to the study area

Locality	LEP Site name	Significance	LEP Item No.
Airly	<i>Airly Bakery</i>	Local	A149
Airly	<i>Airly Big Rock Cave Dwellings</i>	Local	A148
Airly	<i>Airly, Torbane and Genowlan oil shale sites</i>	Local	A144
Airly	<i>Airly Township and Mines Group</i>	Local	A145
Airly	<i>Airly Village Church site</i>	Local	A146
Airly	<i>Boiler and winding house</i>	Local	A158
Airly	<i>Flying Fox rope way</i>	Local	A159
Airly	<i>Gorrms House</i>	Local	A155
Airly	<i>Magazine, spring, stone cave dwelling</i>	Local	A152
Airly	<i>Managers Residence</i>	Local	A151
Airly	<i>Martins Tunnel, ventilation tunnel and chimney</i>	Local	A156
Airly	<i>Potts Point Dwelling Complex</i>	Local	A150
Airly	<i>Skipway, stone retaining wall</i>	Local	A154
Airly	<i>Spring shaft and stone house</i>	Local	A147
Airly	<i>Stone dwelling complex</i>	Local	A153
Airly	<i>Torbane railway cutting</i>	Local	A161
Airly	<i>Torbane retort complex</i>	Local	A162
Airly	<i>Ventilation chimney</i>	Local	A157
Airly	<i>Ventilation shaft, dwelling, skipway</i>	Local	A160

3.2.6 Summary

Analysis of all statutory and non-statutory lists show that at present there are no listed heritage sites or archaeological areas within the study area, however the study area includes part one item currently under assessment for inclusion on the NHL.

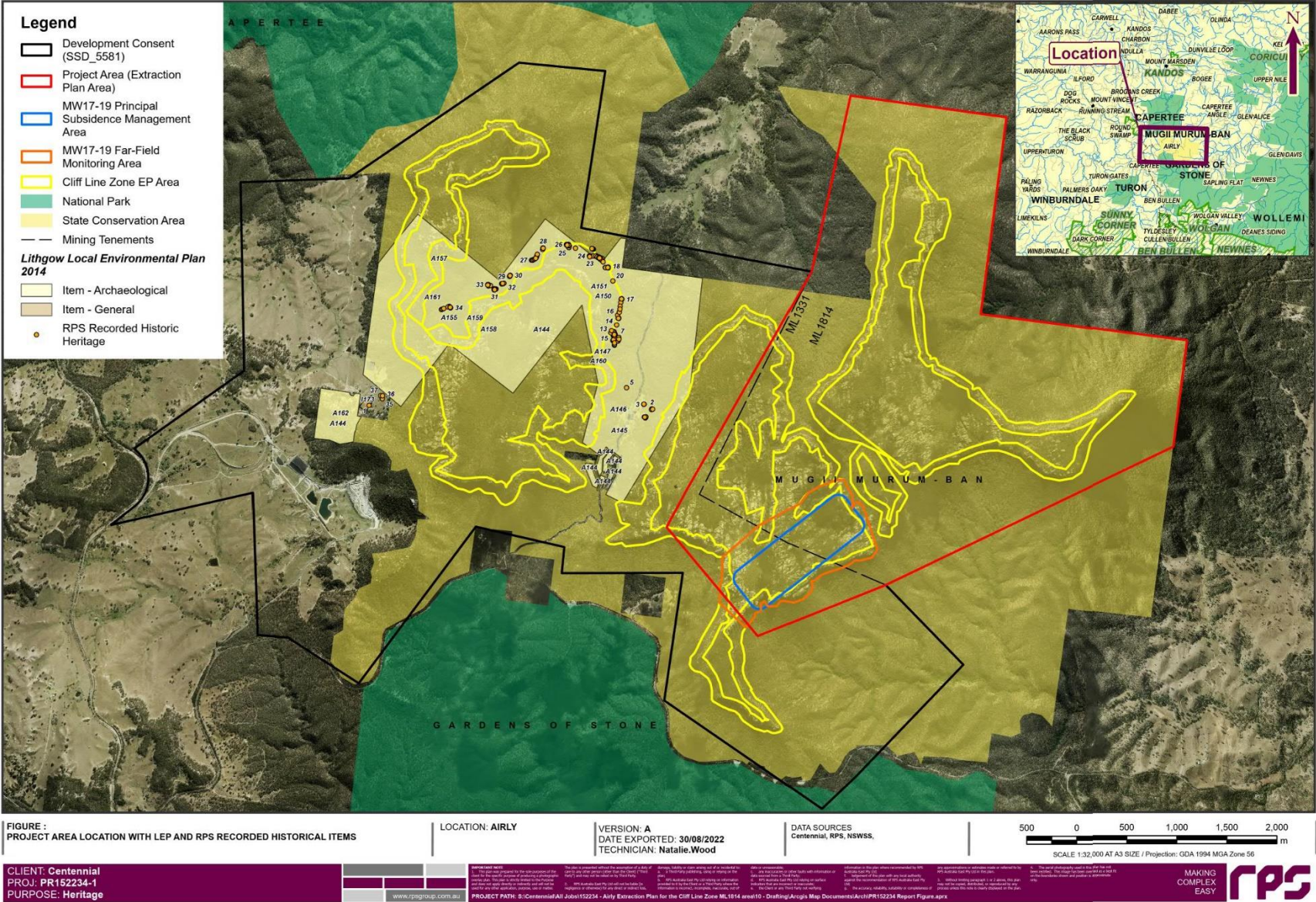


Figure 3-1: All listed historical heritage sites in relation to the study area

3.3 Previous Reports

3.3.1 Mugii Murum-ban State Conservation Area Draft Plan of Management, NSW National Parks and Wildlife Service, September 2015

Much of the study area falls within the Mugii Murum-ban State Conservation Area which covers a total of 3650 Hectares bounded by Glen Davis Road, the Gardens of Stone National Park and Capertee National Park. NSW NPWS produced a Plan of Management for the Area in 2015 (NSW National Parks and Wildlife Service, 2015). The historical background and discussion of historical heritage value within this report focuses on the Oil Shale mining industry and Airly Village west of the study area. It does also indicate that the Ribaux family mined for gold and diamonds on the Genowlan mesa which is within the present area. Many of the tracks established by the Ribaux family remain in use to the present day.

This indicates that if the Ribaux families mining operations included areas within the present study area they are likely to be along these established tracks.

3.3.2 Baseline Historic Heritage Assessment – Airly Mine, Capertee, RPS, 2013.

In 2013 a baseline heritage assessment was conducted for the Airly shale mining complex in order to identify evidence of historic mining activity at Mount Airly and Torbane (RPS, 2013).

The survey identified a total of 37 sites forming the Airly shale mining complex with remains comprising working areas, habitation sites and transportation systems.

The Airly shale mining complex was assessed against the NSW heritage significance criteria and in line with the Burra Charter. The assessment concluded the complex is of local significance based upon the 2013 research and investigations of the area.

This complex is well documented in historical records and is located west of the present study area. It is assessed as being of local significance.

3.3.3 Airly Mine Extension Project, Cultural Heritage Impact Assessment, RPS 2014

This extensive assessment covered both Aboriginal Cultural Heritage and Historical heritage items across the entire of the ML1331 and ML1814 areas (RPS, 2014). As part of this assessment survey was carried out for Aboriginal heritage within the ML1814 and MW17-19 area. Although not specifically targeting historical items, were they located by the team they were noted. Table 3-5 provides the conditions and results of this survey. No items of historical heritage were identified during this survey. Likewise, no items of Aboriginal heritage were identified within the present study area during this survey, although items outside of the present study area but within the survey units were identified and recorded at that time.

Table 3-5: Summary of the results of the relevant 2012 survey units

Survey Unit (SU)	Location	Landform/s	Visibility - ground surface exposure	Aboriginal Archaeology	Historical Archaeology
8A	steep slopes and gullies near pit top/ admin area	steep slope and associated gullies	Not recorded	Y	N

REPORT

Survey Unit (SU)	Location	Landform/s	Visibility - ground surface exposure	Aboriginal Archaeology	Historical Archaeology
12A	Grotto and carpark; tracks from Nissen hut to lookout (Chennas)	upper, mid and lower slopes, but mostly undulating slopes in drainage lines between pagodas of Mt Genowlan, west through the grotto to the northern portion	Not recorded	Y	N
13A	near Genowlan trig point; along ridgeline, sandstone pagodas and steep cliffs	difficult terrain	Low - due to fog	N	N
14A	lower, mid & upper slopes SE of Nissen hut	sandstone pagodas, steep	20%-30%	N	N
16A	short track taken through the grotto to NE side & continue NE from track	Not recorded	Very low	N	N
17A	existing access track along creek	creek, surrounded by outcrops and pinnacles	60%-80%	N	N
27A	forest flats E of SUB1	Top crest area to 1000m elevation, E on Genowlan	Low	Y	N
28A	Eastern arm of Mt Genowlan - elevation 940m	Eroded sandstone formation with iron leeching noted; undulating landform	0-5% to 80% in clearings (low, heavy leaf litter) - low-medium GS exposure	N	N
1B	From crest, walked in SE direction towards SS pagodas at 950m elevation	Heavily eroded pagodas	Poor - leaf litter	N	N
2B	North arm of plateau, followed track along Mterod sandstone Genowlan to point	large extensive complex of eroded sandstone	GSV-90% on road; 0-5% due to low shrubs GSE-limited to road	N	N
3B	view of sandstone overhang & from lookout	rock shelter with depth of shelter floor 80-20cm	0-10% in areas of dense vegetation; 80-95% in exposed sandstone areas	N	N
4B	Steep hills, cave area,	Sandstone outcrops, cave area,	GSV- 90%(track); 0-5%(vegetated areas)	N	N

Survey Unit (SU)	Location	Landform/s	Visibility - ground surface exposure	Aboriginal Archaeology	Historical Archaeology
5B	Base of Chennas lookout	High rising sandstone cliffs	0-2%	N	N
6B	East facing toward rock cavity near drainage line	steep hills and dense shrubs; two overhangs	GSE-limited due to pagodas; GSV-poor due to dense fern/leaf litter	N	N
7B	Large track cavity with water source - NW facing	sloped floor and water source	Not recorded	N	N

3.3.4 Historic Heritage management Plan for Cliff Line Zone of First Workings Extraction Plan within ML1331 – Airly Mine RPS, 2017

A Historic Heritage Management Plan (HHMP) for the inclusion in the Airly Mine Extraction Plan (EP) for the Cliff Line Zone of First Workings was produced in 2017 (RPS, 2017). Twelve (12) historic heritage items were identified within the EP area.

Cliff Line Zone consists of first workings only comprising roadways and cut-throughs for mine development and are considered long term stable and therefore monitoring was not deemed a requirement for these works. This work relates to the items identified in the 2013 Baseline Assessment

3.3.5 Historic Heritage management Plan (EP-HHMP) for the Splitting and Quartering Extraction Plan (ML1331), RPS, 2018

A HHMP was produced in 2018 for the Splitting and Quartering (SQ) area within ML1331 at Airly . Four items of historic heritage were identified within the SQ area (Site 1, Site 2, Site 31 and Site 33), these sites were originally recorded in the 2013 report. Recommendations were for three of these items, Site 1, Site 2 and Site 31 are to undergo phased monitoring under the Centennial's Western Region HHMP.

3.3.6 Archaeological Assessment and Baseline Recording of Sites 1, 2 ,3 and 4 at Airly Village RPS, 2019

In December 2018, a baseline recording and groundtruthing of four items (Site 1, Site 2, Site 3 and Site 4) was conducted under Centennial's Western Region HHMP . The four sites were originally recorded during the 2013 historic heritage assessment. The inspection confirmed the location of these four sites and conducted a full recording including photogrammetry and survey points.

3.3.7 Summary

Review of previous reports that relate to the region including the study area indicate that there are no known areas of historical heritage within the study area. Survey undertaken in 2013 (RPS 2014) visited the area and no sites were noted. That said, this survey was expressly for the purposes of locating Aboriginal sites.

The review does provide an indication of the types of historically significant activities that occurred in the wider vicinity and a suggestion of what the physical remains of shale mining activities would look like. The evidence relating to shale mining activity at Airly mine has been established as being locally significant.

3.4 Historical Imagery

3.4.1 Parish Maps

The study area falls within the Parish of Morundurey, County of Roxburgh (Figure 3-2). The earliest Parish Map located that includes the study area was created in 1894. At this time the area of Genowlan Mountain had been divided into Mining Permit areas largely of 640 acres and applied for under Section 28 of the 1874 mining Act. The plan provides a snapshot of some of the people who had interest in mining the area at the time. The numerous issuing and cancelling of permits likely relates to the relative difficulty individuals would have in accessing and exploiting the land (Table 3-6). The 1902 Parish Map shows the same divisions but lists far fewer applicants with only W.M. Hall making an application for MP3, MP4 and MP5 all of which were cancelled on the 30th of June 1905. An area of 1086 acres at the head of Emu Swamp Creek is shown as being demarked as a Crown Lease Area on the 14th of January 1914, valued at £543, and leased to Robert Hardy for a rent of £6 15s 9d. This included small parts of MP7 and MP8. The area west of Genowlan Mountain was also demarked and leased to John Galagher. This included most of MP11 and a part MP7 and MP3. Robert Hardy is shown as still being in possession of his land on the 1916 Parish Map but Galagher's land is in the possession of Christopher Bottrell at this time and has been demarked as Crown Lease Area 2658 listed as being 1011 acres. At some time between 1902 and 1916 many of the 'Mining Permit' areas were reclassified as 'Mineral Leases', with MP7 becoming ML5 and MP8 becoming ML4. The 1931 Parish Map shows Bottrell and Hardy both still in possession of their grants, as does the 1953 Parish Map. This later map also shows Col Ribaux in possession of MP4.

Research into the various grant holders was undertaken to establish whether any could be considered persons of historical significance. No individuals are likely to be so.

J.E. Tonkin is likely to be James Ebenezer Tonkin (1835 - 1906) who was the Alderman of Bathurst from c.1879 and served as Member of the NSW Legislative Assembly for East Macquarie from 1887 to 1895. In 1894, Tonkin and Patrick Joseph Dorahy founded the Giandarra Gold-mining company along with John Robyns, with the company successfully mining for gold at Kiandra, Kosciuszko.

In May 1896 James Ebenezer Tonkin of Sydney with Patrick Joseph Dorahy and John Robyns of Kiandra, were registered as the owners of a 15-year lease over GL31 (Lease 518), GL34 (Lease 519), GL37 (Lease 520) and GL38 (Lease 521), Parish of Kiandra. Operations are recorded as commencing with two men from mid-June. (Registered Leases #517-521, Mines Dept)

Col Ribaux was interviewed as part of the Baseline Historic Heritage Assessment (RPS 2013) for Airly Mine. He used his grant to mine for diamonds without the use of major mine infrastructure

Table 3-6: Summary of mining grants given for some parcels of land within the study area. Information taken from Parish Maps.

Area	Size	Grants		
MP 1	640a	J.E. Tonkin 29/12/1896, cancelled 18/01/1898	P.J. Dorahy 22/01/1898, cancelled 29/07/1898	G. Anderson 29/07/1898, cancelled 20/10/1899
MP 3	640	Walter L. Younger, 27/02/1895, cancelled 10/01/1896	L.D Younger, 04/01/1896, cancelled 11/09/1896	
MP 4	640	Walter L. Younger, 27/02/1895, cancelled 10/01/1896	L.D Younger, 04/01/1896, cancelled 11/09/1896	
MP 5	640	James E. Tonkin, 03/06/1896, cancelled 08/12/1896		

Area	Size	Grants	
MP 7	640	Walter L. Younger, 27/02/1895, cancelled 10/01/1896	L.D Younger, 04/01/1896, cancelled 11/09/1896
MP 8	640a	John Marden, 29/04/1895, cancelled 10/01/1896	Jas Foley 03/08/1897, cancelled 20/010/1899
MP 9	640a	Jas Foley 03/08/1897, cancelled 20/010/1899	

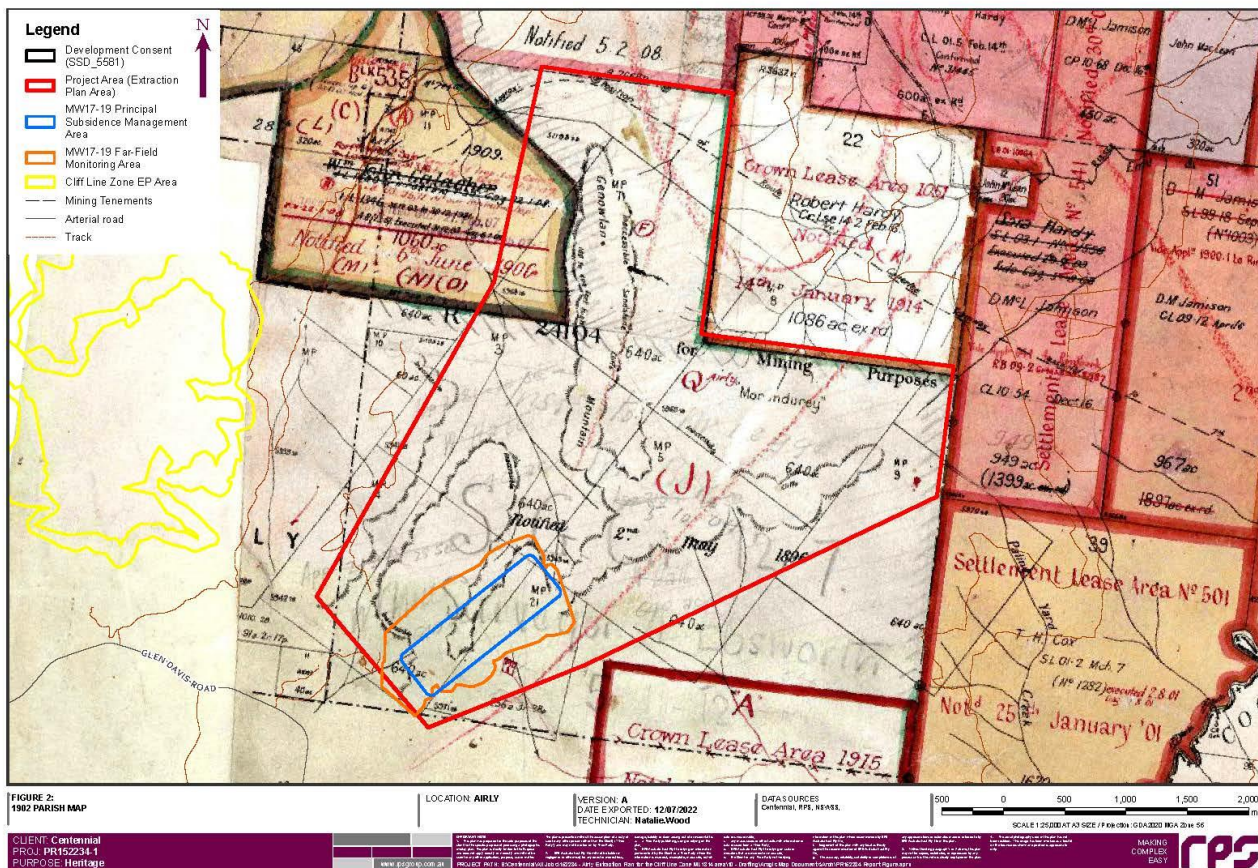


Figure 3-2: Extract from the 1902 Parish Maps showing the mining grants divisions discussed in Table 3-6 at that time. HLRV, Parish of Morundurey, Historical Parish Maps, Sheet ref 1, Ed. 2, 11297601.jp2

3.4.2 Geological Maps

A geological map, produced in 1900 for the Department of Mines and Agriculture prominently features Genowlan Mountain and demonstrates well the inhospitable and rugged nature of the terrain as well as clearly demonstrating the location of each Mining Permit Area (Figure 3-3). There is no indication of any sites of historical heritage within the study area.



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Figure 3-4 shows a bush hut, nicknamed the Genowlan Hotel. The photograph was taken by John Henry Harvey, an industrious architect and amateur photographer. The structure shown is single-story with a gable roof and is primarily constructed of wood with a plastered front wall. The front and rear of the structure both have a basic verandah with wooden posts supporting the extending roof. The roof is primarily timber shingles with possible corrugated iron at one end. The end with iron roofing also features a chimney which has been plastered. The front wall of the structure has two doorways and three windows, two of which are glazed 12-panelled sash windows. The photograph provides an indication of the kinds of habitation used by the inhabitants of the area. Remaining evidence of structures similar to this would include posts, collapsed walls with areas of plaster, glass and iron sheeting.



Figure 3-4: A bush hut (Genowlan Hotel) Capertee Valley N.S.W. SLV, H91.300/478

3.4.4 Summary

Analysis of the Parish maps confirms that the area was desirable for mining purposes and that numerous individuals were in possession of mining leases. None of these individuals are figures of historical significance and the parish maps do not provide any indication of items of historical heritage in the study area.

The study area was demarked into various areas and leased as mining permits throughout the later 19th and early 20th century, which raises the possibility of occupation and use of the land during this period which may have generated an archaeological resource that meets the threshold of significance. No visual evidence of the kinds of activity undertaken has been located within the study area.

3.5 Conclusions

The study area is:

- **Included** in one are currently being assessed for inclusion on the *National Heritage List* (The Greater Blue Mountains Area – Additional Values, Place ID 105696)
- **Listed** as an Indicative Place on the *Register of the National Estate* (The Pagoda Country Place ID 18258)
- **Adjacent** to a number of other sited sites including those on the National Parks s170 Register, Lithgow LEP 2014, and the UNESCO WHL.

Previous studies in the vicinity of the study area have demonstrated that there is considerable material culture relating to shale mining practices in the wider area. This includes the 37 sites that form the Airly Shale mining complex and Torbane. The Ribaux family continued to mine the area into the late 20th century.

Analysis of historical imagery demonstrates that much of the study area was divided into individual mining grants under Section 28 of the *Mining Act 1874*. These grants were held by various individuals throughout the late 19th and early 20th centuries.

None of the people identified are of historical significance. No indication of any activities that may have left archaeological evidence have been located in the historical imagery

4 HISTORICAL HERITAGE BASELINE ASSESSMENT

4.1 Archaeological Potential

Archaeological potential is an assessment of how likely it is for evidence of past activity to have survived into the present day considering the whole life history of a site including recent impacts. It is not an appraisal of the significance of any potential evidence, although it does have implications for significance. The assessment of potential for the project was informed by reviewing historical land use (Section 2) and an investigation of sites in the vicinity (Section 3). Several assumptions and principles were used to assess historical archaeological potential.

Two key questions inform all assessments of archaeological potential:

- has the area been used in the past in such a way that will have left a recognisable archaeological resource?
- have subsequent activities on the site removed any or all traces of these past activities?

This assessment assumes that structural evidence such as postholes, wall footings, pads, wells, cisterns, and cesspits etc. that can be identified on historical plans and in historical images, are likely to survive in the ground if no later activity has impacted upon them. The interrogation of this assumption primarily relies on examining the history of the site as a guide to how it has been used over time. It also assumes that later phases of landscape use are likely to have impacted on previous evidence including the possibility of total removal. This includes, but is not limited to, the erection of buildings that have foundations, the excavation of basements, and trenching for utilities. When available, the blueprints of existing or previously constructed buildings can be consulted. Where possible, the present-day site can also be visited to provide further information not recorded in more formal documents.

The assessment also recognised that many landscape features may not be recorded in any formal or informal way. This means they may not appear in the historic record in general. Additionally, when features are marked on plans or maps it may only be indicative and not a precise representation of the form of the feature. This may include:

- plough marks and other associated early farming features
- cesspits, wells, cisterns, rubbish pits and other dug features
- fence-lines, channels, gullies, and other landscape markers
- paths, gardens, orchards, vines, yards, and other external features.

These features are archaeological evidence in themselves and can help to preserve other kinds of archaeological data. This includes pollen and macrofossils within plough marks and cesspits, as well as artefacts within wells and rubbish pits.

The potential of the site is graded according to the levels outlined in Table 4-1.

Table 4-1: Grades of archaeological potential used in this assessment

Grade of Potential	Events that determine grading
Nil	Past activity left no discernible impact on the landscape and caused practically no material culture to be deposited Later activity has removed wholesale any indication of previous use of the site There is no indication in historical accounts of activity at the site.
Low	Past activity left only minor impacts to the landscape and only minimal amounts of material culture to be deposited, Later activity has caused widespread damage to the archaeological resource Historical accounts indicate activity in the general area but are unclear or imprecise.
Medium	Past activity left a moderate impact on the landscape and caused some material culture to be deposited

Grade of Potential	Events that determine grading
	Later activity has impacted the landscape but in isolated areas or to depths that have only removed some of the resource Historical accounts provide some precision and clarity on the activity undertaken at the site.
High	Past activity left a large impact on the landscape and caused plentiful amounts of material culture to be deposited Later activity has had virtually no impact on the resource There are clear and precise historical accounts of where activity occurred within the site.

4.2 Heritage Significance

Once the potential for archaeological evidence to be present has been established, it is necessary to assess whether that evidence has any cultural significance as only evidence with significance is protected. This assessment of significance has been guided by the principles of the *Burra Charter* and legislation in the *Heritage Act 1977*. It is supported by relevant Guidelines produced by the Heritage Council of NSW/Heritage NSW including, but not limited to, *Archaeological Assessment Guidelines* and *Assessing Significance for Historical Archaeological Sites and 'Relics'*.

The ICOMOS Charter for the Conservation of Places of Significance, also known as The Burra Charter, defines cultural significance as meaning

Aesthetic, historic, scientific, and social value for past, present and future generations.

Section 4 of the *Heritage Act 1977* defines two levels of significance: local and State, noting that an item of State significance can also be of local significance however an item that is primarily of local significance may not necessarily be of State significance. In the Act heritage significance means significance to either the State or area in relation to the historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic value of a place, building, work, relic, moveable object or precinct.

Heritage NSW has defined a series of specific criteria for the assessment of heritage which have been used here. They are as follows:

- Criterion (a) an item is important in the course, or pattern, of NSW's cultural or natural history (or the local area)
- Criterion (b) an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the local area)
- Criterion (c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)
- Criterion (d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area)
- Criterion (e) an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area)
- Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area)
- Criterion (g) an item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).

The significance of an archaeological resource is tied directly to events that have occurred on a site in the past. This means that various human activities can occur in the same vicinity at the different periods in time and that leave behind archaeology of varying levels of significance. A key consideration of significance is research potential (Criterion (e)) which is the most relevant criterion for assessing archaeological sites. Included within assessment of this criterion is the question of whether the study of the material recovered would contribute to answering research questions (Heritage Office 1996).

In addition to the clearly established criteria outlined above, other factors including intactness, site history and potential have been considered when assessing significance to ensure a broader approach to

archaeological significance (Heritage Branch 2009). This includes an acknowledgement that the significance of an archaeological resource can change prior to, during, and following excavation based on these attributes.

4.3 Assessment

The assessment undertaken of the wider Airly Mine area (RPS 2013) surmised that evidence of shale mining was of **local** significance with the structures contained in Airly village contributing the most to this level of significance. The archaeological potential was considered **high** largely due to the volume of extant features.

Based on the information outlined in the Gap Analysis including examination of the historical context the archaeological potential of the study area is **very low**. Primarily this is due to a low likelihood past activity occurring in the area and the lack of clear evidence of activities taking place. The only potential activities to have occurred in the study area are all related to mining, either as part of larger scale commercial operations by companies such as the GSC, ASS, or AKO&M, or as part of smaller scale individual operations.

Based on the criteria outlined above archaeological evidence of shale mining by larger companies may have significance under the following criterion

- Criterion (c) – evidence of the kinds of technologies used in mining may be significant especially if they demonstrate rare or innovative qualities and signs of adaptation to a unique and inhospitable environment.
- Criterion (d) – the Airly mining complex generally has significance to the local community and to groups such as bushwalkers who are believed to frequent the area. There is also possible significance to the present mining community and the descendants of the original workers in the area.
- Criterion (e) – Given the remoteness of the area, if activity occurred evidence of it is likely to be relatively intact. This provides the possibility for a large corpus of physical evidence to remain. If intact sites are found then they would likely contain unique evidence of how mining was undertaken in the area.
- Criterion (f) – Multiple shale mining sites are known throughout NSW including some, such as Joadja, that are well studied. Shale mining sites are not therefore considered rare generally. That said, each site contains unique adaptations of a common technological background and as such each site could be considered uncommon.
- Criterion (g) – The Airly mining complex is considered to be a good representation of the type because it contains an abundance of clear evidence. Any further sites could readily contribute to this representativeness

Based on this, any evidence of commercial shale mining is likely to be of **local significance**, but any other activity is unlikely to meet the threshold of significance.

5 FIELD SURVEY

5.1 Introduction

The results of the Gap Analysis did not indicate the locations of any potential historical archaeological sites within the study area. However, research indicates that unrecorded, informal sites may exist in various locations across the area. If these sites related to shale mining, then they would be of local significance.

5.2 Methodology

5.2.1 Aims

The survey aimed to ascertain whether any items of potential historical heritage were present in the ML1814 area. If any items were located the survey aimed to map their extent and record sufficient information to make a preliminary assessment of the item's significance as per HNSW guidelines. The survey also aimed to identify any areas where further survey was required and identify any areas that may have archaeological potential.

5.2.2 Sampling Strategy & rationale

Given the remote and partially inaccessible nature of the terrain, survey was limited to areas that were safely accessible on foot. This also reflects the areas that are most likely to contain historical heritage items. Landforms that had the potential for at least temporary occupation were targeted meaning areas such as cliff faces were avoided. Where possible tracks were followed with the area surrounding the track examined.

It is possible that all areas of the mountain were accessed in the past but only the areas that were subjected to prolonged habitation are likely to have generated an archaeological resource. This likely means at least some kind of structural remains but may also include rubbish dumps. These would not have been built in areas that were not readily accessible by people in the past who would also require nearby water.

5.2.3 Field methods

The survey was undertaken fully on foot (pedestrian) and consisted of walking the landscape along established paths and examining any features which appeared to be potential sites of historical heritage. A Garmin GPSMAP 64st was used to record tracks and waypoints on the survey with an accuracy of no less than 3m. Photographic recording was undertaken using a 64mp digital camera and saved in .jpg format. The fieldwork was assigned the code AIR22 with each site identified assigned a sequential numerical identifier prefixed with HHA (Historical Heritage Assessment).

The survey lasted two days. Dr Gary Marriner undertook both days of survey. Day one focused on the north-south arm of mount Genowlan heading to Genowlan Point. Day two focused on the east-west arm heading towards Mugii Dhudungura Point (Figure 5-1).

5.3 Results

Day one of the survey aimed to cover the entirety of the north-south arm, which was achieved. The survey largely followed the well establish trackway. The area around the trackway was most likely to have historical heritage items. Areas adjacent to the trackway were also examined if they were largely clear of scrub and safely accessible. A distance of 3.1km was covered and in that time one potential historical site was encountered – AIR22 HAA01.

Day two of the survey aimed to cover the east-west arm. Unlike day 1 there was no clear trackway to follow in this part of the study area and the terrain generally was more challenging. This prevented the full arm from being investigated as no safe route could be found in the time given. The inaccessibility and challenging nature of the terrain makes the presence of intact and identifiable historical items highly unlikely in this area. It would not have been a suitable location for prolonged habitation and would have required substantial engineering and mechanical equipment to be mined. No sites were identified during the survey on day 2.

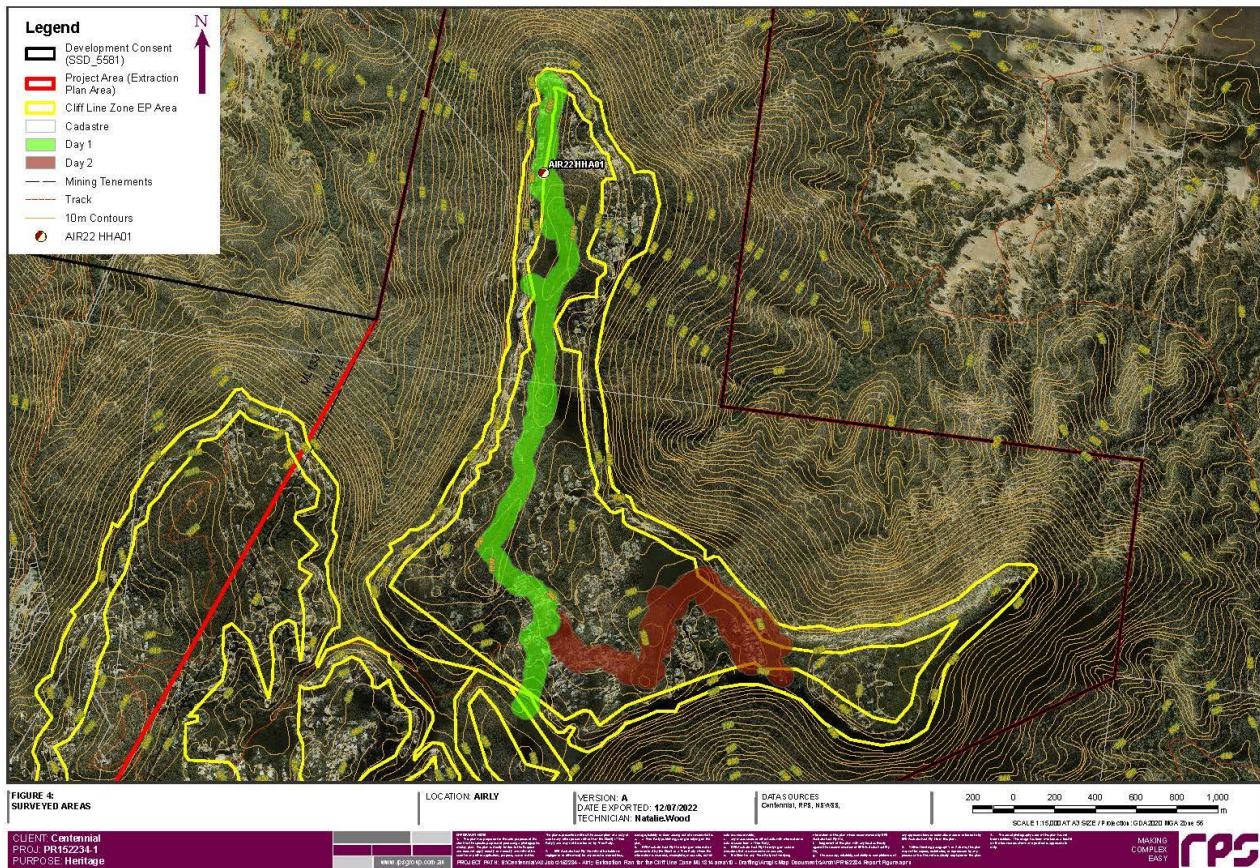


Figure 5-1: Areas surveyed during day one (green) and day two (brown)

5.3.1 Sites located

One potential historical heritage site was identified:

AIR22 HAA01	
Date	21/06/22
Time:	12:12pm
Coordinates	-33.085644°/ 150.071748°
General location	On Genowlan Plateau just before the break of slope down towards Genowlan Point in a small clearing.
Description	Large oval shaped depression orientated approximately north south. 8.5m long, 5.5m wide with shallow gradual sloping sides and a flat base (Figure 5-2, Figure 5-3). At the northern end is a 1.2m long, 5m wide pile of rubble (Figure 5-4). Rubble a mix of orange and grey 250-350mm subangular stones with smaller 25-50mm subangular stones. Similar stones found in smaller quantities cross the depression. No artefacts or objects of any kind found. Area covered in scrubby grass but more cleared than elsewhere.

