



Centennial Coal

Airly



***Airly Mine
Cliff Line Zone of First Workings
Extraction Plan (ML1331)***

Volume 1: EP Main Document

SSD_5581

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			Refer also detailed stakeholder consultation for supporting management plans (component plans) described within this EP.		

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- **Biodiversity Management Plan (EP-BMP)**
- **Historic Heritage Management Plan (EP-HHMP)**
- **Site Water Management Plan (site WMP)**

Abbreviations

BMP	Biodiversity Management Plan
CLZ	Cliff Line Zone and Zone of First Workings, an approved Mining Zone defined in SSD_5581 as “ <i>The area of proposed mining shown in Figure 2 in Appendix 3 <of the consent>, as may be modified by an Extraction Plan</i> ”
DOC	Depth of Cover
DP&E	NSW Department of Planning and Environment
DRE	former Division of Resources and Energy, NSW Department of Planning & Environment (DP&E), and prior located within NSW Department of Industry. Recent restructure within DP&E in 2017 divided DRE into the <i>Division of Central Coast Coordination and Resources Regulation (Mine Safety Operations)</i> (commonly referred to as the ‘Resources Regulator’) and the <i>Division of Resources and Geoscience (DRG)</i> . Importantly for this management plan, the <i>Principal Subsidence Engineer</i> (PSE) resides within the Resources Regulator (Mine Safety Operations). For clarity and consistency with terminology within the development consent, the Resources Regulator (Mine Safety Operations) in relation to the PSE is referred to as ‘DRE’ as used throughout this document
DRG-ESU	Environmental Sustainability Unit, Division of Resources and Energy, NSW DP&E
EP	Extraction Plan
EP&A Act	Environmental Planning and Assessment Act 1979
EPL	Environment Protection License
HHMP	Historical Heritage Management Plan
IEP	Independent Expert Panel (post-consent)
IRP	Independent Review Panel (pre-consent)
LMP	Land Management Plan
MEP	Airly Mine Extension Project
ML	Mining Lease
MOD	Modification to Airly DA162/91 (former consent)
Mtpa	Million tonnes per annum
NPWS	NSW National Parks and Wildlife Service
OEH	NSW Office of Environment & Heritage
PAC	Planning Assessment Commission
PSMP	Public Safety Management Plan

RR	NSW Resources Regulator	NSW Department of Planning & Environment
ROM	Run of Mine	
SCA	State Conservation Area	
SSD	State Significant Development	
SSD_5581	Airly Mine Extension Project SSD Development Application	
SMP	Subsidence Monitoring Program	
TARP	Trigger Action Response Plan	
UCS	Unconfined Compressive Strength	
WMP	(Site) Water Management Plan	

1. INTRODUCTION

1.1. Background

Airly Mine is an existing underground coal mine located approximately 40 kilometres northwest of Lithgow in New South Wales, 170km northwest of Sydney and 4 km to the northeast of Capertee, as illustrated on **Figure 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.

Development Consent for the Airly Mine Extension Project (MEP) was approved on 15 December 2016 subject to the conditions set out in Schedules 2 to 6, as 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.

The conservative mine design for proposed workings under this Extraction Plan (EP) has been **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.

Subsequently, substantial focus is made on monitoring and inspections to confirm mining has been undertaken as per design specifications and that environmental impacts are not occurring. A Subsidence Monitoring Program (EP-SMP) has been specifically developed to address the project performance measures, supported by Trigger Action Response Plans (including adaptive management measures if required).

This Extraction Plan (EP) has been prepared for the **Cliff Line Zone and Zone of First Workings** (CLZ) as defined in SSD_5581 and shown on **Figure 2**, as required by Condition 7, Schedule 3 of SSD_5581. Accordingly as it represents first workings only, it is not a typical 'extraction' plan usually developed for secondary extraction of coal, as further discussed in Section 1.2 below. The EP has been prepared generally in accordance with the NSW DP&E's *Draft Guidelines for the Preparation of Extraction Plans* and generally in accordance with the recently released *Guide to Managing Risks of Subsidence - WHS (Mines and Petroleum Sites) Legislation* (Department of Industry Resources Regulator - Mine Safety, 2017). Regulatory requirements applicable to the development of this Extraction Plan are outlined in **Section 3.3** and detailed in **Appendix 2**.

The scope of this plan currently applies to the Extraction Plan Application Area (EP Area) as defined in **Section 3.1**, noting that the EP Area is located only within existing Mining Lease ML1331 and represents a sub-section of the overall approved *Cliff Line Zone of First Workings* area for the **Airly Mine Extension Project (MEP)** approved under development consent SSD 5581, as further outlined in Section 3.1.

1.1. Purpose

The purpose of this Extraction Plan is to meet the requirements of Condition 7 of Schedule 3 of development consent SSD_5581 and associated relevant guidelines, leases and licenses, including describing 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 during first workings within the Extraction Plan Area (EP Area) defined in **Section 3**.

First workings for mine development (including roadways, main headings and cut-throughs which form large pillars for later secondary extraction) provide long term stable support to the surface with

negligible ground movement, which are considered non-subsiding. **No secondary extraction** is proposed under the current Extraction Plan, which experiences ground movements conventionally referred to as subsidence.

Whilst **no surface impacts** have been predicted for first workings, this management plan importantly establishes appropriate monitoring and management frameworks to confirm such for the Cliff Line Zone whilst also providing baseline monitoring for subsequent secondary extraction plans to follow in future.

This is the first time in NSW an Extraction Plan and supporting management plans have been required only for first workings. After an extensive and detailed EIS (Golders 2014a) assessment process, this further highlights the conservative approach to mine design, management and approval to protect sensitive features.

1.2. Scope

This Extraction Plan:

- Addresses specific requirements set by Condition 7 in Schedule 3 of SSD_5581, and related regulatory requirements in accordance with Condition 2 of Schedule 6 as outlined in **Section 3.3** and **Appendix 2**;
- Manages first workings within the Extraction Plan Area defined in Section 3.1 of this EP.
- Addresses the monitoring and management of potential subsidence-related impacts to public safety resulting from first workings mine development within the EP Area at Airly Mine.
- Addresses Work Health and Safety legislation specifically in relation to subsidence as a principal mining hazard in relation to the safety of 'other persons' (primarily public safety within the SCA), addressed through the supporting **Public Safety Management Plan (EP-PSMP)** as detailed in **Section 3.3** and **Appendix 2**.

2. DEVELOPMENT

2.1. Stakeholder Identification and Engagement

During development of this Extraction Plan and its component plans, substantial consultation has been undertaken with key stakeholders (including detailed consultation during the Airly Mine Extension Project (of which the EP Area is a part), as outlined in the following sections.

2.1.1. Identification of Key Stakeholders

Stakeholder analysis undertaken during preparation of this Extraction Plan (EP) included:

- Risk-based consideration of key environmental and built features within the proposed mining area
- Stakeholders prescribed for consultation for this EP within the Development Consent (refer Section 2.1.2 below)
- Stakeholders identified within previous Environmental Assessments (former DA 162/91) and within the Airly Mine Extension Project EIS process (2014-2016);
- Existing and known stakeholders to the operational Airly Mine, including the Community Consultative Committee.

- Identified landowners. There are no private property or infrastructure owners in the EP Area.
- Stakeholders identified within the previously approved MOD3 Extraction Plan (2015) and MOD3 EP Variation Area (2016).

Key Stakeholders identified for consultation included:

- Independent Expert Panel (IEP) as required by SSD_5581;
- NSW Department of Planning and Environment (DP&E)
- NSW National Parks and Wildlife Service (NPWS)
- NSW Office of Environment & Heritage (OEH)
- Division of Resources Regulation and Central Coast Coordination – Mine Safety Operations ('NSW Resources Regulator'), within NSW DP&E. Formerly NSW Department of Industry - Resources Regulator (Mine Safety), and prior the Principal Subsidence Engineer resided within the Division of Resources and Energy (DRE).
- Division of Resources and Geosciences – Environmental Services Unit (ESU), NSW Department of Planning and Environment (DRG) (formerly part of NSW DTIRIS – Division of Resources and Energy (DRE))
- Commonwealth Department of Environment and Energy (DoEE) - EPBC matters
- NSW Environmental Protection Authority (EPA)
- NSW Department of Primary Industries – Division of Water (DPI Water)
- Lithgow City Council (consulted as part Airly MEP EIS and the HHMP)
- Airly Mine Community Consultative Committee (CCC)

It is noted that following review of updated land ownership (including SCA boundary changes gazetted in 2016), surface features mapping and risk assessment, the following additional stakeholders were confirmed **not applicable to the current EP Area**:

- NSW Department of Industry – Division of Lands and Forestry ('Crown Lands') – no crown lands within EP Area (now gazetted into the SCA where applicable);
- Telstra (Network Integrity Services) - (buried cable and a communications tower are outside the EP Area)
- Private land owners (none within EP Area)

2.1.2. Specific Agency Consultation for the Extraction Plan Required By Development Consent SSD_5581

Condition 7 in Schedule 3 of development consent SSD_5581 requires the preparation of this Extraction Plan in consultation with key relevant stakeholders as detailed in Section 3.3. Condition 7 I includes requirements to consult with specific agencies during preparation of related components:

- Conditions 7d, e, f, g, and h, require the Independent Expert Panel (IEP) to be consulted through the Extraction Plan approval process regarding mine design parameters and subsidence impact predictions
- Condition 7 (i) i requires Subsidence Monitoring Program which has been prepared in consultation with the IEP, DRE and OEH,
- Condition 7 (i) ii requires *Built Features Management Plan* which has been prepared In consultation with DRE

- Condition 7 (i) iii requires *Water Management Plan* which has been prepared in consultation with OEH and DPI Water
- Condition 7 (i) iv requires *Biodiversity Management Plan* which has been prepared in consultation with DoE (now DoEE) and OEH
- Condition 7 (i) v requires *Land Management Plan* which has been prepared in consultation with the IEP, DRE, OEH and any affected public authorities
- Condition 7 (i) vi requires *Heritage Management Plan* which has been prepared in consultation with OEH and relevant Aboriginal stakeholders.
- Condition 7 (i) vii requires Public Safety Management Plan which has been prepared in consultation with the IEP, DRE and OEH

The majority of these agencies (with the exception of the IEP) were also consulted during development of the previously approved MOD3 Extraction Plan (approved 28/7/15) and also during development of the MOD3 EP Variation (2016), as detailed in the following sections.

A summary of consultation undertaken specifically for this Extraction Plan is presented in **Table 2.1**. Associated documentation is contained in **Appendix 4**.

Table 2.1 Summary of Consultation for this Extraction Plan and Supporting Plans

Stakeholder	Dates	Aspects/Issues Raised	Section Addressed
NPWS and OEH Threatened Species Division	14/3/2017	Meeting at Mudgee NPWS – introduction to the current Extraction Plan, mine design, proposed monitoring and biodiversity management aspects and heritage management.	Section 4 (EP BMP)
OEH (NPWS)	24/3/2017	Changes to SCA Boundary for inclusion in LMP figures	Section 4
NSW Department of Planning and Environment (DP&E)	26/5/2017 30/5/17	Letter from Centennial Airly requesting endorsement of the Secretary for the project team for the Extraction Plan, and providing preliminary information to the IEP and DP&E including figures, plans, pillar stability assessment report and outline of proposed remote monitoring methods.	Section 3.3, App 4
DP&E and Independent Expert Panel (IEP)	31/5/2017	Centennial meeting with IEP and DP&E which included project presentation advising staged implementation of mining zones in this EP and consultation on proposed management and monitoring.	Volume 2 (supporting plans including SMP)
EPA, OEH, Water NSW, DPI Water	23/6/17 27/7/17	Draft site Water Management Plan provided for comment	Section 4
OEH, NPWS	13/7/17	draft Biodiversity Management Plan provided for comment	Section 4
DoEE	18/7/17 31/7/17	Contacted on two occasions for consultation interest for the Extraction Plan, confirming previous discussions in relation to state assessment of management plans.	Section 4.
'DRE' ¹ / Resources Regulator (Mine Safety Operations – Senior Subsidence Engineer)	19/7/17 20/7/17	Phone and email detailed correspondence with Dr Gang Li (Senior Subsidence Engineer) regarding consultation on the current Extraction Plan and DRE requirements, including this PSMP and recently released guidelines for managing subsidence risks in relation to WHS legislation. Refer Appendix 4 for details.	Sections 5,10
OEH (Historical Heritage Division)	19/7/17	draft Historic Heritage Management Plan for comment	Section 4
Lithgow City Council	27/7/17	draft Historic Heritage Management Plan for comment	Section 4

NPWS (OEH)	14-28/7/17	Updated information regarding crown lands under licence to NPWS for inclusion in LMP figures	Section 3
NPWS, DRE, IEP, DP&E, DRG-ESU	30/8/17	Draft SMP, LMP and PSMP provided for comment (refer Section 4 for details).	Section 4
DRG-ESU	14/9/17	DGR-ESU advised no objection to the drafts extraction plan methodology and monitoring regime, and recommends that the final EP is submitted. A new Mining Operations Plan is to be developed to incorporate the First Workings Cliff Line Zone.	Section 4,5
IEP	19/9/17	IEP response letter to draft SMP, PSMP, LMP.-IEP considered the draft plans reasonable and appropriate to manage unlikely events of surface impacts, the pillar designs expected to be long term stable as a primary control, and the TARP expected to be effective. The IEP also provided general comment encouraging development of a demonstrably effective ground movement monitoring network for the mine which includes the cliff line environment to monitor any ground movements in the CLZ whether they be natural processes or mining-related (page 40 of the SMP has been updated accordingly to clarify such context).	Section 4,5 Volume 2: SMP

Further, as an existing mine, substantial consultation has been undertaken with key stakeholders over an extended period which has fed into the development of this Extraction Plan. This includes (but is not limited to) detailed consultation during the Airly Mine Extension Project EIS and approval process (2014-2016) and the recent MOD3 Extraction Plan (2015) and Variations (2016), which can be referred to for further details if required.

2.1.3. Consultation for Environmental Impact Assessments

- Consultation with NSW Department of Planning and Environment (DP&E) (then DP&I) for MOD3 (2014) MOD4 (2015) and MOD5 (2016) to former development consent DA162/91;
- Significant detailed consultation undertaken for the EIS for the **Airly Mine Extension Project (MEP)** in accordance with a *Stakeholder Engagement Plan* developed for the project, including government agencies, the community, Aboriginal groups and other stakeholders. This included:
 - *Special Monitoring Committee Meetings*
 - *Community Information Sessions (six sessions)*
 - *Community Technical Information Sessions (four sessions)*
 - *Social Impact Assessment Consultation*
 - *Indigenous Stakeholder Consultation**
 - *Government Agency Consultation*

* it is also noted that detailed consultation was also undertaken with the indigenous community during development of the *Western Region Aboriginal and Cultural Heritage Management Plan* that specifically includes Airly Mine.

Further details on the above consultation processes and outcomes are described within the above documents, and have been considered in development of this EP.

2.1.4. Post-EIS Investigations and Correspondence:

- EIS Response to Submissions and subsequent correspondence (February-July 2015)
- Planning Assessment Commission (PAC) Review (November 2015) and Centennial Response (December 2015)
- Independence Review Panel Report (July 2016), and Centennial Response (July 2016)
- Note: The above processes included focus on sensitive land features including cliffs and pagodas, primarily in relation to secondary extraction but also first workings.

2.1.5. Results and Outcomes of Consultation Specifically for this Extraction Plan and Component Plans

The outcomes of consultation undertaken for supporting component plans are summarised in each relevant plan including where issues raised have been addressed. Copies of consultation correspondence is provided in **Appendix 4**, including project presentations from the mine to the IEP/DP&E and formal correspondence received from key stakeholders.