AIR22 HAA01

Interpretation Possible attempted or abandoned mine shaft site. Based on location and lack of disturbance likely to have been hand dug and so not related to 19th century shale mining. Likely related to diamond mining in 20th century.

Assessment No further potential or investigation required. Unlikely to be of significance.



Figure 5-2: Shallow oval depression located at AIR22, HAA01, view to the north, scale =2m



Figure 5-3: Shallow oval depression located at AIR22, HAA01, view to the south, scale =2m



Figure 5-4: Rubble pile at northern end of shallow oval depression located at AIR22, HAA01, view to the north, scale =2m

6 CONCLUSIONS & RECOMMENDATIONS

This Baseline assessment focuses only on historical heritage contained within the MW17-19 Extraction Plan area and the Cliff Line Zone Extraction Plan area in ML1814. The conclusions and recommendations here are applicable to the management of historical heritage in both areas which collectively for the study area.

Assessment of the study area indicated that there was low potential for it to contain locally significant archaeological resources related to historical shale mining in the area. Gap Analysis did not provide an indication of any areas that may contain an archaeological resource of significance but did provide a general overview of what types of archaeological evidence may remain in the study area. Analysis of all statutory and non-statutory lists show that at present there are no listed heritage sites or archaeological areas within the study area, however the study area includes part one item currently under assessment for inclusion on the NHL. Field survey of two areas was undertaken in order to confirm the findings of the Gap Analysis and interrogate the assessment of potential. During this survey one potential historical heritage site was found. This site is likely 20th century and does not relate to shale mining activities and does not meet the threshold of significance on its own merit. Therefore, it does not require further monitoring.

This assessment has undertaken historical research, databases searches, and a field survey and has identified no actual or potential sites of historical heritage that would meet the threshold of significance. As such, the management of historical heritage in the MW17-19 Extraction Plan area and the Cliff Line Zone Extraction Plan area in ML1814 can be undertaken as an extension of the existing management documents. In particular the unexpected finds protocol, contained in Section 6.4 of the existing Wester region HHMP which applies to the entire area.

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Our ref: AU213005571

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Date: 19 December 2022

Sam Price
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Dear Sam,

Desktop review of ML 1814 area and MW17-19 EP Area for Aboriginal Cultural Heritage

Background

RPS have been assisting Centennial Coal with the heritage management of the Airly Mine since 2013 and during this time have produced numerous documents regarding Aboriginal and Historical heritage and archaeology. This included the production of an overarching Aboriginal Cultural Heritage Management Plan (ACHMP) for the Western Region, first issued in 2014 and last updated in September 2021.

The purpose of the ACHMP is to provide Centennial with a consistent approach to consultation with the local Aboriginal communities regarding Aboriginal cultural heritage matters as well as identifying consistent minimum standards and processes for Aboriginal cultural heritage identification, monitoring, and management across all of Centennial's western operations.

In 2022 Centennial began planning for an extension to the Airly Mine to incorporate Cliff Line Zone ML1814, and the MW17-19 Extraction Plan. As stated in section 1.3 of the ACHMP, location specific Extraction Plans are required for each mining area under the Mining Act 1992. This desktop review has been written to ascertain what work, if any, will be required to inform the Extraction Plan for the project site and provide a suggested methodology for any potential works.

Archaeological Context

Cliff Line Zone ML1814

There is one known Aboriginal site recorded on the AHIMS database within the Cliff Line Zone ML 1814 site. The Western Region ACHMP (RPS 2021) includes an assessment of the cultural and scientific significance of sites. The ACHMP classifies that site within this area is a Rockshelter with Deposit (AHIMS 45-1-0167). It is assessed as having extremely high cultural significance, high local scientific significance, and high regional scientific significance.

MW17-19 Extraction Plan

There are no AHIMS registered sites within the MW17-19 Extraction Plan area.

Our ref: AU213005571

As per the monitoring protocols laid out in the ACHMP baseline recording is required for this site prior to any works that may cause an impact.

Relevant Previous Work

Airly Mine Extension Project, Cultural Heritage Impact Assessment, 2014

This comprehensive assessment included extensive survey of the entire Airly Mine area which identified 22 new AHIMS sites during the survey component, although none within the either the Cliff Line Zone ML1814 or MW17-19 Extraction Plan area. One previously recorded site was identified within the Cliff Line Zone ML1814 – 45-1-0167.

AHIMS Site Card 45-1-0167

The AHIMS site card for 45-1-0167 was lodged on the 17th of February 1992. It records the site as:

Genowlan Creek 1 – Shelter with Archaeological Deposit

Location:

The shelter is situated on the eastern side of a steeply inclined valley with cliffline on both sides. It is about 500 metres upstream of a junction of Genowlan Creek. Vegetation in the valley is dominated by tree ferns, bracken and tall eucalypts. Above a vehicle track, the shelter is about 30 metres from the Creek above a 30% gradient.

Description

Facing southwest, this is a large shelter, the main body of the overhang being 41 metres long more than six metres deep and six metres high. The floor is fairly level and most of it is dry. The deposit consists of pale grey and yellow sandy soil with some roof fall. Behind an area of roof fall the deposit appears potentially deep. Part of the drip line is covered in bracken and ferns.

Six artefacts were recorded at the northwestern end of the shelter where the deposit appeared to be of restricted depth overlying, rockfall. Here as well as behind the roof fall deposit is <10cm deep.

Point Hatteras, Airly Heritage Baseline Assessment, 2021

This desktop baseline assessment included AHIMS 45-1-0167. At the time there was no plan to undermine the site and it was located beyond the 26.5 degree Angle of Draw area. As such there was no predicted impact to the site. Nevertheless, it was recommended that it should be monitored and managed in accordance with the most recent ACHMP. No site recording was undertaken.

Conclusions

Cliff Line Zone ML1814

There is one AHIMS sites within the project site which has extremely high cultural significance. As per Section 6.5 of the Western Region ACHMP, the sites should have 3-phase site monitoring prior to the commencement of mining. To date the site has not had Baseline (Phase 1) monitoring. The detail contained in the AHIMS listing should provide sufficient detail for the completion of the site specific EP-ACHMP for the project area.

MW17-19 Extraction Plan

There are no AHIMS registered sites within the MW17-19 Extraction Plan area. The Aboriginal Cultural Heritage management protocols contained within the Western Region ACHMP are sufficient for this area.

Recommendations

- Development and production of a new Extraction Plan Aboriginal Cultural Heritage Management Plan (EP-ACHMP) that covers the areas of ML1814.

Our ref: AU213005571

- The existing EP-ACHMP is approaching five years old and is specifically tailored to the ML1331 area. It explicitly excludes any other area.
- Undertake Baseline (Phase 1) survey of the AHIMS site prior to the commencement of mining. Representatives of the registered Aboriginal Parties should be invited to participate in the Baseline (Phase 1) recording. RPS advises that:
 - As per the policies of the Western Region ACHMP, baseline (Phase 1) recording must include:
 - Detailed archaeological recording, to be undertaken by a suitably qualified and experienced Heritage Consultant and to include photographs of the site, and observation of the rock morphology.
 - Archival-quality photos to be taken in accordance with Heritage NSW guidelines. A 3D terrestrial scan may be considered.
 - The designation of a minimum of six (6) control points to be established by a suitably qualified surveyor using a total station or better equipment if available, selected in consultation with the heritage consultant. These are to be used for monitoring.

RPS are happy to provide a fee proposal for the above work. Please get in touch should you wish us to do so.

Yours sincerely,
for RPS AAP Consulting Pty Ltd



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4 July 2024



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AIRLY5650 - Rev 4 Addendum

Dear Jacqueline

ADDENDUM - HIGH LEVEL SUBSIDENCE, CONDUCTIVITY AND CONNECTIVITY REVIEW FOR THE GROTTA AND THE OASIS AT AIRLY MINE

1. INTRODUCTION

Centennial Coal Pty Ltd (Centennial) owns and operates Airly Mine, an existing underground coal mine located 40 km northwest of Lithgow in the Western Coalfield of NSW. Airly Mine uses first workings, pillar extraction and miniwall mining methods to extract the Lithgow Seam and is currently developing miniwall (MW) 16 under Mt Genowlan. This letter report incorporates the Rev3 letter report issued on the 25 March 2024 with updated groundwater monitoring results up to May 2024.

Centennial engaged SCT Operations Pty Ltd (SCT) to complete a high-level assessment of the planned mine layout and proposed extraction workings surrounding an area known as The Grotto and The Oasis. The Grotto is a narrow slot canyon with surrounding internal cliff lines that is categorised by the Independent Review Panel (IRP) to be a significant landform on the national and international stage. The Oasis, also known as Jurassic Park, is a wider deeply incised gorge typified by tall forest communities. Therefore, The Grotto and The Oasis is to be protected similarly to the Cliff Line Zone (CLZ) by only containing first workings with pillars designed to be long term stable and produce minimal subsidence. Development consent (SSD_5581) for mining lease ML 1331 notes the subsidence impact performance measure for The Grotto and The Oasis to be negligible subsidence impacts or environmental consequences.

The location of The Grotto and The Oasis with existing and proposed workings are shown in Figure 1. The Grotto and The Oasis fall outside of the current Extraction Plan (EP) for mining lease ML1331 and is located within ML1814 and current first workings EP application.

This letter report consists of a high-level assessment of the potential subsidence impacts, groundwater characteristics, and surface connectivity for The Grotto, The Oasis and surrounding CLZ, and consists of a review of industry standards and experience, and existing mining impacts at adjacent workings (MW15a and MW16) at Airly Mine. The areas discussed in the report are identified on Figure 1.

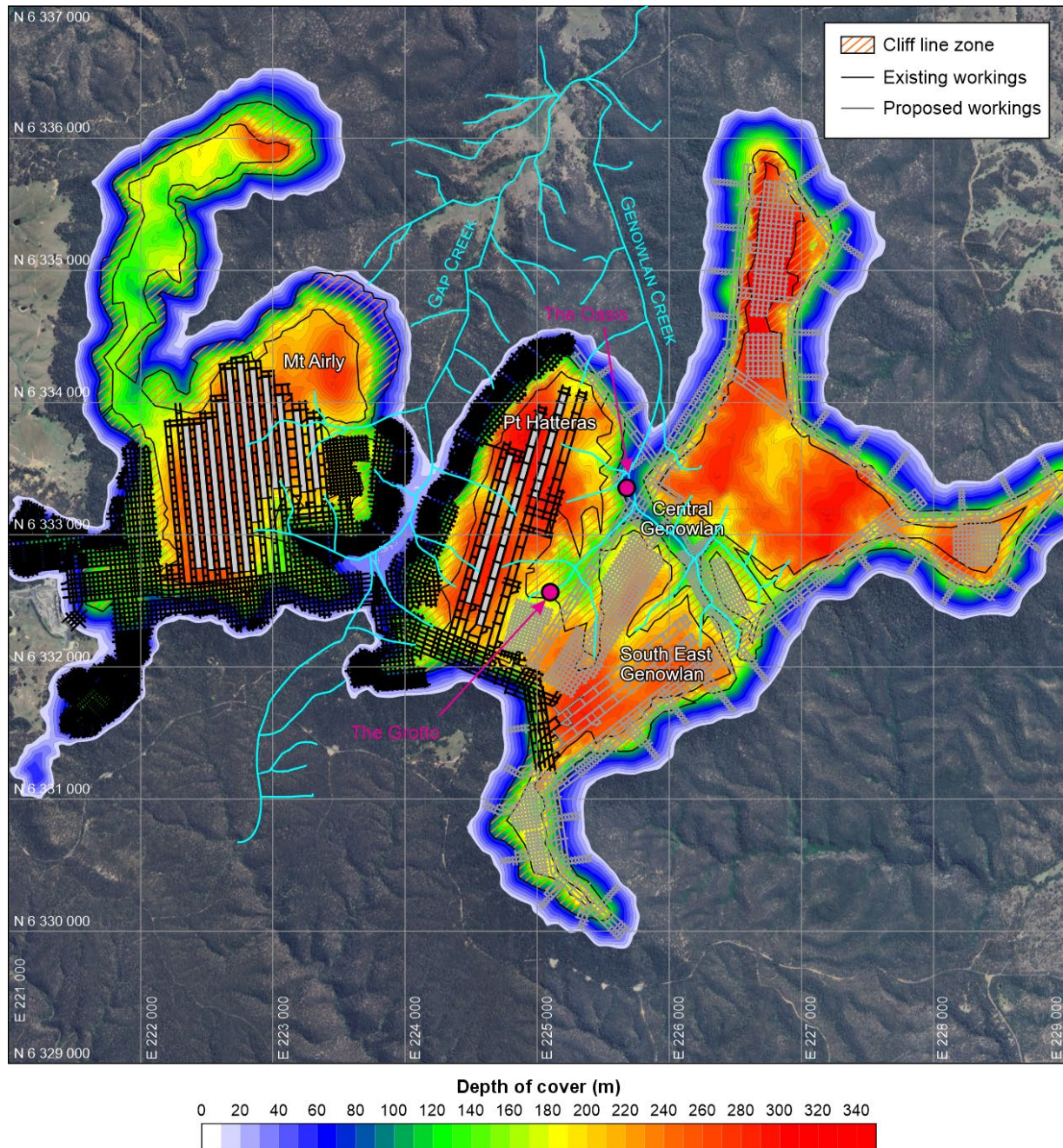


Figure 1: Existing and proposed workings at Airly Mine.

2. SCOPE AND DELIVERABLES

A scope of work for The Grotto overburden subsidence, conductivity and connectivity review was provided by Centennial via email on the 10th of July 2023. A subsequent program of work was provided by SCT and is presented in Table 1 and forms the scope of work for the initial report submitted on the 24th of August 2023.

After the completion of the initial report, Centennial requested that The Oasis also be included in all the assessment items listed in Table 1 on the 23rd of February 2024. A further request for an addendum report was made with the availability of updated groundwater and subsidence data on the 20th of June 2024.

This Rev 4 Addendum report provides an updated assessment to include the most recently available groundwater data.

Table 1: Scope and Deliverables for the initial report submitted on the 24th of August 2023

Item	Scope	Deliverable
1	High level review of the latest Airly Mine reports that encompass the CLZ first workings and any influence of the Grotto lineaments. - Subsidence monitoring. - Subsidence predictions both empirical and modelling. - Groundwater review – review VWP and conductivity data of the overburden to characterise current mine geometry.	Industry and site context of anticipated conductivity, connectivity and mining induced groundwater impacts.
2	High level review of proposed mine design and caving/subsidence impacts.	Subsidence predictions review and commentary on potential variations.
3	Review of Airly piezometric and conductivity data of the overburden to characterise current situation and understand existing mining impacts at Airly Mine.	Review of current groundwater scenario and existing groundwater impacts from Airly mining.
4	High level summary of potential groundwater impacts for proposed extraction. Estimation of overburden conductivity and connectivity including commentary around faults/lineaments.	Commentary on estimates of overburden conductivity and connectivity above proposed first workings. Commentary on potential for increased connectivity from faulting.
5	Provide a review of areas that may require further assessment in relation to overburden conductivity and connectivity.	Provide recommendations for further work based on gap analysis.

3. SITE DESCRIPTION

The current mining area consisting of miniwall panels MW13-MW16 is located under Mt Genowlan at Point Hatteras. Mt Genowlan is a mesa, whereby the surrounding strata has been eroded away.

Figure 2 shows a topographic and stratigraphic section through the current mining area under Mt Genowlan, and the existing mining area under Mt Airly and point Hatteras. The Lithgow Seam is mined at Airly Mine and outcrops near the base of the Mt Airly escarpments.

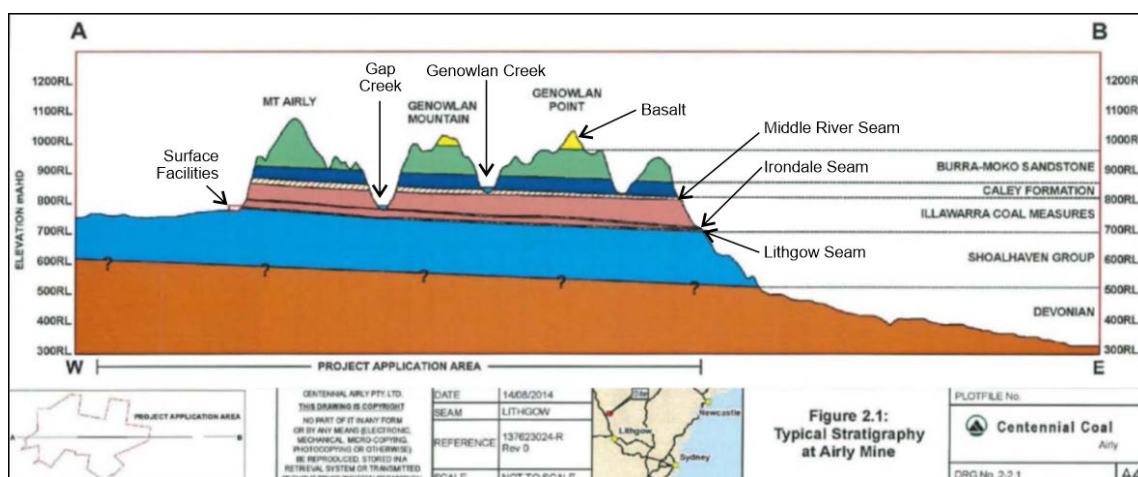


Figure 2: Geology and lithology of Mt Airly and Mt Genowlan (Golders 2018).

The Lithgow Seam is stratigraphically at the base of the Permian Illawarra Coal Measures, which overlies the marine sediments of the Shoalhaven Group. The Illawarra Coal Measures are approximately 110 m thick. Overlying the Illawarra Coal Measures are the Triassic Caley Formation and the Burra-Moko Sandstone. The Burra-Moko Sandstone is a massive sandstone unit that forms the upper most unit of Mt Airly and Mt Genowlan and is observed in the cliffs surrounding the mesas.

The area of interest for this review is the deeply incised gorge of The Grotto. Figure 3 shows the narrow deeply incised gorge of The Grotto, which forms an upper tributary of the Genowlan Creek. Monitoring by Airly Mine has shown the water flow in The Grotto to be ephemeral and rainfall dependant (Golder EIS, 2014). Short episodes of streamflow happen in both Gap and Genowlan Creeks during and after rain events, but rapidly subside to a no-flow state when there's inadequate rainfall and runoff to sustain the flow of surface water.

In areas where there is a greater source of sediments, the gorges become wider and allow the accumulation of deeper soil profiles. In these areas, more regular surface water flow encourages the growth of taller moist forest communities. This type of gorge is typified by The Oasis, which is located on the lower portion of Genowlan Creek within Genowlan Mountain. Figure 4 shows the typical landscape of a wider deeply incised gorge in the form of The Oasis (Golder EIS, 2014).

The Grotto and The Oasis form internal cliffs to the Mt Genowlan mesa, created along joints and fractures in the sandstone. Figure 5 shows the structural interpretation of basement and surface faults and joints for Airly Mine. Lineaments, indicative of the underlying basement faults, are common at Airly Mine and can have implications on subsidence, cliff line and overhang instability, aquifer connectivity and groundwater flow.



Figure 3: The Grotto.



Figure 4: The Oasis.

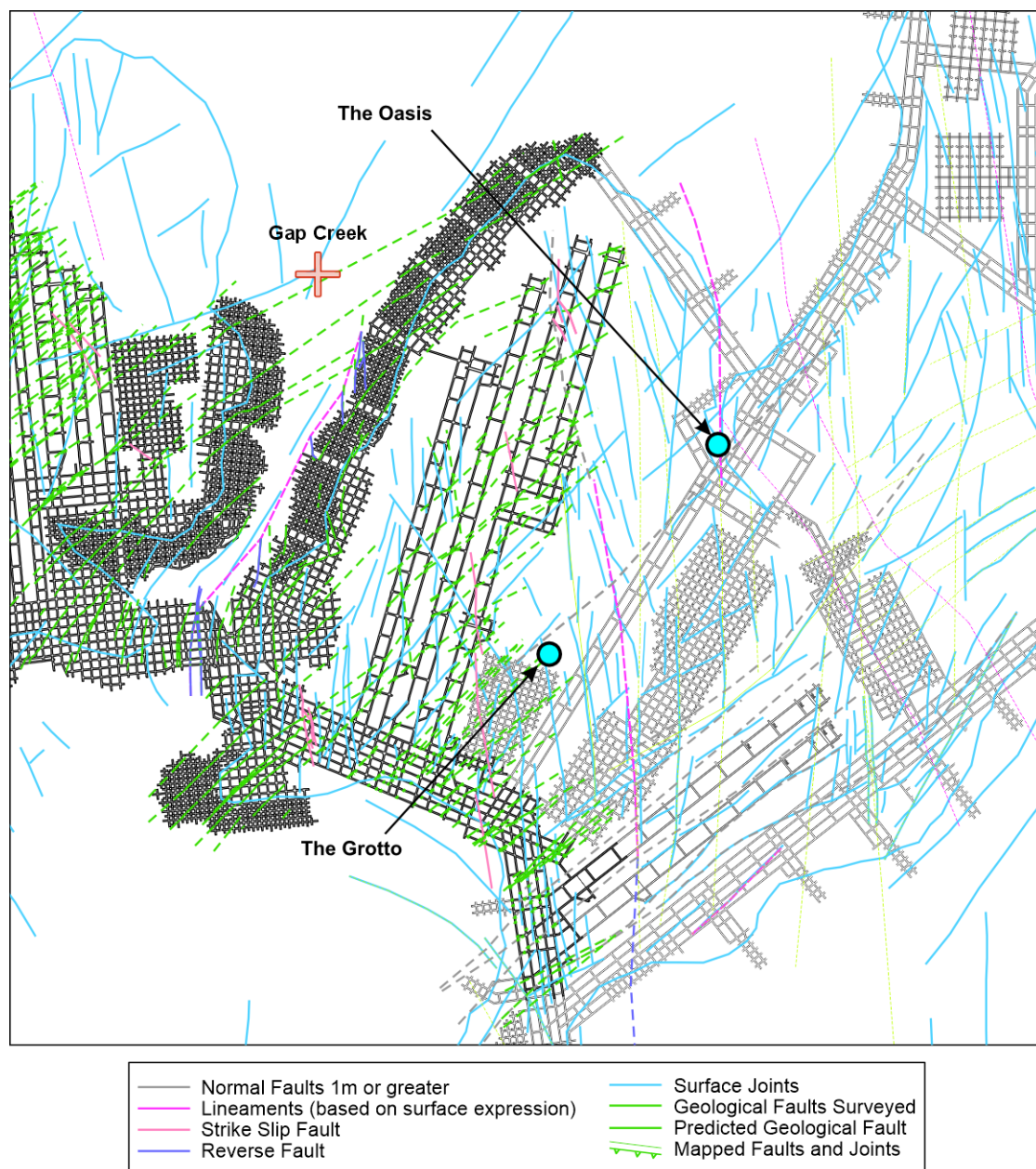


Figure 5: Airly Mine structural interpretation of basement and surface faults and lineaments.

4. CONCLUSION

The high-level review of the available subsidence data, and groundwater monitoring at Airly Mine indicates the planned mining layout nearby The Grotto and The Oasis to have low levels of potential subsidence impacts and effects.

Horizontal movements at The Grotto due to the extraction of MW13 to MW16 are predicted and measured to be small at The Grotto. Impacts from Point Hatteras are predicted to be negligible at The Oasis, no subsidence monitoring is currently available at The Oasis. The sub critical mining geometry and landform at The Grotto is expected to result in negligible horizontal movements due to the low horizontal stress environment at Airly Mine.

The estimated subsidence magnitudes for the proposed herringbone pillar workings to the south of The Grotto are predicted to have negligible subsidence effects to the adjacent CLZ and The Grotto. The estimated subsidence magnitudes for the proposed Central Genowlan main headings mined beneath the CLZ are predicted to have negligible subsidence effects to the adjacent CLZ and The Grotto to the west and have been designed to be long term stable.

The estimated subsidence magnitudes for the proposed pillar workings to the east of The Oasis would be expected to have negligible subsidence impacts. The estimated subsidence magnitudes for the proposed Central Genowlan main headings would be expected to have negligible subsidence effects to the adjacent CLZ and The Oasis in either of the proposed options.

For a baseline groundwater impacts assessment, a review of potential mining impacts in the Gap Creek lineament, located between Mt Airly and Mt Genowlan, was conducted as first workings and pillar splitting occurred adjacent to the lineament. The Lithgow Seam is 25 m under Gap Creek and the first workings are approximately 50 m from the Gap Creek piezometers. The Gap Creek example shows that if the mining horizon water head level is connected to the surface water source, depressurisation of the mining horizon has the potential to produce downwards flow through the fracture network, including through lineaments. Updated groundwater monitoring indicates water level recovery in the Alluvium and Permian strata. Creek flow variability is also in line with rainfall patterns. These trends are an indication of a return to baseline conditions pre-mining. There is no evidence of long-term adverse impacts to Gap Creek surface water flows because of mining.

The lineaments may provide a conduit to the perched alluvial aquifer and laterally provide a conduit to another lineament that is connected to the aquifer. The potential for reactivation of faults and lineaments traversing the area and adjacent workings is considered low due to the low stress environment and low stress redistribution from first workings. There is a low probability of groundwater impacts at The Grotto and The Oasis due to low levels of predicted subsidence and an increased depth of cover as compared to Gap Creek.

A review of the potential mining impacts to the groundwater and tributary flow at Genowlan Creek was conducted after miniwall extraction in the Point Hatteras Panel and Pillar mining Zone (PPMZ) and updated with the 2024 Q1 monitoring results.

Little to no variation in pressure head has occurred because of adjacent mining at Point Hatteras in the vicinity of The Grotto. No influence of mining is observed in the standpipe piezometer results. No influence of the adjacent lineament has been observed at the monitoring locations.

Monitoring at The Oasis in the Lithgow Seam and has maintained a steady water head throughout the monitoring period up until mid-December in 2023. In the recent Q1 2024 monitoring results, water levels dropped by 0.51 m which can potentially be attributed to the adjacent mining at MW16. The distance of 575 m to the MW16 workings indicate a potential conduit through basement features. No influence of mining is observed in the standpipe piezometer results at The Oasis within the perched water table. No influence of the adjacent lineament has been observed at the monitoring locations within the perched water table.

The perched aquifer in the alluvium of The Grotto and The Oasis would not be expected to be impacted by adjacent mining. The theoretical height of total depressurisation for the Point Hatteras PPMZ is calculated as 53 m above the coal seam. These calculations are based on a panel width of 60 m, mining height of 3 m and mining depth of 280 m using the Tammetta (2012) empirical equation.

The surface water flows at The Grotto, The Oasis, Grotto Creek and Genowlan Creek are shown to be related to rainfall patterns and are intermittent in dry periods. Recent flows appear to be greater than pre mining with an increase in rainfall since 2019. There is no evidence of impacts to Genowlan Creek surface water flows because of mining.

5. THE GROTTA SUBSIDENCE REVIEW

At the time of this report, there is currently no planned extraction directly below The Grotto, however, first workings and secondary extraction are planned adjacent to The Grotto at both Point Hatteras and the Southeast Genowlan area (current EP). MW15b is approximately 280 m to the west of The Grotto and the HB1 panel is approximately 100 m to the south. A set of main headings to the Central Genowlan mining area are proposed under the internal CLZ that extend beyond The Grotto and is located approximately 80 m to the west of The Grotto. The subsidence of these workings has been assessed based on the proximity to The Grotto with potential subsidence impacts noted.

The Grotto is classified to be in the CLZ in the EIS and EP. The following extract is from the EIS,2014 outlining the mining method, geometry, and design restrictions within the CLZ.

Mining in Cliff Line Zone and Zone of First Workings zone would consist of first workings only with pillars designed to be long term stable. The pillars used in this area would be typically large with an appropriately high FOS equivalent to that used for protection of key surface features (typically FOS >2.11). Apart from the major cliff lines, this zone also covers other key areas where subsidence impact would be significant, such as around The Grotto. Key features of this type of mining include:

- *Mining height: <3.0 m.*
- *Maximum roadway width: 5.5 m.*
- *Maximum void width: <10 m.*
- *Pillar system FOS: >2.11 (protection of key surface features).*
- *Pillar width to height ratio: >8.0.*

Condition 2, Schedule 3 of the development consent SSD_5581 stipulates no greater subsidence impacts or environmental consequences in the CLZ than predicted in the EIS (i.e., occasional rock falls, displacement, dislodgement of boulders or slabs of less than 30 m² or fracturing, that do not impact Aboriginal heritage, EECs, or public safety), that in total do not impact more than 2% of the total area of such cliffs.

5.1 Point Hatteras Panel and Pillar Mining Zone

The Point Hatteras Panel and Pillar Mining Zone (PPMZ) EP states that the predicted far-field horizontal movements due the proposed MW13 to MW16 are expected to be small and could only be detected by precise surveys. Such movements tend to be bodily movements towards the mining area and are accompanied by very low levels of strain (i.e., less than 0.3 mm/m), generally outside of survey tolerance. Potential impacts of far-field horizontal movements on the natural and built features within the vicinity of the proposed miniwalls are not expected to be significant.

In 2021 and 2022, SCT conducted a subsidence assessment of the Point Hatteras pillar width design which resulted in the adoption of 70 m pillar widths (AIRLY5265 and AIRLY5368). The subsidence assessment of the Point Hatteras pillar width redesign used numerical rock failure modelling which simulates miniwall caving and subsidence. The modelling provided the subsidence profiles for MW13 to MW16 at Point Hatteras, for 280 m depth of cover.

Figure 6 shows the resulting modelled subsidence profile for the three adjacent miniwalls at Point Hatteras, with the CLZ boundary and The Grotto extents to the east. The CLZ is located 110 m to the east from the starting position of MW15B, which is approximately half the depth of cover to the workings and consistent with the stipulated angle of draw offset of 26.5 degrees as set out in the EIS. The Grotto is located between 190 and 360 m to the east of the starting position of MW15B.

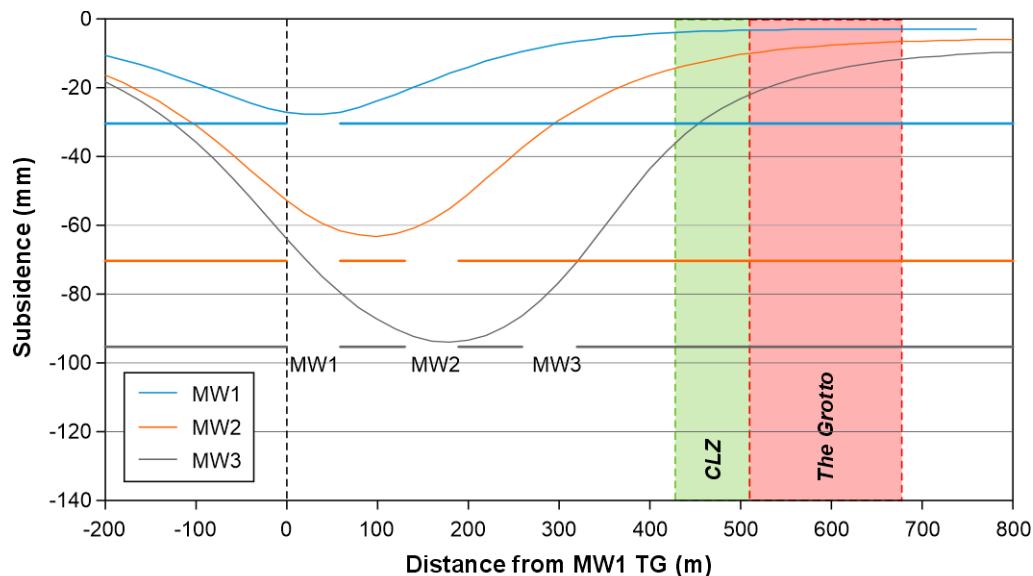


Figure 6: Point Hatteras modelled subsidence profile (AIRLY5265) with the CLZ and The Grotto extents.

The predicted subsidence and strain for the CLZ and The Grotto are presented in Table 2. The subsidence predictions are extrapolated from a depth of cover of 280 m. It is noted that The Grotto adjacent to MW15B is at a shallower depth of cover (170 m) and therefore would experience reduced subsidence magnitudes from the extraction of MW15B.

Table 2: Maximum subsidence magnitude estimates based on AIRLY5265 modelled profiles

Panels	Pillar Width (m)	Modelled Max Subsidence (mm)	CLZ Max Subsidence (mm)	CLZ Strain (mm/m)	The Grotto Subsidence (mm)	The Grotto Strain (mm/m)
MW13 MW14 MW15	70	94	33	0.15	20	0.05

The modelled subsidence profiles outside of the panels can overestimate the subsidence due to model boundary effects. This was observed by comparison of modelled versus measured subsidence profiles at Mt Airly. Recent Global Navigation Satellite System (GNSS) monitoring at Mt Genowlan has shown the modelled far field magnitudes to be more accurate.

5.1.1 Mt Airly Comparison

A comparison of modelled and surveyed subsidence for Mt Airly is presented in Figure 7. Note the surveyed lines presented in Figure 7 show two lines for each panel edge as two lines were surveyed (A Line and B-Line from Mt Airly). The curves show the surveyed (solid lines) and modelled (dashed lines) subsidence profiles, while the horizontal lines show the location of the extracted miniwall panels in relation to each profile.