Additionally, **Section 4** of this EP includes a table summarising submission of draft copies of management plans (component plans) to various stakeholders (including beyond those required by Condition 7, Schedule 3 of consent) and

Further information regarding consultation undertaken for the Extraction Plan can be provided if required upon request.

2.2. Project Team

The project team for the Extraction Plan consisted of the following key personnel from Centennial and their consultants.

Table 2.2 Extraction Plan Project Team

Name	Position	Company	Experience	Role
David King	Senior Mining Engineer	Centennial Airly	23	EP Project Manager for Centennial Mine engineering, planning and design Risk Assessment facilitation, QA review Assist preparation of SMP, LMP, PSMP, RA.
James Wearne	Group Manager - Approvals	Centennial Coal	12	Project direction, targeted QA review
David Hill	Technical Director	Golder Associates	36	Specialist Pillar Stability and Settlement Subsidence Assessment
John Stevens	Contract Mine Surveyor	CEH	37	Prepared A0 Plans

Craig Bagnall	Senior Environmental Engineer	Niche Environment & Heritage (Niche)	22	Lead Consultant Project Manager Assist preparation of EP, PSMP, LMP, SMP, RA.
Chris McEvoy	Principal, Approvals	Niche	18	Consultant, assist preparation of PSMP, LMP, SMP, RA.
Lachlan Hammersley	Senior Environmental Engineer	GHD	8	Water Management Plan (Surface Water)
Dr Stuart Gray	Senior Hydrogeologist	GHD	15	Water Management Plan (Groundwater)
Tessa Boer-Mah	Cultural Heritage Manager, Newcastle Officer	RPS	17 (7 mining)	Historic Heritage Management Plan
Arne Bishop	Ecology Manager, Newcastle Office	RPS	14	Biodiversity Management Plan
Brian Hammonds and Jason Pollock	Discipline Leader – Survey & Mapping Survey Manager, Newcastle	RPS	Over 25 years	Consultant surveyors assisting components of the Subsidence Monitoring Program including cliff and pagoda monitoring.

As required by Condition 7(a) of development consent SSD_5581, Centennial provided an application letter and enclosed CVs for key representatives of the Extraction Plan team for approval to NSW DP&E on 26/5/2017. The Extraction Plan lead consultants (Niche) were previously endorsed for the existing MOD3 EP (2015) and MOD3 EP Variation Area (2016). The environmental consultants preparing the HHMP, WMP and BMP (GHD and RPS) were also involved in the EIS for the Airly Mine Extension Project (2014).

2.3. Process for Updating Subsidence Predictions and Impact Assessment

This Extraction Plan has primarily relied on recently updated predictions of subsidence effects, subsidence impacts and environmental consequences documented within the following documents contained in **Appendix 5** to this Extraction Plan. The most current subsidence predictions have been provided via a Pillar Stability Assessment report prepared by Golder Associates in 2017 as detailed below which has provided the main platform for development of the EP and supporting component plans. In chronological order the relevant documents are:

- **Golder (2014a), *Airly Mine Extension Project Environmental Impact Statement***, Golder Associates, April 2014, with consideration of the following specialist technical reports:
 - **Golder (2014b), *Subsidence Predictions and Impact Assessment (SIA) for Airly Mine***, 127621105-003-R-Rev0, January 2014, Golder Associates.
 - **Golder (2014c) *Subsidence Impact Assessment on the Cliff Lines and Associated Landforms for Airly Mine***. Report Number. 127621105-001-RRevA
- **MSEC (March 2015), MSEC749 *Peer Review of Airly Mine Subsidence Predictions and Assessments* - letter 150318**. Following consultation with DRE and DPE in December 2014,

a **technical peer review** of the mine design and subsidence impact assessments for the Airly Mine Extension Project was completed in March 2015 by MSEC.

- **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*** - Ken Mills (SCT), Ismet Canbulat (UNSW), Don Kay (MSEC). The IRP made five recommendations focussing on trialling and monitoring secondary extraction methods, and further assessing stability of cliff formations at pinch points, and loading distributions below cliffs for secondary extraction, which will be addressed in future extraction plans. The IRP confirmed their expectation that the proposed pillar geometry for first workings would be long term stable and the proposed 30 m cliff protection zones (of first workings) would protect cliffs from rock falls at close to background levels.
- **Golder Associates (2016). The Adequacy of Coal Pillars proposed for First Workings in ML1331, Airly Mine. GA Report No. 127621105-235-R-Rev0 to Airly Mine.**
- **Golder (2017) *The Adequacy Of Coal Pillars Planned For The Cliff Line Zone In ML1331, Airly Mine***. Project No. 127621105-313-R-Rev1. This report is the current and final assessment of coal pillar sizes for the final detailed mine plan presented within this Cliff Line Zone of First Workings Extraction Plan. The primary issues addressed in this report are:
 - Long Term Stability of first workings pillars;
 - Potential loading effects of future secondary extraction in adjacent mining zones (this addresses IRP recommendations regarding loading distribution assessment);
 - Revised pillar settlement subsidence estimates associated with first workings.
 - Potential effects of post-mining flooding of workings (part of 'worst-case' analysis)

The recent revised stability analyses and associated pillar settlement subsidence estimates Golder (2017) are consistent with previous findings outlined in the Airly MEP EIS and indeed has lower subsidence predictions than the EIS as detailed in **Section 3.5. No surface impacts have been predicted at these levels of subsidence.**

3. OVERVIEW

3.1. Management Area (Extraction Plan Application Area)

This management plan applies to the following Extraction Plan Area (EP Area) illustrated on **Figure 2**:

- The Cliff Line Zone of First Workings only within Mining Lease ML1331, excluding Authorisation area A232 (east of ML1331) and excluding existing approved Extraction Plan Areas as recognised by Condition 7 of SSD_5581 (MOD3 EP Area and MOD3 EP Variation Area).
- Includes all first workings proposed within the EP Area from the 31st January 2017 onward (activation date of SSD_5581 following expiry of permissible mining under former development consent DA162/91 on that date) for the duration of approval granted under SSD_5581, as detailed in the Extraction Plan.

The EP Area is wholly located within the Mugii Murum-ban State Conservation Area (SCA) with no private land ownership as illustrated on **Figures 9 and 10**.

3.1.1. Context to Approved Mining Zones

Airly Mine has five (5) approved mining zones under development consent SSD_5581, which are illustrated on **Figure 3**. These zones provide appropriate types of mining in specific areas to protect surface features. Staged approval of extraction plans within mining zones will be undertaken. As per **Section 3.1**, only part of the Cliff Line Zone approved by SSD_5581 is applicable to the current EP Area - A232 has been deliberately excluded which includes most sensitive areas of Genowlan Mountain.

No significant first workings are proposed within the CLZ/EP Area in the vicinity of the *New Hartley Shale Mine Potential Interaction Zone*.

3.1.2. Related Management and Monitoring Plans:

This Cliff Line Zone of First Workings Extraction Plan (ML1331) is supported by various required sub-plans (component plans) as detailed further in **Sections 3.3 and 4** of this EP. In summary, these include:

- **Extraction Plan** main document (**this document**)
 - **Subsidence Monitoring Program** (EP-SMP)
 - **Public Safety Management Plan** (EP-PSMP)
 - **Land Management Plan** (EP-LMP)
 - **Biodiversity Management Plan** (EP-BMP)
 - **Historic Heritage Management Plan** (EP-HHMP)
 - **Mine Site Water Management Plan** (site WMP)

As mentioned in **Section 3.1**, for clarity it is also noted that the existing approved management plans of the previous MOD3 Extraction Plan (as varied 2016) will continue to apply within the MOD3 EP Area as recognised under Condition 7 of Development Consent SSD_5581.

3.1.3. General Description of the EP Area

The EP Area includes steep, rugged and generally inaccessible topography including cliffs, pagodas and rock outcrops, dominated by the mesas of Mount Airly and the western edge of Genowlan Mountain. A saddle area between the two mountains known as 'Airly Gap' provides the primary unsealed access road and conveys the ephemeral headwaters of Gap Creek, as illustrated in **Figures 5 and 6**.

Subsequently, with the exception of SCA Management Trails (unsealed access tracks) and associated gates and fences, no other significant built features occur within the EP Area.

The sensitive and rugged terrain above the mine is primarily comprised of the Mugii Murum-ban State Conservation Area (SCA) managed by NPWS and is a focal point of environmental protection that requires low impact, non-intrusive monitoring and management.

For context, it is noted that **Airly Mine has previously successfully mined under the following features located beyond the current EP Area without any significant impact to date:**

- Cliffs, pagodas and steep slopes within the existing approved MOD3 EP Area and in other areas outside MOD3
- Airly Gap Campground (SCA campground)
- Airly Gap Trail
- Stone Cottage Airly Gap (privately owned)
- General SCA land surface (including areas containing threatened flora and fauna)
- SCA fences and access gates
- Telstra copper phone line (Airly Gap)
- Crown lands under licence to NPWS within Airly Gap
- Aboriginal Heritage Rock Shelter 45-1-2761 (with Potential Archaeological Deposit)