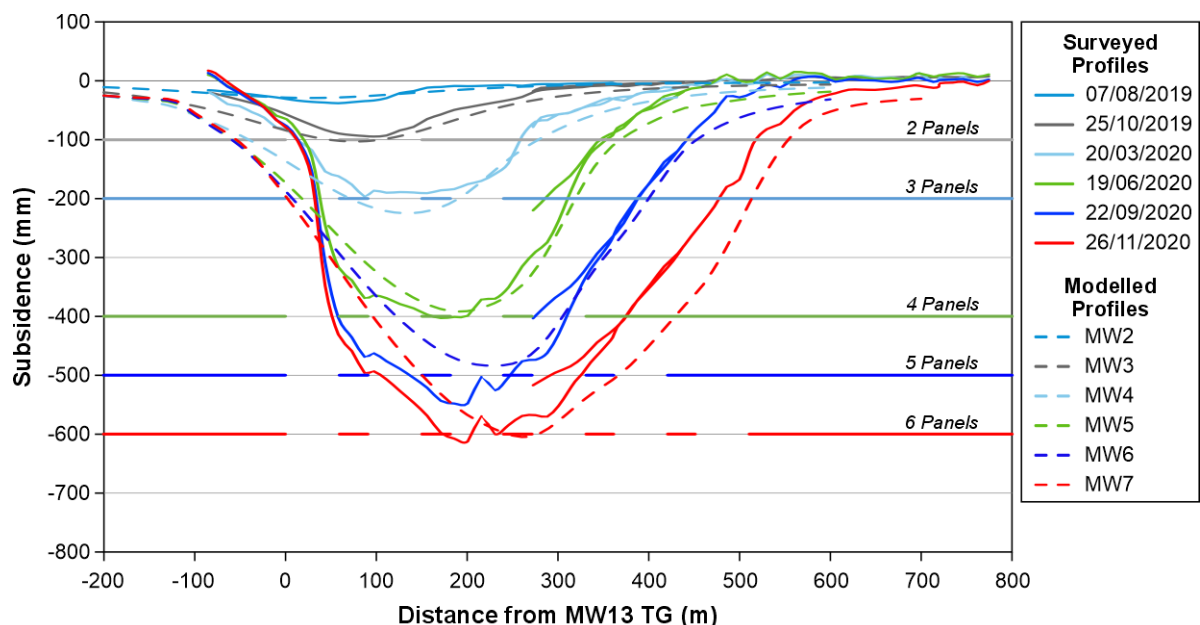


Figure 7: Surveyed and modelled vertical subsidence comparison.

The model results show similar subsidence profile curves and similar maximum subsidence to the surveyed subsidence. The western edge is steeper in the surveyed data as there is an additional tensile crack on the MW2 tailgate focussing the strain at this location. The eastern edge indicates a reduction in the measured subsidence as compared to the modelling. As such, the predicted subsidence magnitudes for the Grotto are likely to be conservative.

Figure 8 shows the subsidence monitoring for Mt Airly MW2 to MW4 with the conceptual extents of the CLZ and The Grotto for Point Hatteras. Horizontal movement measured at Mt Airly for the mining of MW2 to MW4 showed compressive strain of less than 0.5 mm/m at the extents of what the CLZ would be for MW15 at Point Hatteras.

The 0.5 mm/m of strain measured at Mt Airly was associated with 200 mm of subsidence. The predicted compressive strain of 0.15 mm/m at the CLZ adjacent to The Grotto, and 0.05 mm/m at The Grotto are associated with 94 mm of subsidence. Based on the Mt Airly comparison, horizontal movements at The Grotto are also expected to be negligible.

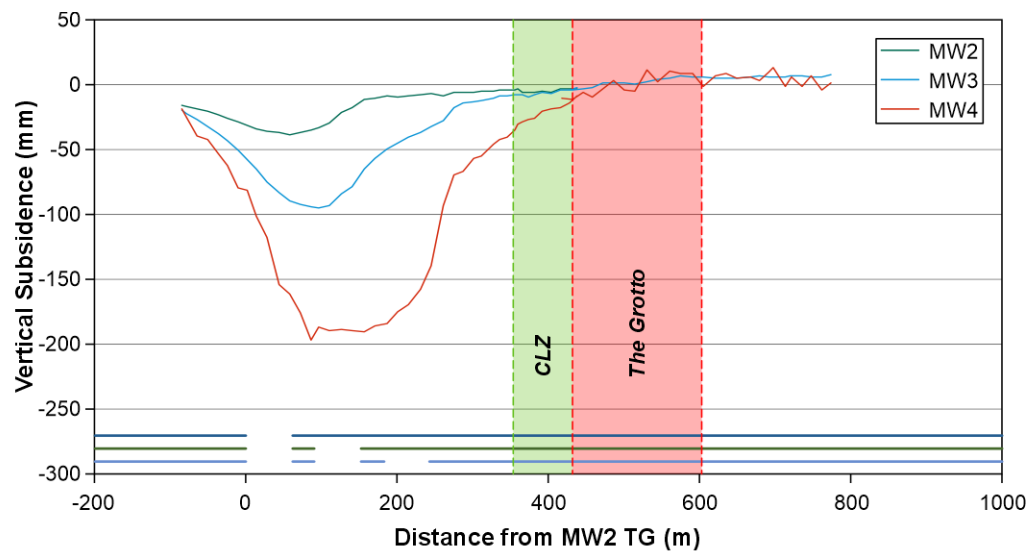
5.1.2 Mt Genowlan Monitoring

Global Navigation Satellite System (GNSS) monitoring has been conducted at Airly Mine over both miniwall and first workings extraction. GNSS data results have been interrogated for the Point Hatteras miniwall panels with the subsidence contours presented in Figure 9. The subsidence magnitudes have been interpolated using natural neighbour. The natural neighbour gridding method interpolates grid values by weighting neighbouring data points based on proportionate areas. The 20 mm subsidence contour line has been highlighted for comparisons with previous assessments. Note the GNSS resolution is at best ± 5 mm with clear sky above the station and can be greater with overhanging vegetation or cliffs, solar interference, or troposphere anomalies.

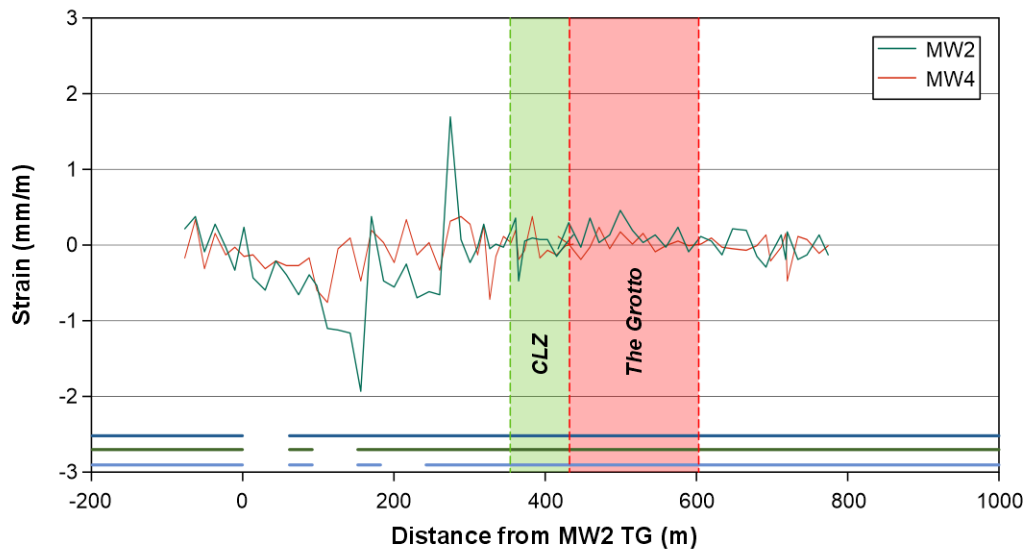
Subsidence profiles from the GNSS monitoring (updated to the 28th of February 2024) have been extrapolated to encompass far field subsidence movement for the CLZ and The Grotto to the east of MW15. Figure 10 presents the GNSS subsidence data for the extraction of MW13 and MW14 at the south of Point Hatteras and MW13, MW14 and MW15 to the north at Point Hatteras. The modelled profiles from SCT report AIRLY5265 have also been plotted for comparison. The GNSS interpolated subsidence magnitudes are reliable for comparison and are shown to closely match predicted subsidence magnitudes from the modelling. The far field GNSS subsidence magnitudes at the CLZ and The Grotto also correlate with the models with low levels of measured subsidence between 9 to 14 mm.

5.1.3 Horizontal Movement

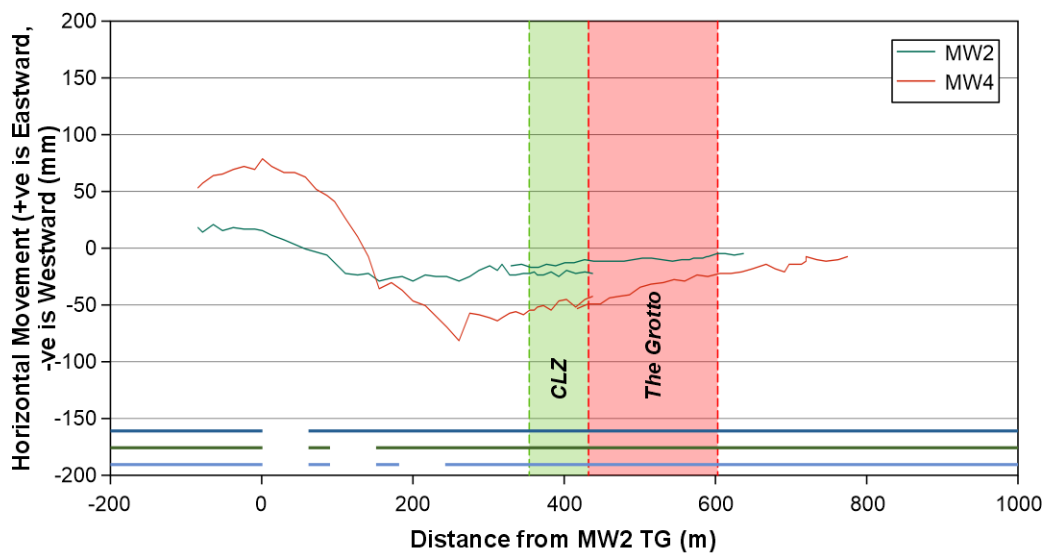
The potential energy released by subsiding rock strata is available to generate horizontal subsidence movements within the overburden strata generally, but particularly at the surface and especially when the surface topography is variable. The horizontal movements associated with variable topography cause movement to occur in a downslope direction. This movement causes valley closure and compression of the rock strata in the base of the valley. The relative upward movement of the compressed rock strata in the base of the river channel is called upsidence (Mills, 2009).



a) Subsidence



b) Strain



c) Cross-Panel Horizontal

Figure 8: Mt Airly subsidence monitoring relative to the TG edge of MW2.

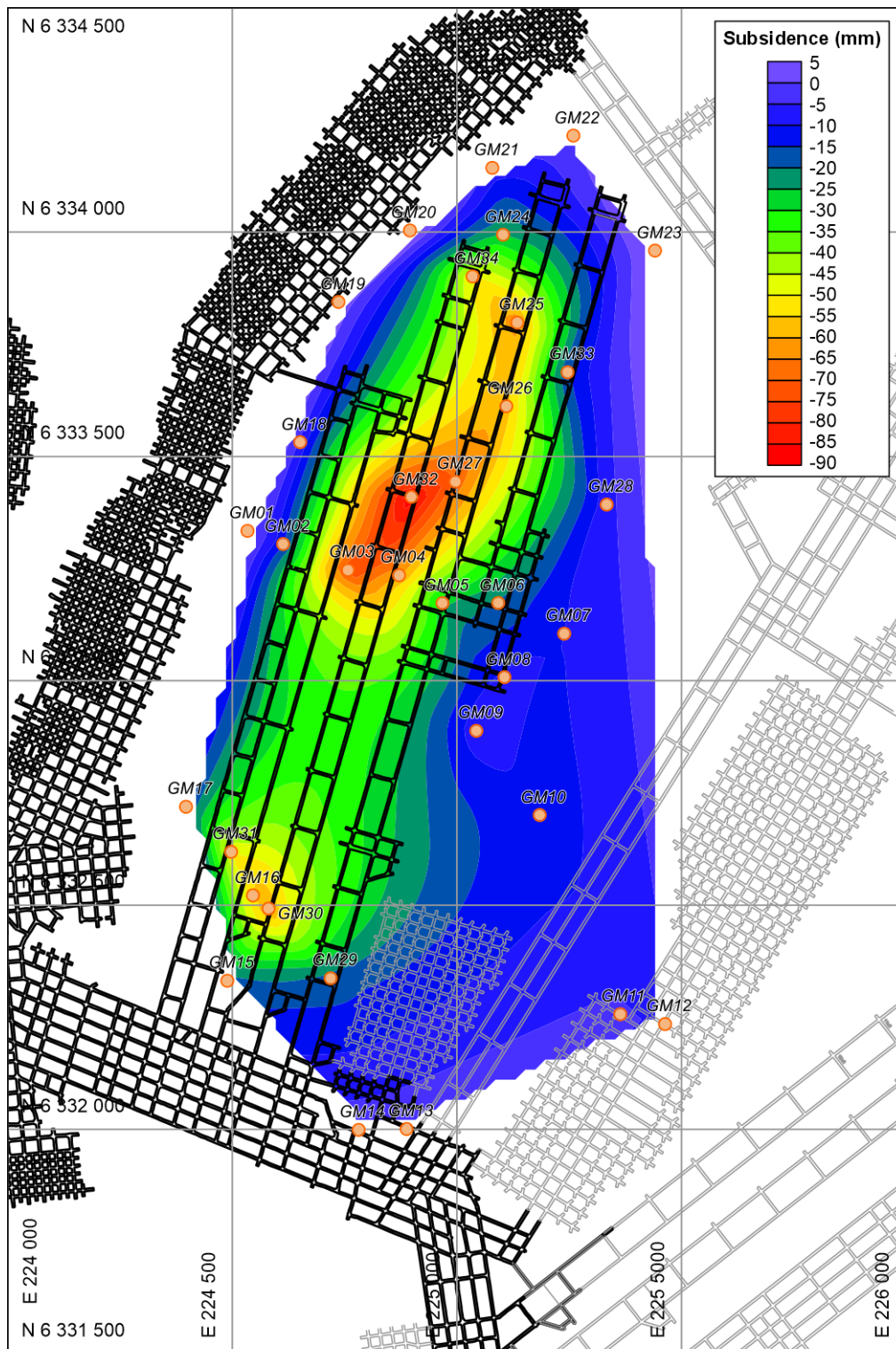


Figure 9: Interpolated GNSS subsidence monitoring contours for Point Hatteras.

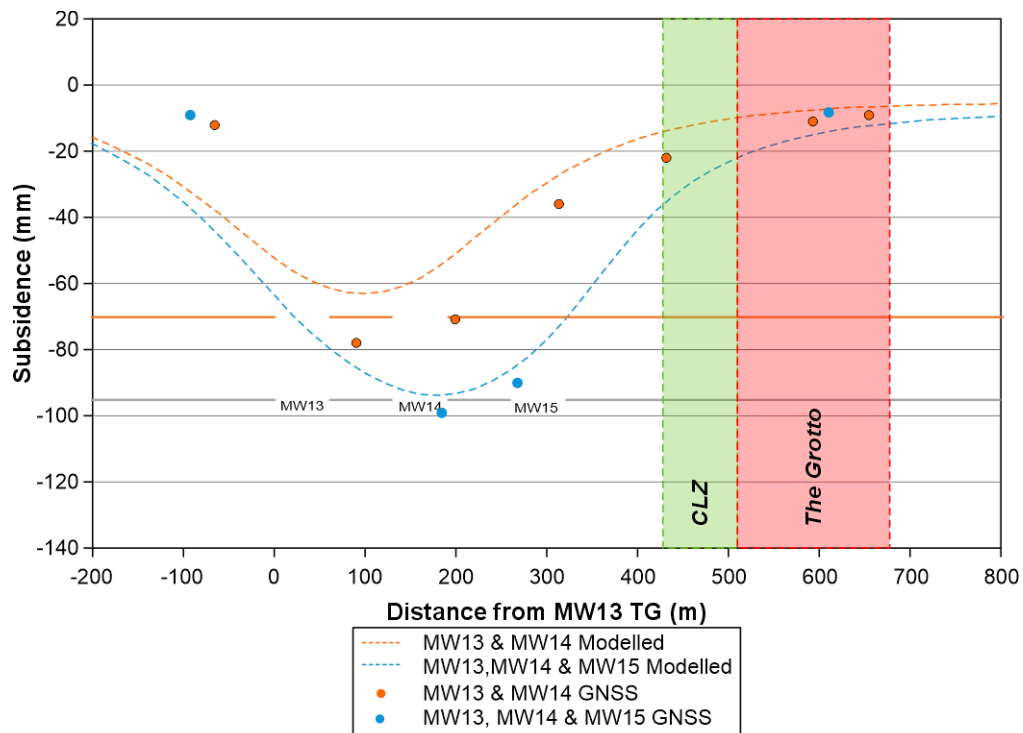


Figure 10: GNSS and modelled vertical subsidence comparison.

Mills (2009) noted several contributing factors recognised to cause horizontal movements that included:

- Horizontal stresses locked within the overburden strata become concentrated about the base of valleys so that failure of the rock bar causes valley closure.
- Stress relief of the overburden strata above the base of a valley toward the valley.
- Horizontal movements toward topographic low points caused by strata dilation along vertical joints and block rotation within the overburden as differential subsidence movements occur.
- Combinations of systematic subsidence and strata dilation movements.
- Horizontal compression of buttress rock between top of goaf and surface.

The sub critical mining geometry and landform at The Grotto is expected to result in negligible horizontal movements due to the low horizontal stress environment at Airly Mine. Using the same contouring method as the vertical subsidence, horizontal vector plots have been interpolated by using the eastings and northings movement measured by the GNSS instruments. Figure 11 presents the horizontal movements as a vector plot with direction and magnitude. Horizontal movements around The Grotto have been interpolated to be 5 – 15 mm in a westerly direction. Both the magnitude and direction are consistent with experience at Mt Airly.

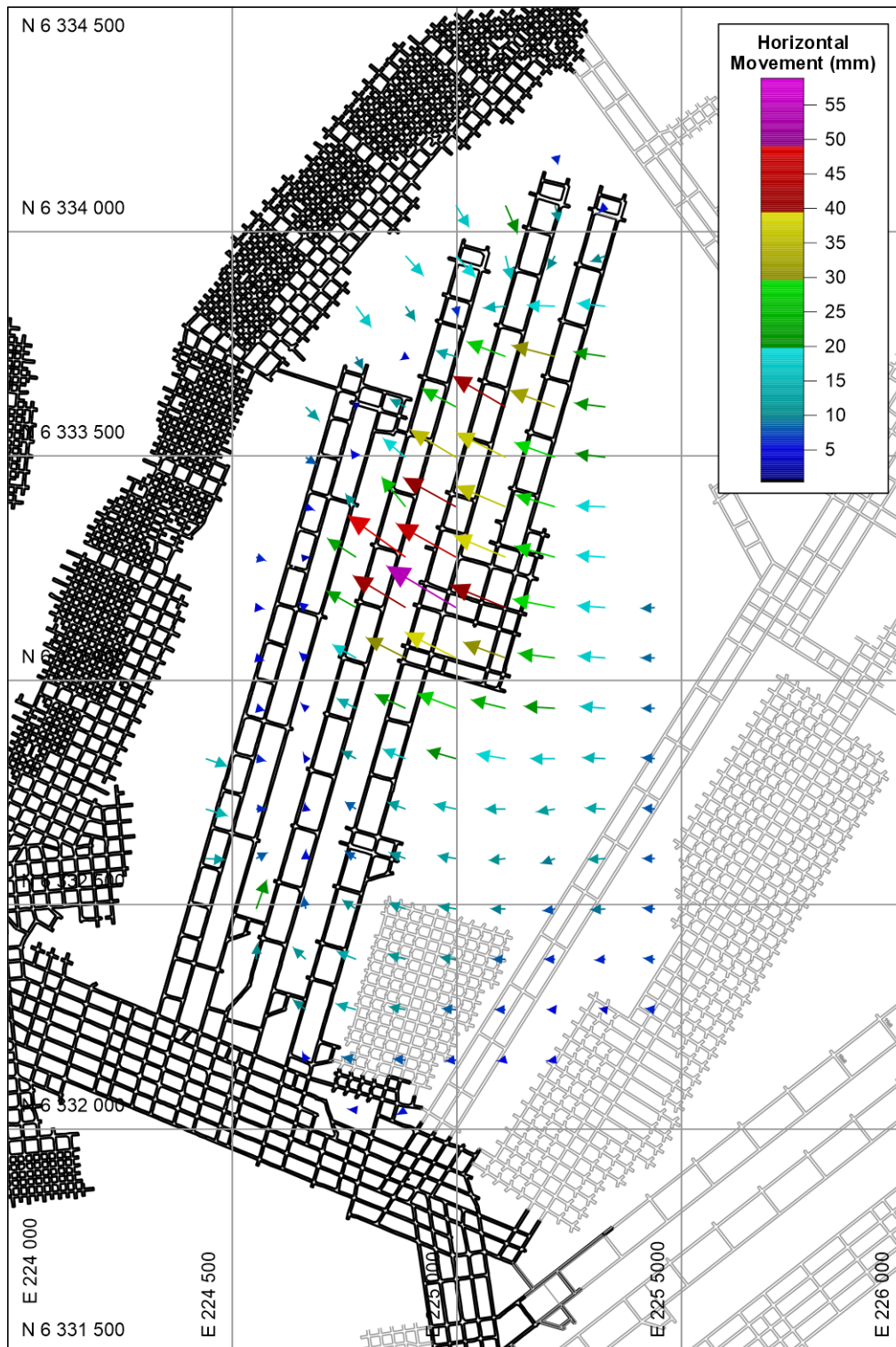


Figure 11: Interpolated GNSS horizontal movement.

5.2 Subsidence Impacts of Southeast Genowlan Workings on The Grotto

The Southeast Genowlan panel and pillar mining zone forms part of the ML1314 extraction plan. The high-level subsidence review for the Southeast Genowlan area is based on the 20230710_AM_WAE 2020.dwg plan supplied by Centennial on the 17th of July 2023. A comprehensive subsidence impact assessment will be required for the ML1814 first workings EP application.

Table 3 presents the subsidence estimates for the proposed pillar design containing herringbone bord and pillar workings to the south of The Grotto CLZ. The estimated subsidence is in the range of 25–29 mm. Assumptions for these subsidence calculations include:

- 2.8 m pillar height
- 5.5 m roadway width
- 2.5 g/cm² density
- 35 m pillar centres.

Table 3: HB1 Herringbone pillar workings subsidence estimates to the south of The Grotto

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	D Stress (MPa)	Subsidence (mm)	Maximum tensile strain (mm/m)	Maximum compressive strain (mm/m)	Tilt (mm/m)
170	5.25	7.75	2.50	25	0.22	0.29	0.72
180	5.50	8.15	2.65	26	0.22	0.29	0.72
190	5.75	8.55	2.80	28	0.22	0.29	0.72
200	6.00	8.95	2.95	29	0.22	0.29	0.72

The estimated subsidence magnitudes for the herringbone pillar workings would be expected to have negligible subsidence effects to the adjacent CLZ and The Grotto to the north.

Table 4 presents the subsidence estimates for the proposed main headings to the Central Genowlan mining area. The Central Genowlan headings are directly beneath the CLZ adjacent to The Grotto. The estimated subsidence is in the range of 10 – 12 mm. Assumptions for these subsidence calculations include:

- 2.8 m pillar height
- 5.5 m roadway width
- 2.5 g/cm² density
- 35 by 105 m pillars.

Table 4: Central Genowlan main heading subsidence estimates under the internal CLZ adjacent to The Grotto

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	D Stress (MPa)	Subsidence (mm)	Maximum tensile strain (mm/m)	Maximum compressive strain (mm/m)	Tilt (mm/m)
160	5.00	6.01	1.01	10	0.09	0.12	0.31
170	5.25	6.32	1.07	11	0.09	0.12	0.31
180	5.50	6.64	1.14	11	0.09	0.12	0.31
190	5.75	6.95	1.20	12	0.09	0.12	0.31
200	6.00	7.26	1.26	12	0.09	0.12	0.31

The estimated subsidence magnitudes for Central Genowlan main headings would be expected to have negligible subsidence effects to the adjacent CLZ and The Grotto to the west.

6. THE OASIS SUBSIDENCE REVIEW

The Oasis is not located within the CLZ as per the development consent and is classified as being within the Shallow Zone. The Shallow Zone is a second zone of first workings between the 100 m and 20 m depth of cover contours. In areas of European heritage, this zone often extends into slightly deeper areas, with first workings protection areas around the heritage sites defined by half the depth (CLZ EP, 2015). No mining is planned directly below The Oasis as shown in Figure 12 with only long term stable pillars (FOS<2.11) to the east.

Centennial provided the proposed workings and geology for The Oasis as presented in Figure 12. No first workings are planned directly below The Oasis. Proposed main headings to the access the Mt Genowlan mining area flank The Oasis as does two headings to ventilate workings to the North. The subsidence of these workings has been assessed based on the proximity to The Oasis, with potential subsidence impacts noted.

Table 5 presents the subsidence estimates for the proposed headings to ventilate the workings to the north. The two proposed headings run past The Oasis to the west. The estimated subsidence is in the range of 7–10 mm. Assumptions for these subsidence calculations include:

- 2.8 m pillar height
- 5.5 m roadway width
- 2.5 g/cm² density
- 40 m by 54 m pillar centres.

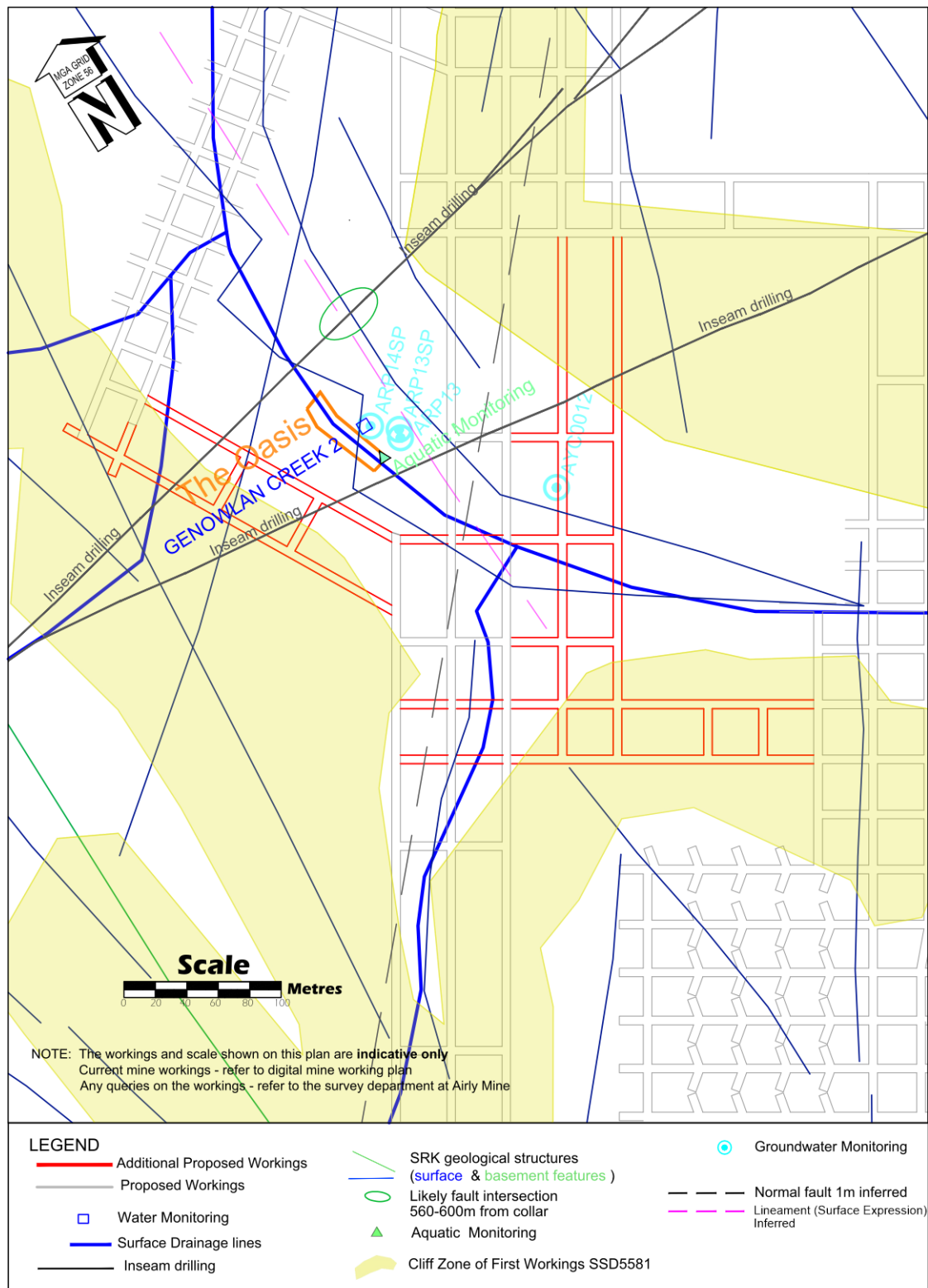


Figure 12: Potential mining scenarios for the area surrounding The Oasis.

Table 5: Subsidence estimates for the internal CLZ adjacent to The Oasis

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	D Stress (MPa)	Subsidence (mm)	Maximum tensile strain (mm/m)	Maximum compressive strain (mm/m)	Tilt (mm/m)
90	3.25	3.90	0.65	7	0.12	0.16	0.41
100	3.50	4.23	0.73	8	0.12	0.16	0.41
110	3.75	4.55	0.80	9	0.12	0.16	0.41
120	4.00	4.87	0.87	10	0.12	0.16	0.41

The estimated subsidence magnitudes for the two proposed headings to the west would be expected to have negligible subsidence effects to the adjacent CLZ and The Oasis.

Table 6 presents the subsidence estimates for the proposed main headings to the Central Genowlan mining area. The Central Genowlan headings run past The Oasis to the east. The estimated subsidence is in the range of 6 – 9 mm. Assumptions for these subsidence calculations include:

- 2.8 m pillar height
- 5.5 m roadway width
- 2.5 g/cm³ density
- 35 m by 65 m pillar centres.

Table 6: Central Genowlan main heading subsidence estimates adjacent to The Oasis-

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	D Stress (MPa)	Subsidence (mm)	Maximum tensile strain (mm/m)	Maximum compressive strain (mm/m)	Tilt (mm/m)
70	2.75	3.38	0.63	6	0.13	0.17	0.43
80	3.00	3.72	0.72	7	0.13	0.17	0.43
90	3.25	4.07	0.82	8	0.13	0.17	0.43
100	3.50	4.41	0.91	9	0.13	0.17	0.43

The estimated subsidence magnitudes would be expected to have negligible subsidence effects to the adjacent CLZ and The Oasis to the east.

As with The Grotto, there is potential for horizontal subsidence movements within the overburden strata generally, but particularly at the surface and especially when the surface topography is variable. The horizontal movements associated with variable topography cause movement to occur in a downslope direction. This movement can cause valley closure and compression of the rock strata in the base of the valley to cause upsidence. The mining geometry and landform at The Oasis is expected to result in negligible horizontal movements.

7. THE GROTTO AND OASIS CONNECTIVITY REVIEW

The local groundwater sources within Airly Mine are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams that occur within Mount Airly and Genowlan Mountain (Mod 3,2019). Local water sources include the Alluvium and quaternary strata, Narrabeen Sandstone, and Illawarra coal measures. Regional groundwater sources below the Lithgow Seam include The Shoalhaven Group and Lower Devonian Metamorphic strata.

Genowlan Creek and Gap Creek segments receive a consistent supply of water from subsurface flows driven by rainfall, which emerge from Quaternary colluvium and alluvium deposits and released slowly into the upper reaches of Genowlan Creek above The Grotto and The Oasis. Monitoring by Airly Mine has shown the water flow in The Grotto to be ephemeral and rainfall dependant whereas anecdotally the flows through The Oasis are more persistent, varying from approximately 2.2 L/s in average conditions to 1 L/s during drought (Golder EIS, 2014).

The Airly Mine groundwater monitoring network is presented in Figure 13. For the Gap Creek and Genowlan Creek review the following monitoring stations have been assessed:

- Gap Creek Groundwater monitoring
 - ARP04 – multi level VWP
 - ARP05 and ARP11 – standpipe water level piezometer.
- Mt Genowlan Groundwater Monitoring
 - ARP06, ARP07, ARP08, ARP13 and ARP15 muti level VWP
 - ARP08, ARP09, ARP12, ARP13, ARP14 and ARP15 – standpipe water level piezometer.

7.1 Airly Mine Gap Creek Experience

A review of potential mining impacts in the Gap Creek lineament at Airly Mine was conducted as first workings were mined adjacent to the lineament. The Lithgow Seam is 25 m under Gap Creek and the first workings are approximately 50 m from the Gap Creek piezometers.