Figure 1: Airly Mine Locality

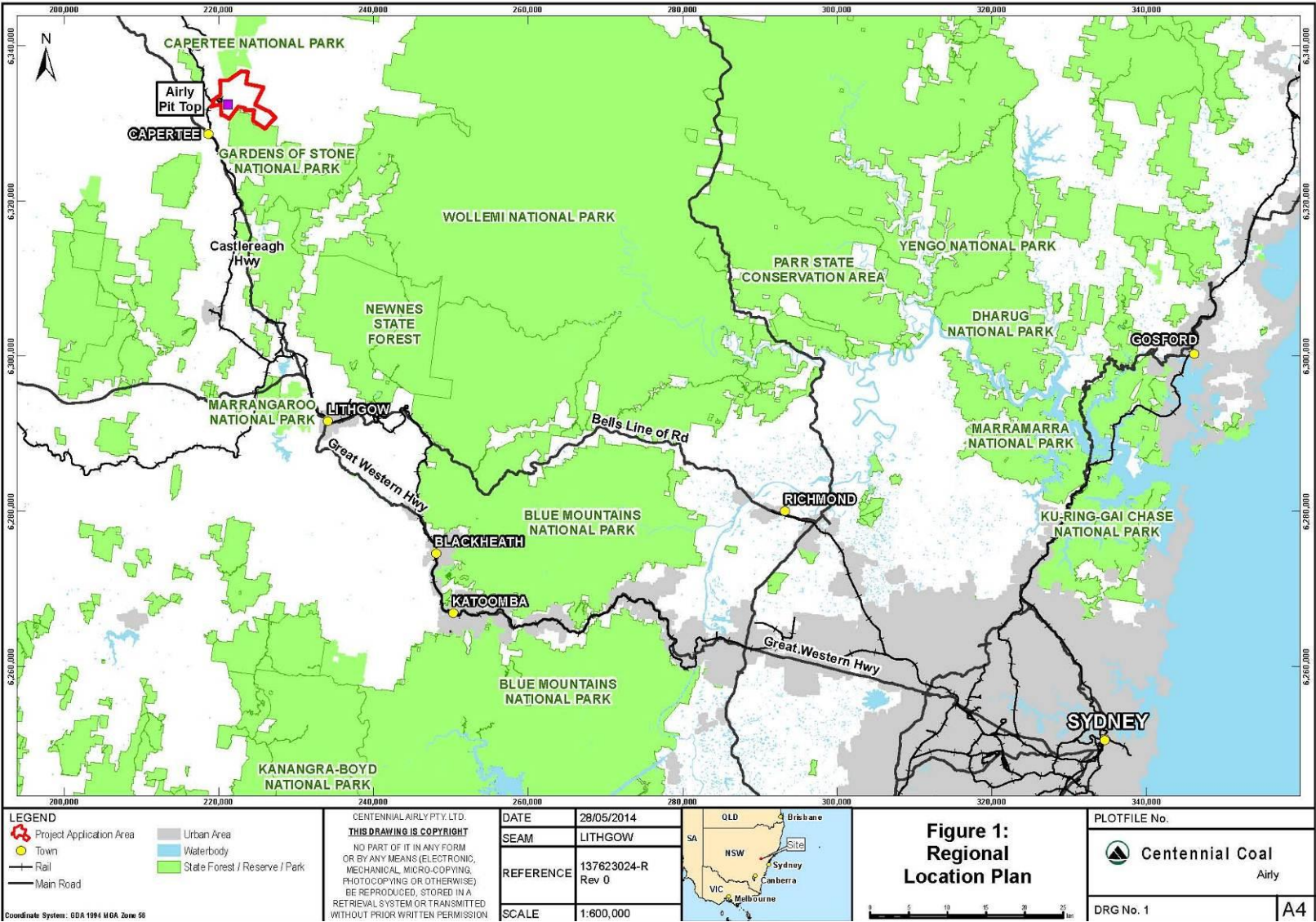


Figure 2 Extraction Plan Application Area

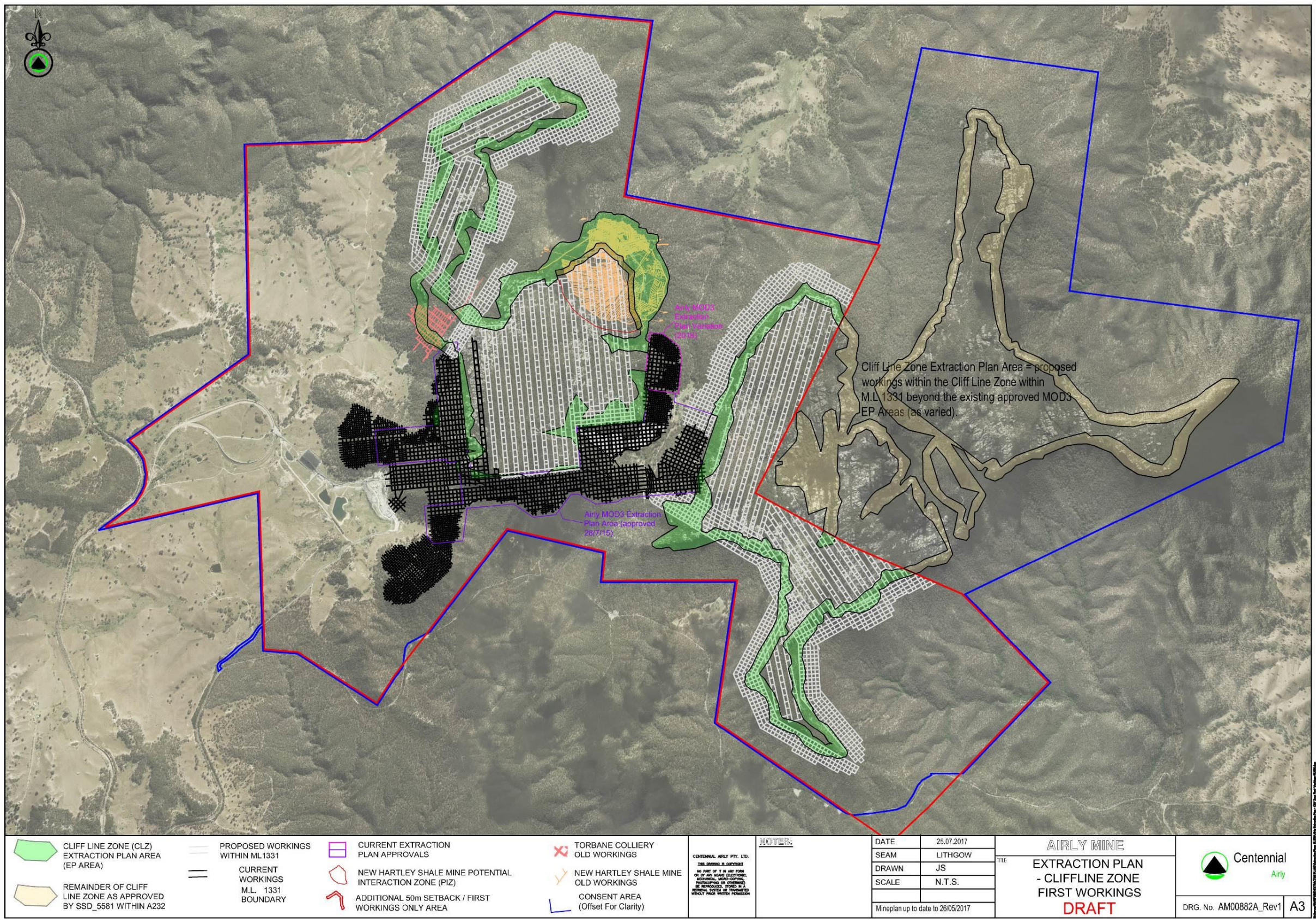


Figure 3 Approved Mining Zones by Development Consent SSD_5581

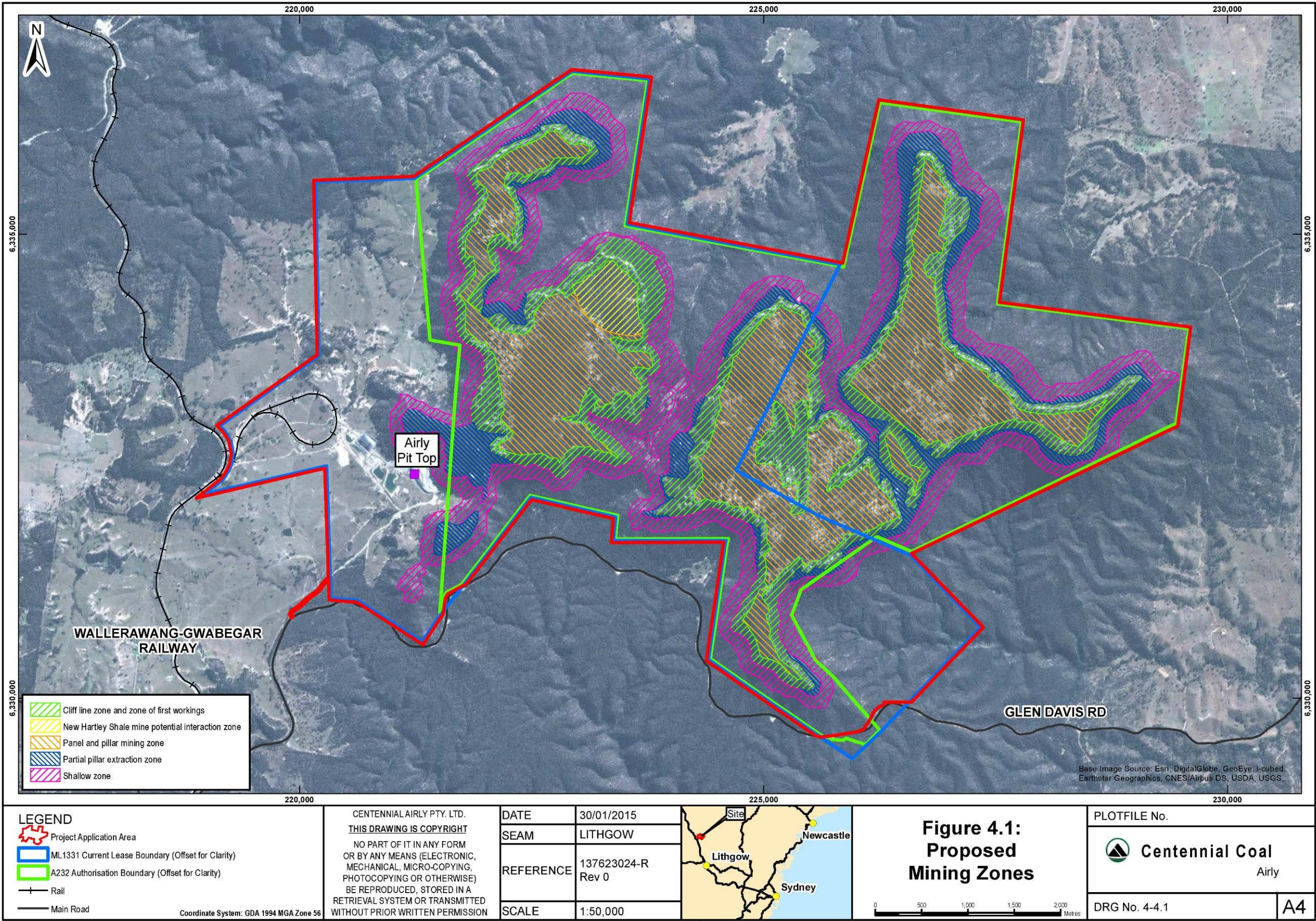


Figure 4 General Identification of Cliff Areas and Mining Zones (EIS Response to Submissions, 2015)