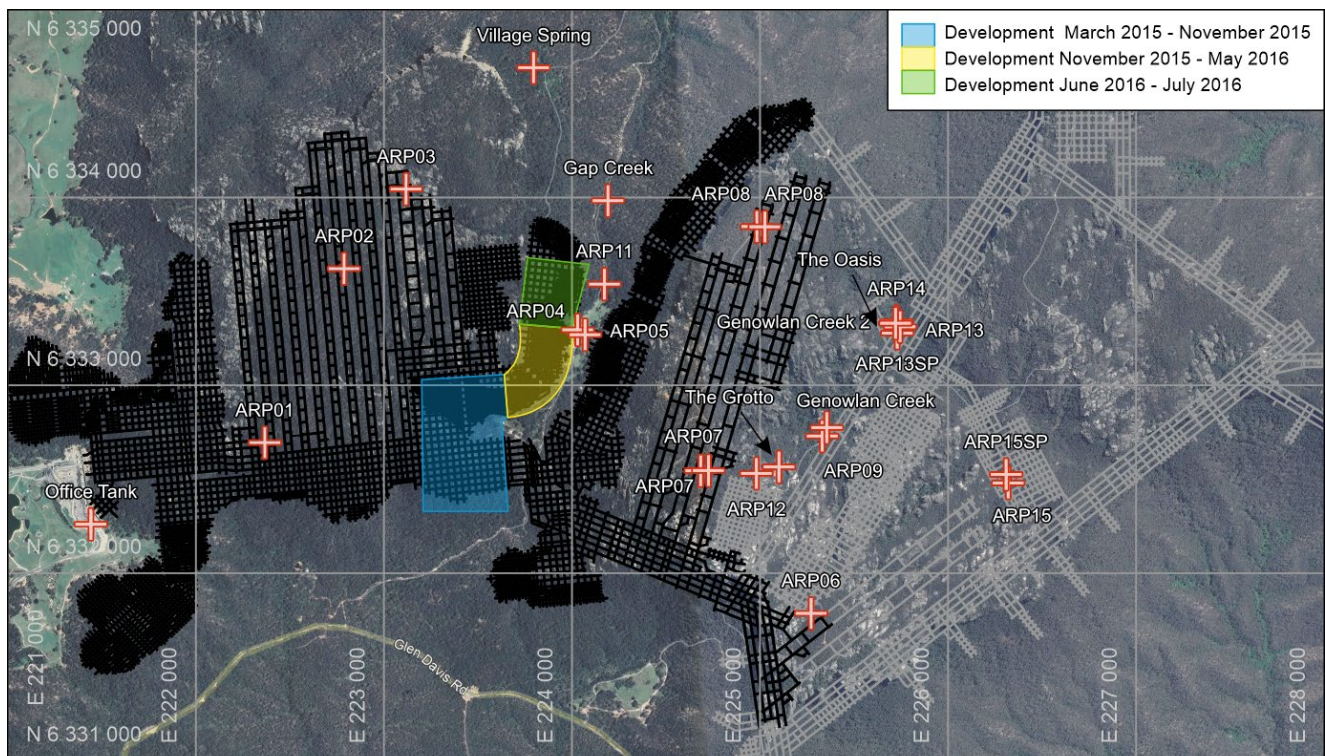


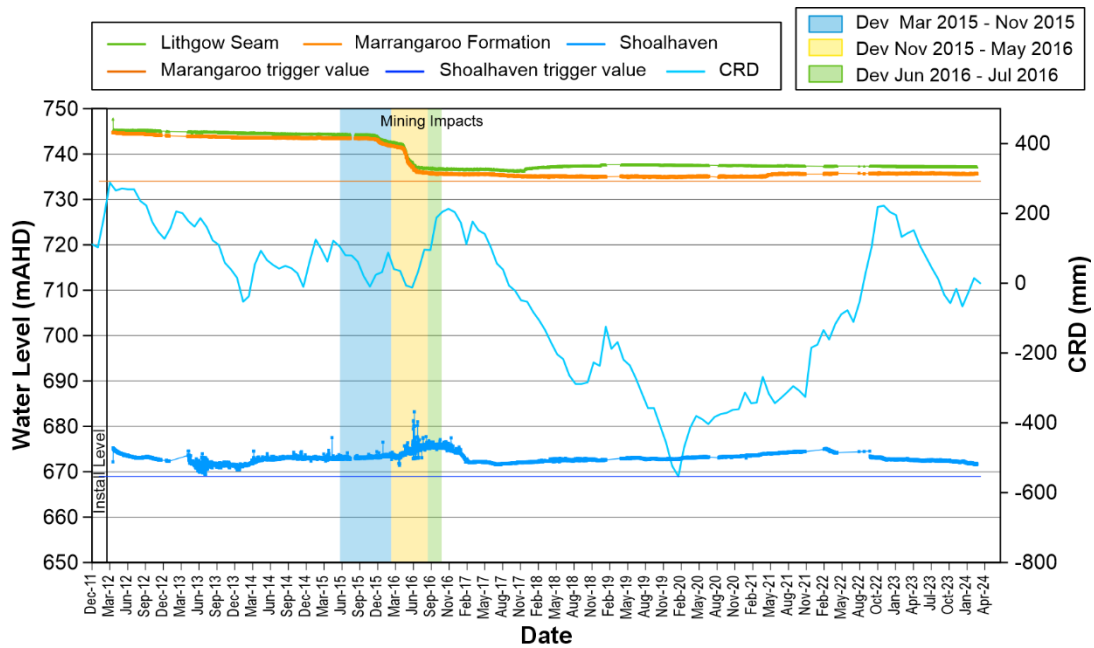
Figure 13: Groundwater monitoring location.

The pre-mining Lithgow Seam head level at Gap Creek in Borehole ARP04 was 744-745 mAHD (Figure 14a). The Gap Creek alluvial head level in ARP05 was 754 mAHD in 2012 then dropped to historical lows in 2015 and became dry at the piezometer level of 747.5 mAHD (Figure 14b). It is likely that the alluvial head level dropped to the groundwater level consistent with the Lithgow Seam of 744 mAHD.

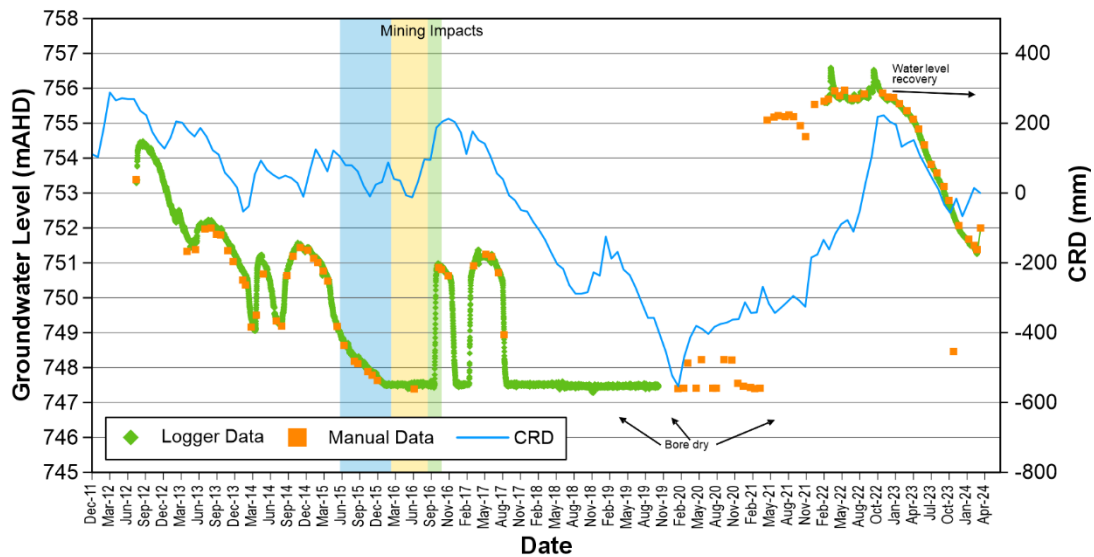
The three areas of underground development to the west of Gap Creek are shaded on Figure 14 and highlight the progressive groundwater impacts. The departure of historical behaviour at ARP05 is shown to correlate with the undermining of the Gap Creek tributary between March and November 2015. The depth of cover for the tributary ranges from 30 to 100 m. Prior to 2015, groundwater levels at ARP05 indicate a generally decreasing trend that is seen to accelerate with the commencement of adjacent mining.

With first workings extractions and pillar quartering in the Lithgow Seam to the southwest of Gap Creek between November 2015 and May 2016, the Gap Creek piezometers showed a 2 m head drop in Lithgow Seam pressure from 744 mAHD to 732 mAHD. The depth of cover for the tributary ranges from 30 to 100 m.

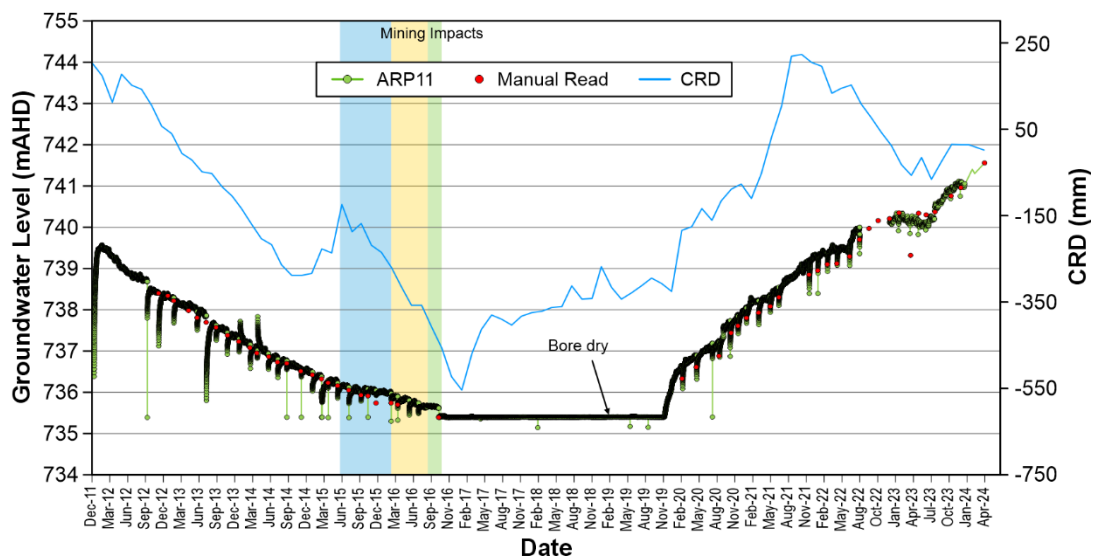
With first workings extractions in the Lithgow Seam adjacent to Gap Creek between June and July 2016, the Gap Creek piezometers showed a 5 m head drop in Lithgow Seam pressure from 742 mAHD to 737 mAHD. From April 2021, the Gap Creek VWP in the Marrangaroo formation has shown a small increase in water head of 3-4 m.



a) ARP04 head pressure during adjacent first workings mining.



b) Alluvial groundwater levels in ARP05 in Gap Creek.



c) Alluvial groundwater levels in ARP11 in Gap Creek.

Figure 14: Airly Mine first workings with monitored connectivity at Gap Creek.

ARP05 standpipe piezometer indicated continued rapid water level reduction following rainfall events in 2016 and 2017 with water levels reducing faster than historical rates prior to 2016. The fall off rate increase is likely to be due to the now reduced groundwater table below from the depressurisation of the Lithgow Seam nearby. Although there is evidence of connection between the alluvial and the mining horizon, and some loss of flow is likely, this loss of flow is difficult to measure, and the ephemeral nature of the creek has since produced alluvial head levels similar to that of historic levels. From early 2021 ARP05 has measured full water recovery to 756 mAHD in above average rainfall conditions. Recent trends at ARP05 indicate water level recovery in the Alluvium and Permian strata and variability in line with rainfall patterns. These trends are an indication of a return to baseline conditions pre-mining.

Groundwater levels at ARP11 (Figure 14c), installed in the shallow strata near the Gap Creek alluvium shows a generally decreasing trend throughout 2017 and early 2018. This decreasing trend is considered a combination of generally below average rainfall over the monitoring period and the influence of adjacent mining. As with ARP05, there is a recovery response at ARP11 from late 2021 with above average rainfall. Recent trends at ARP11 indicate water level recovery and variability in line with rainfall patterns.

The Gap Creek lineament may also aid in the inability to maintain head pressure in the alluvial with its likely higher conductivity providing higher flow rates down to the lowered water table than the surrounding strata. Lineament reactivation causing increased downward flow is considered low due to the small subsidence impacts of development and pillar extraction.

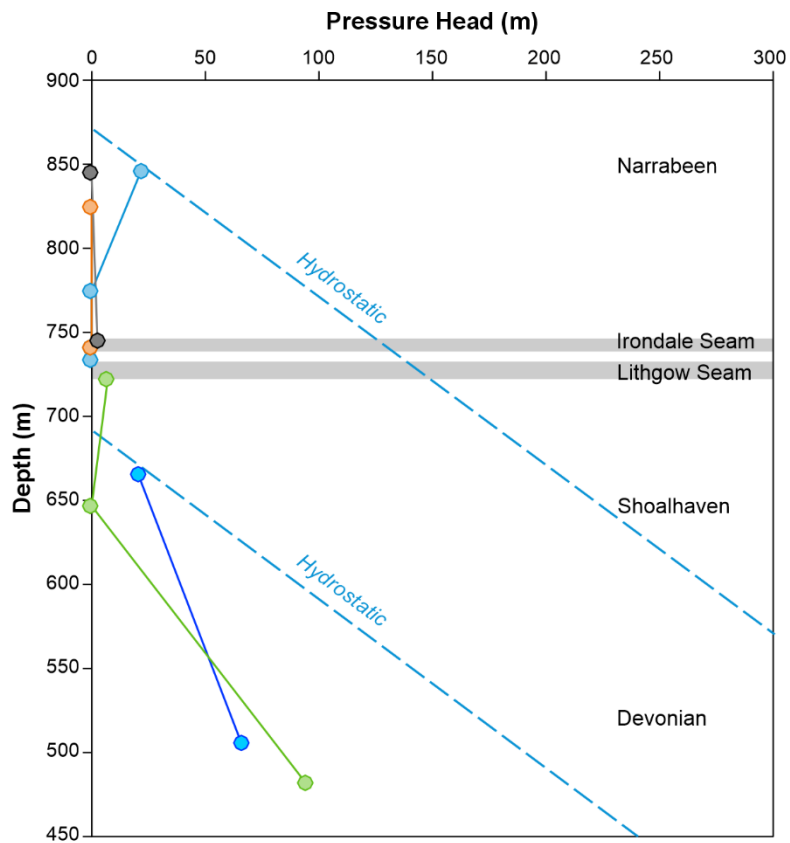
The Gap Creek example shows that if the mining horizon water head level is connected to the surface water source, depressurisation of the mining horizon has the potential to produce downwards flow through the fracture network, including through lineaments. Updated groundwater monitoring indicates a level of self-healing of the fracture network and reduced conductivity through the process of deposited sediment and weathering carried by the groundwater.

The surface water flows at Gap Creek are shown to be related to rainfall patterns and are intermittent in dry periods. Recent flows appear to be greater than pre mining with an increase in rainfall since 2019. There is no evidence of long-term adverse impacts to Gap Creek surface water flows as a result of mining.

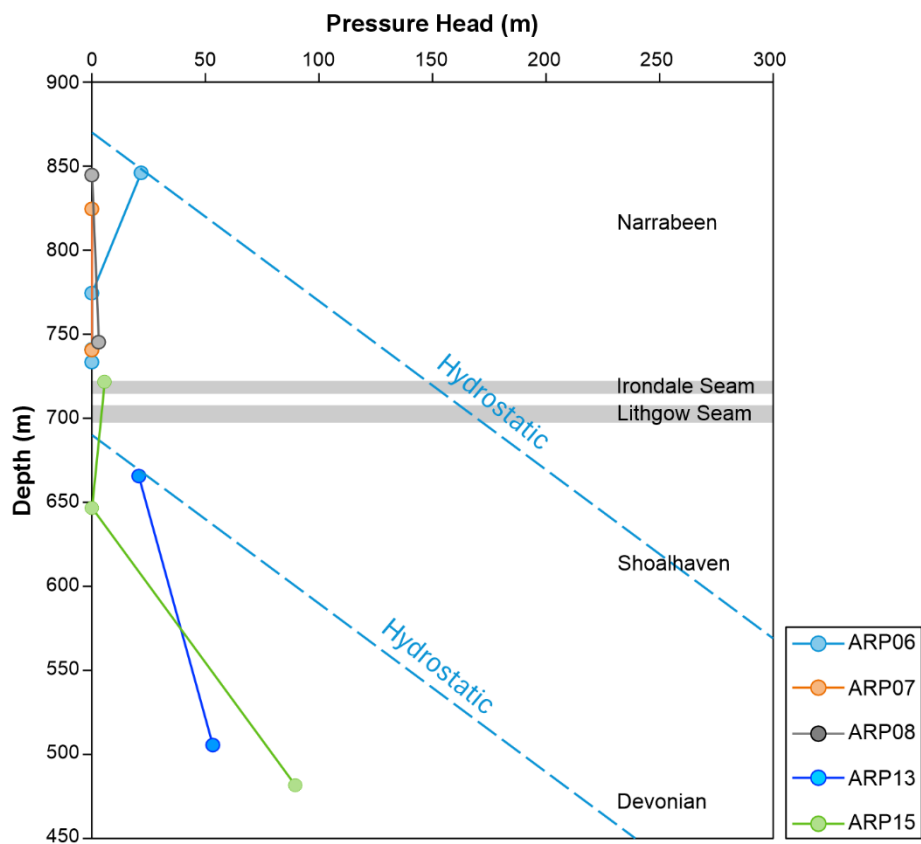
7.2 Mt Genowlan Monitoring

A review of the potential mining impacts to The Grotto, The Oasis, Grotto Creek and Genowlan Creek was conducted after miniwall extraction in the Point Hatteras PPMZ. The Lithgow Seam ranges from 70 to 170 m under the groundwater monitoring locations along The Grotto tributary and Genowlan Creek.

Figure 15 shows the pre-mining and post mining VWP pressure head profiles for the Mt Genowlan VWP monitoring network updated to the 14th of March 2024. This includes ARP06, ARP07, ARP08, ARP13, and ARP15. This profile demonstrates how the multiple instruments in a hole are reporting the head pressure relative to their depth of installation. This is useful in identifying the effects of depressurisation as it compares the theoretical hydrostatic head pressure with the VWP measured head pressure profile. Individual annotated hydrographs for each monitoring site are included as an Appendix 1 for long term trends.



a) Pre Mining MW13 (Jan 2022)



b) Post mining MW13, MW14 and MW15 (June 2023), * Lower Irondale VWP damaged by MW14 September 2022

Figure 15: Mt Genowlan groundwater piezometer head pressures.

Figure 15a shows the VWP pressure head prior to mining MW13 in January 2022. Prior to mining, there was no head pressure in the Narrabeen Sandstone or Illawarra Coal Measures (Irondale and Lithgow Seam) in the vicinity of The Grotto. ARP06 to the east of The Grotto does show pressure head in the Narrabeen Sandstone in a perched water table. The Narrabeen Sandstone and Illawarra Coal Measures are localised sources of groundwater due to the elevation above the valley floor. The Shoalhaven and Devonian VWP pressure head identify the aquifers defined as regional groundwater sources (Mod 3, 2019).

Figure 15b shows the VWP pressure head post mining MW13, MW14, MW15 and MW16 taken as of March 2024. Little to no variation in pressure head has occurred with adjacent mining at Point Hatteras or in the vicinity of The Grotto. It is noted the lower VWP in ARP08 was damaged during the mining of MW14. Recent monitoring results indicate that development mining beneath ARP06 has had no impacts to the perched water table in the Narrabeen Sandstone. A drop of 1.4 m water levels within the Devonian (below the Lithgow Seam) at ARP13 corresponds with a reduction in water pressure at ARP15 and is not considered to be mining related. Groundwater pressure remains stable in the overlying Shoalhaven Siltstone (Middle River Seam) just below the Narrabeen Sandstone at ARP13.

Mining is now complete at MW16 and ongoing monitoring will be required to establish future trends. Proposed miniwall panels at North Central Genowlan are located at a similar distance as MW16.

The height of depressurisation is a convenient concept for groundwater modelling purposes because it provides a bridge between the geomechanical disturbance caused by mining and a characteristic of the groundwater that can be incorporated into hydrogeological models.

Tammetta (2012) presents a method for determining the height of depressurisation above a longwall panels, based on observations from a comprehensive set of known worldwide experience in the public domain, giving the following empirical equation:

$$H = 1438 \ln (4.315 \times 10^{-5} \mu + 0.9818) + 26$$

where $\mu = wt^{1.4}d^{0.2}$

H = Height of depressurisation above the mining horizon (m)

μ = Tammetta Factor

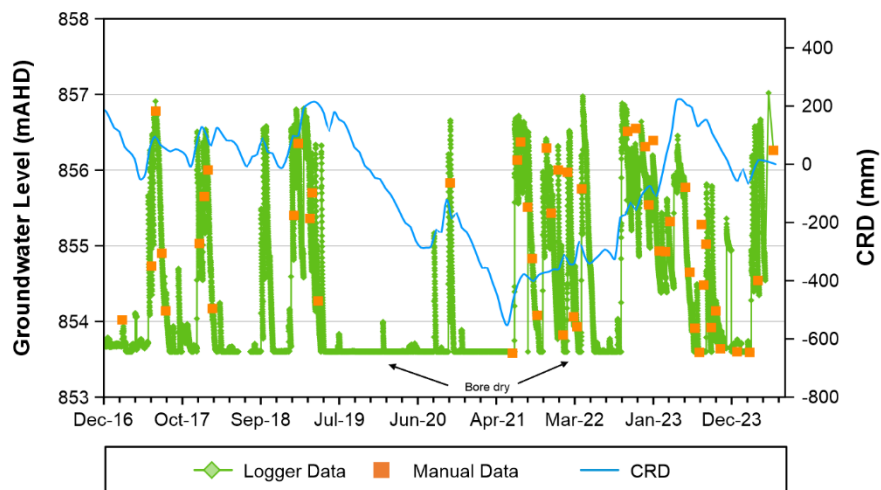
w = Panel Width (m)

t = Mining Height (m)

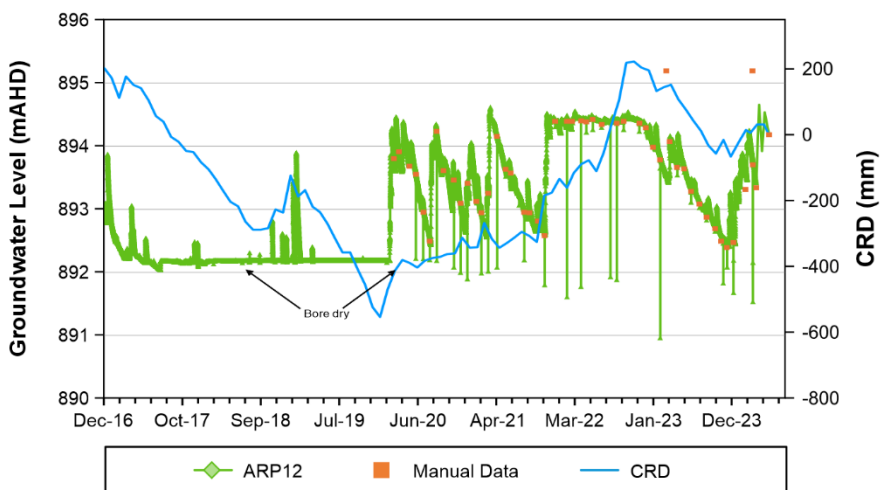
d = Mining Depth (m)

The theoretical height of total depressurisation for the Point Hatteras PPMZ is calculated as 53 m above the coal seam. These calculations are based on a panel width of 60 m, mining height of 3 m and mining depth of 280 m using the Tammetta (2012) empirical equation. The predicted height of depressurisation and piezometric profile in the post mining HOFWD02 Borehole is plotted in Figure 15.

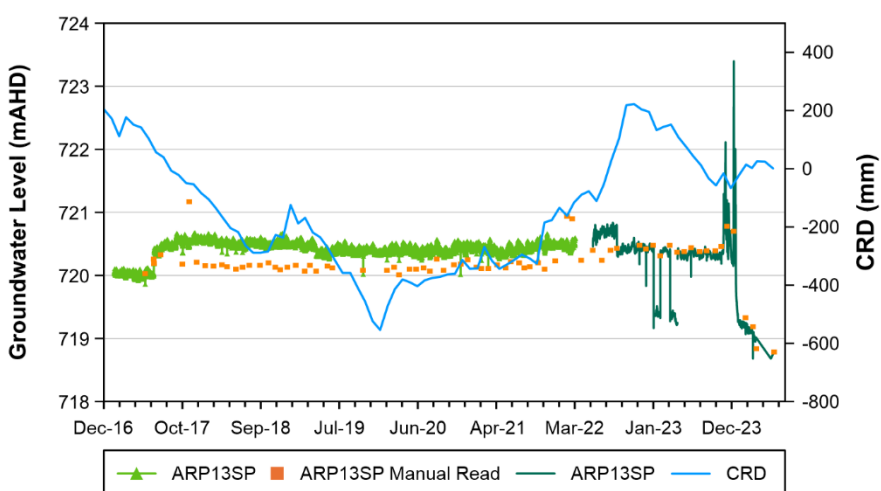
Figure 16 shows the monitoring results for the standpipe piezometers that are installed from upstream of The Grotto to downstream along the Genowlan Creek to The Oasis. Standpipe piezometers ARP09, ARP12, and ARP13SP are shown to be rainfall dependent with installations in the alluvium and Permian strata.



a) ARP09 – downstream of The Grotto, upstream of The Oasis.



b) ARP12 – upstream of The Grotto and The Oasis.



c) ARP13SP – downstream of The Grotto and directly adjacent to The Oasis.

Figure 16: Standpipe peizometer results for The Grotto and Genowlan Creek.

The alluvial deposits linked with Gap Creek and Genowlan Creek receive recharge from both rainfall and the movement of water between aquifers from nearby (mainly Permian) rock layers. This groundwater from the sediment deposits flows into the connected streams.

ARP13SP is installed in the Lithgow Seam and has maintained a steady water head throughout the monitoring period up until mid-December in 2023. In the recent Q1 2024 monitoring results, water levels at ARP13SP dropped by 0.51 m which can potentially be attributed to the adjacent mining at MW16. The distance of 575 m to the MW16 workings indicate a potential conduit through basement features.

The surface water flows at The Grotto, The Oasis, Grotto Creek and Genowlan Creek are shown to be related to rainfall patterns and are intermittent in dry periods as shown in Figure 17. Recent flows appear to be greater than pre mining with an increase in rainfall since 2019. There is no evidence of impacts to Genowlan Creek surface water flows as a result of mining.

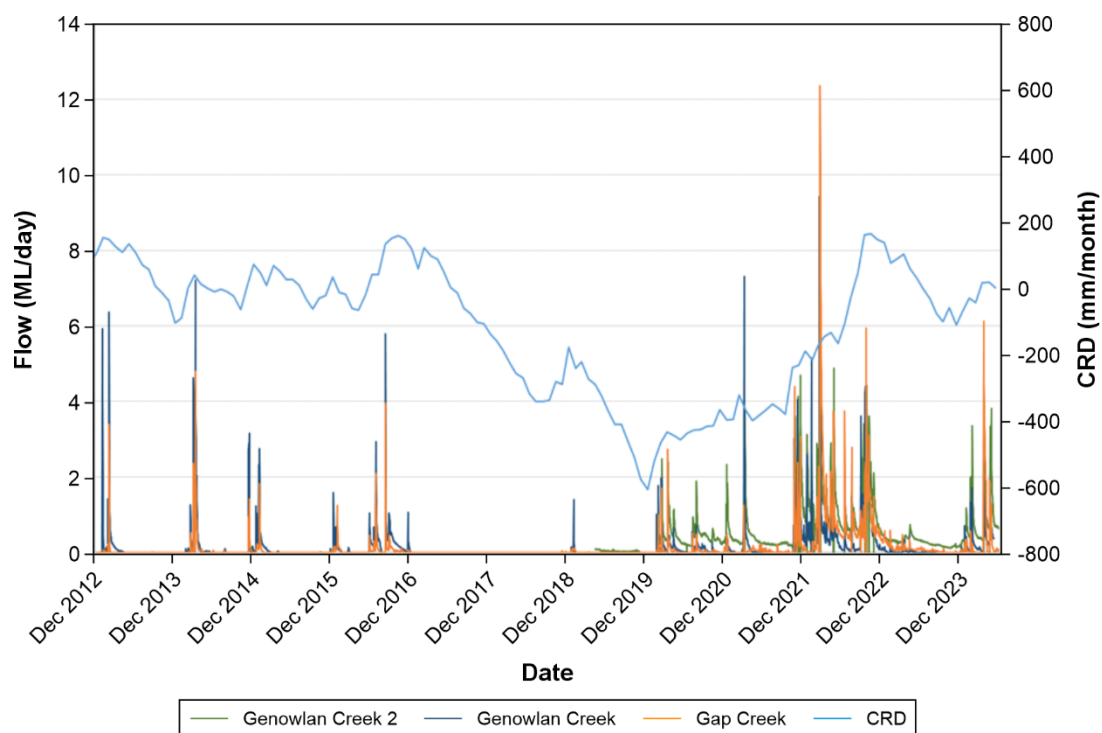


Figure 17: Surface water flow recorded in Gap Creek and Genowlan Creek.

No influence of mining is observed in the standpipe piezometer results within the perched water table. No influence of the adjacent lineament has been observed at the monitoring locations within the perched water table.

8. ESTIMATION OF OVERBURDEN CONDUCTIVITY AND CONNECTIVITY

A summary of overburden conductivity and connectivity for Airly Mine is presented in Table 7. Only a limited dataset was available for interrogation for the overburden conductivity and generally represents in-situ values without the impact of mining. Actual conductivity values would be expected to range by one order of magnitude lower or greater. Testing included packer testing and falling head testing conducted and reported by RPS and GHD.

Table 7: Summary of measured overburden conductivity at Airly Mine

Stratigraphy/Lithology	Hydraulic Conductivity of Overburden
Gap Creek Alluvium	$1 \times 10^{-7} \text{m/s}$
Narrabeen Sandstone	$1 \times 10^{-7} \text{m/s}$ to $1 \times 10^{-10} \text{m/s}$
Lithgow Seam	$1 \times 10^{-7} \text{m/s}$ to $1 \times 10^{-8} \text{m/s}$
Marrangaroo	$1 \times 10^{-8} \text{m/s}$
Upper Shoalhaven	$1 \times 10^{-9} \text{m/s}$
Structure/lineaments	Potential for connectivity – estimated 1-10 times magnitude of depth equivalent

Due to the limited available dataset of conductivity for pre and post mining at Airly Mine, it is useful to look at a conceptual model of the conductivity impacts of full extraction (such as longwall or miniwall mining). The below model does not apply to first workings.

Fracturing of the overburden strata above a longwall goaf can be divided into multiple zones as shown in Figure 18 (Mills, 2022).

These zones are based on field measurements throughout Australian longwalls but is applicable to miniwall extraction based on the panel width to depth of cover. The three major zones are classified as:

- Zone of elastic relaxation - A zone of small ground movements from 1.6 to 3 times panel width above the mining horizon.
- Zone of bedding plane separation - A zone of bedding plane separation from about 1.0 to 1.6 times panel width above the mining horizon.
- Zone of large downward movement - A zone of large downward movement from seam level to a height above the mining horizon approximately equal to the panel width.

Based on the caving zones described above, there is also a resultant modification to either or both the vertical and horizontal conductivity. The application of the empirical model places The Grotto in the zone of elastic relaxation with horizontal tension/strain possibly increasing vertical permeability. This would be expected to be localised to this elastic zone with no connectivity to the zones below. The Oasis located near first workings would have no expected variation in conductivity or connectivity in the alluvial groundwater.

The diagram illustrates the vertical profile of a coal seam and the surrounding rock, showing the effects of extraction. The top boundary is the **Ground Surface**. The coal seam is at the bottom, labeled **Extracted coal seam**. The rock above the seam is divided into three distinct zones, each with specific stress and permeability characteristics:

- Zone of elastic relaxation (3W):** The uppermost zone, bounded by dashed lines. It is characterized by **Horizontal tension possible increased** and **vertical permeability** changes.
- Zone of bedding plane separation (1.6W):** The middle zone, bounded by dashed lines. It shows **Horizontal tension, vertical compression, some permeability increases possible** and **Horizontal compression, vertical tension, no change in vertical permeability, likely increase in horizontal permeability**.
- Zone of large downward movement (W):** The lower zone, bounded by dashed lines. It is characterized by **Permeability increased** and **Totally destressed large increases in bulk permeability**.

At the base of the rock zone is a layer of **Loose caved blocks of rock** directly above the **Extracted coal seam**. The diagram uses different patterns (dotted, solid, and hatched) to represent these various geological and stress-related regions.