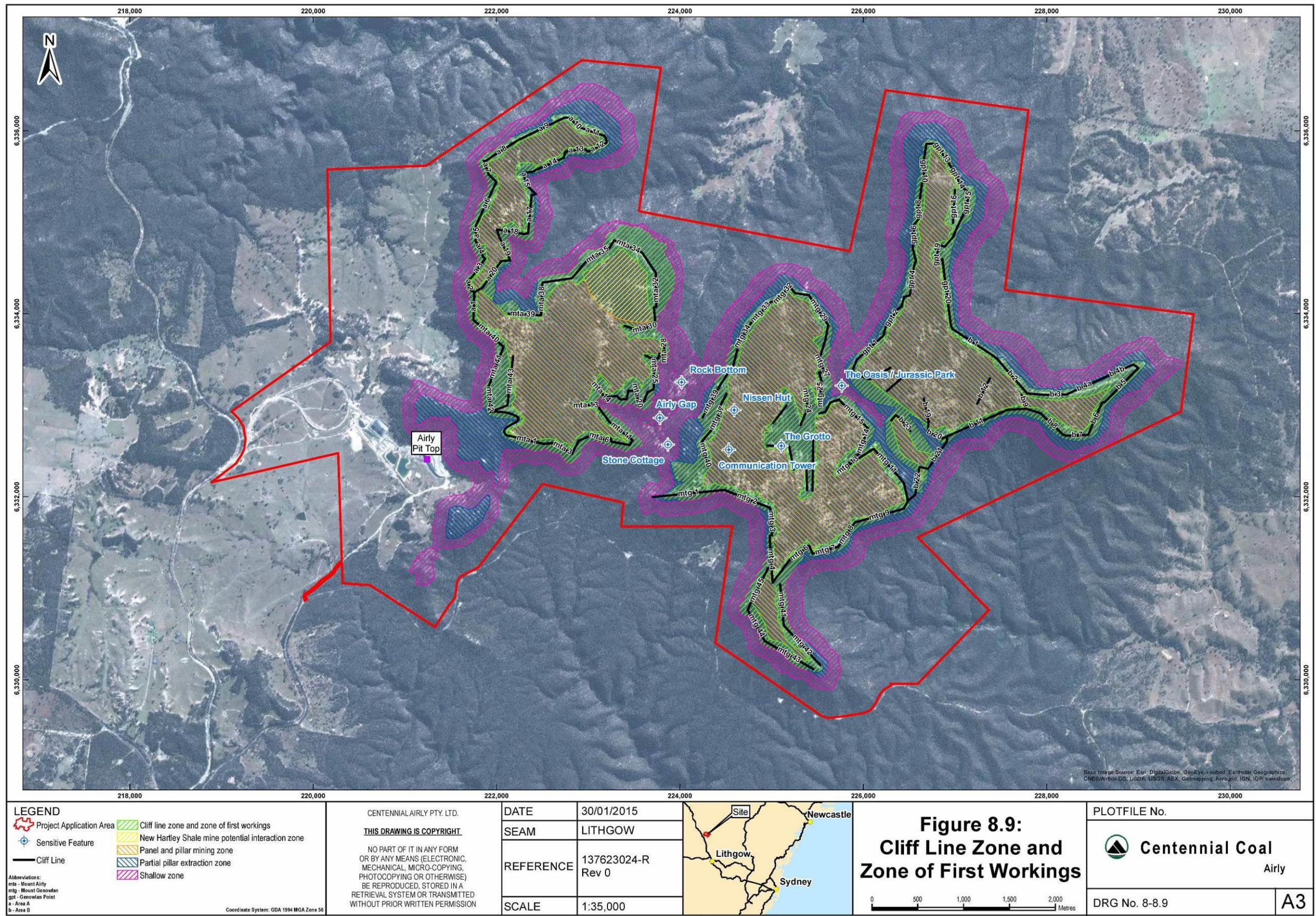


Figure 5 Landscape Features - EP Area

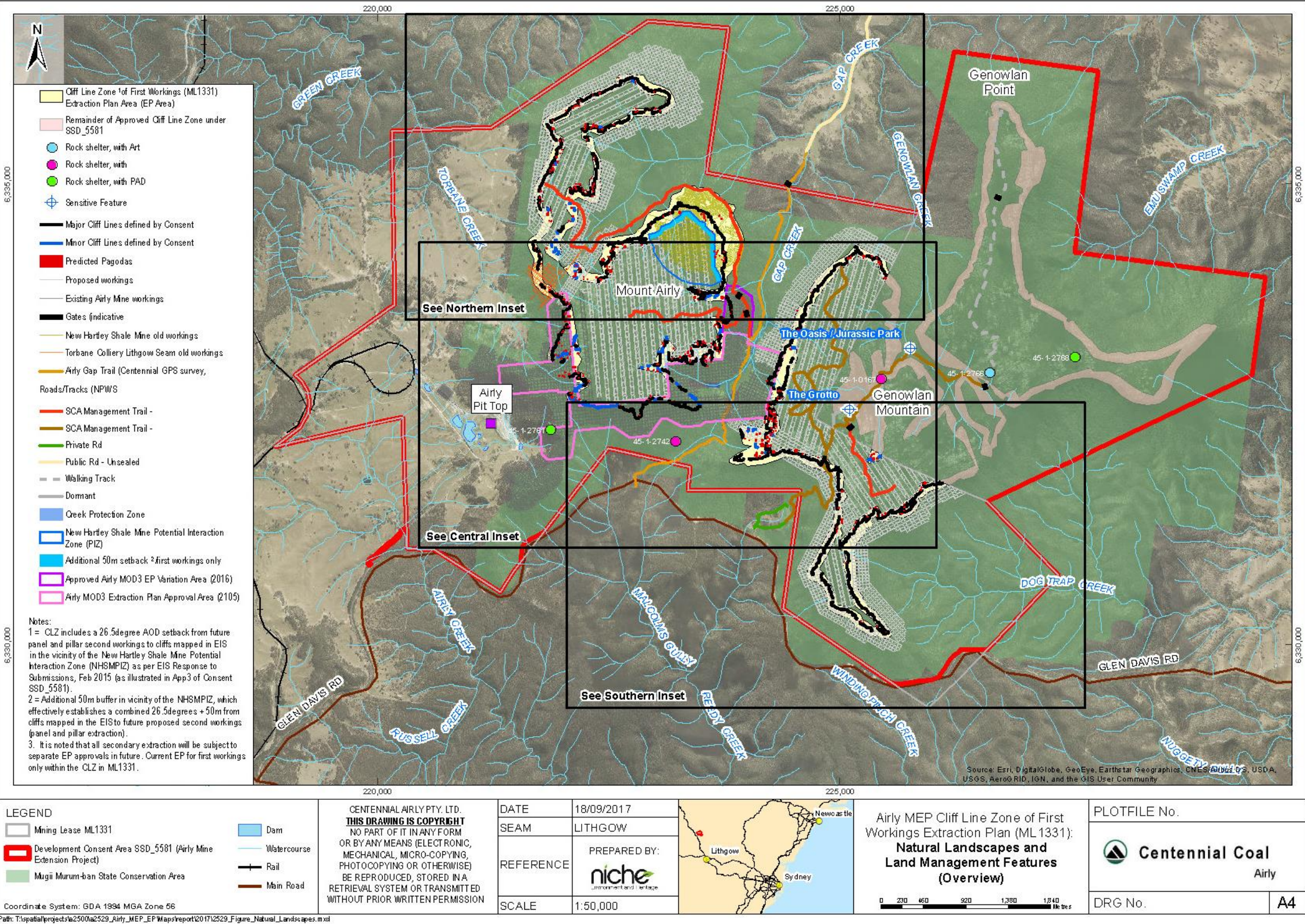


Figure 6 Land Management Features in the EP Area – Northern Inset

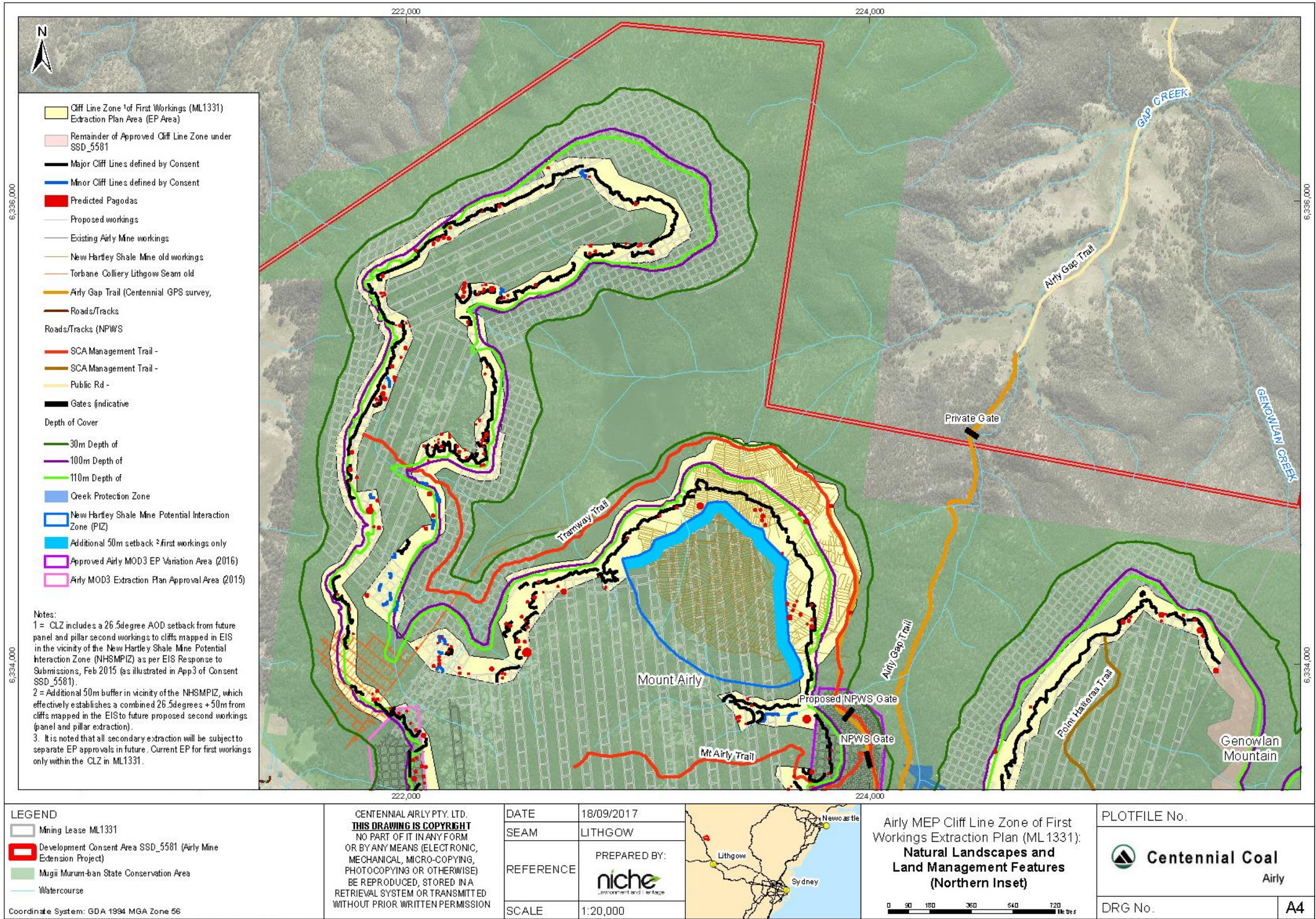


Figure 7 Land Management Features in the EP Area – Central Inset

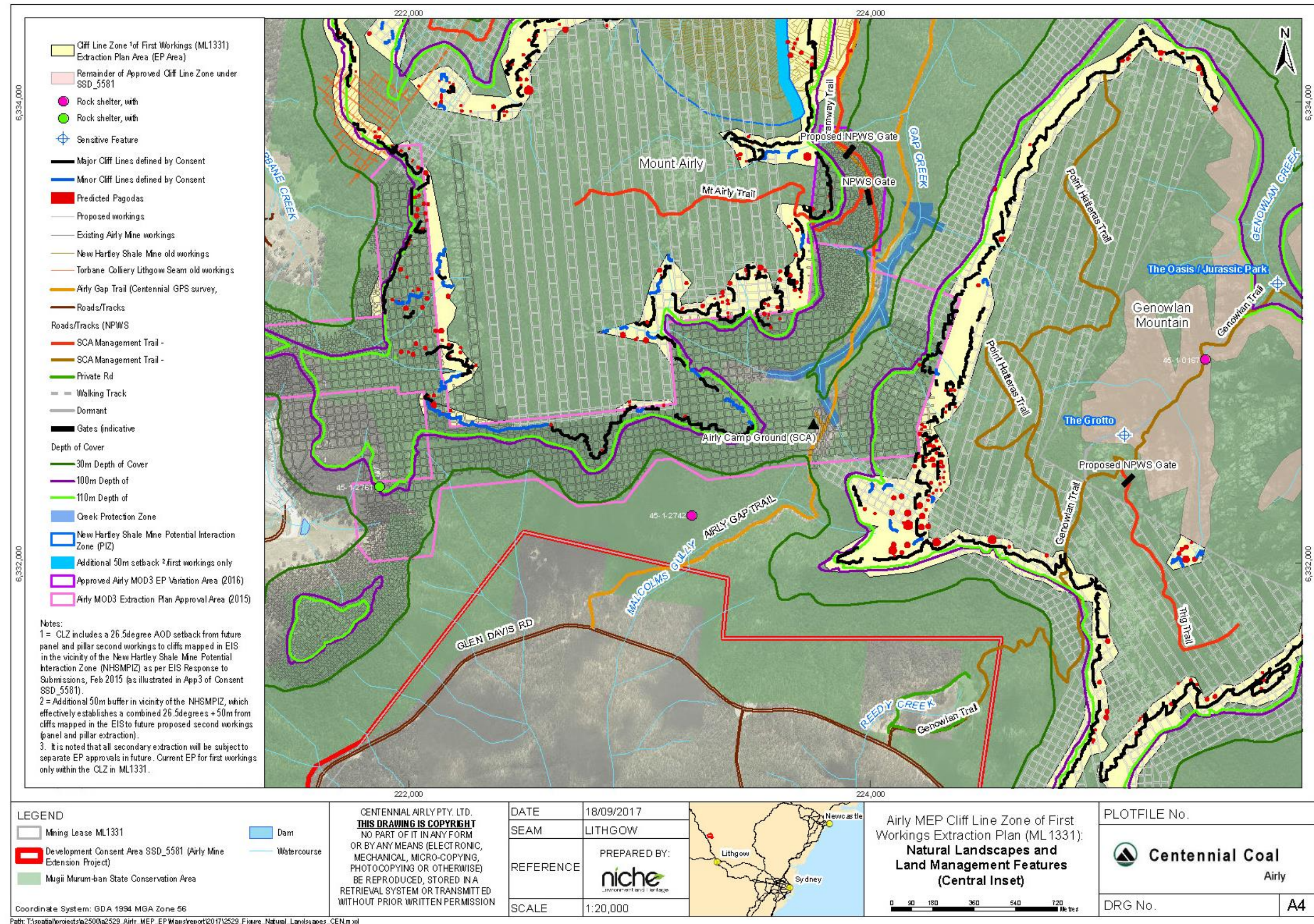


Figure 8 Land Management Features in the EP Area – Southern Inset

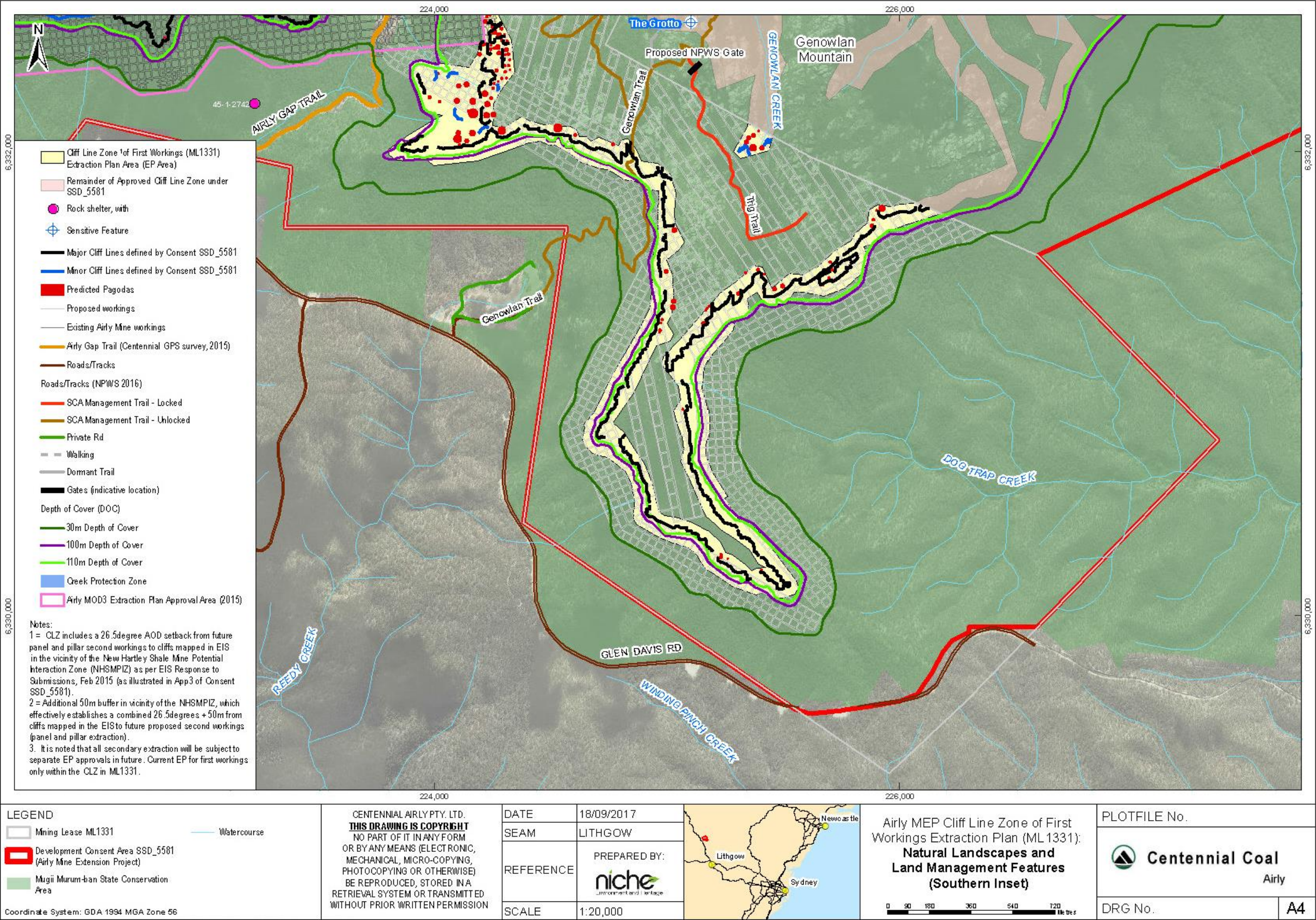


Figure 9 **Land Ownership Relevant to the EP Area (Overview)**

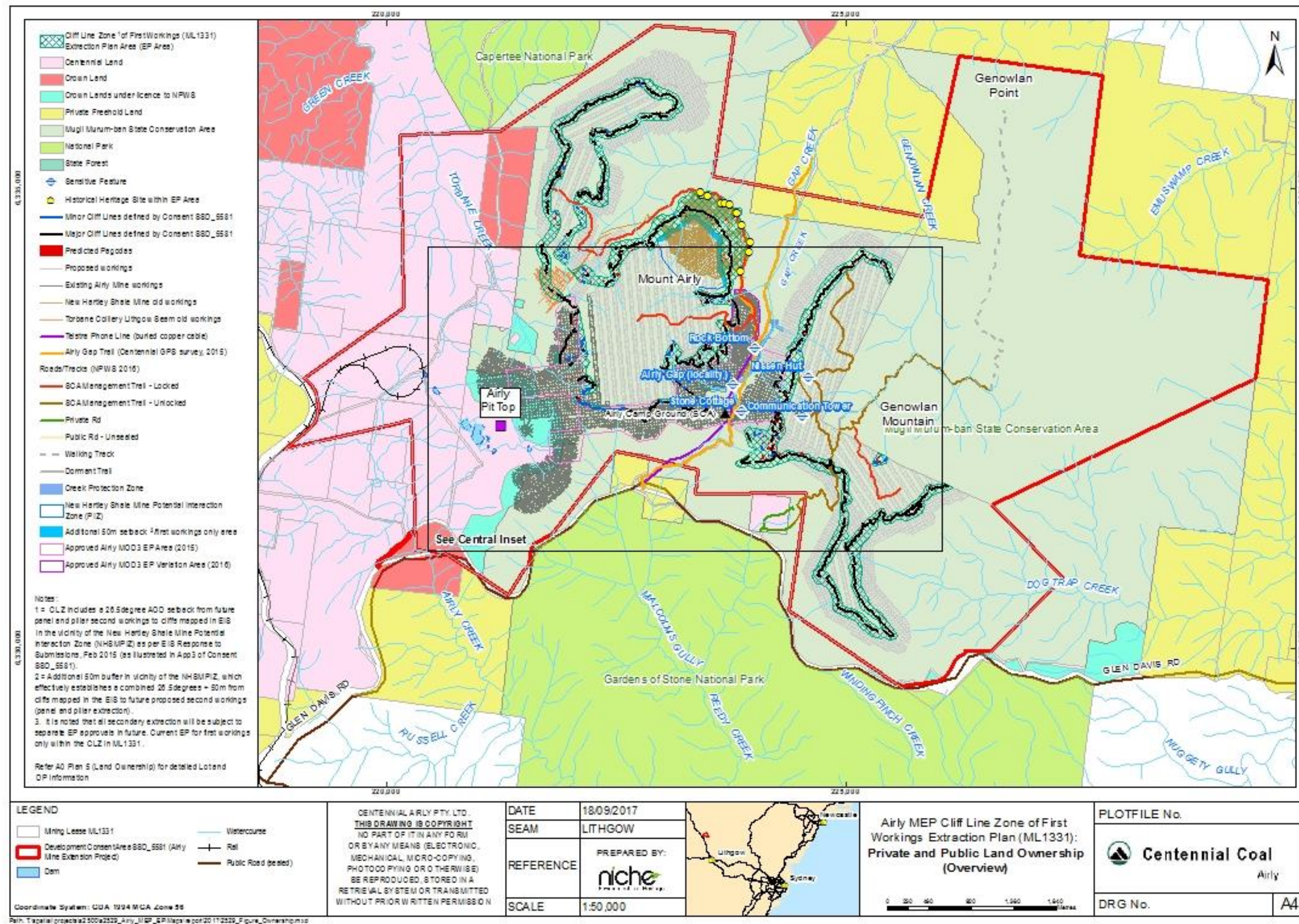
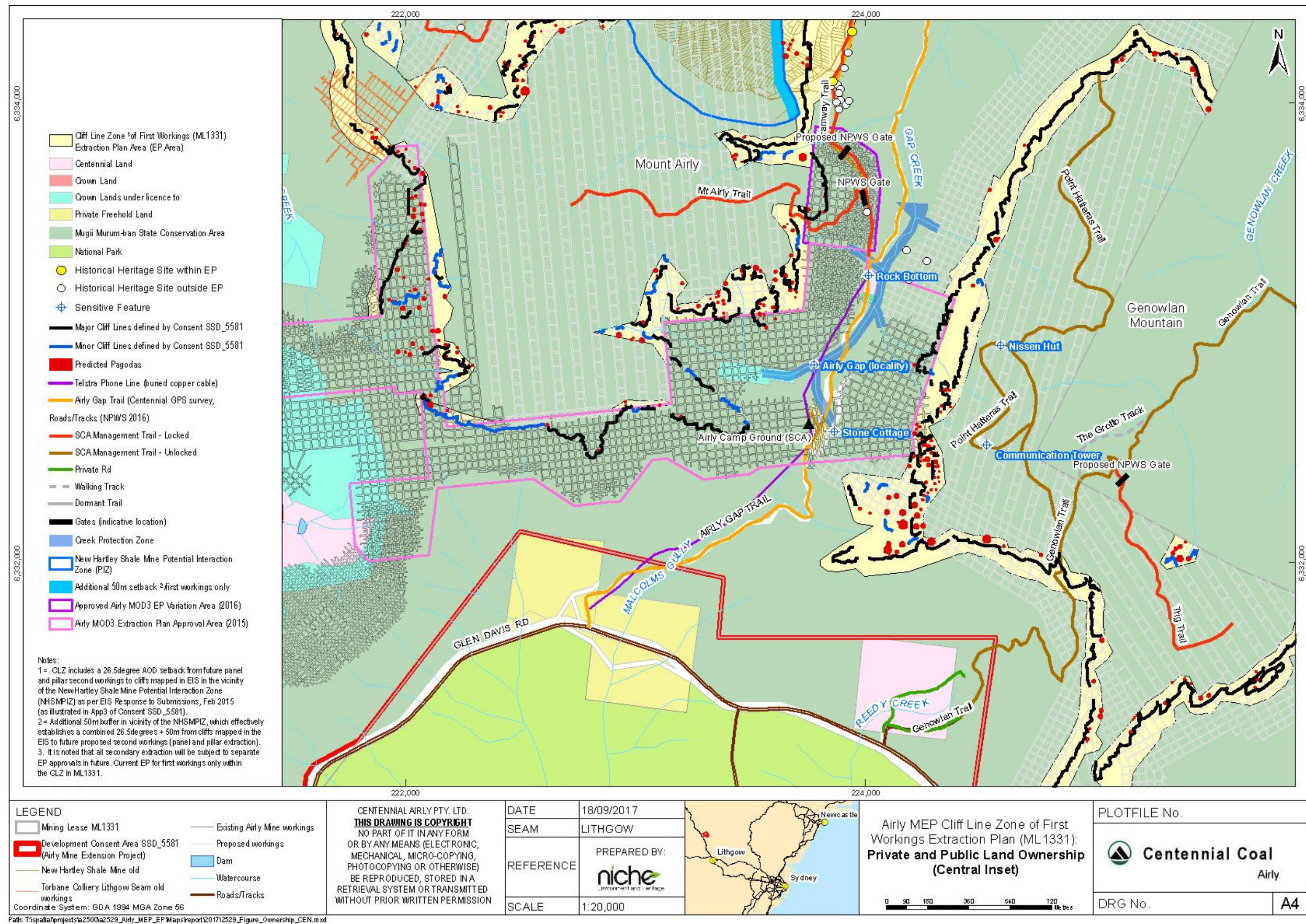


Figure 10

Land Ownership Relevant to the EP Area (Central Inset Area)



3.2. Regulatory Requirements

This section summarises 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.