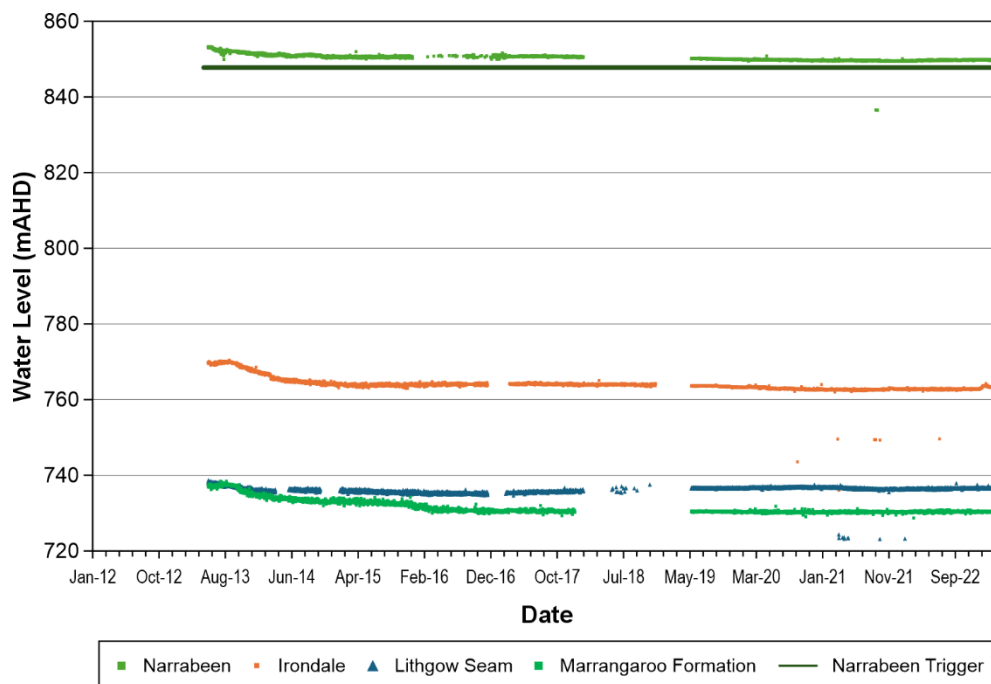
Yours sincerely

Adrian Rippon
Principal Geotechnical Engineer

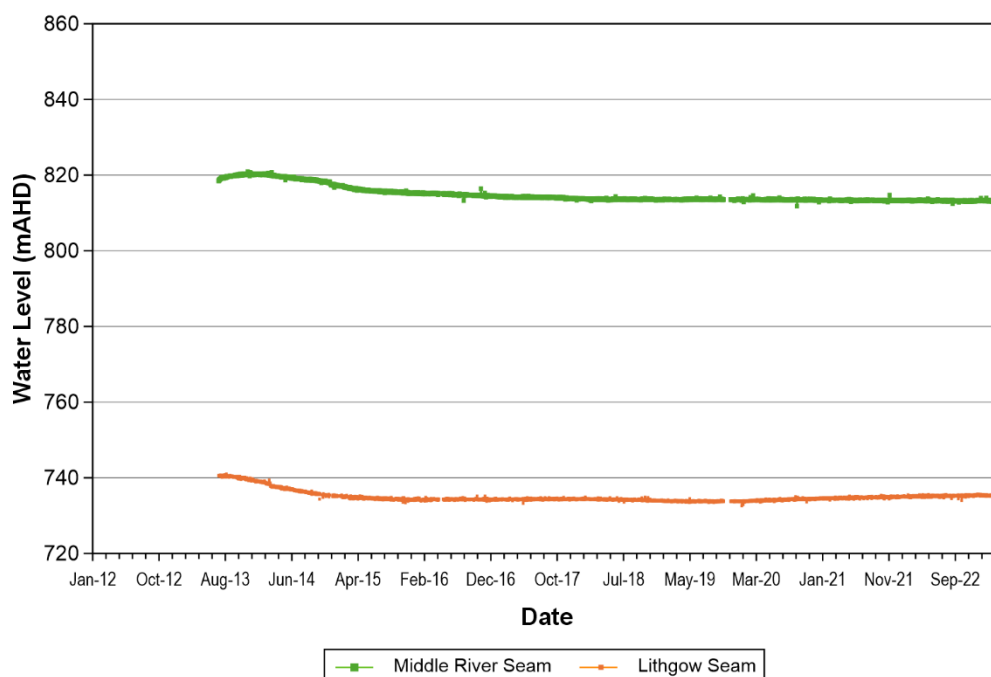
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APPENDIX 1

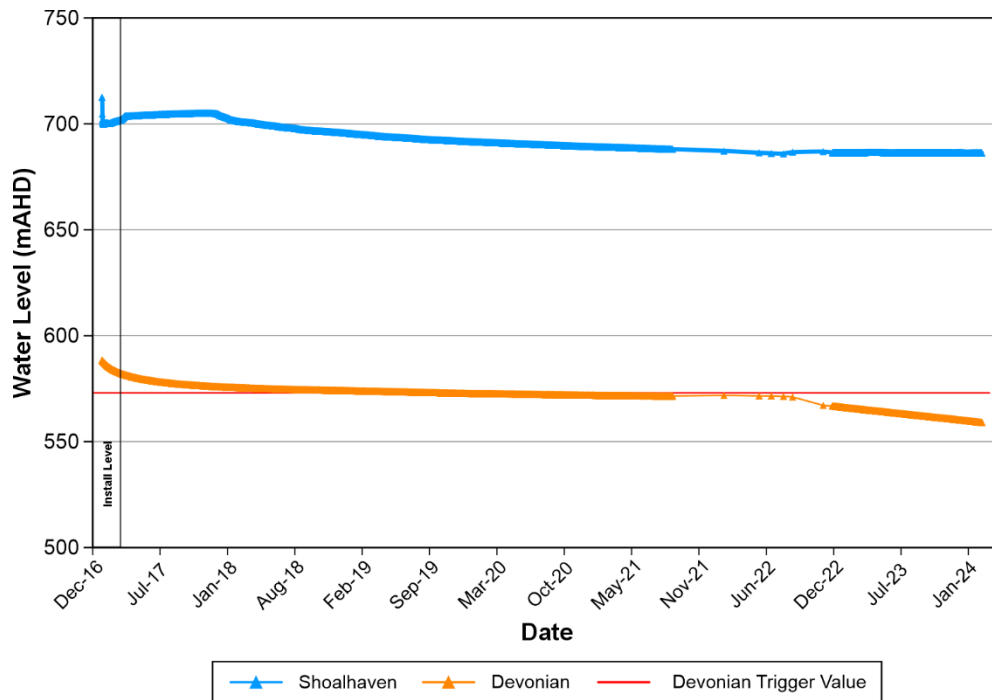


a) ARP06.

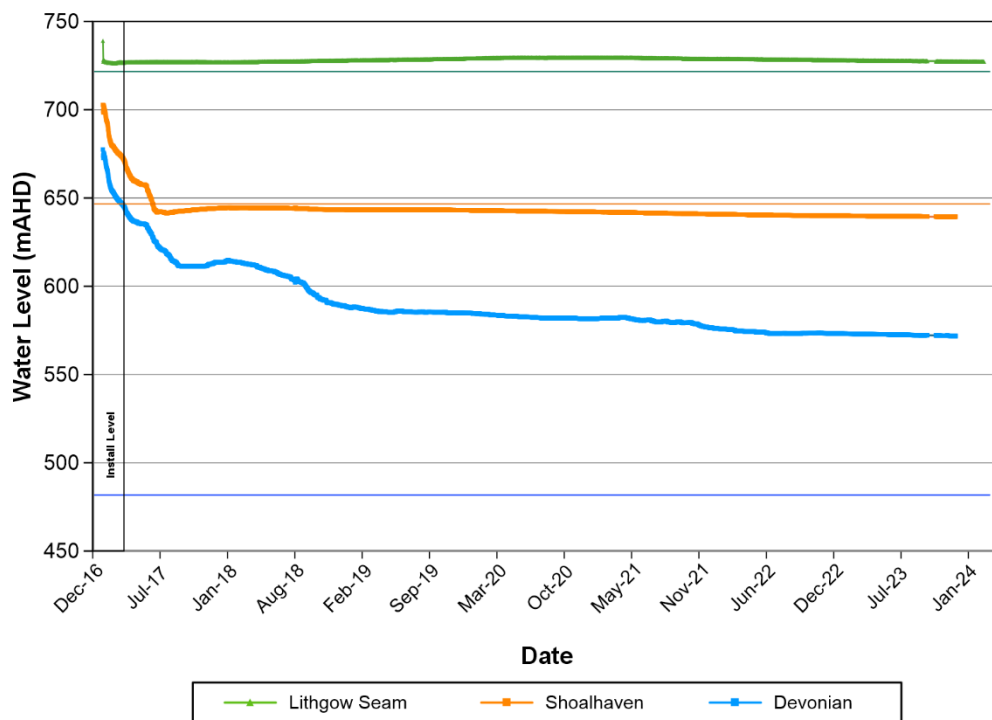


b) ARP07.

Appendix A1: VWP hydrographs.



c) ARP13.



d) ARP15.

Appendix A2: VWP hydrographs.

23 July 2024



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AIRLY5796

Dear Jacqueline

AIRLY MINE OVERBURDEN SUBSIDENCE AND CONDUCTIVITY REVIEW FOR THE GROTTA AND THE OASIS - Q2 2024

1. INTRODUCTION

Centennial Coal Pty Ltd (Centennial) owns and operates Airly Mine, an existing underground coal mine located 40 km northwest of Lithgow in the Western Coalfield of NSW. Airly Mine uses first workings, pillar extraction and miniwall mining methods to extract the Lithgow Seam. Airly Mine have completed MW13 to MW16 and are currently developing HB1 panel to the south of The Grotto.

Centennial engaged SCT Operations Pty Ltd (SCT) to complete a Q2 2024 assessment of the existing subsidence impacts from current mining and potential impacts from proposed workings surrounding an area known as The Grotto and The Oasis. The Grotto is a narrow slot canyon with surrounding internal cliff lines that is categorised by the Independent Review Panel (IRP) to be a significant landform on the national and international stage. The Oasis, also known as Jurassic Park, is a wider deeply incised gorge typified by tall forest communities. Therefore, The Grotto and The Oasis is to be protected similarly to the Cliff Line Zone (CLZ) by only containing first workings with pillars designed to be long term stable and produce minimal subsidence. Development consent (SSD_5581) notes the subsidence impact performance measure for The Grotto and The Oasis to be negligible subsidence impacts or environmental consequences.

The location of The Grotto and The Oasis with existing and proposed workings are shown in Figure 1. The Grotto and The Oasis is located within ML1814 and current first workings EP application.

This letter report consists of a high-level assessment of the potential subsidence impacts, groundwater characteristics, and surface connectivity for The Grotto, The Oasis and surrounding CLZ, and consists of a review of industry standards and experience, and existing mining impacts at adjacent workings (MW15a and MW16) at Airly Mine. The areas discussed in the report are identified on Figure 1.

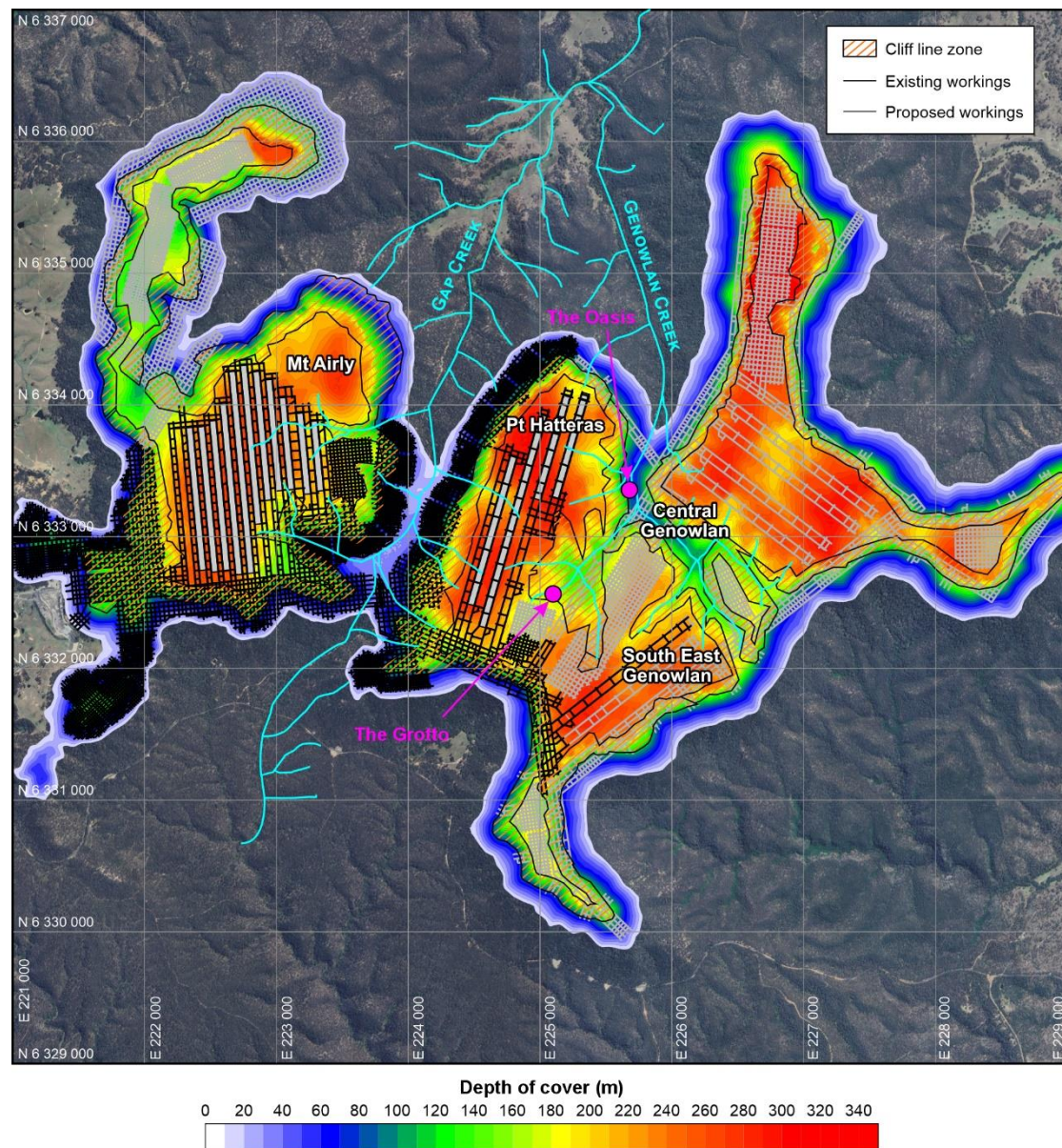


Figure 1: Existing and proposed workings at Airly Mine.

2. PROJECT BACKGROUND

This report builds on several previous packages of work where relevant data, assessments and key outcomes have been included. Previous scopes of work that this report builds on include:

- AIRLY5650
 - High level review of the latest Airly Mine reports that encompass the CLZ first workings and any influence of the Grotto lineaments.
 - High level review of proposed mine design and caving/subsidence impacts.
 - Review of Airly piezometric and conductivity data of the overburden to characterise current situation and understand existing mining impacts at Airly Mine.
 - High level summary of potential groundwater impacts for proposed extraction. Estimation of overburden conductivity and connectivity including commentary around faults/lineaments.
 - Provide a review of areas that may require further assessment in relation to overburden conductivity and connectivity.
- AIRLY5650_Rev1 and 2
 - After the completion of the initial report, Centennial requested that The Oasis also be included in the assessment.
- AIRLY5650_Rev3
 - A further request for an addendum report was made with the availability of updated groundwater and subsidence data on the 20th of June 2024.
- AIRLY5650_Rev 4
 - Provides an updated assessment to include the most recently available groundwater data.

3. CONCLUSION

The high-level review of the available subsidence data and groundwater monitoring at Airly Mine indicates that mining activities up to Q2 2024 nearby The Grotto and The Oasis to have caused low levels of subsidence.

Based on recent GNSS monitoring, measured far field subsidence movements range from 9 mm to 15 mm at The Grotto after the completion of MW13 to MW16. At the completion of the proposed first workings, including the HB1 pillar workings and Central Genowlan main headings, subsidence is predicted to be within 20 - 30 mm at The Grotto. Total subsidence values have been estimated using empirical analysis and previous numerical modelling for first workings at Pt Hatteras. The addition of adjacent first workings to miniwall subsidence was included in the HB1 pillar assessment (SCT report AIRLY5695) and identified the potential for additional surface subsidence from adjacent first workings. The subsidence predictions for this assessment are consistent with those identified in AIRLY5695.

The estimated subsidence magnitudes for the proposed herringbone pillar workings to the south of The Grotto are predicted to have negligible subsidence effects on the adjacent CLZ and The Grotto. The estimated subsidence magnitudes for the proposed Central Genowlan main headings mined to the east of The Grotto are predicted to have negligible subsidence effects and have been designed to be long term stable.

The Oasis is beyond the current GNSS monitoring sites however subsidence magnitudes are expected to be outside the subsidence monitoring tolerance (+/- 5 mm) from the extraction of MW13 to MW16. The estimated subsidence magnitudes for the proposed Central Genowlan main headings would be expected to have negligible subsidence effects to the adjacent CLZ and The Oasis and be less than 9 mm.

Horizontal movements at The Grotto due to the extraction of MW13 to MW16 are measured to be 5 mm to 15 mm in a south westerly direction. Horizontal movements at The Oasis due to the extraction of MW13 to MW16 are predicted to be less than that of The Grotto. The sub critical mining geometry and landform is expected to result in negligible horizontal movements due to the low horizontal stress environment at Airly Mine.

For a baseline groundwater impacts assessment, a review of potential mining impacts in the Gap Creek lineament, located between Mt Airly and Mt Genowlan, was conducted as first workings and pillar splitting occurred adjacent to the lineament. The Lithgow Seam is 25 m under Gap Creek and the first workings are approximately 50 m from the Gap Creek piezometers. The Gap Creek example shows that if the mining horizon water head level is connected to the surface water source, depressurisation of the mining horizon has the potential to produce downwards flow through the fracture network, including through lineaments. Updated groundwater monitoring indicates water level recovery in the Alluvium and Permian strata. Creek flow variability is also in line with rainfall patterns. These trends are an indication of a return to baseline conditions pre-mining. There is no evidence of long-term adverse impacts to Gap Creek surface water flows because of mining.

The lineaments may provide a conduit to the perched alluvial aquifer and laterally provide a conduit to another lineament that is connected to the aquifer. The potential for reactivation of faults and lineaments traversing the area and adjacent workings is considered low due to the low stress environment and low stress redistribution from first workings. There is a low probability of groundwater impacts at The Grotto and The Oasis due to low levels of predicted subsidence and an increased depth of cover as compared to Gap Creek.

A review of the potential mining impacts to the groundwater and tributary flow at Genowlan Creek was conducted after miniwall extraction in the Point Hatteras Panel and Pillar mining Zone (PPMZ) and updated with the 2024 Q1 monitoring results.

Little to no variation in pressure head has occurred because of adjacent mining at Point Hatteras in the vicinity of The Grotto. No influence of mining is observed in the standpipe piezometer results. No influence of the adjacent lineament has been observed at the monitoring locations.

Monitoring at The Oasis in the Lithgow Seam and has maintained a steady water head throughout the monitoring period up until mid-December in 2023. In the recent Q1 2024 monitoring results, water levels dropped by 0.51 m which can potentially be attributed to the adjacent mining at MW16. The distance of 575 m to the MW16 workings indicate a potential conduit through basement features. No influence of mining is observed in the standpipe piezometer results at The Oasis within the perched water table. No influence of the adjacent lineament has been observed at the monitoring locations within the perched water table.

The perched aquifer in the alluvium of The Grotto and The Oasis would not be expected to be impacted by adjacent mining. The theoretical height of total depressurisation for the Point Hatteras PPMZ is calculated as 53 m above the coal seam. These calculations are based on a panel width of 60 m, mining height of 3 m and mining depth of 280 m using the Tammetta (2012) empirical equation.

The surface water flows at The Grotto, The Oasis, Grotto Creek and Genowlan Creek are shown to be related to rainfall patterns and are intermittent in dry periods. Recent flows appear to be greater than pre mining with an increase in rainfall since 2019. There is no evidence of impacts to Genowlan Creek surface water flows because of mining.

4. SITE DESCRIPTION

The current mining area consisting of miniwall panels MW13-MW16 is located under Mt Genowlan at Point Hatteras. Mt Genowlan is a mesa, where the surrounding strata has been eroded away.

Figure 2 shows a topographic and stratigraphic section through the current mining area under Mt Genowlan, and the existing mining area under Mt Airly and point Hatteras. The Lithgow Seam is mined at Airly Mine and outcrops near the base of the Mt Airly escarpments.

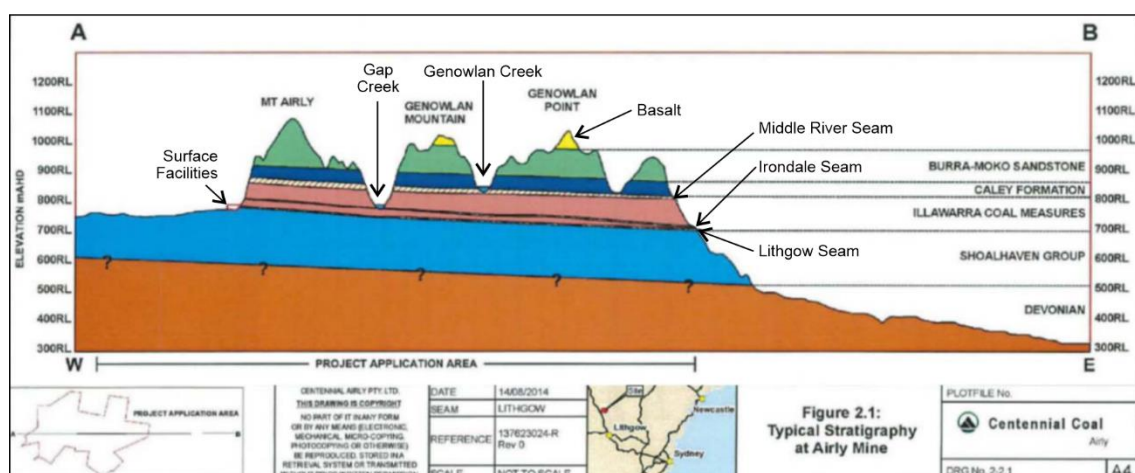


Figure 2: Geology and lithology of Mt Airly and Mt Genowlan (Golders 2018).

The area of interest for this review is the deeply incised gorge of The Grotto. Figure 3 shows the narrow deeply incised gorge of The Grotto, which forms an upper tributary of the Genowlan Creek. Monitoring by Airly Mine has shown the water flow in The Grotto to be ephemeral and rainfall dependant (Golder EIS, 2014). Short episodes of streamflow happen in both Gap and Genowlan Creeks during and after rain events, but rapidly subside to a no-flow state when there is inadequate rainfall and runoff to sustain the flow of surface water.

In areas where there is a greater source of sediments, the gorges become wider and allow the accumulation of deeper soil profiles. In these areas, more regular surface water flow encourages the growth of taller moist forest communities. This type of gorge is typified by The Oasis, which is located on the lower portion of Genowlan Creek within Genowlan Mountain. Figure 4 shows the typical landscape of a wider deeply incised gorge in the form of The Oasis (Golder EIS, 2014).

The Grotto and The Oasis form internal cliffs to the Mt Genowlan mesa, created along joints and fractures in the sandstone. Figure 5 shows the structural interpretation of basement and surface faults and joints for Airly Mine. Lineaments, indicative of the underlying basement faults, are common at Airly Mine and can have implications on subsidence, cliff line and overhang instability, aquifer connectivity and groundwater flow.

5. THE GROTTO SUBSIDENCE REVIEW

At the time of this report, there is currently no planned extraction directly below The Grotto, however, first workings and secondary extraction are planned adjacent to The Grotto at both Point Hatteras and the Southeast Genowlan area (current EP). MW15b is approximately 280 m to the west of The Grotto and the HB1 panel is approximately 80 m to the south at its closest point. A set of main headings to the Central Genowlan mining area are proposed under the internal CLZ that extend beyond The Grotto and are located approximately 80 m to the east of The Grotto. The subsidence of these workings has been assessed based on the proximity to The Grotto with potential subsidence impacts noted.

The Grotto is classified to be in the CLZ in the EIS and EP. The following extract is from the EIS, 2014 outlining the mining method, geometry, and design restrictions within the CLZ.

Mining in Cliff Line Zone and Zone of First Workings zone would consist of first workings only with pillars designed to be long term stable. The pillars used in this area would be typically large with an appropriately high FOS equivalent to that used for protection of key surface features (typically FOS >2.11). Apart from the major cliff lines, this zone also covers other key areas where subsidence impact would be significant, such as around The Grotto. Key features of this type of mining include:

- *Mining height: <3.0 m.*
- *Maximum roadway width: 5.5 m.*
- *Maximum void width: <10 m.*
- *Pillar system FOS: >2.11 (protection of key surface features).*
- *Pillar width to height ratio: >8.0.*

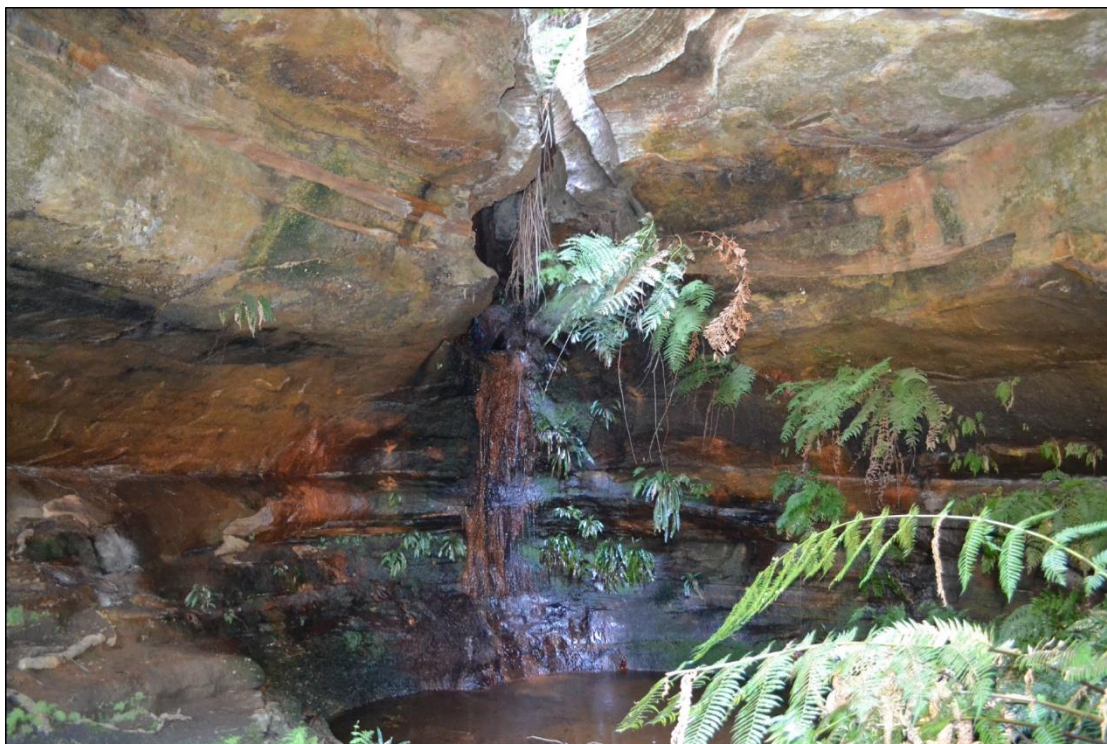


Figure 3: The Grotto.

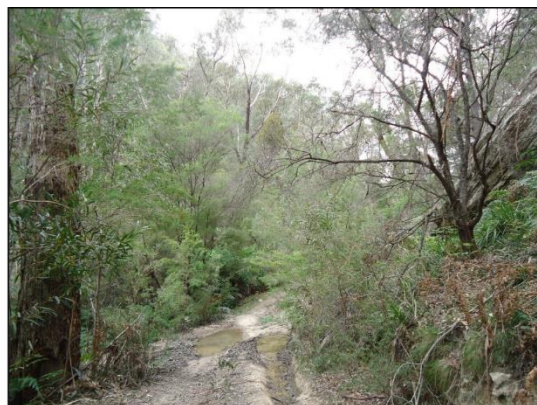


Figure 4: The Oasis.

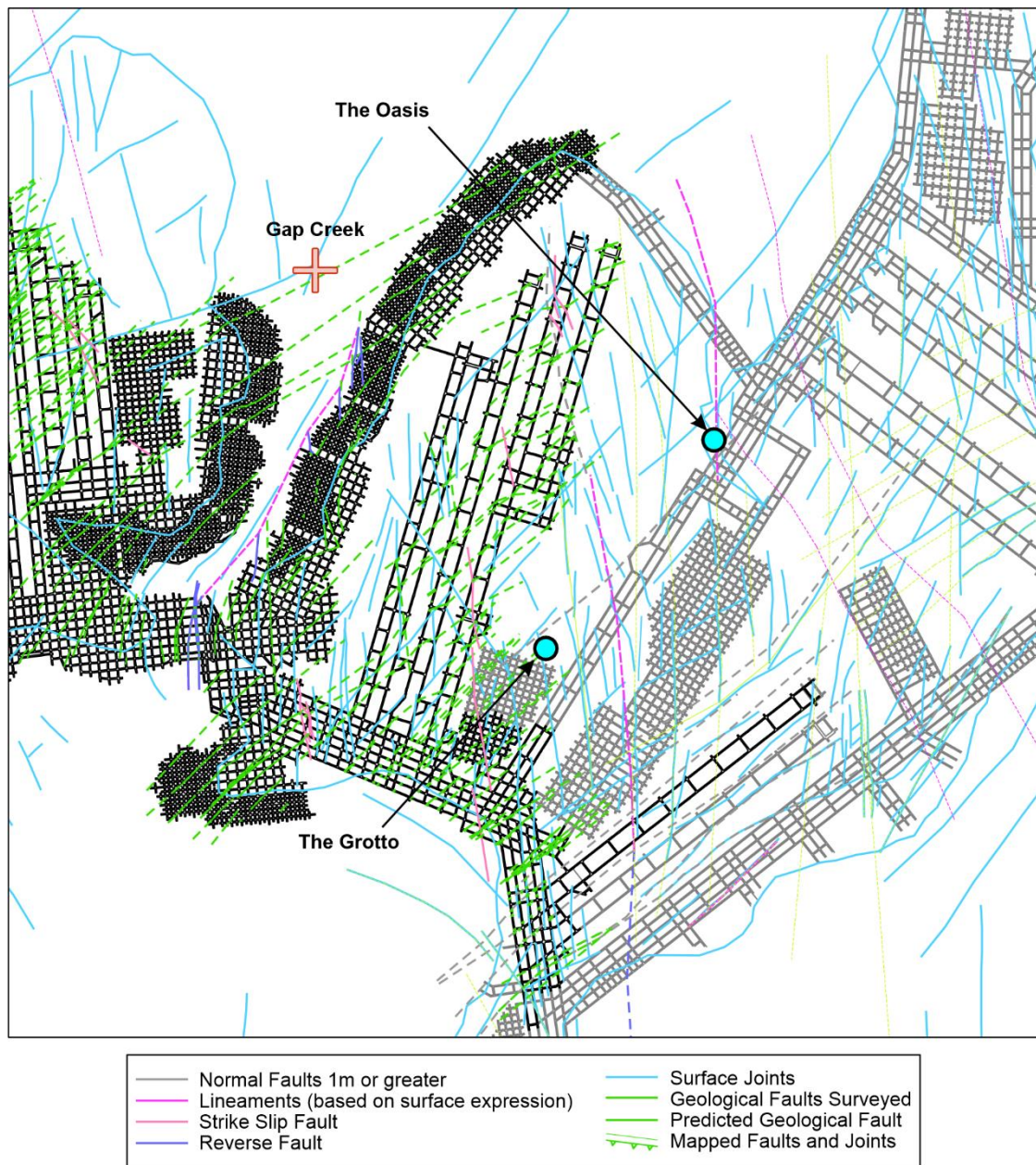


Figure 5: Airly Mine structural interpretation of basement and surface faults and lineaments.

Condition 2, Schedule 3 of the development consent SSD_5581 stipulates no greater subsidence impacts or environmental consequences in the CLZ than predicted in the EIS (i.e., occasional rock falls, displacement, dislodgement of boulders or slabs of less than 30 m² or fracturing, that do not impact Aboriginal heritage, EECs, or public safety), that in total do not impact more than 2% of the total area of such cliffs.

5.1 Point Hatteras Panel and Pillar Mining Zone

The Point Hatteras Panel and Pillar Mining Zone (PPMZ) EP states that the predicted far-field horizontal movements due to the proposed MW13 to MW16 are expected to be small and could only be detected by precise surveys. Such movements tend to be bodily movements towards the mining area and are accompanied by very low levels of strain (i.e., less than 0.3 mm/m), generally outside of survey tolerance. Potential impacts of far-field horizontal movements on the natural and built features within the vicinity of the proposed miniwalls are not expected to be significant.

Global Navigation Satellite System (GNSS) monitoring has been conducted at Airly Mine over both miniwall and first workings extraction. GNSS monitoring supplied for this assessment was dated 6th of May 2024. GNSS data results have been interrogated for the Point Hatteras miniwall panels with the subsidence contours presented in Figure 6. The subsidence contours are created using Surfer, a 2D and 3D geological modelling software package. The subsidence magnitudes have been interpolated using natural neighbour. The natural neighbour gridding method interpolates grid values by weighting neighbouring data points based on proportionate areas. The 20 mm subsidence contour line has been highlighted for comparisons with previous assessments. Based on GNSS monitoring the vertical subsidence at The Grotto is in the order of 10 mm due to MW13 to MW16 extraction. Noting the GNSS resolution is at best +/-5 mm with clear sky above the station and can be greater with overhanging vegetation or cliffs, solar interference, or troposphere anomalies.

Subsidence profiles from the updated GNSS monitoring have been extrapolated to encompass far field subsidence movement for the CLZ and The Grotto to the east of MW16. Figure 7 presents the GNSS subsidence data for the extraction of MW13 and MW15b at the south of Point Hatteras and MW13, MW14, MW15a and MW16 to the north at Point Hatteras. The modelled profiles from SCT report AIRLY5265 have also been plotted for comparison. The GNSS interpolated subsidence magnitudes are reliable for comparison and are shown to closely match predicted subsidence magnitudes from the modelling. The far field GNSS subsidence magnitudes at The Grotto also correlate with the models with low levels of measured subsidence between 9 to 15 mm.

The potential energy released by subsiding rock strata is available to generate horizontal subsidence movements within the overburden strata generally, but particularly at the surface and especially when the surface topography is variable. The horizontal movements associated with variable topography cause movement to occur in a downslope direction. This movement causes valley closure and compression of the rock strata in the base of the valley. The relative upward movement of the compressed rock strata in the base of the river channel is called upsidence (Mills, 2009).