Additional relevant regulatory **approvals, leases, licences and guidelines** are detailed in **Appendix 2**, including requirements of the draft Extraction Plan Guidelines (NSW DP&E, 2015) and the recently released *Guide to Subsidence Risk Management (WHS Mines and Petroleum Sites) Legislation* (NSW Department of Industry Resources Regulator – Mine Safety, February 2017).

Other additional legislation specifically relevant to individual supporting environmental management plans (i.e. the EP-BMP, EP-HHMP and the site WMP) are also detailed within those relevant plans.

3.2.1. Development Consent

Centennial Airly's operations are conducted in accordance with applicable State and Commonwealth environmental, planning, mining, safety, and natural resource legislation. Centennial Airly maintains a register of relevant environmental legislative and regulatory requirements in a compliance database.

The Airly Mine Extension Project (MEP) was granted Development Consent SSD_5581 on the 15th December 2016. The consent provides the conditional planning approval framework for mining activities to be addressed within in an Extraction Plan and supporting management plans required by Condition 7 in Schedule 3, as detailed in **Table 3.1**. Performance Measures relevant to this management plan (as described in Schedule 3 of SSD_5581) are detailed separately in **Section 3.6**.

In accordance with Condition 2, Schedule 6 of SSD_5581, other applicable requirements of development consent, EIS/Statement of Commitments, and other related approvals, leases, licences and guidelines relevant to this Extraction Plan are presented in **Appendix 2**. This includes the draft *Guidelines for the Preparation of Extraction Plans* (DP&E, V5 2015).

Table 3.1: Key Conditions of Development Consent SSD_5581

Condition	Requirement	Section Addressed
Schedule 3, Condition 2 (Performance Measures - General)	The Applicant must ensure that the development does not cause any exceedances of the performance measures in Table 1 to the satisfaction of the Secretary. (Refer Section 6 for details of relevant Performance Measures listed by SSD_5581)	Section 3.6
Schedule 3, Condition 7 (Extraction Plan)	Prior to carrying out any <u>first workings within the Cliff Line Zone and Zone of First Workings</u> (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:	
	a) Be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the secretary	Section 2
	b) Provide a detailed justification for any proposed divergence from the advice of the IEP or DRE;	Section 2, Section 3.4
	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	Volume 3 (A0 Graphical Plans)
	d) Include adequate consideration of mine roof and floor conditions, pillar width to height ratio, final pillar design dimensions and the long-term	Section 3.4

Airly Mine Cliff Line Zone of First Workings Extraction Plan (ML1331)

	stability of pillars, following consultation with the IEP;	Appendix 6 (Pillar Stability Assessment Report)
	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 3.4 Appendix 4
	f) Provide an assessment of the likely stability of cliff lines, pagodas and steep slopes, in consultation with the IEP;	Section 3.4, 3.5, 3.7. Appendix 6 (Pillar Stability Assessment Report)
	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 3.5 Appendix 6
	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, and manage or remediate any impacts and/or environmental consequences to meet the rehabilitation objectives in condition 31 of Schedule 4, following consultation with the IEP.	Section 3.6 Appendix 1 Volume 2 (supporting plans)
	<p>i) Include a:</p> <p>i) Subsidence Monitoring Program which has been prepared in consultation with the IEP, DRE, and OEH to:</p> <ul style="list-style-type: none"> • 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. 	<p>Section 4</p> <p>Volume 2: Subsidence Monitoring Program (EP-SMP)</p>
	<p>(ii) Built Features Management Plan, which has been developed in consultation with DRE, to manage the potential subsidence impacts of the proposed underground workings on built features, and which:</p> <ul style="list-style-type: none"> • 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. 	<p>Not Applicable (no significant built features, minor features managed within LMP)</p> <p>Refer Sections 1 and 4</p>
	...(iii) Water Management Plan which has been developed in consultation with	Section 4

	<p>DPI Water, which provides for the management of potential subsidence impacts and/or environmental consequences of the proposed underground workings on watercourses and aquifers, including:</p> <ul style="list-style-type: none"> Detailed baseline data on: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> stream flows and quality; stream and riparian vegetation health; channel and bank stability A groundwater monitoring program to monitor and report on: <ul style="list-style-type: none"> 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; 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. 	<p>Volume 2: Site Water Management Plan</p>
	<p>...(iv) Biodiversity Management Plan which has been developed in consultation with DoE and OEH, 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:</p> <ul style="list-style-type: none"> <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) 	<p>Section 4</p> <p>Volume 2: Biodiversity Management Plan (EP-BMP)</p>
	<p>...(v) Land Management Plan which has been prepared in consultation with the IEP, DRE, OEH 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</p>	<p>Section 4</p> <p>Volume 2: Land Management Plan (EP-LMP)</p>
	<p>...(vi) Heritage Management Plan which has been prepared in consultation with OEH 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 23 of Schedule 4.</p>	<p>Sections 1, 4</p> <p>Volume 2: Historic Heritage Management Plan (EP-HHMP)</p>

		<p><u>Note:</u> No known Aboriginal or cultural heritage sites within current EP Area.</p>
	(vii) Public Safety Management Plan which has been prepared in consultation with the IEP, DRE and OEH to ensure public safety and manage access on the site	<p>Section 4</p> <p>Volume 2 Public Safety Management Plan (EP-PSMP)</p>
	(viii) include Trigger Action Response Plans, or equivalent, to prevent greater than predicted subsidence impacts and environmental consequences that may result from mine subsidence	<p>Section 3.7</p> <p>Appendix 1</p>
	(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;	<p>Section 3.7</p> <p>Appendix 1</p>
	(x) Proposes appropriate revisions to the Rehabilitation Management Plan required under Condition 33 in Schedule 4;	Section 3.7
	(xi) include a program to collect sufficient baseline data for future Extraction Plans	<p>Section 4.6, 5.2</p> <p>Volume 2 (SMP and supporting MPs)</p>
	The Applicant must implement the approved Extraction Plan for the development	Section 6
	<p><u>Notes:</u></p> <ul style="list-style-type: none"> 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. 	Section 3.1
	<ul style="list-style-type: none"> In accordance with Condition 4 in Schedule 6, the preparation and implementation of Extraction Plans may be <u>staged</u>, with each plan covering a defined area of underground workings. In addition these plans are only required to contain management plans that are relevant to the specific underground workings that are being carried out. 	Section 1, 3
	<ul style="list-style-type: none"> Due to the sensitive and rugged terrain of the Mugii Murum-ban State Conservation Area, the Applicant may propose remote subsidence monitoring techniques. 	<p>Section 5,</p> <p>Volume 2: Subsidence Monitoring Program (EP-SMP)</p>
Schedule 6, Condition 2 (Management Plan Requirements)	The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:	<p>Volume 2</p> <p>Appendix 2</p>
	a) Detailed baseline data;	<p>Section 5.2</p> <p>Volume 2: SMP</p>
	<p>b) A description of:</p> <ul style="list-style-type: none"> The relevant statutory requirements (including any relevant approval, licence or lease conditions); Any relevant limits or performance measures/criteria; 	<p>Section 3.3, Appendix 2</p> <p>Section 3.6,</p>

	<ul style="list-style-type: none"> 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. 	Volume 2 Section 3.6 Section 3.7
	c) A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria.	Section 3.7, Volume 2
	d) A program to monitor and report on the: <ul style="list-style-type: none"> Impacts an environmental performance of the development; Effectiveness of any management measures (see c) above); 	Section 5 Volume 2: SMP
	e) A contingency plan to manage any unpredicted impacts and consequences	Section 3.7 Appendix 1
	f) A program to investigate and implement ways to improve the environmental performance of the development over time	Section 6 Volume 2: SMP
	g) A protocol for managing and reporting any: <ul style="list-style-type: none"> Incidents; Complaints; Non-compliances with statutory requirements; and Exceedances of the impact assessment criteria and/or performance criteria; and 	Section 6
	h) A protocol for periodic review of the plan.	Section 6

3.2.2. Work, Health and Safety Legislation (as relevant to Subsidence)

The following outlines Work, Health and Safety (WHS) requirements considered for the Extraction Plan principally within the context of subsidence related risks to public safety, including to private property and public infrastructure. An outline of key relevant requirements is provided below, with further details provided in **Appendix 2** including tables where these have been addressed by this PSMP and the current Extraction Plan. Further details on WHS aspects are described within the supporting Public Safety Management Plan (EP-PSMP) in Volume 2 (and compliance aspects specifically relating to the monitoring of subsidence detailed within the *Subsidence Monitoring Program* (EP-SMP) for the Cliff Line Zone of First Workings Extraction Plan.

Principle Duty of Care to ‘Other Persons’:

In relation to public safety relevant to the Extraction Plan, under Section 19 of the Work Health and Safety Act 2011 (WHS Act) 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.

Under clause 9(1) of the WHS (Mines and Petroleum) Regulation (2014) (*WHSMP Regulation*¹), 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 clause 67(1) of the WHSMP Regulation, the mine operator of an underground coal mine must, in complying with clause 9, manage risks to health and

safety associated with subsidence at the mine. Clause 67(2) sets out specific requirements in relation to subsidence

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.

3.3.2.1 Subsidence as a Principal Hazard

Clause 5 of the WHS (Mines and Petroleum) Regulation (2014) (*WHSMP Regulations*) provides the definition of a **principal hazard** as:

“..a principal hazard is any activity, process, procedure, plant, structure, substance, situation or other circumstance relating to the carrying out of:

*(a) mining operations that have a **reasonable potential to result in multiple deaths in a single incident or a series of recurring incidents** in relation to any of the following:*

.....(vi) subsidence,

Given that the pillar system design has a Factor of Safety is 2.11 or greater (equivalent to a failure probability of 1 in 1 million), and has been assessed as long term stable by the Independent Expert Panel and the specialist Pillar Stability Report (Golder Associates 2017), it is considered that there is no reasonable potential to cause multiple deaths from such a system. Notwithstanding this, Airly Mine has conservatively prepared this PSMP generally in accordance with the relevant WHS legislation and guidelines as outlined further below and detailed in **Appendix 2**.

Under clauses 23(1) and 23(2) of the WHSMP Regulation, the mine operator must identify all principal mining hazards associated with mining operations at the mine, and conduct a risk assessment in relation to each principal hazard identified that involves a comprehensive and systematic investigation and analysis of all aspects of risk to health and safety associated with each principal hazard. Airly Mine has prepared a risk assessment to identify and assess principal hazards and controls in relation

1. *WHSMP Regulations 2014 – as amended by the Work Health and Safety (Mines and Petroleum) Amendment (Harmonisation) Regulation 2016.*

Under clause 24 of the WHSMP Regulation, 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 clause 24 and Schedule 1.

This PSMP is intended to constitute the PHMP for subsidence in relation to the protection of ‘other persons’ for the Cliff Line Zone of First Workings Extraction Plan, and seeks to address the relative requirements outlined under clause 24(3) of the WHSMP Regulation in **Table 3** below.

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.

3.3.2.2 Assessment for High Risk Activity

Further to the above processes (and those in Appendix 2) which have informed subsidence risk assessment, the following is noted for clarity in relation to the proposed first workings in the EP Area in relation to definition of High Risk Activities (HRA) under relevant WHS legislation (in particular Clause 33 and Schedule 3 of the WHSMP Regulation). The first workings pillars proposed within the EP Area are:

- **Not secondary extraction** (clause 16) – Proposed workings are **permanent first workings only** (no secondary extraction of any form at time following development, including any form of partial pillar extraction or reduction)
- **Not shallow workings** (clause 17) and are >50m depth of cover (minimum depth within EP Area is approximately 80m).
- Not highwall mining (clause 28)
- Have been assessed in consultation with the IEP as **long term stable with negligible pillar settlement and the design is considered effectively non-subsiding by the Independent Expert Panel**. They are not expected to experience any significant later settlement due to adverse conditions (e.g. no weak floor conditions identified by geotechnical assessment, no significant additional movement predicted by potential for flooding or additional loading by nearby later secondary extraction areas, average panel FOS significantly exceed design minima (Golder Associates, 2017)).
- **Accordingly, the proposed working within the current Cliff Line Zone of First Workings Extraction Plan are not considered to require notification as a High Risk Activity.**

3.3.2.3 Guidelines for Managing Risks of Subsidence (WHS Legislation)

In February 2017, the (then) NSW Department of Industry Resources Regulator (Mine Safety) released the document *Guide to Managing Risks of Subsidence (WHS Mines and Petroleum Legislation)*.

Table A2.6.2 in Appendix 2 lists key recommended factors to be considered in the management of subsidence risks to ‘other persons’ (including for Principal Hazard Management Plans) in accordance with the new guidelines.

As detailed in Section 4.2.2 above, no High Risk Activities (HRA) are associated with the current EP Area. Accordingly HRA components of the guidelines do not apply for this PSMP.

3.3.3 Existing Related Extraction Plan Approvals

Condition 7 of Schedule 3 of SSD_5581 (Extraction Plans) recognises any existing Extraction Plan approval areas held by the mine at the time SSD_5581 was granted in December 2016, as follows:

Notes:

- *This condition does not apply to first or second workings which are covered by an Extraction Plan or Subsidence Management Plan approved, or under assessment as at the date of this development consent.*
- *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 management plans that are relevant to the specific underground workings that are being carried out.*
- *Due to the sensitive and rugged terrain of the Mugii Murum-ban State Conservation Area, the Applicant may propose remote subsidence monitoring techniques.*

The MOD3 Extraction Plan was granted approval on 28th July 2015 and subsequently varied in 2016, as a requirement of Mining Lease ML1331. The former Development Consent DA 162/91 (as modified) was applicable at the time of approval.

Accordingly, the existing approved MOD3 Extraction Plan areas will continue to apply and have subsequently been excluded from the current EP Area as defined in Section 3.1 of this plan.

3.4 Mine Planning and Design

3.4.1 Proposed Mining Method and Mine Design to Avoid Potential Impacts

The mine design has been specifically developed in response to the sensitive surface features and environment in order to avoid significant impact. As a result, Airly Mine operates in specific mining zones using low-impact underground mining methods that limit void widths and leaves sufficiently large pillars to support the overburden and prevent subsidence impacts.

The proposed first workings panels within the EP Area will be developed using **bord and pillar mining methods** employing continuous miners. **No secondary extraction** is proposed in future within the EP Area (i.e. first workings are considered permanent). Bord and pillar mining techniques have been successfully undertaken at Airly Mine since 2011 without subsidence impact or any evidence of underground pillar instability. The system is specifically designed to support the surface, whilst providing a safe and productive mining system. Large, long term stable pillars are proposed which will experience negligible pillar settlement and are considered effectively non-subsiding (as also assessed by the IEP), Details of the proposed mining geometry are provided in Section 3.4.7.

Further, in accordance with the Coal Mines and Petroleum Health & Safety Regulations 2014 (as amended 2016), these pillars require a minimum plan dimension of no less than one tenth the depth of cover from surface or 10m, whichever is greater. I

The mine design is discussed in further detail in **Section 3.4.5** and **3.4.7**.

3.4.2 Coal Seams and Floor and Roof Geology

Roof, floor and coal seam strata conditions play an important role in the selection of appropriate mining systems in an underground mine. Strata competency is determined by the strength properties of the rock masses, the type and amount of geological structure (such as faults, jointing and seam undulations) and the stress environment of the strata (Golder Associates, 2014). These aspects are discussed in the following sections.

The underlying Permian Illawarra Coal Measures outcrop around the perimeter of the topographically elevated plateau or mesa, and in the north-south trending "gap" which separates Mount Airly in the west from Genowlan Mountain in the east.

Of the available coal seams, the only coal seam deemed to be of any significant economic importance for current mining operations is a lower section of the coalesced Lithgow/Lidsdale Seam. All of the existing and proposed workings in Airly Mine are located in the Lithgow Seam. In the EP Area the combined Lithgow and Lidsdale seam is 4.8 to 5.9 metres (m) thick, averaging 5 m and thinning to the south-east.

The Lithgow Seam (plies LT1 to LT3) constitutes the base of the combined seam and averages 3.4 m in thickness. This is of higher quality and is the target for mining. The planned development height is 2.8 m on average (with upper limit of 3m in accordance with the approved EIS), approximately mid-way between the LW1 claystone band and the lower LW2 claystone band, the latter being typically 0.1 m thick. This results in a roof bolt horizon typically comprised of 0.3 m to 0.4 m of top coal, overlain by 0.4 m of LW1 claystone and the Lidsdale Seam with its dirt bands.

The overlying 6 m of the **roof** within the EP Area is comprised typically of mudstone / siltstone grading upwards into siltstone / sandstone. This upper material is more consistently strong, with UCS (Unconfined Compressive Strength) values of around 40 MPa and is less prone to delamination and is therefore deemed more competent. The remainder of the Permian overburden, which varies in thickness from 70 m to 140 m and averages 105 m, is composed of interbedded mudstone, siltstone and sandstone units with thin coal seams. Material strengths are typically of the order of 30 to 40MPa.

The Triassic capping overburden is up to 200 m thick and is dominated by thickly bedded to massive sandstones varying from fine grained to conglomeratic, with occasional thin claystone and mudstone beds and lenses. The sandstone UCS is typically around 40 MPa, with occasional bands of up to approximately 60 MPa. Generally, the fine grained units are better cemented and therefore stronger than the coarse grained sandstone conglomerate units.

The immediate 1 to 2 metres of the **floor** within the EP Area is generally comprised of silty sandstone with a UCS of around 40 MPa, underlain by medium grained sandstone with a UCS of 20 to 30 MPa. The sandstone has very little sensitivity to moisture. **As the floor at Airly has been assessed as moderate to strong**, no significant issues are expected with regard to the floor bearing capacity. A detailed pillar stability assessment completed for the current EP Area (Golder Associates, 2017) conservatively also included an assessment of the potential effect of future flooding of the workings post-mining should such occur as part of 'worst case' scenario assessments (refer Section 3.5 for further details). The depth of cover at Airly Mine in general within ML1331 (including beyond the EP Area) ranges from 20 m at the sub-crop to a maximum of 280 m under Mount Airly and 310 m under Genowlan Mountain. The **depth of cover** for proposed workings **within the EP Area** ranges from approximately 80 m (i.e. no shallow workings) to a maximum of approximately 200 m. Subsequently, the formal mining limitations (exclusion zones) applying to protected shallow areas (e.g. under protected creeks, heritage sites etc.) are not applicable to the current EP Area, but have been appropriately identified and considered in mine planning as illustrated on A0 Graphical Plans..

Golder Associates (2017) in their pillar stability assessment report also noted that a review of the updated geotechnical database is currently being undertaken. One component of that review relates to strata properties. Preliminary results indicate that an outcome will be an upgrade of the rock moduli values applied to-date, **such that future subsidence estimates are likely to be slightly reduced.**

At depths of less than 300 m a major horizontal stress magnitude of less than 15MPa could be expected which is a moderate level in the Australian mining context (Golder Associates, 2014), but given the topography and the associated potential for horizontal stress relief by virtue of the neighbouring cliff lines and surface valleys, it is considered likely that the maximum horizontal stress may be around 12 to 13 MPa. Whilst the roof is relatively weak (CMRR of 40), these moderate levels of horizontal stress at Airly Mine facilitate safe mining methods which rely on long term roof and pillar stability, avoiding surface impacts. **No evidence of deterioration from horizontal stress has been evident in existing workings of Airly Mine to date** (Golder Associates, 2014). Consideration of pillar stresses incurred by first workings within the EP Area have been assessed with the Pillar Stability Assessment Report by Golder Associates (2017), as discussed further in Section 3.5.

3.4.3 Geological Structures

Geological and geotechnical features and structures are detailed within Section 8.2.1 of the MEP EIS (Golder Associates, 2014).

A number of studies into the geological structural environment within ML1331 at Airly have been conducted to date. For example, in 2012 SRK Consulting (Australasia) Pty Ltd analysed the results of high resolution aeromagnetic scans of the Mount Airly and Genowlan Mountain mesas. The study considered the various structural features encountered in the workings at that time as the jointing and lineal features visible on the aerial photograph of the Airly Mine holdings. This work was done to better understand the structural environment over the lease area. SRK (2012) found that:

- There are a number of basement and surface faults trending northwest, northeast and north to south.
- The north to south trending faults pose the higher geotechnical risk.
- The intersections of the various trending faults are likely to concentrate horizontal stress.
- Igneous intrusions are not pervasive across the mining area and therefore have low geotechnical risk to the operation.

Further to the analysis of aeromagnetic survey by SRK (2012), Golder Associates (2014) analysed data from various sources to better define the geotechnical environment and confirm the overall structural environment at Airly Mine (refer section 8.1 of the MEP EIS for details). It found that while no faults of greater than two metres displacement had been encountered or inferred in the workings to date, such faults could be expected based on surface topography and experience elsewhere in the Western Coalfield. Significant magnetic signatures and persistent surface lineal features such as valleys, large cliffs or jointing have been shown at Angus Place Colliery and Springvale Mine to correlate with significant underground strata disturbances. Given the presence of similar features at Airly, it is expected that there will be some seam level geological structure that will have an impact on mining conditions, particularly in deeper parts of the mine.

The Cliff Line Zone of First Workings (CLZ) has a maximum depth of approximately 200m within the EP Area and is not considered significantly deep. Mining to date has progressed to depths in excess of 250m under the plateaus. No additional adverse geotechnical impacts have been observed. Experience mining under cliffs under the previous development consent has not shown any additional adverse impacts from faulting. It is therefore expected that such conditions would continue in the CLZ.

The potential impact of localised geological structures, such as faults, also diminishes rapidly as pillar w/h ratio increases (Golder Associates 2017). International coal industry experience confirms the importance of w/h ratio to stability; incidences of collapse are concentrated at low w/h ratios, even in known weak floor environments. Furthermore, back analysis of the results of in situ coal pillar tests from South Africa indicates that the post-peak modulus (stiffness) of actual pillars becomes positive (i.e. suggesting strain hardening behaviour) once the w/h ratio exceeds 4.1, as is proposed in the current EP Area (≥ 8.0). In other words, **even if the coal is heavily fractured, the overall pillar does not fail in the commonly understood sense**; a creep event becomes the likely worst-case scenario, which is considered highly unlikely for the current EP Area (and not predicted) given the very high width to height ratios employed in combination with Factors of Safety beyond 2.11 and up to 4.0 within the EP Area.

Pillar w/h ratio, applied in conjunction with other design criteria, such as FoS, is a useful indicator of design reliability (Golder Associates, 2017). There are no failed cases in the combined database with a w/h ratio of greater than 8.2, even at a very low FoS, and there is only one failed case at a w/h ratio of >5 . The highest FoS assigned to a bord and pillar collapse is 2.1 and this was associated with a w/h ratio of only 2.2. Although there are cases of failed highwall mining pillars with Factors of Safety of >2 , all of them have w/h ratios of <2 .

Subsequently, given the above factors, the influence of geological structures and/or faulting is **not** expected to significantly impact the proposed workings in the EP Area. The location of known faulting is illustrated on EP A0 Graphical **Plan 3** (refer **Section 7**) and on dedicated figures for geological structures (including insets) presented in **Appendix 3**.

3.4.4 Existing Workings

All existing and historical workings are illustrated on EP A0 Graphical **Plans 1 and 4**.

Airly Mine Workings:

All of the existing workings of Airly Mine are located in the **Lithgow Seam**. To date, mining has consisted of first workings in all areas mined, with splitting and quartering (technically defined as secondary extraction) practised in areas of less than 120 metres depth of cover. For context to the current EP Area and the Cliff Line Zone of First Workings, no secondary extraction has occurred to date at Airly Mine within what were previously defined as 'Environmental Protection Zones' under the former development consent (DA162/91), which included a 25° angle of draw from both the crest and toe of the external cliffs greater than 20 metres. First workings in those areas have successfully been undertaken without significant impact to date.

New Hartley Shale Mine Workings:

Within the EP Area in the northwest of Mt Airly are the historical oil/shale workings (or torbanite) of the New Hartley Shale Mine (see **Figure 2** and **A0 Graphical Plans 1 and 4**). These old workings are located **approximately 25 m above the roof of the Lithgow Seam**. This mine operated between 1893 and 1913 and fully extracted oil shale from the deposit using a type of **hand worked advancing longwall method**. Due to the fully extracted nature of the old workings, the surface areas on the plateau over these old oil/shale workings has already been significantly impacted by the previous oil shale mining with many large subsidence cracks still visible as documented and illustrated in the MEP EIS (2014). It has also been noted that these old workings were extracted beneath some of the major cliff lines around the northern parts of Mount Airly and it is understood that, the extraction of the oil/shale workings probably led to several cliff falls. The specialist groundwater report for the MEP EIS (GHD, 2014) also noted cracking to the surface and drainage of overlying groundwater sources (primarily Narrabeen Sandstone) into the old workings. It is reported that the seep at Village Spring is fed by drainage from the old shale workings. Based on groundwater monitoring undertaken at Airly Mine it appears that recovery of groundwater pressure within the Narrabeen Sandstone has taken place over time, most likely due to the infilling of old cracks (GHD, 2014).

Records of the New Hartley Shale Mine Workings are scant, but analysis of historical records, the mine plans, and interviews with local residents who are familiar with the operational history of the shale mines shows the following (as detailed in Section 8 of the MEP EIS, Golder Associates 2014):

- The depth of cover varied from 20 to 260 m;
- Main access and gate roads (or their equivalent) were probably 1.8 m high
- Production workings were 0.8m high on average and were partially backfilled with hand-stacked waste rock
- The extraction ratio is unlikely to have exceeded 0.75 (75% extraction of deposit), given the need to retain some pillars to protect workers.

Due to the existing impacts to surface features (cliffs in particular), there is a need to constrain the type and extent of mining in the Lithgow Seam so as to eliminate any further impact on these features. The Airly MEP EIS (2014) subsequently identified the **New Hartley Shale Mine Potential Interaction Zone (NHSMPIZ)** which is specifically regulated as one of the approved mining zones under SSD_5581, and was assessed in detail in relation to mining within and in adjacent mining zones (such as future mining in the Panel and Pillar Mining Zone), with appropriate setbacks to protect the existing impacted cliffs as noted in Section 3.4.6. In regards to the current Extraction Plan, **no significant workings have been proposed in the vicinity of the Cliff Line Zone within the NHSMPIZ**. Isolated minor workings associated with bleeder roads are proposed within the buffer zone (setback) from the cliffs within the Mt Airly mesa as illustrated on **A0 Plans 1 and 4**. Given the separation between the new Airly Mine workings and the overlying old shale mine workings is approximately 25m as identified on A0 Plan 4 and the mine design has been specifically designed for

no impact to overlying strata such that no impact to the surface has been predicted (refer **Section 3.5** for details), and there is no significant risk of physical intersection with old existing workings due to the substantial cover separation of the seams.

Mining will not proceed under the NHSMPIZ without first removing any inrush potential from that source. Whilst beyond the scope of this EP, it is noted that Airly Mine has developed Principal Hazard Management Plans to address relevant WHS aspects of existing workings including inrush and management of noxious and flammable gases. A High Risk Activity (HRA) notification is undertaken with regulators prior to workings commencing in proximity to existing workings.

Torbane Colliery Workings:

Coal from the **Lithgow Seam** was also mined at the Torbane Colliery (predominantly under the western side of Mt Airly) and was used to provide heating to the oil shale retorts located adjacent to the village of Torbane. These retorts processed oil shale of the New Hartley Shale Mine delivered to the works via a rope haulage tramway that penetrated through Airly Mountain in the Lithgow Seam level at the Torbane Colliery workings as illustrated on A0 Graphical Plan 4. No measureable groundwater inflows into these workings have been reported (GHD, 2014). The workings were inspected during previous ownership in circa 1982 and no water accumulations were noted in any part of the mine (noting this being several decades after cessation of historical mining).

These old workings of Torbane Colliery are located within the EP Area and will be intersected by proposed workings. The Torbane workings have not previously been intersected by the mine. Accordingly, Airly Mine has developed Principal Hazard Management Plans to address relevant WHS aspects of existing workings including inrush and management of noxious and flammable gases. A High Risk Activity (HRA) notification is undertaken with regulators prior to workings commencing in proximity to existing workings. Methane is not considered likely as this gas has not been encountered in measurable quantities in any part of the mine or any exploration borehole in the lease. Any potential inrush source will be removed prior to the intersection of the workings in accordance with legislated requirements to manage inrush risk.

It is proposed to intersect the Torbane Colliery workings through a single roadway known as the "Coal Tunnel". This was an extension of the mine workings through the mountain to the surface on the East side of the mountain and provided a haulage route for oil shale from the New Hartley mining area. By intersecting through the Coal Tunnel, the risk of pillar collapse in the old workings is eliminated as they are avoided. The risk of roof collapse is minimised due to the limited exposure to old roadways making stabilisation works practical.

3.4.5 History and Development of the Current Mine Design

The mine design has been specifically developed in response to the sensitive surface features and environment in order to avoid significant impact.

Airly Mine began full scale operation in December 2009 under the former consent (DA162/91), commencing in areas focused on shallower parts of the deposit adjacent to the mine entrances in order to gain experience in the conditions of the deposit and determine the most appropriate method(s) for long term operations. Historically, first and second workings (using splitting and quartering techniques) have been successfully undertaken at Airly Mine to date without subsidence impact or any evidence of underground pillar instability. A continuation of the previously used pillar dimensions for first workings within what is now the approved the Cliff Line Zone under the new development consent SSD_5581 is proposed within the scope of this plan.

To date, mining has consisted of first workings in all areas mined, with subsequent splitting and quartering (technically secondary extraction but also long term stable design) practised in areas of less than 120 metres depth of cover. All roadways have been maintained at 5.5 m and pillar width to height ratios of at least 4.0:1, with pillar system factors of safety (FOS) of at least 2.0 or greater which are considered long term stable (with no significant impacts using this noted to date, as further detailed in Section 8.3 of the MEP EIS (2014)). The mine design for the current Cliff Line Zone of First Workings was outlined in the MEP EIS (2014) which was subsequently peer reviewed (MSEC 2015) and then subject to review of the Independent Review Panel of geotechnical experts in a report to the Planning Assessment Commission during assessment of the EIS (IRPR Report, 2016) prior to granting of Development Consent SSD_5581. Detailed mine design presented in this Extraction Plan consistent with the EIS and consent (refer Section 3.4.7) has been further reviewed by the post-approval Independent Expert Panel (IEP). All reviews have concurred that the proposed pillar system designs are long term stable and effectively non-subsiding.