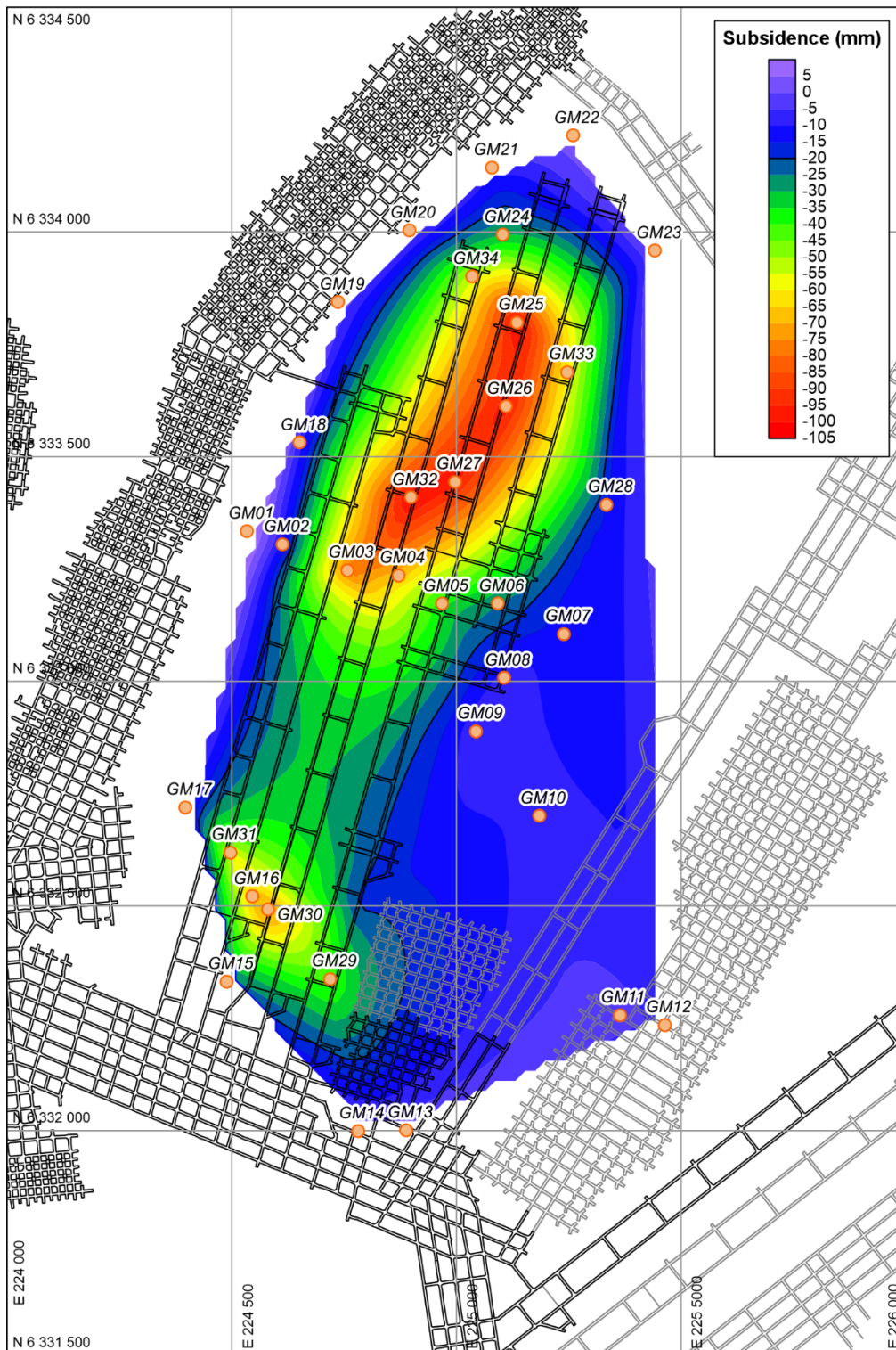


Figure 6: Interpolated GNSS subsidence monitoring contours for Point Hatteras.

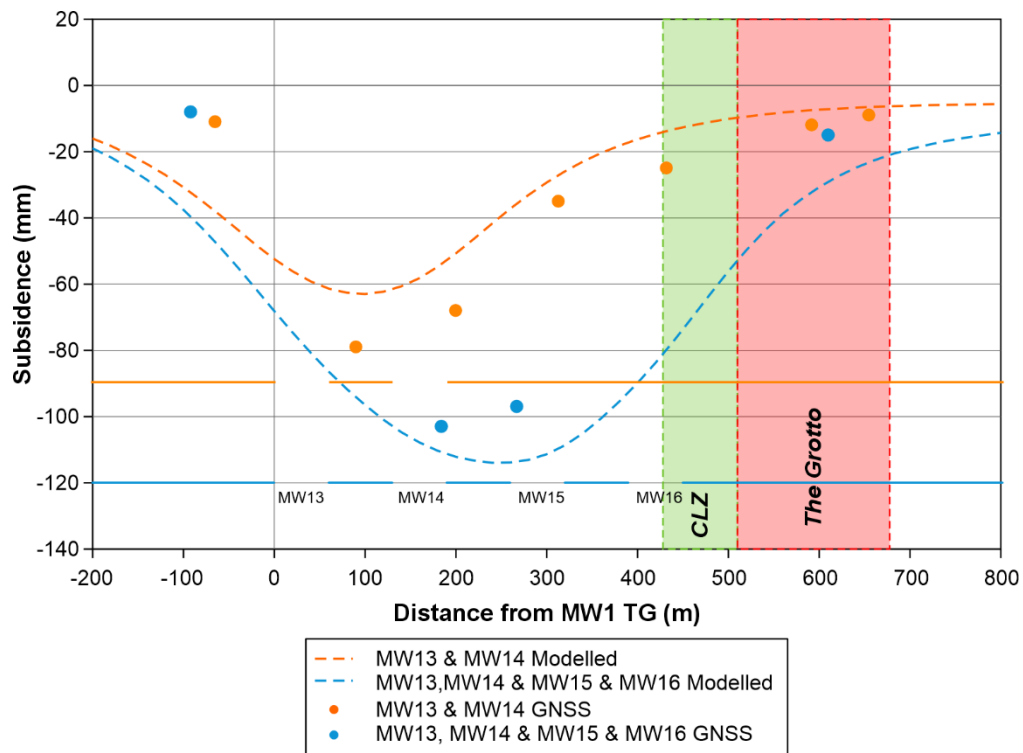


Figure 7: GNSS and modelled vertical subsidence comparison.

Mills (2009) noted several contributing factors recognised to cause horizontal movements that included:

- Horizontal stresses locked within the overburden strata become concentrated about the base of valleys so that failure of the rock bar causes valley closure.
- Stress relief of the overburden strata above the base of a valley toward the valley.
- Horizontal movements toward topographic low points caused by strata dilation along vertical joints and block rotation within the overburden as differential subsidence movements occur.
- Combinations of systematic subsidence and strata dilation movements.
- Horizontal compression of buttress rock between top of goaf and surface.

The sub critical mining geometry and landform at The Grotto is expected to result in negligible horizontal movements due to the low horizontal stress environment at Airly Mine. Using the same contouring method as the vertical subsidence, horizontal vector plots have been interpolated by using the eastings and northings movement measured by the GNSS instruments. Figure 8 presents the horizontal movements as a vector plot with direction and magnitude. Horizontal movements around The Grotto have been interpolated to be 5 mm to 15 mm in a south westerly direction. Influenced by the extraction of MW15b. Both the magnitude and direction are consistent with experience at Mt Airly.

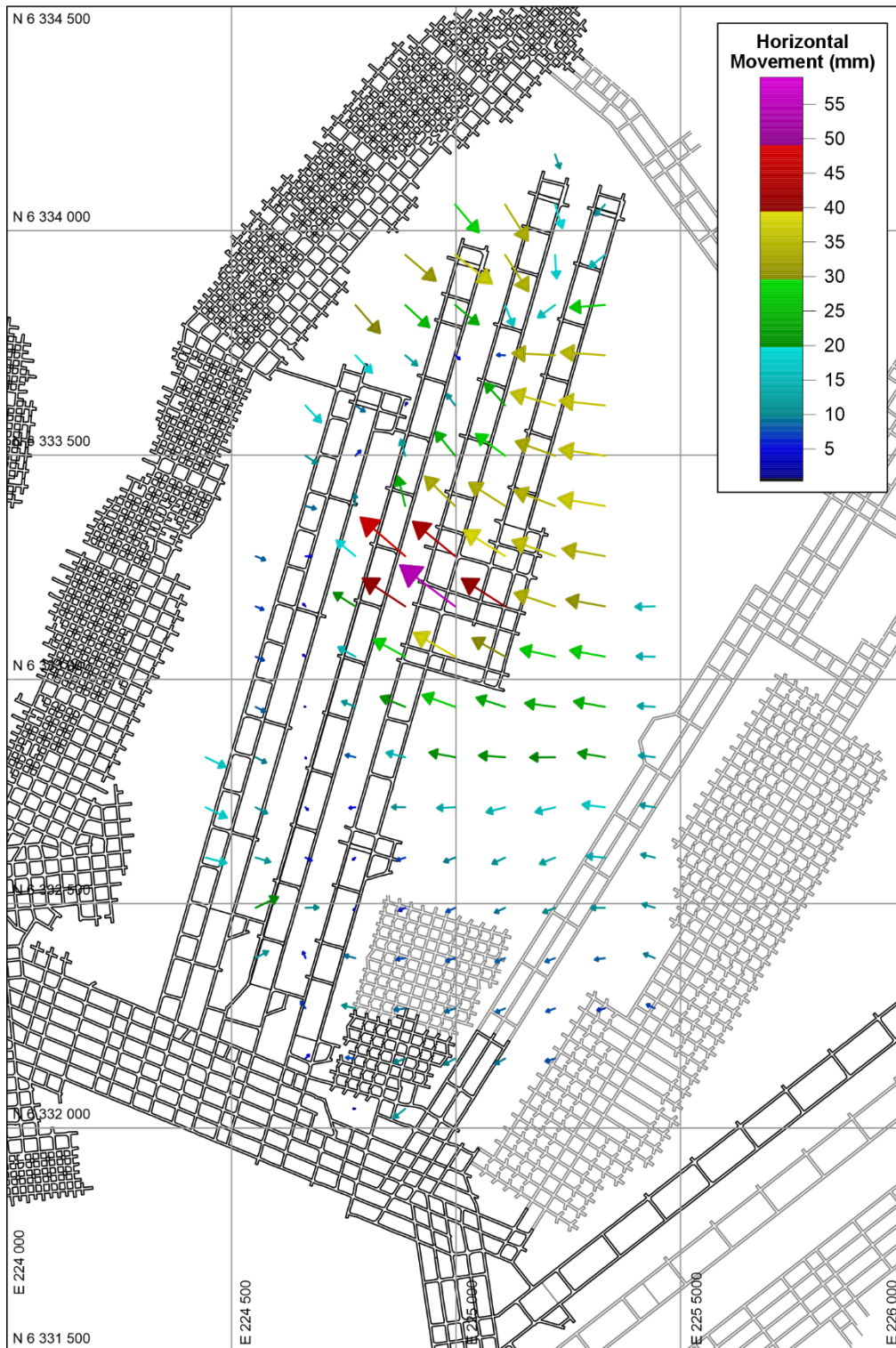


Figure 8: Interpolated GNSS horizontal movement.

5.2 Subsidence predictions for mining adjacent to The Grotto

The Southeast Genowlan panel and pillar mining zone forms part of the ML1814 extraction plan. The high-level subsidence review for the Southeast Genowlan area is based on the Airly Cliffline Zone Extraction Plan Workings - ML1814 - 20240715.dwg supplied by Centennial on the 15th of July 2024. A comprehensive subsidence impact assessment has been completed for the ML1814 first workings EP application presented in SCT report AIRLY5535,2023 – Pillar geometry assessment for cliff line zone extraction plan.

Table 1 presents the subsidence estimates for the proposed pillar design containing herringbone bord and pillar workings to the south of The Grotto CLZ. The estimated subsidence above the workings is in the range of 25 mm to 29 mm. Assumptions for these subsidence calculations include:

- 3.2 m pillar height
- 5.5 m roadway width
- 2.5 g/cm³ density
- 26.5 m pillar centres.

Table 1: HB1 Herringbone pillar workings subsidence estimates to the south of The Grotto

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	Δ Stress (MPa)	Subsidence (mm)	Maximum tensile strain (mm/m)	Maximum compressive strain (mm/m)	Tilt (mm/m)
170	5.25	7.75	2.50	25	0.22	0.29	0.72
180	5.50	8.15	2.65	27	0.22	0.29	0.72
190	5.75	8.55	2.80	28	0.22	0.29	0.72
200	6.00	8.95	2.95	30	0.22	0.29	0.72

The estimated subsidence magnitudes for the herringbone pillar workings would be expected to have negligible subsidence effects to the adjacent CLZ and The Grotto to the north. The Grotto is approximately 80 m to the north of the HB1 Herringbone pillar workings where maximum depth of cover is 190 m. The estimated vertical subsidence caused by the HB1 Herringbone pillar workings is therefore expected to be less than 28 mm at The Grotto and in the range of 10 mm.

Table 2 presents the subsidence estimates for the proposed main headings to the Central Genowlan mining area. The Central Genowlan headings are directly beneath

the CLZ, adjacent to The Grotto. The estimated subsidence is in the range of 10 mm to 12 mm. Assumptions for these subsidence calculations include:

- 3.2 m pillar height
- 5.5 m roadway width
- 2.5 g/cm³ density
- 35 m by 105 m pillars.

Table 2: Central Genowlan main heading subsidence estimates under the internal CLZ adjacent to The Grotto

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	Δ Stress (MPa)	Subsidence (mm)	Maximum tensile strain (mm/m)	Maximum compressive strain (mm/m)	Tilt (mm/m)
160	5.00	6.01	1.01	10	0.09	0.12	0.31
170	5.25	6.32	1.07	11	0.09	0.12	0.31
180	5.50	6.64	1.14	11	0.09	0.12	0.31
190	5.75	6.95	1.20	12	0.09	0.12	0.31
200	6.00	7.26	1.26	12	0.09	0.12	0.31

The estimated subsidence magnitudes for Central Genowlan main headings would be expected to have negligible subsidence effects on the adjacent CLZ and The Grotto to the west. The Grotto is approximately 80 m to the west of the Central Genowlan main headings where maximum depth of cover is 190 m. The estimated vertical subsidence caused by the Central Genowlan main headings is expected to be less than 12 mm at The Grotto and in the range of 5 mm.

6. THE OASIS SUBSIDENCE REVIEW

The Oasis is not located within the CLZ as per the development consent and is classified as being within the Shallow Zone. The Shallow Zone is a second zone of first workings between the 100 m and 20 m depth of cover contours. In areas of European heritage, this zone often extends into slightly deeper areas, with first workings protection areas around the heritage sites defined by half the depth (CLZ EP, 2015). No mining is planned directly below The Oasis as shown in Figure 9 with only long-term stable pillars (FOS > 2.11) to the east.

Centennial provided the proposed workings and geology for The Oasis as presented in Figure 9. No first workings are planned directly below The Oasis. Proposed main headings to the access the Mt Genowlan mining area flank The Oasis. The subsidence of the workings has been assessed based on the proximity to The Oasis, with potential subsidence impacts noted.

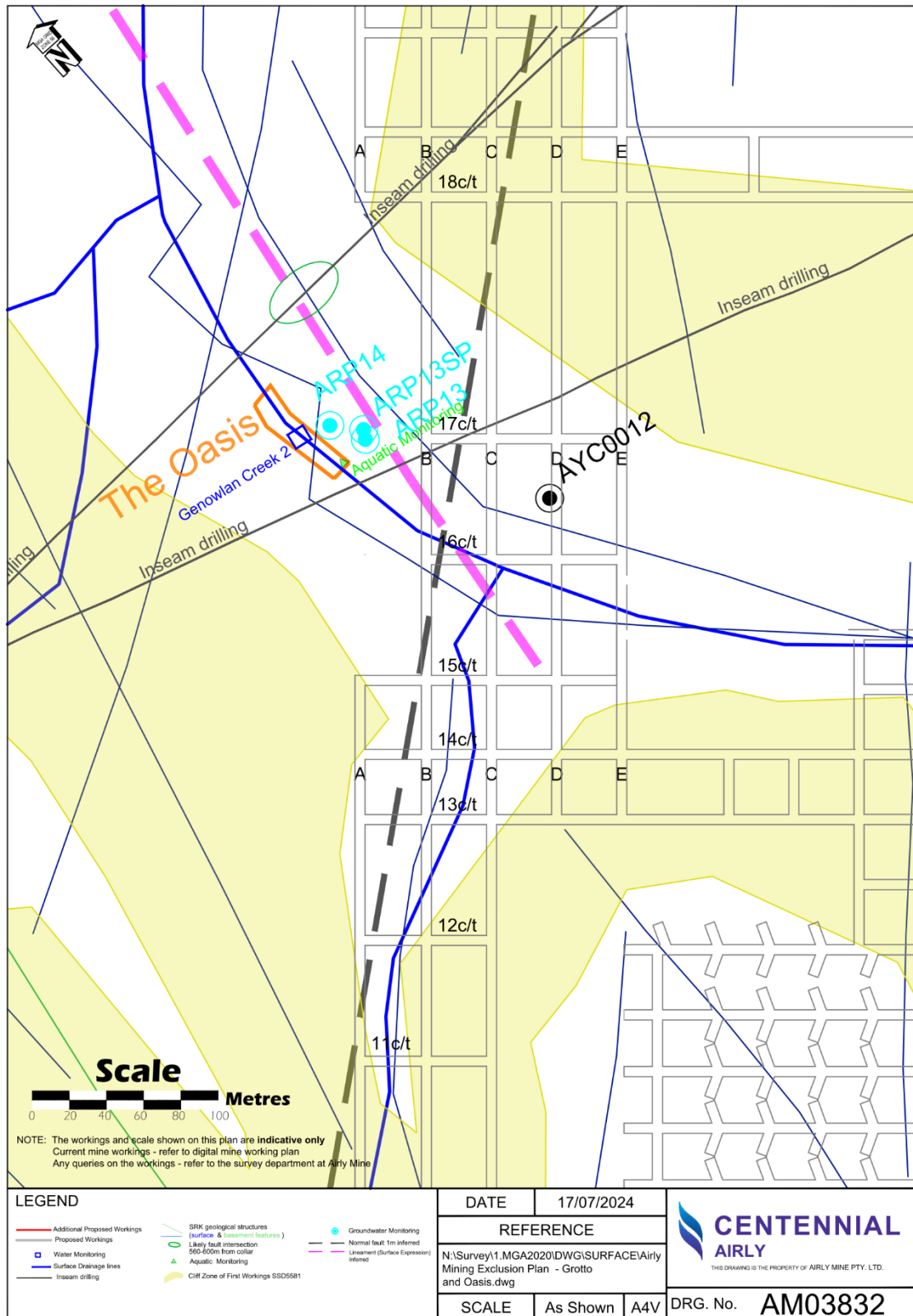


Figure 9: Potential mining scenarios for the area surrounding The Oasis.

Table 3 presents the subsidence estimates for the proposed main headings to the Central Genowlan mining area. The Central Genowlan headings run past The Oasis to the east. The estimated subsidence is in the range of 6 mm to 9 mm. Assumptions for these subsidence calculations include:

- 3.2 m pillar height
- 5.5 m roadway width
- 2.5 g/cm³ density
- 35 m by 65 m pillar centres.

Table 3: Central Genowlan main heading subsidence estimates adjacent to The Oasis.

Depth (m)	Vertical stress (MPa)	Average pillar stress (MPa)	Δ Stress (MPa)	Subsidence (mm)	Maximum tensile strain (mm/m)	Maximum compressive strain (mm/m)	Tilt (mm/m)
70	2.75	3.38	0.63	6	0.13	0.17	0.43
80	3.00	3.72	0.72	7	0.13	0.17	0.43
90	3.25	4.07	0.82	8	0.13	0.17	0.43
100	3.50	4.41	0.91	9	0.13	0.17	0.43

The estimated subsidence magnitudes would be expected to have negligible subsidence effects to the adjacent CLZ and The Oasis to the east. The Oasis at its closest point is 20 m to the west of the Central Genowlan main headings where maximum depth of cover is 100 m. The estimated vertical subsidence caused by the Central Genowlan main heading is expected to be less than 9 mm at The Oasis.

As with The Grotto, there is potential for horizontal subsidence movements within the overburden strata generally, particularly at the surface and especially when the surface topography is variable. The horizontal movements associated with variable topography cause movement to occur in a downslope direction. This movement can cause valley closure and compression of the rock strata in the base of the valley to cause upsidence. The mining geometry and landform at The Oasis is expected to result in negligible horizontal movements.

7. THE GROTTO AND OASIS CONNECTIVITY REVIEW

The local groundwater sources within Airly Mine are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured sandstone and coal seams that occur within Mount Airly and Genowlan Mountain (Mod 3, 2019). Local water sources include the Alluvium and quaternary strata, Narrabeen Sandstone, and Illawarra coal measures. Regional groundwater sources below the Lithgow Seam include The Shoalhaven Group and Lower Devonian Metamorphic strata.

Genowlan Creek and Gap Creek segments receive a consistent supply of water from subsurface flows driven by rainfall, which emerge from Quaternary colluvium and alluvium deposits and released slowly into the upper reaches of Genowlan Creek above The Grotto and The Oasis. Monitoring by Airly Mine has shown the water flow in The Grotto to be ephemeral and rainfall dependant whereas anecdotally the flows through The Oasis are more persistent, varying from approximately 2.2 L/s in average conditions to 1 L/s during drought (Golder EIS, 2014).

The Airly Mine groundwater monitoring network is presented in Figure 10. For the Gap Creek and Genowlan Creek review the following monitoring stations have been assessed:

- Gap Creek Groundwater monitoring
 - ARP04 – multi level VWP
 - ARP05 and ARP11 – standpipe water level piezometer.
- Mt Genowlan Groundwater Monitoring
 - ARP06, ARP07, ARP08, ARP13 and ARP15 muti level VWP
 - ARP08, ARP09, ARP12, ARP13, ARP14 and ARP15 – standpipe water level piezometer.

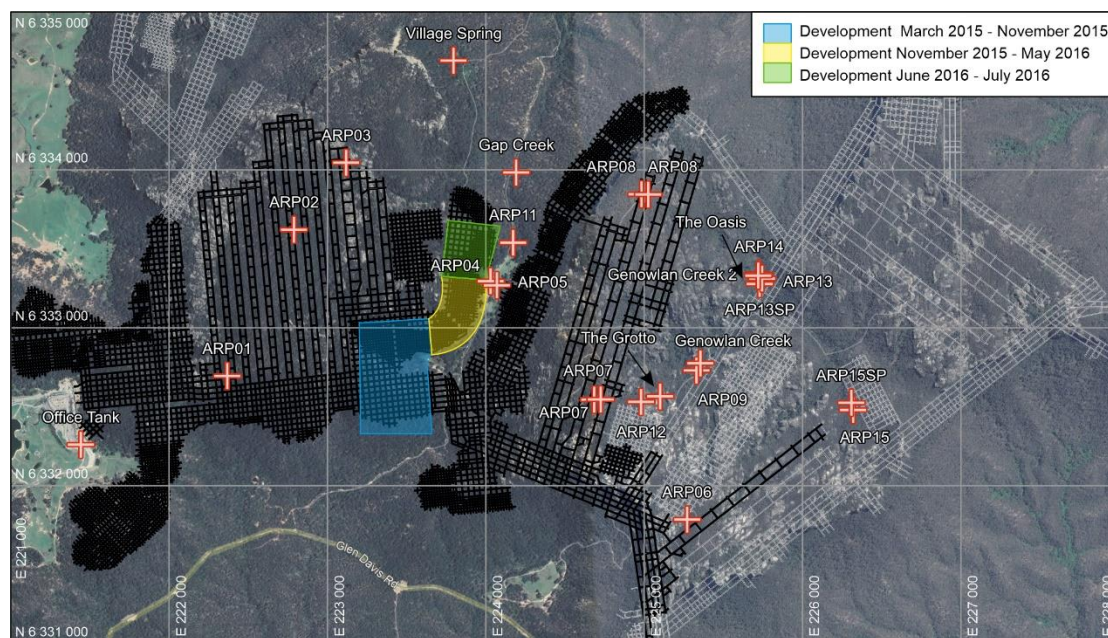


Figure 10: Groundwater monitoring location.

7.1 Airly Mine Gap Creek Experience

A review of potential mining impacts in the Gap Creek lineament at Airly Mine was conducted as first workings were mined adjacent to the lineament. The Lithgow Seam is 25 m under Gap Creek and the first workings are approximately 50 m from the Gap Creek piezometers.

The pre-mining Lithgow Seam head level at Gap Creek in Borehole ARP04 was 744-745 mAHD (Figure 14a). The Gap Creek alluvial head level in ARP05 was 754 mAHD in 2012 then dropped to historical lows in 2015 and became dry at the piezometer level of 747.5 mAHD (Figure 14b). It is likely that the alluvial head level dropped to the groundwater level consistent with the Lithgow Seam of 744 mAHD.

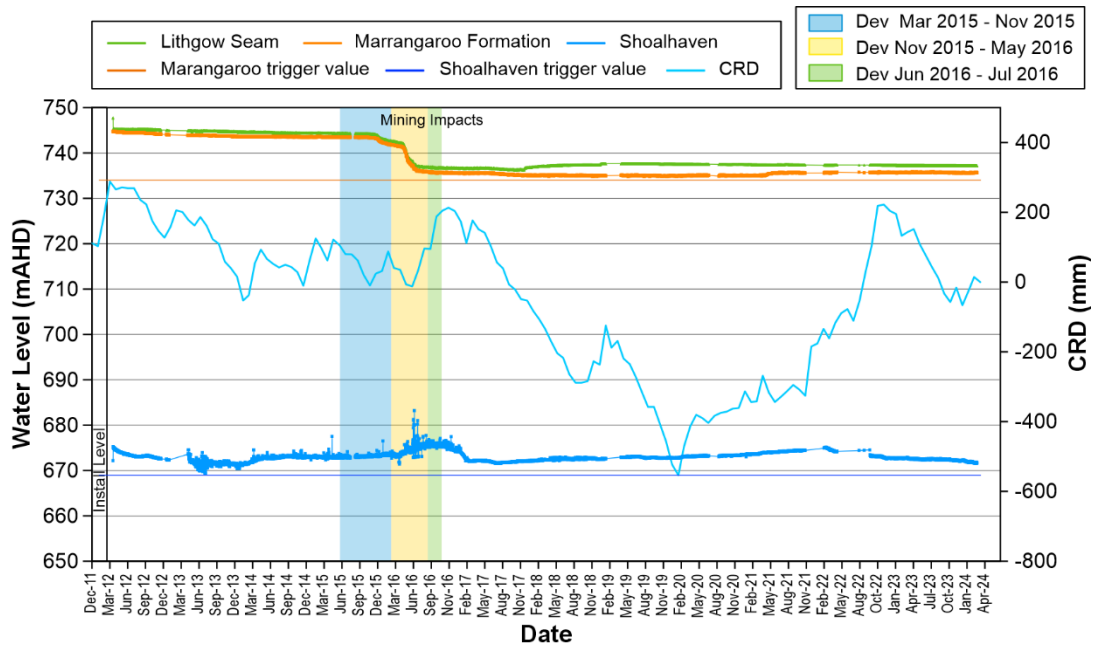
The three areas of underground development to the west of Gap Creek are shaded on Figure 11 and highlight the progressive groundwater impacts. The departure of historical behaviour at ARP05 is shown to correlate with the undermining of the Gap Creek tributary between March and November 2015. The depth of cover for the tributary ranges from 30 m to 100 m. Prior to 2015, groundwater levels at ARP05 indicate a generally decreasing trend that is seen to accelerate with the commencement of adjacent mining.

With first workings extractions and pillar quartering in the Lithgow Seam to the southwest of Gap Creek between November 2015 and May 2016, the Gap Creek piezometers showed a 2 m head drop in Lithgow Seam pressure from 744 mAHD to 732 mAHD. The depth of cover for the tributary ranges from 30 m to 100 m.

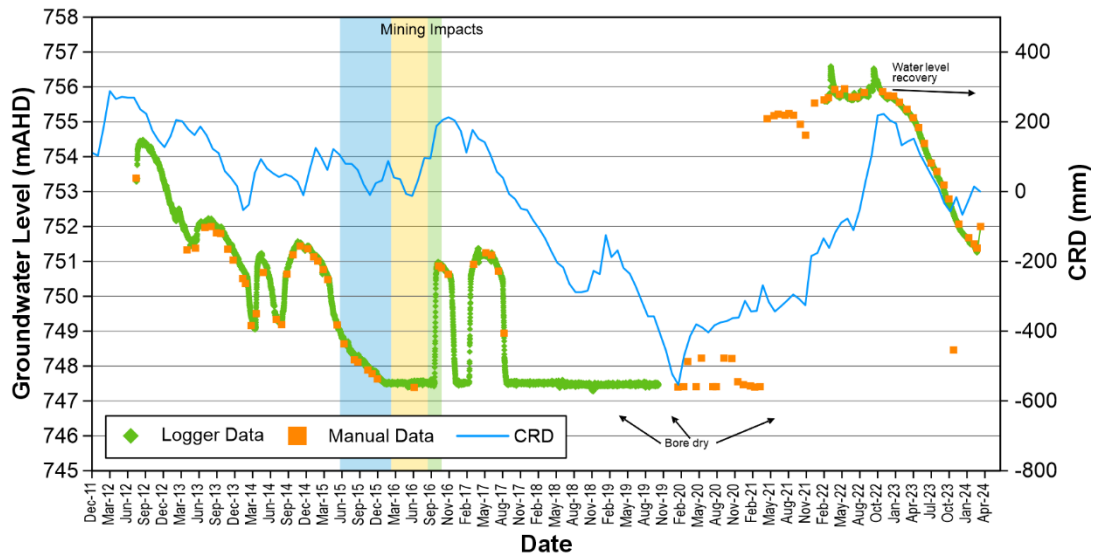
With first workings extractions in the Lithgow Seam adjacent to Gap Creek between June and July 2016, the Gap Creek piezometers showed a 5 m head drop in Lithgow Seam pressure from 742 mAHD to 737 mAHD. From April 2021, the Gap Creek VWP in the Marrangaroo formation has shown a small increase in water head of 3 m to 4 m.

ARP05 standpipe piezometer indicated continued rapid water level reduction following rainfall events in 2016 and 2017 with water levels reducing faster than historical rates prior to 2016. The fall off rate increase is likely to be due to the now reduced groundwater table below from the depressurisation of the Lithgow Seam nearby. Although there is evidence of connection between the alluvial and the mining horizon, and some loss of flow is likely, this loss of flow is difficult to measure, and the ephemeral nature of the creek has since produced alluvial head levels like that of historic levels. From early 2021 ARP05 has measured full water recovery to 756 mAHD in above average rainfall conditions. Recent trends at ARP05 indicate water level recovery in the Alluvium and Permian strata and variability in line with rainfall patterns. These trends are an indication of a return to baseline conditions pre-mining.

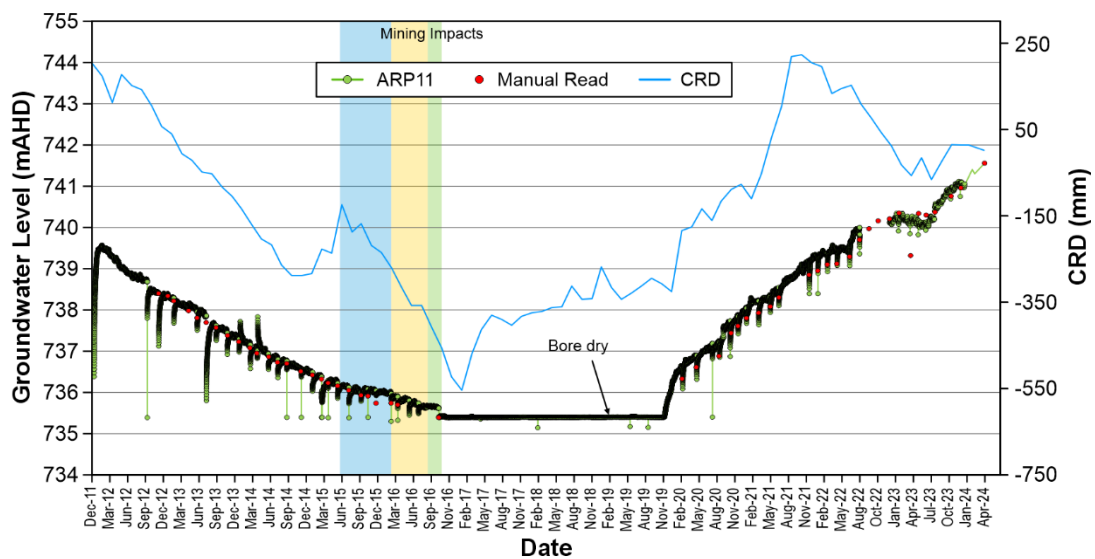
Groundwater levels at ARP11 (Figure 14c), installed in the shallow strata near the Gap Creek alluvium shows a generally decreasing trend throughout 2017 and early 2018. This decreasing trend is considered a combination of generally below average rainfall over the monitoring period and the influence of adjacent mining. As with ARP05, there is a recovery response at ARP11 from late 2021 with above average rainfall. Recent trends at ARP11 indicate water level recovery and variability in line with rainfall patterns.



a) ARP04 head pressure during adjacent first workings mining.



b) Alluvial groundwater levels in ARP05 in Gap Creek.



c) Alluvial groundwater levels in ARP11 in Gap Creek.

Figure 11: Airly Mine first workings with monitored connectivity at Gap Creek.

The Gap Creek lineament may also aid in the inability to maintain head pressure in the alluvial with its likely higher conductivity providing higher flow rates down to the lowered water table than the surrounding strata. Lineament reactivation causing increased downward flow is considered low due to the small subsidence impacts of development and pillar extraction.

The Gap Creek example shows that if the mining horizon water head level is connected to the surface water source, depressurisation of the mining horizon has the potential to produce downwards flow through the fracture network, including through lineaments. Updated groundwater monitoring indicates a level of self-healing of the fracture network and reduced conductivity through the process of deposited sediment and weathering carried by the groundwater.

The surface water flows at Gap Creek are shown to be related to rainfall patterns and are intermittent in dry periods. Recent flows appear to be greater than pre mining with an increase in rainfall since 2019. There is no evidence of long-term adverse impacts to Gap Creek surface water flows because of mining.

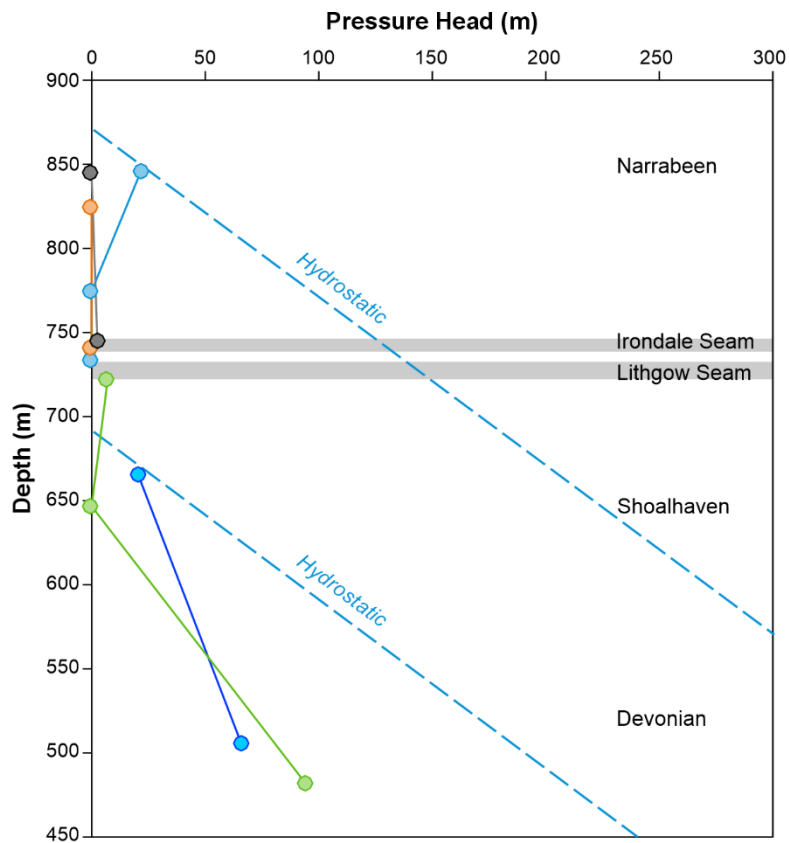
7.2 Mt Genowlan Monitoring

A review of the potential mining impacts to The Grotto, The Oasis, Grotto Creek and Genowlan Creek was conducted after miniwall extraction in the Point Hatteras PPMZ. The Lithgow Seam ranges from 70 to 170 m under the groundwater monitoring locations along The Grotto tributary and Genowlan Creek.