Community, regulatory and industry expectations have changed since the former development consent (DA162/91) was granted in 1993. Airly Mine has developed a detailed mine design that provides outcomes which take into consideration the sensitive surface and sub-surface features within the current development consent area for SSD_5581. As a result, Airly Mine operates using low-impact underground mining methods that limits void widths and leaves sufficiently large pillars to support the overburden and prevent subsidence impacts. For context, it is noted that subsidence limits applied to the mine design for secondary extraction areas at Airly Mine have been reduced from 1.8m in the original consent (1993, which permitted longwall mining) to just 125mm in the current consent (SSD_5581), **more than ten times lower**. Airly Mine has (and continues to) mine successfully within these design limits to protect surface features.

Whilst the bord and pillar mining will not result in any discernible surface impacts, Airly Mine has established a mine design philosophy that limits designs for predicted subsidence for first workings to the following parameters, as reflected in the EIS referenced by Condition 2, Schedule 2 of the new development consent SSD_5581:

- Vertical subsidence: 10 to 65 mm.
- Tilt: 0.6 to 1.1 mm/m.
- Tensile strain: 0.2 to 0.3 mm/m
- Compressive strain: 0.2 to 0.5 mm/m.
- Fractured zone height: <10m above the seam

Actual subsidence predictions are **significantly less than this** as outlined in Section 3.5. Such low levels of proposed subsidence are a result of conservative design to give long term stable and effectively non-subsiding pillars for first workings, which thereby prevents surface fracturing and therefore damage to sensitive surface features.

This type of first workings using pillar designs with large width to height ratios and factors of safety in the pillar system design will provide long term stable pillar systems in the EP Area to provide **permanent support** to the overburden to subsequently avoid impacts. To achieve the subsidence outcomes above, Airly Mine has undertaken a detailed Pillar Stability Assessment of the minimum pillar sizes required to achieve a **pillar system factor of safety equal to or greater than 2.11 and an average width to height ratio of no less than 8.0** within the EP Area noting that there may be the need for occasional smaller pillars for operational reasons. Pillars with these factors of safety and width to height ratios are considered to be long term stable and effectively non-subsiding as assessed by the Independent Expert Panel (IEP).

A summary of key conservative mine design criteria for proposed first workings within the Cliff Line Zone Extraction Plan Area is provided below:

- No shallow workings (minimum depth of cover for proposed workings in the EP Area is approximately 80m);
- **Minimum** setbacks of 30m from the crest and toe of cliffs defined in the approved EIS to any second workings (first workings areas only) (as illustrated on EP A0 Graphical **Plan 1** and **Figure 3.5** below).
- First workings using pillar systems with FOS>2.11* (and designed up to 4.0) and average width to height ratios of at least 8.0 (and designed up to 10.0) across each panel in the EP Area;
- First workings within EP Area in Depths of cover between approximately 80m to 200m depth of cover.
- No (future) secondary extraction within EP Area.
- No (future) panel and pillar extraction voids within 40m of the pillars formed in the Cliff Line Zone of First Workings EP Area.
- No secondary extraction (including panel and pillar workings) within 26.5 degree Angle of Draw plus 50m from the crest and toe of cliffs defined in the EIS in the vicinity of the New Hartley Shale Mine Potential Interaction Zone.

* It is noted that a FOS of >2.11 has an associated pillar failure probability of over 1 in one million (Golder Associates, 2017).

3.4.6 Mining Zones

As introduced in Section 3.1, in accordance with Condition 7 in Schedule 3 of the current development consent SSD_5581 Airly Mine is pursuing staged approval of mining with the approved Mining Zones for Airly Mine. Accordingly, and as defined in Section 3.1, this Extraction Plan applies only to the identified portion of the Cliff Line Zone of First Workings (CLZ) within Mining Lease 1331 (excluding portions of the CLZ within the existing approved MOD3 Extraction Plan Area (as varied 2016)).

For clarity, the following Mining Zones are beyond the scope of the current Extraction Plan and will be subject to separate future staged Extraction Plan applications:

- **Remainder of the approved Cliff Line Zone within A232** (beyond ML1331), including the sensitive areas of Genowlan Mountain including the Grotto, The Oasis and Genowlan Point.
- **Shallow Mining Zone**
- **Partial Pillar Extraction Mining Zone**

- **Panel and Pillar Mining Zone**
- **New Hartley Shale Mine Potential Interaction Zone** (portions beyond current CLZ EP Area, primarily associated with Panel and Pillar Mining and Shallow Zone mining).

Section 8 of the MEP EIS (2014) provides further details on the definitions of each of these zones if required.

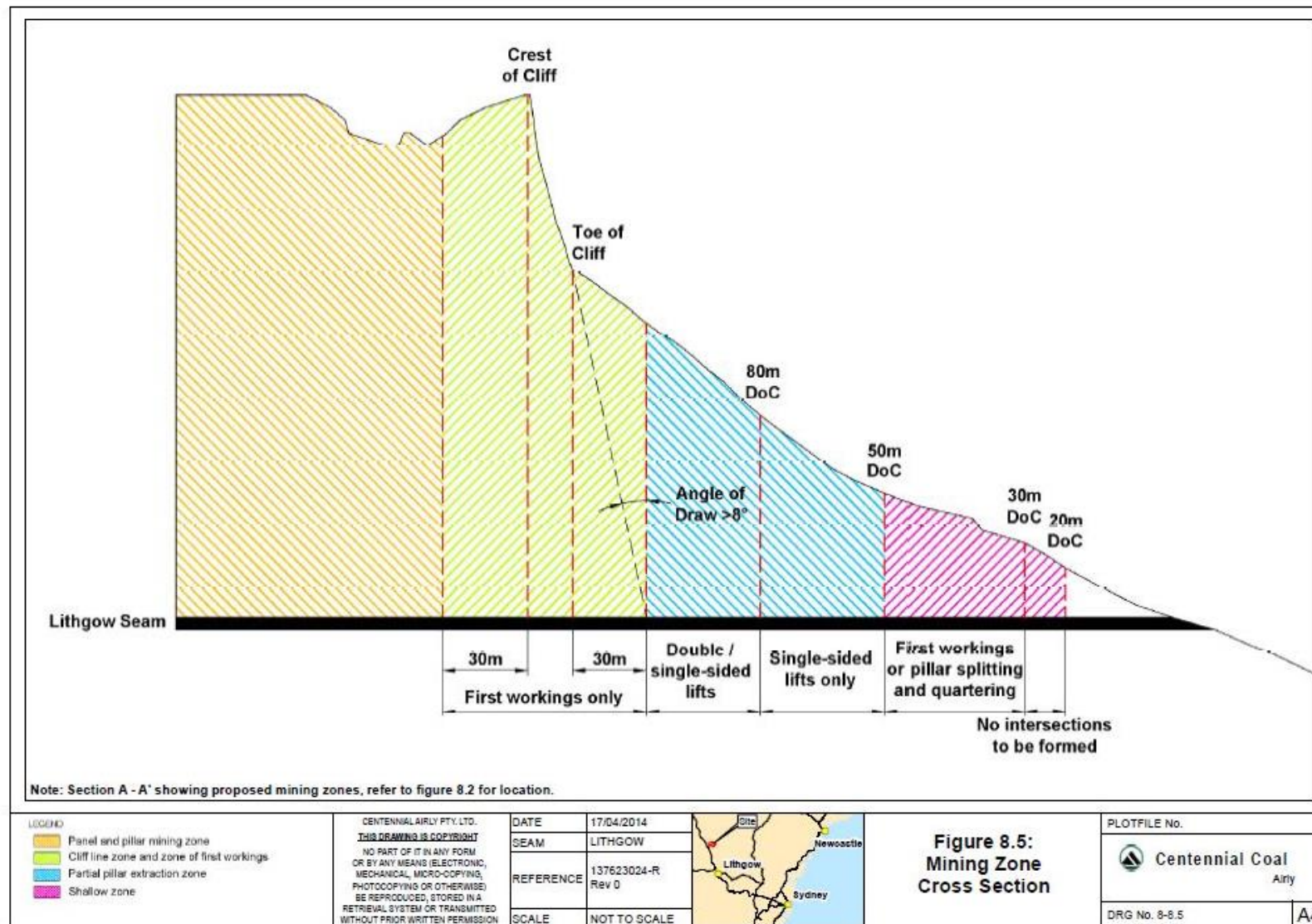
The Cliff Line Zone of First Workings approved in SSD_5581 was defined in the EIS to protect sensitive cliff areas as follows and illustrated on **Figure 11**:

- Minimum 30m setback each side of the toe and crest of cliffs defined in the EIS throughout the EP Area as illustrated on **Figure 11**;
- Within the vicinity of the New Hartley Shale Mine Potential Interaction Zone, the setback from cliffs defined in the EIS to (future) secondary extraction in the Panel and Pillar Mining Zone (i.e. increased area of first workings only) increases to 26.5 degree angle of draw (half depth of cover) as per the EIS, PLUS an additional 50m buffer (i.e. 26.5 degree AOD plus 50 m) has also been incorporated in the mine design in accordance with recommendations of the Independent Review Panel (IRP).
- A 40m barrier has also been adopted between first workings pillars in the Cliff Line Zone and the (future) secondary extraction voids of the Panel and Pillar mining zone as recommended by the Independent Review Panel (IRP).

The mining geometry of first workings within the Cliff Line Zone and EP Area is detailed further in Section 3.4.7 below and within the Pillar Stability Assessment Report (Golder Associates, 2017).

Subsequently, Centennial Airly have adopted a very conservative mine design that results in subsidence prediction well below approved levels (as detailed in Section 3.5), and that is not expected to cause any adverse impacts on natural features within the EP Area, most notably cliffs and pagodas specifically protected by this mining zone.

Figure 11: Mining Zones Cross Section from Figure 8.5 of the EIS, illustrating the 30m setbacks from cliffs identified in the EIS for the CLZ



3.4.7 Mine Geometry

For workings within this Extraction Plan, two pillar design scenarios were assessed within the Pillar Stability Assessment Report (Golder Associates, 2017), these are:

- First workings on 35 m x 35 m centres with 5.5 m bords (Geometry A)
- First workings on 35 m x 45 m centres with 5.5 m bords (Geometry B).

Following the above report and satisfactory outcomes for both geometries (including 100% probability of long term stability for first workings), **Geometry A will be pursued within the EP Area**. Mining within the CLZ EP Area will consist of first workings only with long term stable pillars which experience negligible pillar settlement such that they have been deemed as effectively non-subsiding (as assessed by the Independent Expert Panel). Typical panel layouts for first workings for the CLZ within the EP Area will include the following as detailed in Section 8.3 of the MEP EIS:

- A mining height of <3.0 m (2.8 m has been designed for and used within the design predictions),
- Maximum roadway (bord) width of 5.5 m.
- Maximum void width of <10 m
- Pillar system FOS >2.11 for protection of key surface features (failure probability of > 1 in 1 million)
- Pillar width to height ratio of >8.0 (averaged across the pillars within the panel being mined). This accounts for occasional smaller pillars formed for operational reasons. Such smaller pillars will have a minimum size of 1/10 the depth from surface or 10m, whichever is greater, and a minimum width to height ratio of 4. The intent is to maintain a consistent large pillar size of 35m x 35m (centres) wherever possible throughout the panels being mined.

The depth of cover assessed within the specialist report by Golder (2017) varies from 80 m to 250m, however as noted earlier above maximum depth of cover for proposed workings in the EP Area is approximately 200 m.

In reality the system FOS is much higher as the only pillars to experience full loading are those under the deepest cover. As the surface is steep, depth of cover decreases rapidly from side of the panel to another and therefore load also decreases. FOS for pillars on the shallowest side of the panel is well in excess of the minimum design value of 2.11. This further limits any possibility of pillar system failure below the already conservative values in the design criteria.

3.4.8 Mining Schedule

Panels proposed to mined within the EP Area are illustrated on EP A0 Graphical **Plan 1**.

In accordance with EIS commitments (s4.7 Mining Sequence), mining will continue from the existing workings in the west of the development consent area and progress generally eastwards under Mount Airly and Genowlan Mountain.

The Cliff Line Zone of First Workings within the main body of Mount Airly is to be mined first, followed by the CLZ in the western portion of Genowlan Mountain (within ML1331). The more sensitive areas of the CLZ on Genowlan Mountain within A232 (including the Grotto and the Oasis) are proposed to follow but are beyond the current EP Area and will be subject to a separate Extraction Plan approval in future. The last area of the Cliff Line Zone proposed to be mined is the northern outlier of Mount Airly locally referred to as '*Black Mountain*', where coal reserves are expected to be of lower quality than the above mentioned areas (noting this includes the area of the historical Torbane Colliery

workings - separate High Risk Activity notifications (not subsidence related but due to other WHS considerations) would be lodged with the NSW Resource Regulator prior to commencement of workings in proximity to historical existing workings of Torbane Colliery and New Hartley Shale Mine).

Results of initial monitoring of first workings completed within Mount Airly will help provide confirmation of the mine design and allow any further adaptive management input if/where required (not expected) prior to mining in the remaining areas beyond Mount Airly (including more sensitive areas on Mount Genowlan) to ensure impacts remain within predicted levels.

Centennial Airly is currently preparing a modification to SSD_5581 which will include addressing some administrative issues in the Development Consent. This will include addressing specific timing details in mine scheduling illustrated within Appendix 3 but noting the key commitment to monitoring confirming mine design for the CLZ under Mount Airly prior to commencing in Genowlan Mountain is expected to be maintained.

3.4.9 Resource Recovery

Expected resource recovery from the EP Area is presented in **Table 3.2**. The tonnages listed have been based on a working height of 2.8 m. The specific gravity of the coal (relative coal density) is 1.48.

Table 3.2 Reserves and Resource Recovery

Area	Total Coal Resource (Tonnes)	Recoverable Resource (First Workings) (Tonnes)	Recovery (%)*	Comments
Total in CLZ within Development Consent Area (SSD_5581)	8,474,000	2,643,000	31%	Recovery consistent with EIS Response To Submissions, considered upper estimate due to "rates not accounting for main headings pillars (lower recovery ratio), areas left unmined at the ends of production panels, and areas not feasible to recover. The actual resource recovery may be below the values quoted for each mining zone."
CLZ within A232 only (beyond EP Area)	3,674,000	1,160,000	32%	
CLZ within ML1331 (i.e. excluding A232)	4,800,000	1,483,000	31%	
Remaining areas of CLZ within existing approved MOD3 EP Areas as varied 2016 (excluded from current EP Area)	53,000	19,000	36%	Quantities are for remaining areas yet to be mined for first workings. 637,000t already recovered from CLZ within MOD3 EP areas from a total Resource of 1,996,000t.
Additional 50m Setback / First Workings Only Area	141,000	36,500	26%	In vicinity of New Hartley Shale Mine Potential Interaction Zone
Current EP Area Resources (i.e. CLZ within ML1331 excluding existing approved MOD3 EP Areas)	4,888,000	1,500,500	31%	

* All recovery percentages are approximate only and may vary depending on final panel layout and geological restrictions.

3.5 Subsidence Predictions

The current extraction plan include only permanent first workings and does not include any later secondary extraction (partial or complete). First workings addressed within this management plan are specifically required to provide **long term stable** support to the surface, rather than experiencing conventional subsidence which occurs following secondary extraction. This provides important context to the following information presented in this section.