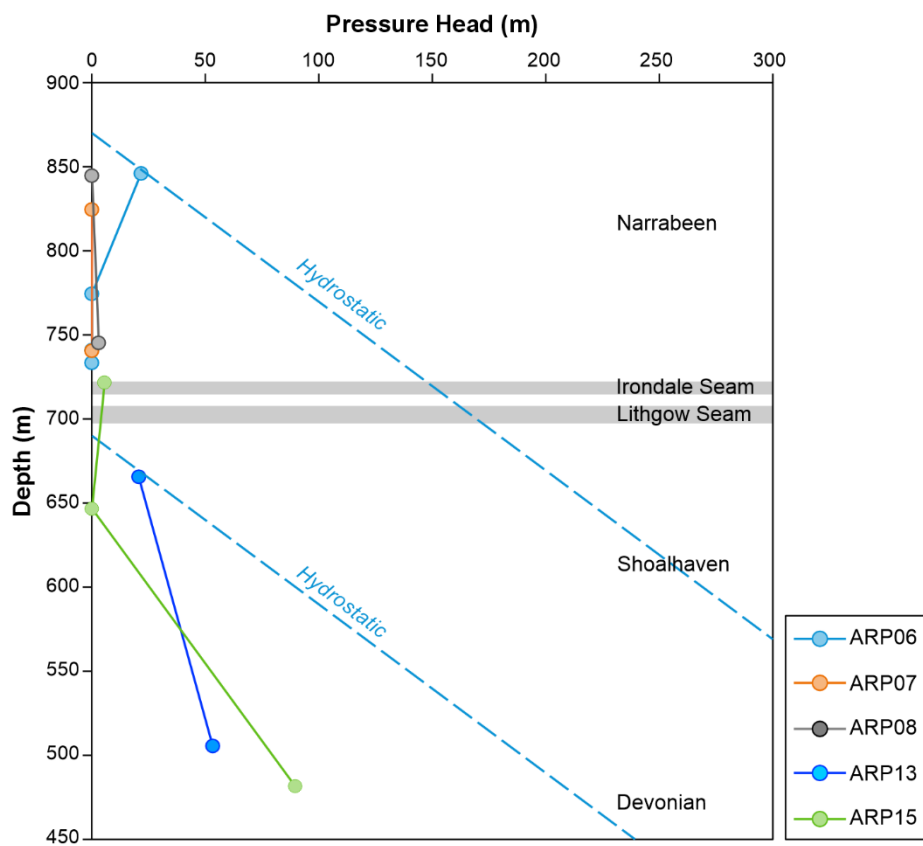
Figure 12 shows the pre-mining and post mining VWP pressure head profiles for the Mt Genowlan VWP monitoring network updated to the 14th of March 2024. This includes ARP06, ARP07, ARP08, ARP13, and ARP15. This profile demonstrates how the multiple instruments in a hole are reporting the head pressure relative to their depth of installation. This is useful in identifying the effects of depressurisation as it compares the theoretical hydrostatic head pressure with the VWP measured head pressure profile. Individual annotated hydrographs for each monitoring site are included as an Appendix 1 for long term trends.

Figure 12a shows the VWP pressure head prior to mining MW13 in January 2022. Prior to mining, there was no head pressure in the Narrabeen Sandstone or Illawarra Coal Measures (Irondale and Lithgow Seam) in the vicinity of The Grotto. ARP06 to the east of The Grotto does show pressure head in the Narrabeen Sandstone in a perched water table. The Narrabeen Sandstone and Illawarra Coal Measures are localised sources of groundwater due to the elevation above the valley floor. The Shoalhaven and Devonian VWP pressure head identify the aquifers defined as regional groundwater sources (Mod 3, 2019).

Figure 12b shows the VWP pressure head post mining MW13, MW14, MW15 and MW16 taken as of March 2024. Little to no variation in pressure head has occurred with adjacent mining at Point Hatteras or in the vicinity of The Grotto. It is noted the lower VWP in ARP08 was damaged during the mining of MW14. Recent monitoring results indicate that development mining beneath ARP06 has had no impacts to the perched water table in the Narrabeen Sandstone. A drop of 1.4 m water levels within the Devonian (below the Lithgow Seam) at ARP13 corresponds with a reduction in water pressure at ARP15 and is not considered to be mining related. Groundwater pressure remains stable in the overlying Shoalhaven Siltstone (Middle River Seam) just below the Narrabeen Sandstone at ARP13.



a) Pre Mining MW13 (Jan 2022).



b) Post mining MW13, MW14 and MW15 (June 2023), * Lower Irondale VWP damaged by MW14 September 2022.

Figure 12: Mt Genowlan groundwater piezometer head pressures.

Mining is now complete at MW16, and ongoing monitoring will be required to establish future trends. Proposed miniwall panels at Central Genowlan are located at a similar distance as MW16.

The height of depressurisation is a convenient concept for groundwater modelling purposes because it provides a bridge between the geomechanical disturbance caused by mining and a characteristic of the groundwater that can be incorporated into hydrogeological models.

Tammetta (2012) presents a method for determining the height of depressurisation above a longwall panels, based on observations from a comprehensive set of known worldwide experience in the public domain, giving the following empirical equation:

$$H = 1438 \ln (4.315 \times 10^{-5} u + 0.9818) + 26$$

where $u = wt^{1.4}d^{0.2}$

H = Height of depressurisation above the mining horizon (m)

u = Tammetta Factor

w = Panel Width (m)

t = Mining Height (m)

d = Mining Depth (m)

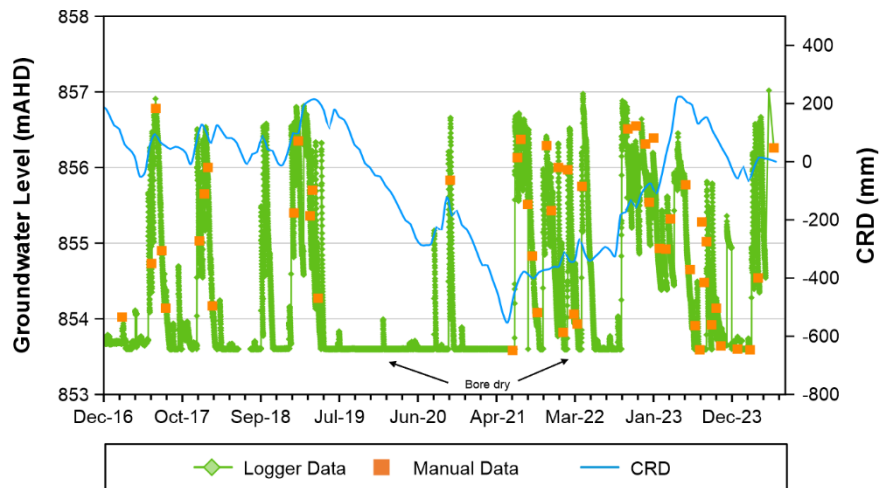
The theoretical height of total depressurisation for the Point Hatteras PPMZ is calculated as 53 m above the coal seam. These calculations are based on a panel width of 60 m, mining height of 3 m and mining depth of 280 m using the Tammetta (2012) empirical equation. The predicted height of depressurisation and piezometric profile in the post mining HOFWD02 Borehole is plotted in Figure 13.

Figure 14 shows the monitoring results for the standpipe piezometers that are installed from upstream of The Grotto to downstream along the Genowlan Creek to The Oasis. Standpipe piezometers ARP09, ARP12, and ARP13SP are shown to be rainfall dependent with installations in the alluvium and Permian strata.

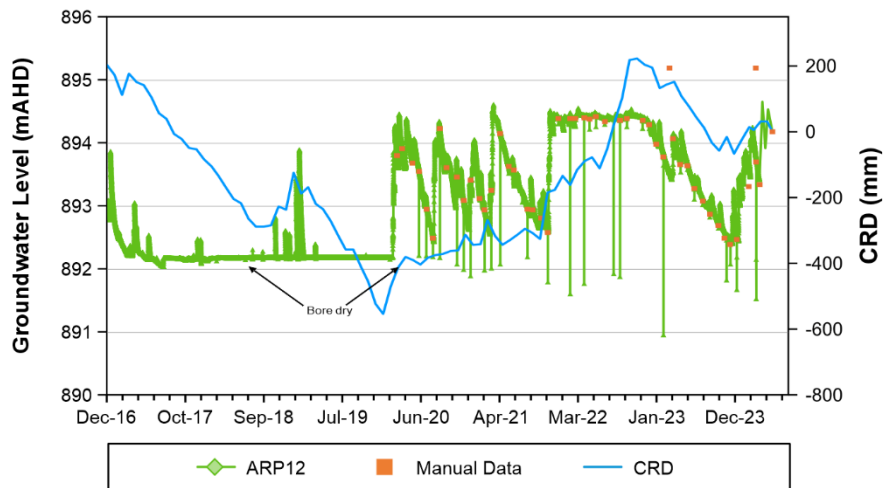
The alluvial deposits linked with Gap Creek and Genowlan Creek receive recharge from both rainfall and the movement of water between aquifers from nearby (mainly Permian) rock layers. This groundwater from the sediment deposits flows into the connected streams.

ARP13SP is installed in the Lithgow Seam and has maintained a steady water head throughout the monitoring period up until mid-December in 2023. In the recent Q1 2024 monitoring results, water levels at ARP13SP dropped by 0.51 m which can potentially be attributed to the adjacent mining at MW16. The distance of 575 m to the MW16 workings indicate a potential conduit through basement features.

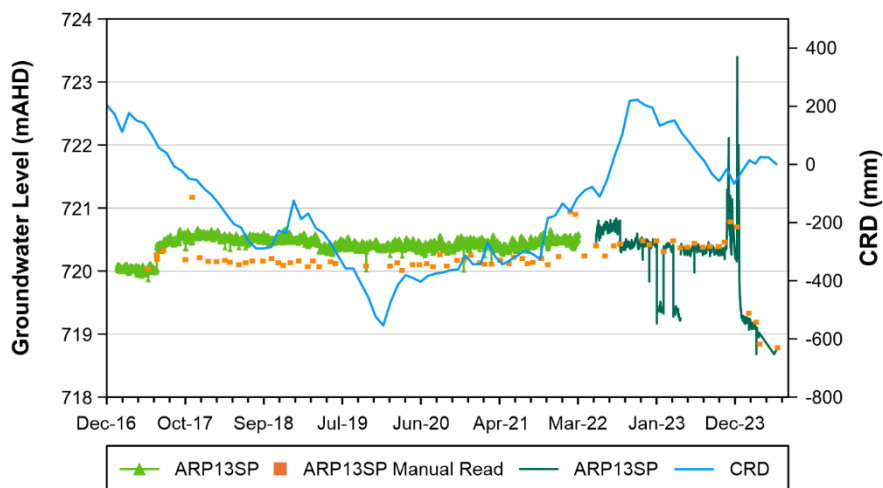
The surface water flows at The Grotto, The Oasis, Grotto Creek and Genowlan Creek are shown to be related to rainfall patterns and are intermittent in dry periods as shown in Figure 14. Recent flows appear to be greater than pre mining with an increase in rainfall since 2019. There is no evidence of impacts to Genowlan Creek surface water flows because of mining.



a) ARP09 – downstream of The Grotto, upstream of The Oasis.



b) ARP12 – upstream of The Grotto and The Oasis.



c) ARP13SP – downstream of The Grotto and directly adjacent to The Oasis.

Figure 13: Standpipe peizometer results for The Grotto and Genowlan Creek.

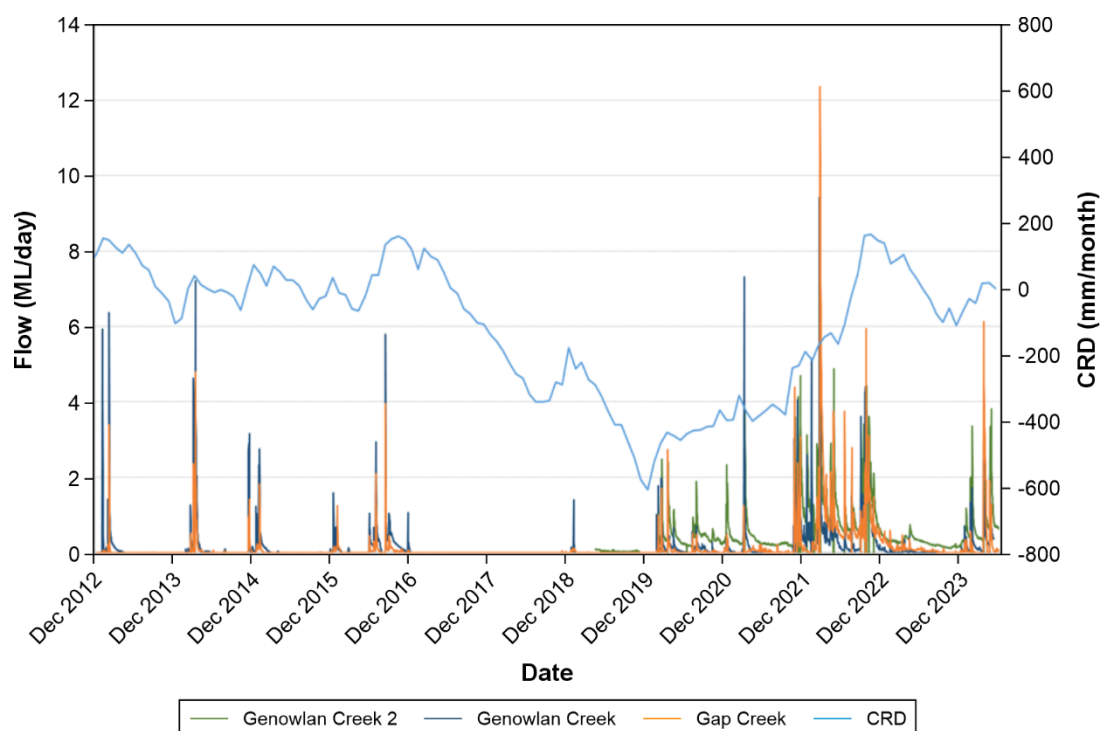


Figure 14: Surface water flow recorded in Gap Creek and Genowlan Creek.

No influence of mining is observed in the standpipe piezometer results within the perched water table. No influence of the adjacent lineament has been observed at the monitoring locations within the perched water table.

8. ESTIMATION OF OVERBURDEN CONDUCTIVITY AND CONNECTIVITY

A summary of overburden conductivity and connectivity for Airly Mine is presented in Table 4. Only a limited dataset was available for interrogation for the overburden conductivity and generally represents in-situ values without the impact of mining. Actual conductivity values would be expected to range by one order of magnitude lower or greater. Testing included packer testing and falling head testing conducted and reported by RPS and GHD.

Table 4: Summary of measured overburden conductivity at Airly Mine

Stratigraphy/Lithology	Hydraulic Conductivity of Overburden
Gap Creek Alluvium	$1 \times 10^{-7} \text{ m/s}$
Narrabeen Sandstone	$1 \times 10^{-7} \text{ m/s}$ to $1 \times 10^{-10} \text{ m/s}$
Lithgow Seam	$1 \times 10^{-7} \text{ m/s}$ to $1 \times 10^{-8} \text{ m/s}$
Marrangaroo	$1 \times 10^{-8} \text{ m/s}$
Upper Shoalhaven	$1 \times 10^{-9} \text{ m/s}$
Structure/lineaments	Potential for connectivity – estimated 1-10 times magnitude of depth equivalent

Due to the limited available dataset of conductivity for pre and post mining at Airly Mine, it is useful to look at a conceptual model of the conductivity impacts of full extraction (such as longwall or miniwall mining). The below model does not apply to first workings.

Fracturing of the overburden strata above a longwall goaf can be divided into multiple zones as shown in Figure 15 (Mills, 2022).

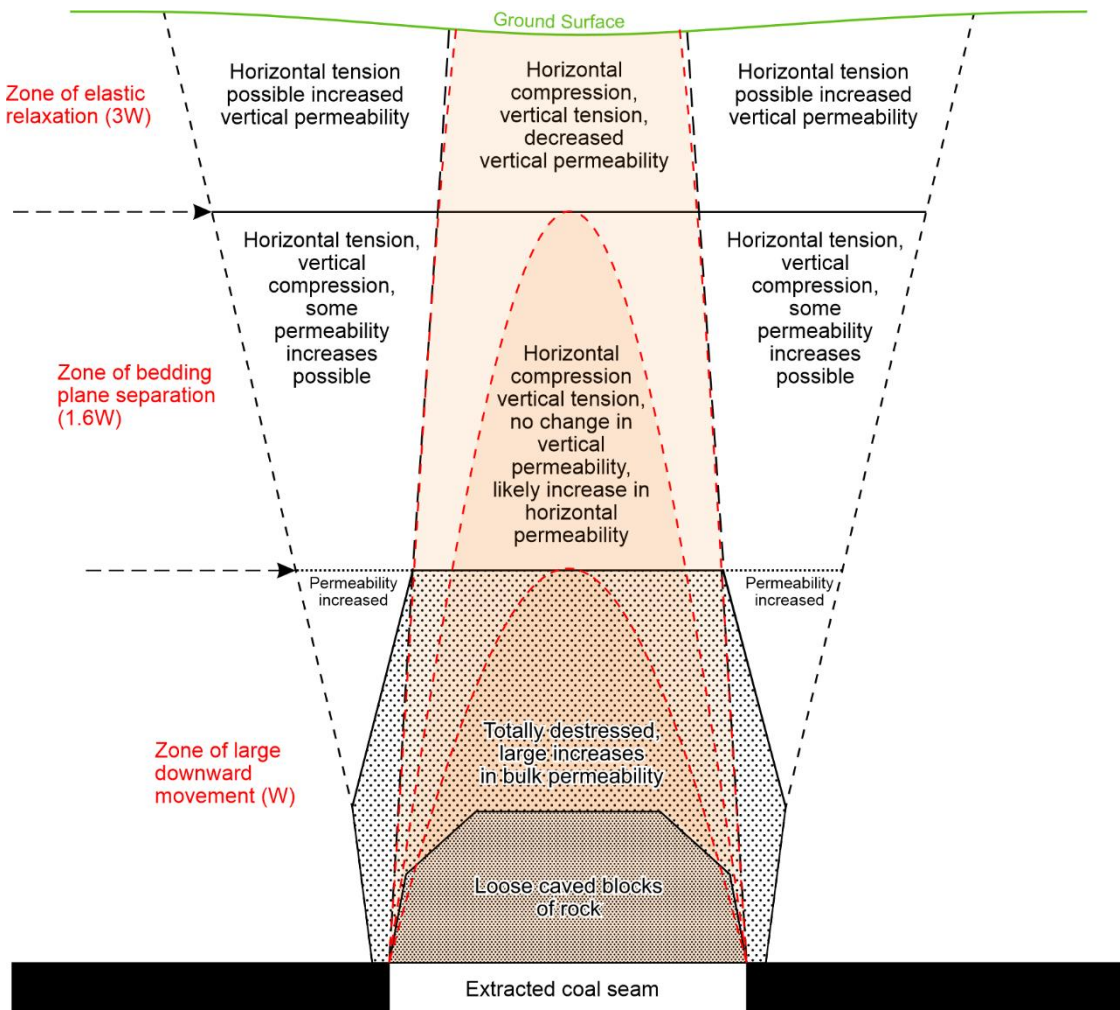


Figure 15: General longwall caving behaviour and terminology.

These zones are based on field measurements throughout Australian longwalls but is applicable to miniwall extraction based on the panel width to depth of cover. The three major zones are classified as:

- Zone of elastic relaxation - A zone of small ground movements from 1.6 to 3 times panel width above the mining horizon.
- Zone of bedding plane separation - A zone of bedding plane separation from about 1.0 to 1.6 times panel width above the mining horizon.

- Zone of large downward movement - A zone of large downward movement from seam level to a height above the mining horizon approximately equal to the panel width.

Based on the caving zones described above, there is also a resultant modification to either or both the vertical and horizontal conductivity. The application of the empirical model places The Grotto in the zone of elastic relaxation with horizontal tension/strain possibly increasing vertical permeability. This would be expected to be localised to this elastic zone with no connectivity to the zones below. The Oasis located near first workings would have no expected variation in conductivity or connectivity in the alluvial groundwater.

Baseline conditions currently observed at The Grotto and The Oasis indicate low levels of conductivity along the lineaments. Downward flow can be facilitated by reactivation of lineaments that may be present between the defined caving zones, although the geometry of the first workings at The Grotto and The Oasis, depth of cover, and the distance from secondary extraction (miniwalls) would make this unlikely.

Yours sincerely

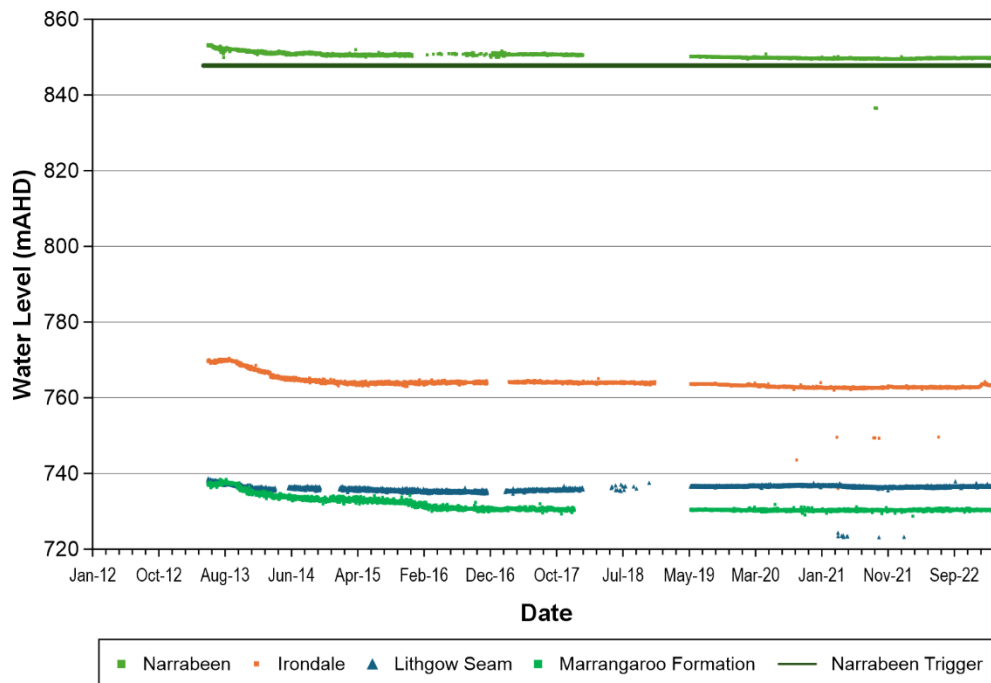


Adrian Rippon
Principal Geotechnical Engineer

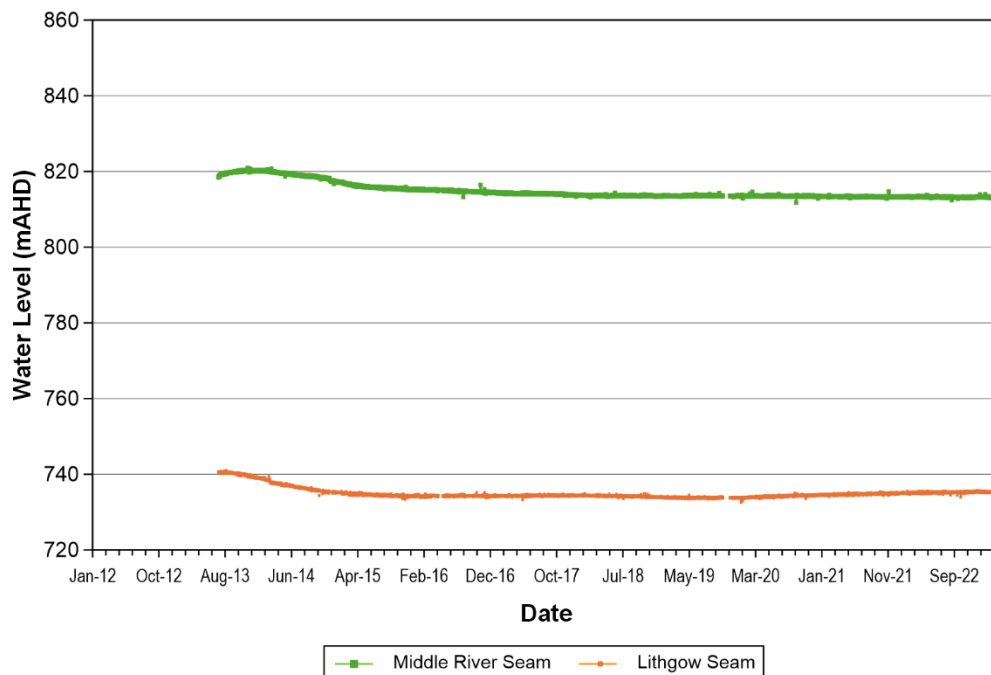
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APPENDIX 1

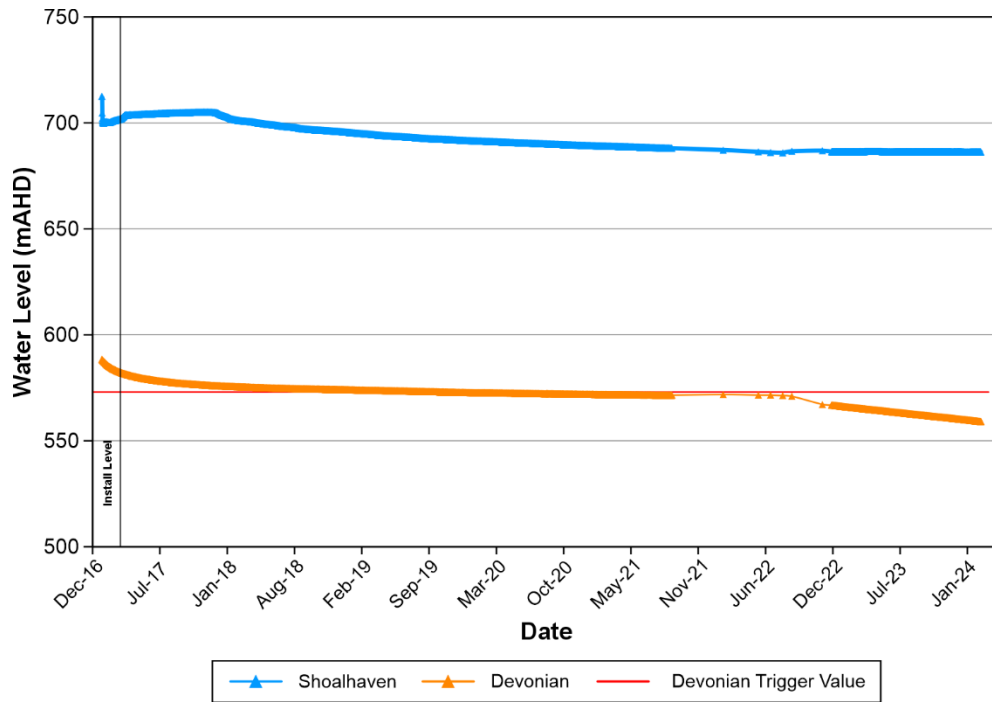


a) ARP06.

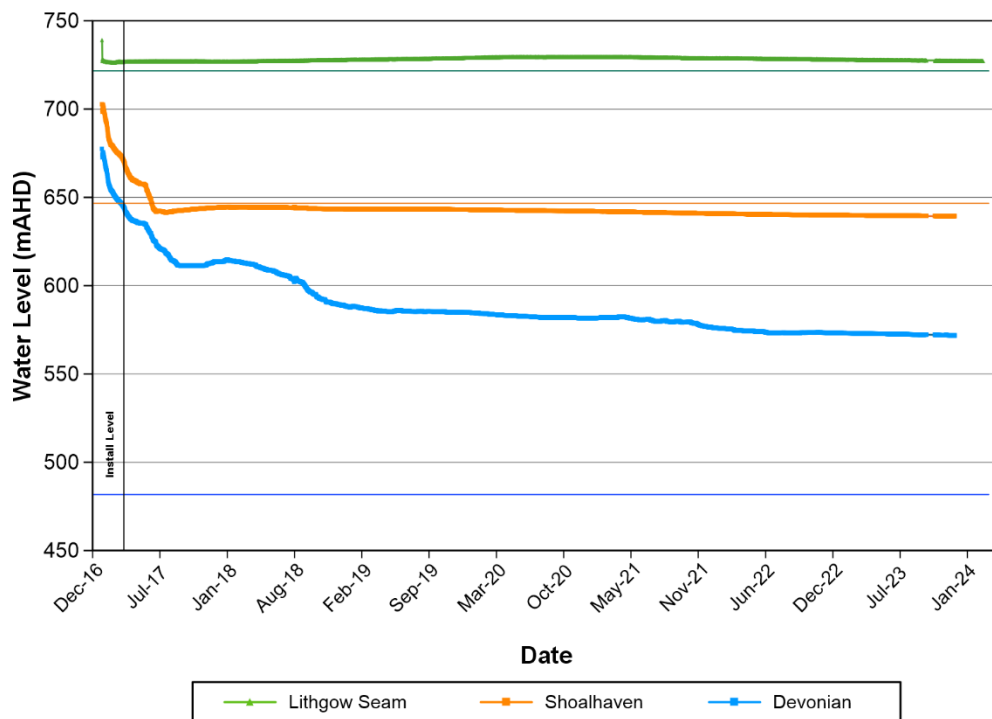


b) ARP07.

Appendix A1: VWP hydrographs.



c) ARP13.



d) ARP15.

Appendix A2: VWP hydrographs.

Centennial Coal:

Airly Colliery – Central Genowlan – 500 Mains Headings and HB1 and HB2 Herringbone First Workings

Subsidence Predictions and Impact Assessments for the Natural and Built Features over and near the proposed 500 Mains and HB1 and HB2 Herringbone First Workings in support of the Extraction Plan Application

DOCUMENT REGISTER

Revision	Description	Author	Checker	Date
01	Initial issue	DK		18-Jul-24

Report produced to: Support an Airly Colliery submission of the 500 Mains Headings Extraction Plan Application to the Department of Planning and Environment.

Background reports available at www.minesubsidence.com¹:

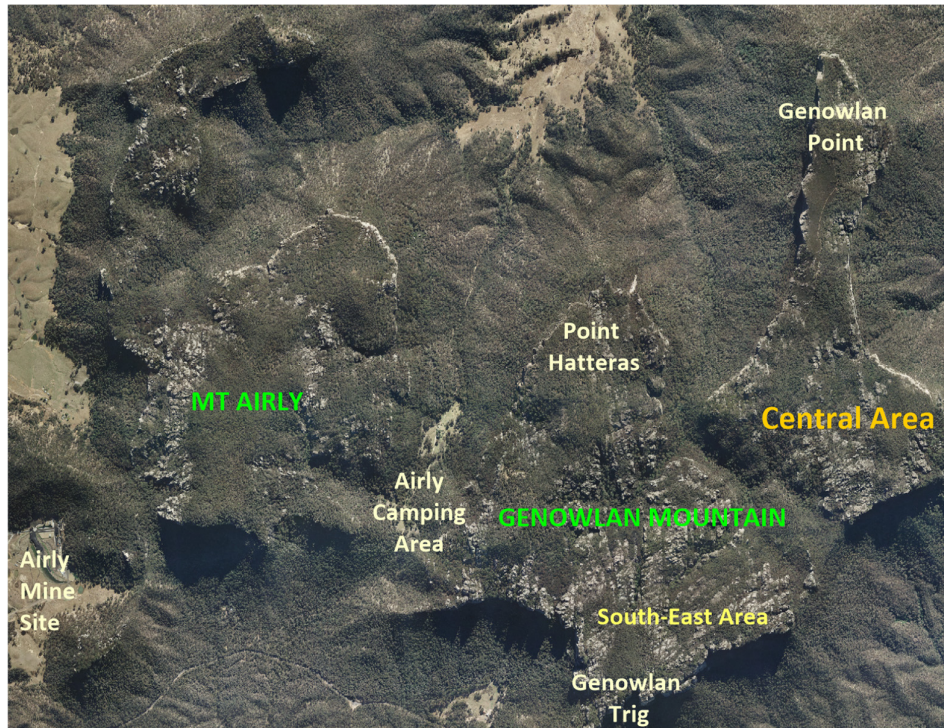
Introduction to Longwall Mining and Subsidence (Revision A)

General Discussion of Mine Subsidence Ground Movements (Revision A)

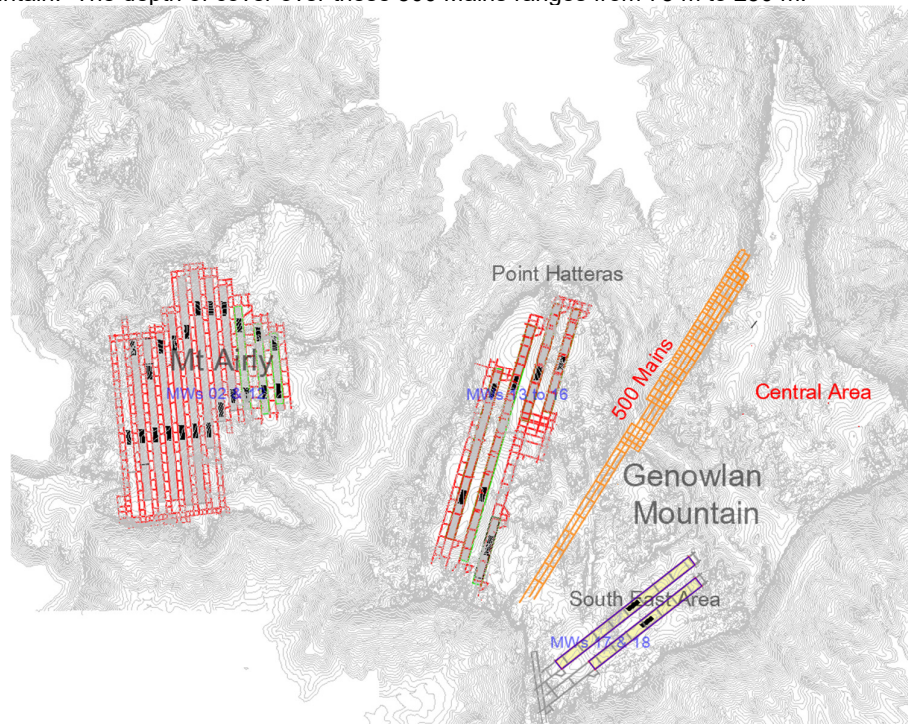
¹ Direct link: http://www.minesubsidence.com/index_files/page0004.htm

Airly Mine (Airly) is an existing underground coal mine that is located 5 kilometres (km) north-east of the village of Capertee, 40 km north-northwest of Lithgow and 171 km north-west of Sydney. Centennial Airly Pty Limited (CA) is the operator of Airly and CA is a wholly owned subsidiary of Centennial Coal Company Limited.

CA has extracted eleven mini walls (MWs) under the Mount Airly mesa and recently CA extracted five mini walls under the Point Hatteras western side of the Genowlan Mountain mesa. CA are about to extract two mini walls in the South-East Area of Genowlan Mountain, i.e. MWs17 & 18. CA are now seeking planning approval to extract the 500 Mains that are Development Headings or Access Ways that will allow CA to extract more mini walls in the Genowlan Mountain Central Area. The aerial photo below shows these locations on the two mesas.



The plan below shows the depth of cover contours over Airly with the mini panels that have been extracted to date, i.e. MWs 02 to 12 on Mt Airly and MWs13 to 16 on Genowlan Mountain. This plan also shows the proposed 500 Mains Headings that will allow access to the future proposed working in the Central and the north-eastern areas of Genowlan Mountain. The depth of cover over these 500 Mains ranges from 75 m to 230 m.



CA engaged MSEC to prepare this report to provide appropriate subsidence impact assessments due to the proposed extraction of the 500 Mains Headings and to support an Extraction Plan Application that CA will soon be submitting to the Department of Planning, Housing and Infrastructure.

SCT has been engaged to prepare subsidence predictions and groundwater impacts.

Background to this 500 Mains Subsidence Impact Assessment Study

The surface areas over Airly are characterised by steep and rugged topography with large areas of cliffs, minor cliffs, pagodas and significant rock outcrops. The surface areas around Airly are dominated by Mount Airly and Genowlan Mountain that are two large mesas that sit broadly within the landscape of the Capertee Valley.

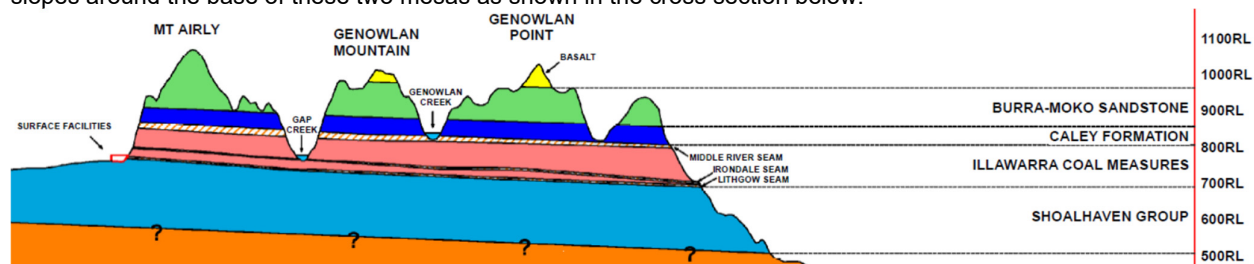
The Mount Airly and Genowlan Mountain mesas are located within the broad Capertee Valley, which measures over 30 km from north to south and east to west. This valley is surrounded by sandstone cliffs and steep talus slopes that are similar to those found on Mount Airly and Genowlan Mountain. Both Mount Airly and Genowlan Mountain are clearly visible for tens of kilometres in all directions.



The above photo, taken from Pearsons Lookout on the Castlereagh Highway, shows Mount Airly (left) and Genowlan Mountain (right) which are in the centre within the Capertee Valley.

As can be noted from the above photo, the surface topography on the top of or within these two mesas varies from gently undulating to steep sided valleys, with major cliff lines, pagodas and gorges. Most of the surface areas over Airly are located within the Muggi Murrumbidgee State Conservation Area (MMSCA) that has significant natural and cultural heritage values and contains significant mineral resources. The MMSCA was gazetted in 2011 to protect environmental and cultural heritage values while permitting mining and exploration.

The Lithgow Seam, which is the target coal seam and the base of the Illawarra Coal Measures, outcrops on the talus slopes around the base of these two mesas as shown in the cross section below.



Airly first gained development approval in 1993 to extract longwall panels beneath both the Mount Airly and Genowlan Mountain with up to 1.8 m of subsidence. However, only main headings and initial accessways were developed before 2019, i.e., no second workings or panels were mined.

As detailed in the Airly Mine Extension Project Environmental Impact Statement (EIS), CA developed a conservative approach to mining throughout the lease which employed different mining methods for different areas, each targeted to suit the specific area, referred to as 'mining zones'. This 2014 EIS report, the design of the mine layout and the initial subsidence prediction reports were all prepared by Golder Associates.

A key objective of this 'zoned' approach was to minimise the risk of impacts to the external cliff lines through appropriate mine design to minimise subsidence. The sensitive external cliffs and high escarpments that are located around the external parts of the Mount Airly and Genowlan Mountain mesas were to be protected by a barrier called the Cliff Line Zone of First Workings (CLZ) within which no secondary extraction was planned, and no impacts were anticipated from the planned first workings and main access headings within the CLZ as the pillars were designed to be long term stable.

Additionally, the proposed partial extraction 'zone' in the centre of the mesas, called the Panel and Pillar Mining Zone (PPMZ), was designed to not cause impacts to the external PPMZ cliffs and escarpments and minimal impact on the internal cliffs within the PPMZ, since;

- the mini wall panels were designed with very narrow panel widths and wide pillars to result in very low levels of subsidence over this PPMZ zone, and
- the nearest edges of the proposed mini walls within this PPMZ were to be located well back and away from the top or back of the external escarpments.

This 2014 Airly EIS mine layout design was principally based on the experience and observations at the Centennial Clarence Mine where, for over twenty years, coal had been successfully extracted from similar narrow panels with similar stable wide pillars at similar depths of cover under and near similarly tall pagodas, cliffs and escarpments. This mining at Clarence resulted in very low monitored subsidence ground movements of less than 100 mm with no adverse mining induced impacts to the cliffs. The EIS acknowledged that the seam mined at Clarence was the top Katoomba Seam, which is not the target seam at Airly, but it advised that appropriate mining methods were planned at Airly to match Airly's geotechnical environment.

The Airly EIS advised that the Clarence Colliery design criteria or objective was to limit mining induced subsidence to be within the overburden elastic displacement behaviour range of 100 mm in order to result in no goaf caving to the surface, no surface cracking and no cliff falls. The Airly EIS then suggested that vertical subsidence at Airly should also be limited to 100 mm, so that allowing for survey tolerances of ± 25 mm, the measured subsidence should never exceed 100 ± 25 mm. That is, this 2014 EIS report predicted that the maximum subsidence over of the Airly mine, with 2.8 m seam extraction from 61 m wide mini panels and 29.5 m wide chain pillars, would be less than 125 mm, while tilts would be less than 2.5 mm/m and strains would be less than 2 mm/m.

In 2016, the Department of Planning and Environment commissioned an Independent Review Panel (IRP) to review and report on the accuracy and reliability of the mine subsidence impacts presented in the 2014 EIS. The IRP advised in its July 2016 report that the various proposed partial mining systems were considered conservative by comparisons with industry standards, and these could be expected to result in low levels of surface subsidence movements, especially with proper management and high confidence monitoring.

In December 2016, Airly was granted approval to extend its operations for another 20 years and this approval included the extraction of mini walls within a PPMZ with consent conditions limiting the maximum subsidence to 125 mm within the PPMZ zones of the Mount Airly and Genowlan Mountain mesas that were to be located away from the escarpments and external cliffs.

Initially CA mined access headings around the Mount Airly PPMZ and in June 2019, CA commenced extracting the mini walls within the PPMZ of Mount Airly. These early mini walls were located with their nearest edges being located further than 26.5° angle of draw (AoD) from the top of the external major cliffs and escarpments. CA had hoped that, after the initial PPMZ mining proved successful, the future MW extraction might be approved closer to external cliff lines as the average measured AoD to 20 mm at the Clarence Mine was only 8° . But, so far, all the Airly MW panels have been extracted with the nearest edge being positioned more than 26.5° AoD from the external cliffs.

Unfortunately, the measured subsidence over the early Mt Airly panels exceeded the expected maximum subsidence levels for those panels and, in January 2020, CA advised that the maximum monitored subsidence after extracting the first three mini walls, i.e., MW02, MW03 and MW04, was 185 mm, which exceeded the approved maximum subsidence limit of 125 mm. The maximum observed subsidence over each of the following mini walls continued to increase and after Airly extracted MW10 in August 2021, the maximum observed subsidence over the PPMZ of Mount Airly, had increased to 680 mm. Later in 2021 some surface cracking and a minor rock fall was observed had been identified over these early mined panels. Fortunately, although the monitored subsidence was much higher than expected, no cliff falls were observed internally over the PPMZ or externally in the CLZ or around the mesa.

To reduce the observed subsidence levels back to the maximum subsidence limit of 125 mm, CA engaged Strata Control Technology (SCT) to study the observed subsidence behaviour and then advise on the necessary modifications to the panel and pillar design so that the mining of the remaining mini walls will not result in more subsidence than the 125 mm maximum limit.

SCT undertook the detailed modelling and redesign of the PPMZ with a FLAC model that confirmed the extraction of the EIS very narrow panel widths could have resulted in very low levels of sag subsidence and the 29.5m pillars could have been long term stable. But the model also revealed that the higher-than-predicted subsidence was primarily the result of the shearing, fracturing and compression of the relatively weak strata layers that lay immediately above the chain pillars, (SCT Report AIRLY5240, Jan 2021). That is, SCT advised that the failures in the claystone and mudstone strata layers above the chain pillars were not related to coal pillar instability or pillar failure at seam level.

SCT then used this calibrated FLAC model to recommend how much wider the chain pillars need to be formed between the future panels to limit subsidence to the EIS maximum subsidence limit of 125 mm. This modelling also implied that increased depths of cover (DoC) results in extra weight on these weaker strata layers and, hence increased DoC over the pillars contributes to higher subsidence. To reduce the predicted subsidence SCT modelled increased coal pillar widths to reduce the stress and failures within these weaker layers that lie above the coal pillars.

To arrest the increased subsidence experienced over MW02 to 10, (*where the DoC ranged up to 274 m*), SCT suggested a 60 m wide chain pillar was required between MW10 and MW11, (*i.e., where the DoC ranged up to 255 m*) and SCT suggested a 40 m pillar was required between MW11 and MW12, (*where the DoC ranged up to 235 m*). Subsequent monitoring over MWs 11 & 12 after they were extracted revealed that, after these wider 60 m and 40 m pillars were formed, they successfully reduced the measured incremental subsidence over MWs 11 and 12 and the ongoing residual subsidence to the levels discussed at the 2014 subsidence limit of 125 mm.

CA then engaged SCT to advise on the necessary modifications to the chain pillar design for MWs 13 to 16 under Genowlan Mountain, (*where the DoC ranged up to 305 m*), where four mini wall panels were to be extracted side by side. The FLAC modelling reviewed the situation and then SCT recommended 70 m wide pillars were required between the four 61 m wide panels, MWs 13 to 16, under the Point Hatteras region of Genowlan Mountain at this deeper DoC.

CA has just extracted MW13 to 16 and the subsequent monitoring indicated that the measured subsidence was predominantly below the modelled or predicted subsidence levels for these four mini wall panels. It can be concluded from these monitoring results, that the FLAC model analyses the complex relationships between changing material properties, panel & pillar widths and varying DoCs over the pillars reasonably accurately.

Next SCT were asked to advise on a modification of the initial mini wall design under the south-eastern side of Genowlan Mountain for three mini walls, (where the DoC ranged up to 291 m), to limit the maximum predicted subsidence to be less than 125 mm. However, after the initial modelling was completed, the measured subsidence over MWs 13 and MW14 had slightly exceeded the predicted subsidence for the first two panels at one of the GNSS subsidence monitoring units, i.e., the measured subsidence was 70 mm compared to the model predicted subsidence of 65 mm.

So, CA chose to further limit the extraction in this south-eastern area of Genowlan Mountain to only two panels, MWs 17 & 18. The new SCT subsidence prediction report, (SCT AIRLY5612, June 2023), found that both the panel widths and the pillar widths would have to be modified.

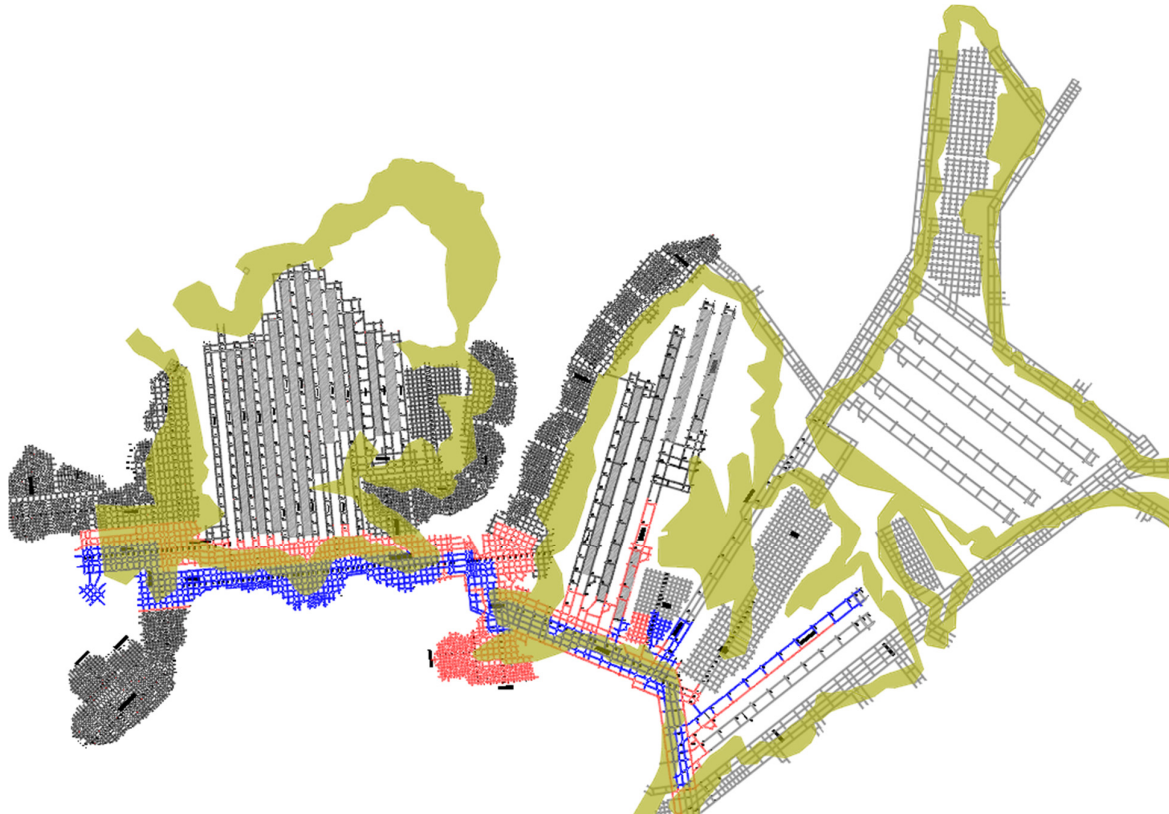
Compared to the EIS mine layout design, the proposed width of the chain pillars between MWs 17 & 18 were widened by more than double, i.e., from 29.5 m to 70 m, whilst the panel void widths were increased from 61 m to 70.5 m, and the seam thickness to be extracted was increased from 2.8 m to 3.0 m. This SCT modelling also indicated that the maximum predicted subsidence level over MWs 17 & 18 would be 88 mm. CA will begin the extraction of these MWs 17 & 18 panels soon.

MSEC was provided with the necessary cliff identification studies that were undertaken for CA by Aerometrex (2024) and a site ground truthing verification of cliffs that was undertaken by Michael Nicholson Consulting Pty Ltd (MNC) (2023). Aerometrex, which is a geospatial tech company that specialises in aerial imagery, mapping, 3D modelling and airborne LiDAR, first identified and labelled all the external major "cliffs" according to the following specific criteria defined in the Airly Development Consent. Then, Aerometrex identified and labelled all the internal "cliffs" that were located behind the major external cliff lines that surround the mesas according to the same specified cliff definitions.

A "cliff" was defined in the Airly Development Consent for the Project (SSD_5581) as a continuous rock face, including overhangs, having a minimum length of 20 m, a minimum height of 10 m and a minimum slope of 2 to 1 (>63.4°). That is, Aerometrex listed all those rock features that had a slope greater than 2 to 1, or > 63.4° in its lists of internal and external "cliffs", but those rock features that had measured heights of less than 10 m, or, if the length of a rock feature was measured to be less than 20 m, were excluded from these lists. Many external major "cliffs" within the CLZ were identified and labelled and, then many internal "cliffs" were identified and labelled by Aerometrex. CA and its consultants then tabled all the internal "cliffs" over and near the 500 Mains.

Need for a 500 Mains Subsidence Impact Assessment Study

The mine plans below show the Airly mine completed to date and some of the proposed workings with the Cliff Line Zones (green). It can be noted that Airly has already extracted many mains headings that pass through the CLZ.



As shown in the plan above the 500 Mains passes through large areas of CLZ and below is a closer or more detailed plan over an aerial photograph overlain with mine plans and locations of some surface features

This sketch below, shows these proposed 500 Mains Headings pass near the previously extracted mini walls, MWs 16 and MW15B, near proposed herringbone first workings and under and near several surface features. These features are known as; The Grotto, Ultimate Slot, Valley of Dinosaurs, Oasis and an overhang site that includes a registered Aboriginal Heritage Site.

CA wishes to ensure these surface features are not impacted by the extraction of the 500 Mains and the proposed herringbone workings labelled HB1 and HB2.



CA then engaged SCT to advise on the necessary modifications to the mine design under the Central Area of Genowlan Mountain, (where the DoC ranges up to 305 m). However, before CA extract these MWs 19 to 22 panels in the Central Area of Genowlan Mountain, access headings are needed to provide safe access and egress.

Summary of predicted subsidence movements over the 500 Mains and at surface features

Because these proposed headings pass near and under some sensitive surface features, CA then asked SCT to provide for guidelines for the geometry of these workings in and near the CLZ and SCT advised in their Report, titled "Pillar Geometry Guidelines for Cliff Line Zone Extraction Zone", STC5535, dated 20 Jan 2023.

SCT reported that after using the Bieniawski and UNSW pillar strength methods with 35m square centre pillars, 5.5m roadway widths and roadway height of 2.8m, plus allowance for rib spall and slightly increased roof heights, would result in 10 mm of subsidence at 80 m DoC and up to 30 mm of subsidence at 230 m DoC along the 500 Mains.

In a further SCT Draft Report, AIRLY5650, Rev 4, 2024, titled "High Level Subsidence, Conductivity and Connectivity Review for The Grotto and The Oasis", SCT predicted the maximum subsidence over HB1 south of the Grotto would range between 21 mm to 29 mm, where the DoC was between 170 m to 200 m and between 10 mm to 12 mm over the 500 Mains near the Grotto where the DoC was between 160 m to 200 m. As the Grotto is located some 100 m or half the depth of cover from the nearest proposed workings it is likely to experience subsidence of up to 20 mm.

SCT also predicted the maximum subsidence over another herringbone workings area under the Oasis would range between 7 mm to 10 mm, where the DoC was between 90 m to 120 m.

Presumably similar subsidence maximum estimates could be predicted under the Valley of Dinosaurs, where the DoC ranges from 200 m to 230 m would range up to 40 mm.

As shown above the 500 mains passes under the Ultimate Slot at a DoC of approximately 200 m and hence it may experience 14 mm plus a small component from the relatively close HB1 workings, say the subsidence expected is 20 mm.

The Overhang is located with a DoC between 140m and 170m and would experience between 8 and 10 mm.

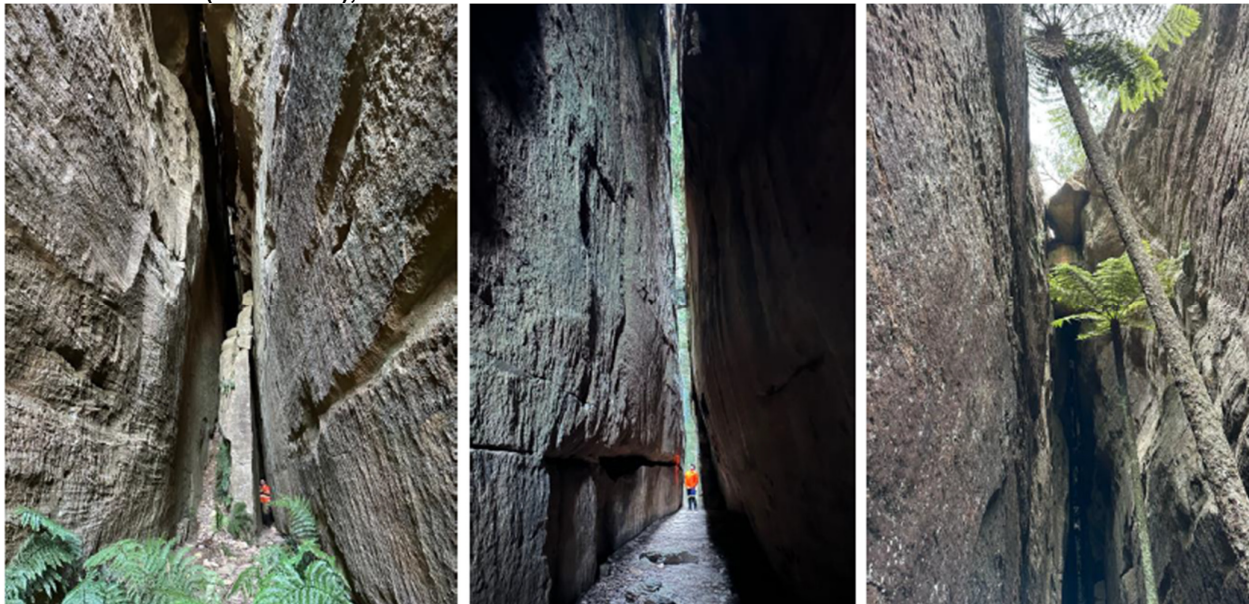
CA then asked MSEC to prepare this subsidence impact report, MSEC1447, on the likely impacts of these predicted levels of subsidence from driving these 500 Mains and Herringbone First Workings on the natural and built features that exist over and the 500 Mains and Herringbone Workings.

Some of these features are shown below;

The Grotto (MNC Photo);



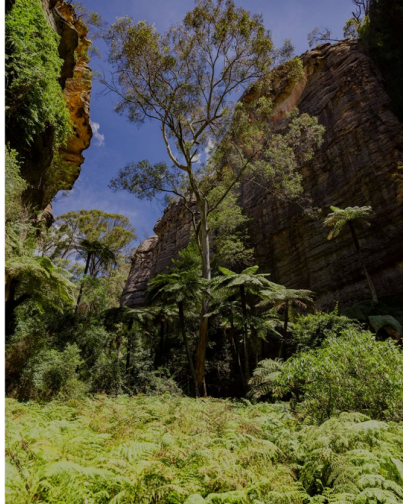
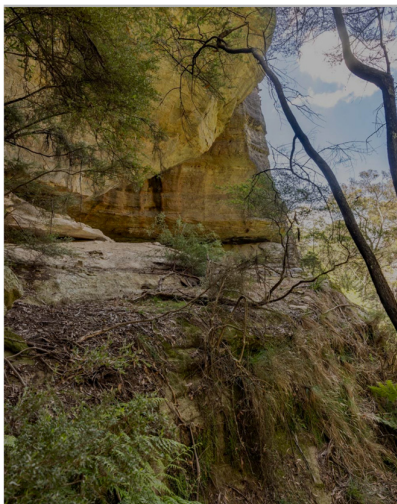
The Ultimate Slot (MNC Photo);



Overhang with registered heritage site; (MNC Photo);



The Valley of Dinosaurs; (Cat and Jo, WalkMyWorld.com)



The Oasis (SCT Photos);



Study Findings

The main subsidence impact findings from this report are as follows:

- **Cliffs and Overhangs:** CA is protecting all the major external cliffs that surround Genowlan Mountain and lie within the CLZ from mine subsidence ground movements by only undertaking first workings within the CLZ and by not undertaking any secondary extraction closer to the CLZ than a 26.5° AoD behind or in front of these cliffs. CA is protecting the internal cliffs, including the Ultimate Slot and overhang that are located over the proposed 500 Mains by using long term stable pillars and no second workings, in order to limit ground movements to very low levels to avoid surface cracking and minimise risks of impacts to these cliff lines, overhangs, pagodas, and other natural features.

CA is protecting the internal cliffs that lie over the proposed Herringbone HB1 and HB2 First Workings Areas by using stable pillars and no second workings, in order to limit ground movements to very low levels of subsidence to avoid surface cracking and minimise risks of impacts to these cliffs, overhangs, pagodas, and other natural features

To ground truth and verify the results of the Aerometrex cliff identification studies CA asked MNC to undertake field site inspections of all the identified cliffs near the proposed 500 Mains and Herringbone HB1 and HB2 First Workings Areas. MNC advised (2023) that visual inspections were carried out at all the external cliffs around the mesa that were near these workings and at each of the identified internal cliffs that were located over and near these workings by either visual inspections or drone inspections where the steeply incised terrain prohibited safe access. That is, not all cliffs could be accessed by foot as the terrain around these cliffs and pagodas was described as extremely rough and difficult to pass through, as many areas were impossible to walk on, the steeply incised terrain.

These site inspections have supported the Aerometrex photographic analysis and has revealed some sensitive looking natural features on the surface over the proposed 500 Mains and Herringbone HB1 and HB2 First Workings Areas. These internal cliff features (called The Grotto, The Ultimate Slot, an overhang with a heritage listing, the Valley of the Dinosaurs and an area called The Oasis) are located over the proposed 500 Mains and HB2 First Workings Areas. Some of these features could be sensitivity to subsidence movements, depending on the extent of the mining induced subsidence ground movements.

The site inspections at these sites also revealed a high amount of natural fracturing and jointing within the rock features, i.e., each cliff line may be sub divided into sections by pre-existing natural jointing and this results in shortened cliff line lengths as per the definitions within development consent SSD 5581. It is also important to note that these features have weathered slowly and regularly accommodate changing temperatures, rain and wind conditions and experience has shown that they can accommodate low subsidence ground movements that are less than 100 mm of subsidence with very low strains and tilts.

Importantly the site inspections did not reveal any large cave features or large overhangs at the identified cliff features that would be susceptible to impacts from subsidence ground movements that are greater than 100 mm.

CA has therefore chosen to leave long term stable 35 m centred pillars in developing the main headings where they pass through the CLZ Headings that, for the depth of cover at these sites, would not lead to more than 30 mm of subsidence and Herringbone workings with stable pillars that, for the depth of cover at these sites, would not lead to more than 30 mm of subsidence

The results of this mining induced cliff impact assessment are based on knowledge gained from developing a data base of known mining induced cliff falls and a data base of the mining conditions and the monitored ground movements at many of these mining induced cliff fall sites in the Western and Southern Coalfields of NSW.

Information on these data bases has been included as Chapters and Appendices in many of the previous MSEC cliff impact assessment reports prepared for Airly and, since they should be readily available, they are not reproduced in this report. See MSEC Report Number MSEC1185, (MWs 11 & 12, July 2021), MSEC Report Number MSEC1195, (MWs 13 to 16 - October 2021), that provide:

- summaries of published reports and papers that discuss coal mining induced rock falls or cliff falls,
- detailed discussion on monitored ground movements at cliffs that experienced mining induced cliff falls, and
- reviews of each of the factors that appear to influence the likelihood of mining induced cliff falls.

The previous MSEC cliff impact assessment reviews from these previous MSEC reports all concluded that, *(considering the very low levels of subsidence being predicted over the identified internal cliffs and rock features, i.e. less than 125 mm)*, there was only an extremely low probability that cliff instabilities would occur at the identified and listed cliffs over those mini walls, especially since these internal cliffs were mostly relatively short, isolated cliffs that were located over solid unmined coal areas beyond the edges of the mini wall panels.

A similar review was undertaken regarding the very low levels of subsidence being predicted over the identified internal cliffs and rock features that were identified and located near and over the proposed 500 Mains and Herringbone HB1 and HB2 First Workings Areas. This review has also concluded that there was only an extremely low probability that cliff instabilities would occur at these identified and listed cliffs over and near the proposed 500 Mains and Herringbone HB1 and HB2 First Workings Areas, which were mostly relatively short, isolated cliffs located over solid unmined coal areas beyond the edges of the mini wall panels.

This cliff impact review also advised that because natural rock falls have been reported to occur regularly over time with ongoing weathering and erosion, it is not possible to guarantee that there would be no rock falls reported during the period of mining. However, there should only be occasional falls of small slabs of rock and, because of the very low levels of subsidence being predicted at the identified internal cliffs and rock features, there should be little chance of exceedance of these development approval conditions for cliffs.

Hence, as the predicted levels of subsidence over the proposed 500 Mains and Herringbone HB1 and HB2 First Workings Areas are similar to those provided in the 2014 EIS, i.e., the maximum predicted subsidence is less than 125 mm with no predicted surface cracking, the assessed levels of potential impact for the cliffs, are similar to those based on the EIS Layout. That is, at these predicted low subsidence levels, it is unlikely that the cliffs, pagodas and rock formations will be adversely impacted by the proposed mini wall extraction.

- **Steep slopes:** The steep slopes and rock outcrops within the Study Area are throughout the Genowlan Mountain mesa. Potential impacts on these features generally occur from increased horizontal movements in the downslope direction, potentially resulting in tension cracks appearing at the tops and on the sides of the steep slopes and outcrops, compression ridges forming at the bottoms of the steep slopes and buckling of the bedrock at the bottoms of the rock outcrops. However, given that the predicted levels of subsidence over these steep slopes and rock outcrops are very low and not greater than 125 mm, it is unlikely that the steep slopes and rock outcrops will be adversely impacted by the proposed mini wall extraction.

- **Drainage lines:** The upper reaches of Genowlan Creek are located above the proposed mining area. There are also other unnamed drainage lines that are located across the proposed mining area. These drainage lines are generally ephemeral.

Since the maximum predicted subsidence is not likely to be near 125 mm, the predicted post-mining grades along Genowlan Creek and the other drainage lines are similar to the pre-mining natural grades. It is unlikely, therefore, that there would be adverse changes in ponding or scouring resulting from the mining-related subsidence or tilt.

It is expected that no fracturing of the bedrock is likely to be observed over the mini walls and beneath the sections of the streams that are located directly above and adjacent to the proposed mini walls. Surface water flow diversions are unlikely to occur along the sections of the streams that are located directly above and adjacent to the proposed mini walls. Further discussions are provided by the other specialist consultants on the project.

- **Conservation Areas:** Most of the surface areas over Genowlan Mountain are located within the MMSCA that has significant natural and cultural heritage values and contains significant mineral resources. Two threatened ecological communities have been identified on Genowlan Point which is nearby, but beyond, the Study Area. Given the predicted low levels of subsidence over the area of mesa that is affected by the proposed extraction, the proposed extraction should not cause physical impacts (such as surface cracking) that could potentially change the environment or habitat for this natural vegetation. Further discussions are provided by the other specialist consultants on the project.

- **Built features:**

There are unsealed roads and tracks located directly above the proposed mining area. It is expected that the potential effects of the low predicted subsidence levels would be negligible and unnoticeable on these roads, and these roads could be maintained in safe and serviceable condition throughout the mining period using normal road maintenance techniques.

Study Conclusions

The subsidence predictions by SCT from their FLAC model that was calibrated from subsidence monitoring data over MWs 02 to 10 have been supported by the monitored incremental subsidence results over MWs 11 to 12 under Mount Airly, as the wider chain pillar between MWs 10 to 11 has now been shown to limit the increased subsidence levels over MWs 11 & 12 to low and negligible subsidence levels.

The monitored incremental subsidence levels over MWs 13 to MW16, including MW15B over Genowlan Mountain are also lower than the predicted low levels of subsidence for two, three and four panels, with no observed surface cracking, rock falls, or cliffs falls.

The predicted ground movements over the 500 Mains and Herringbone First Workings are significantly smaller than the predicted ground movements over MWs 13 to 16. The headings have been designed to ensure safe entry to and egress from the future the Genowlan Mountain MWs 19 to 22 and other Genowlan workings. Hence no observed surface cracking, rock falls, or cliffs falls are expected over the proposed new the 500 Mains that will be designed with the wider heading pillars and rock bolted headings.

That is, at these low predicted subsidence ground movements, it is unlikely that the internal cliffs, overhangs and pagoda formations that are located over and near the 500 Mains will be adversely impacted by the proposed extraction of the 500 Mains and the Herringbone First Workings HB1 and HB2.

Nevertheless, it should be remembered as discussed in the EIS (2014) and the IRP report (2016) there could still be occasional natural rock falls of small slabs of rock. But, because of the very low levels of subsidence being predicted at the identified internal cliffs and rock features, there should be little chance of exceedance of the development approval conditions for cliffs.