3.5.1 Comparison of Subsidence Predictions – EIS vs Revised EP Predictions

Centennial Airly is committed to promoting and practising sustainable mining methodologies that profitably recover the State's coal resources whilst upholding the conservation values that the SCA was established on. To this end the Airly Mine has specifically developed a mine design to avoid impact through long term stable support to the surface and subsurface environment, with almost unmeasurable subsidence predicted.

Condition 7(g) of Development Consent SSD_5581 and the Extraction Plan Guidelines (DP&E, 2015) 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).

An updated assessment of pillar stability and revised subsidence predictions for pillar compression in first workings for the detailed mine plan developed for the EP Area for the Extraction Plan has been addressed in a technical report by Golder Associates (May, 2017, refer full report for details).

Table 3.3 below details the revised subsidence predictions for the Extraction Plan Area.

A key conclusion of the report found that:

'stability analyses and associated subsidence estimates are consistent with previous findings. If anything, the current mine plan is associated with slightly lower subsidence magnitudes than originally envisaged. No surface impacts would be expected at these levels of subsidence.'

Additionally, the above report provided the following specific conclusions:

- The pillar systems proposed for the Cliff Line Zone are considered long-term stable under all scenarios;
- At the proposed offset distances of $\geq 40\text{m}$ between first workings and future extraction voids, the contribution of future adjacent Panel and Pillar mining operations to pillar loading and subsidence within the Cliff Line Zone is negligible (i.e. $< 5\text{mm}$). Essentially, the pillars within the Cliff Line Zone would not "see" the Panel and Pillar operation to any appreciable extent;
- Long-term subsidence estimates for the Cliff Line Zone, even allowing for a future adjacent Panel and Pillar partial extraction operation, remain below those originally put forward in the Subsidence Impact Assessment of the EIS (i.e. now $\leq 53\text{mm}$, versus $\leq 65\text{mm}$ in the EIS Subsidence Impact Assessment);
- Additional subsidence in the Cliff Line Zone due to future proposed splitting and quartering operations in the Shallow Mining Zone would be negligible; and
- **No surface impacts would be expected at the predicted levels of subsidence.** Specifically, **no surface impacts would be expected to cliff lines, pagodas and steep slopes** at these negligible levels of subsidence.

Following completion of the above revised report, consultation with the Independent Expert Panel (IEP) commenced in May 2017, and on 2nd June 2017 the IEP confirmed that:

'The previous report of the Independent Review Panel found that the proposed pillars are long-term stable up to the maximum depth of 290m. Considering the dimensions of the pillars and the maximum depth of cover of the proposed workings are 200m, the IEP considers that the proposed pillars are long term stable as first workings.'

Table 3.3 below provides a summary comparison of the original subsidence predictions of the Airly MEP EIS (Golder and Associates 2014) for the Cliff Line Zone of First Workings, compared to the above revised predictions for the current Extraction Plan by Golder Associates (2017) using the final detailed mine plan. As noted in the table, the current predictions meet or are below the EIS.

Table 3.3: Comparison of Current EP Revised Subsidence Predictions to EIS Subsidence Predictions

Predictions	Pillar Stability	Maximum Pillar Settlement	Tilt	Strain		Surface Cracking?	Surface Impacts	Impacts to Cliffs & Pagodas
		(mm)	(mm/m)	Tensile (mm/m)	Compressive (mm/m)			
EIS Predictions (Cliff Line Zone of First Workings)	Long Term Stable	65mm	0.6-1.1	0.2-0.3	0.2-0.5	Not Expected	Negligible impacts, no surface cracking	Negligible impacts. No cracking, no fracturing of surface rocks structure no collapse. No damage to pagodas. No visual impacts.
EP Revised Predictions (CLZ/EP Area)	Long Term Stable, negligible settlement, effectively non-subsiding	<53mm Worst Case (long term flooded and additional pillar loading)	0.4-0.9	0.1-0.3	0.1-0.3	Not Expected	No surface cracking, no surface impacts	No Impacts to cliffs and pagodas
		Short to medium term <30mm and typically <20mm						
EP Comparison:	Meets EIS	Less than EIS	Less than EIS	Less than EIS	Meets EIS	Meets EIS	Less than EIS	Less than EIS

3.5.2 Review of Potential Subsidence Impacts and Environmental Consequences

Condition 7(g) of Development Consent requires a review of potential impacts and environmental consequences for the revised subsidence predictions (as presented in Section 7.2.1) to confirm these are equal to or less than those approved by development consent under SSD_5581 (as is required).

As noted earlier above, this extraction plan is for first workings only (mine development) forming large long term stable pillars. **No subsidence impacts** to the surface are predicted for first workings in the EP Area (Golder Associates, 2017). Accordingly, no significant impact is predicted to sensitive features managed by this plan and accordingly it is also expected there is negligible additional risk to public safety. This is consistent with (or is below) impacts identified in the EIS, as detailed in **Table 3.3**. This extraction plan is subsequently focused on management measures (including a TARP) to conservatively address any unexpected results should they occur and providing a framework for monitoring (including baseline) for detecting such.

It is noted that potential impacts on surface features associated with future secondary extraction areas in other mining zones will be reviewed during subsequent extraction plans.

For important context to cliffs and pagodas managed under this plan, as noted by the *Independent Review Panel Report (IRPR, July 2016)* prepared by a panel of independent recognised geotechnical experts, it should be recognised that cliff formations do experience rock falls naturally at a relatively rapid rate which is why they exist in the landform, so full protection from *any* falls (which include natural) is not possible. Accordingly, performance measures set by development consent SSD_5581 (refer Section 6) identify acceptable minimal levels of rock fall, and integrated monitoring methodologies for this plan will seek to clarify natural or any potentially mining induced rock falls through a strategic approach (refer Section 10).

3.5.3 Subsidence Assessment/Mine Design Peer Review

Following consultation with DRE and DP&E in December 2014, in March 2015 a peer review of the mine design and subsidence impact assessments for the Airly Mine Extension Project incorporating the EP Area (Golders 2014b) was completed by MSEC (Mine Subsidence Engineering Consultants, Report 479). The report is appended to the Extraction Plan. The review also included consideration of proposed monitoring techniques/programs, and key parameters observed in increased subsidence events at other mines and their applicability (or lack thereof) to Airly, and consideration of setback distances for mining near cliffs (buffer zones).

The peer review concluded that the referenced Golders (2014b,c) Reports “*provide detailed predictions and reasonable assessments of the likely subsidence and subsidence impacts at Airly Mine*”, and that “*the subsidence predictions of the likely small subsidence ground movements appear to be reasonably accurate and appropriate for the conditions*”. MSEC concluded considered that the impact assessments within these reports are realistic for this particular geological region and this particular mine layout.

In addition to the MEP EIS review and assessment by DP&E, DP&E commissioned an **Independent Review Panel (IRP)** to review the accuracy and reliability of subsidence impact predictions provided in the Airly MEP EIS, which was documented in a report from the IRP in July 2016. The IRP was satisfied the proposed mining methods have the potential to avoid significant impacts to cliffs, steep slopes and pagodas, subject to monitoring recommendations (IRP 2016). The report also recognised the natural process associated with cliff formation and natural rock falls as detailed in Section 7.2.3 above. The IRP report also recommended a precautionary approach to establishing appropriate setbacks from cliffs to (future) secondary extraction mining areas (particularly Panel and Pillar Mining, which is not proposed in the current extraction plan). Subsequently, an additional 50m setback was recommended to the 26.5 degree angle of draw, within which only first workings can be undertaken. Further detail is provided in the main Extraction Plan document.

3.6 Performance Objectives

3.6.1 Performance Measures

(i) Performance Measures for Mine Design and Underground Mining Control

The approved mine design developed for Airly Mine is a key risk control to avoid potential surface impacts, including within the Cliff Line Zone of First Workings / EP Area which has been designed for **long term stable and non-subsiding pillars** (required by condition 2, schedule 3 of development consent SSD_5581). The detailed mine design for the current EP to achieve these conditions has been confirmed in consultation with the Independent Expert Panel (IEP) as detailed in Section 1. **Accordingly, adherence to the final mine design during implementation will be monitored as part of Underground Mining Controls described in Section 10 of the supporting Subsidence Monitoring Program (SMP).**

The minimum performance measures for mine design parameters committed to in the EIS that will be monitored as underground performance measures are detailed below in **Table 3.4**, alongside the final mine design for the EP as consulted with the IEP. EIS commitments are the maximum approved conditions by consent and subsequently equate to Condition Red levels set within the specific performance indicators included within the **Master TARP** (refer Appendix 1), and the current mine design levels are used to establish condition amber and green as appropriate to track performance to ensure the approved performance measures are met (refer Appendix 1).

Table 3.4: Underground Mine Design Requirements – Cliff Line Zone of First Workings

Design/Control Aspect (Cliff Line Zone):	Approved Performance Measure (EIS commitment) (EIS Table 8.5)	Mine Design for the current EP (Performance Indicators for TARP Triggers)	Monitoring and Indicators Details
Pillar Stability	Long Term Stable and Non-subsiding^e	Long Term Stable and effectively non-subsiding ^f	Mine Design ^f , Section 10.2, Master TARP
Nominal Mining Height (m)	<3.0m	2.8m	Section 10.2, Master TARP
Nominal Maximum Roadway Width (m)	5.5m	5.5m	Section 10.2, Master TARP
Nominal Maximum Void Width (m)	<10m	<10m	Section 10.2
Minimum Pillar System Factor Of Safety (FOS)	>2.11^{b)}	>2.11 (typically is >4)	Section 10.2, Master TARP
Nominal Pillar Width to Height Ratio (average across panel)	>8.0	>8.0 (typically is >10)	Section 10.2, Master TARP
Minimum pillar size for isolated cases ^{c)}	Minimum pillar dimension at least 1/10 Depth of Cover <u>or</u> >10m^c WHSMP Regulation 2014 ^c	> 1/10 th DOC and >10m, and W/H ratio ≥4	Section 10.2, Master TARP Cliff Line Zone Pillar Stability Design Report (Golder Associates 2017) appended to EP main report.
Pillar Settlement (Compression) (mm)	Maximum ≤65mm For DOC 50-300m	Worst case Long Term ≤53mm, typically <40mm ^d	Section 10, Section 1 (IEP concurrence on monitoring for change in environmental

		Short-medium term <30mm For DOC 80-200m,	consequences), Master TARP
Size of Cliff Line Zone of First Workings (<i>setbacks define a first workings-only area, no second workings</i>)	30m offset horizontally from the crest and toe of a cliff ^{a)}	30m offset horizontally from the crest and toe of a cliff ^{a)}	Mine Design A0 Plans submitted with Extraction Plan
Size of Cliff Line Zone of First Workings within New Hartley Shale Mine Potential Interaction Zone (<i>setbacks define a first workings-only area, no second workings</i>)	EIS commitment for half depth of cover horizontally from crest or toe of a cliff ^{a)} within the NHSMPZ. <u>Additional 50m</u> buffer committed to as per IRPR recommendations (i.e. 26.5 degrees plus 50m setback)	Additional 50m buffer added as per IRPR recommendations (i.e. 26.5 degrees plus 50m).	Mine Design (Section 5 LMP) A0 Plans submitted with Extraction Plan
<i>Note: Section 5.2 of this SMP also describes required setbacks for creeks and historic heritage sites, which are N/A to current EP Area (no shallow workings).</i>			

- (ii) Footnotes: a) as defined in the Airly MEP EIS
- (iii) b) A Factor of Safety of 2.11 correlates to a panel failure probability of one in a million (Golder Associates, 2017)
- (iv) c) By law pillar sizes must conform to minimum requirements set by Schedule 3 (High Risk Activities), Part 3 of Clause 15 (Formation of Non-Conforming Pillars) of the WHS (Mines and Petroleum Sites) Regulations 2014.
- (v) d) Golder Associates 2017 including allowance for additional loading from future secondary extraction in adjacent mining zones.
- (vi) e) Performance Measure of development consent for all first workings under cliffs (Condition 2, Schedule 3), as detailed in Section 5.2.
- (vii) f) Independent Expert Panel reviewed mine design presented for the current EP and concurred long term stable and effectively non-subsiding (refer Section 1).

(ii) Performance Measures for Natural and Built Features, Public Safety and Environmental Consequences

The following performance measures for natural and built features and public safety have been included as part of the integrated monitoring strategy for first workings in the current EP Area of 'monitoring for change' as detailed in Section 10 of the supporting SMP. In particular, the performance measures for cliffs and pagodas against which monitoring will be undertaken are described in **Table 3.5** below.

The approved performance measures for subsidence for the Airly Mine Extension Project are specified in **Schedule 3, Conditions 2 and 3** of SSD5581 and within the commitments made within the documents that constitute the approved EIS, including mine design to avoid surface impacts. These are outlined in the following tables. It is noted that performance measures of development consent not specifically relevant to the current EP Area (i.e. not located within) have been omitted and will be included in future Extraction Plans where applicable (e.g. for the Grotto, Aboriginal Heritage sites etc.).

Subsequently, appropriate monitoring and trigger levels to ensure these measures have been adopted are detailed further within the Master Trigger Action Response Plan (Master TARP) presented in **Appendix 1**.

Table 3.5: Subsidence Impact Performance Measures – Natural and Heritage Features*(Table 1 Condition 2 in Schedule 3 of Development Consent SSD_5581)*

Water Resources	Performance Measure	Where Addressed
Gap and Genowlan Creeks	<ul style="list-style-type: none"> Wherever depth of cover is <40m, no first or second workings within 20m of the edge of the creek bed, measured horizontally within the seam. Negligible environmental consequences to water quality and to bed and bank stability No greater environmental consequences than predicted <Refer WMP for details> 	<ul style="list-style-type: none"> No shallow workings <40m DOC within EP Area (i.e. N/A). Regardless, creek protection zones are still identified DOC on the mine plan (refer A0 Plan 2). Only upper ephemeral tributaries of Gap Creek in EP Area (all 1st order with 1 2nd order), and one 1st order tributary of Genowlan Creek (refer Figure 4 & Appendix 3). Site Water Management Plan (WMP), including dedicated TARP Section 8 (baseline) Section 10 (cross reference to monitoring info in WMP)
All other Watercourses	No greater subsidence impacts or environmental consequences than predicted in the EIS. <Refer WMP for details>	As above
Land	Performance Measure	Where Addressed
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.	<ul style="list-style-type: none"> Land Management Plan (LMP) Section 8 (baseline) Section 10 (integrated monitoring program) Master TARP
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).	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 pagodas	As above for cliffs
Pagodas within a 26.5 degree angle of draw of the New Hartley interaction zone	No greater subsidence Impacts or environmental consequences than predicted In the EIS (<i>refer Section 7.2.1 of LMP for details</i>).	As above for cliffs
Minor cliffs	No greater subsidence Impacts or environmental consequences than predicted In the EIS. (<i>refer Section 7.2.1 of LMP for details</i>).	As above for cliffs
Steep slopes	No greater subsidence Impacts or environmental consequences than predicted In the EIS. (<i>refer Section 7.2.1 of LMP for details</i>).	<ul style="list-style-type: none"> Land Management Plan (LMP) Section 10 (integrated monitoring program)

		including underground mining control) <ul style="list-style-type: none"> • Master TARP
All other land not covered by a performance measure above	No greater subsidence impacts or environmental consequences than predicted in the EIS. (refer Section 7.2.1 of LMP for details).	As above for steep slopes
Biodiversity	Performance Measure	Where Addressed
Threatened species, threatened populations, EECs and Groundwater Dependent Ecosystems (GDEs), with the exception of those listed below	Negligible environmental consequences	<ul style="list-style-type: none"> • Biodiversity Management Plan (EP-BMP), referencing existing site monitoring program within the site BMP. • Section 10 (outline) • Master TARP.
Heritage Sites	Performance Measure	Where Addressed
Non-Aboriginal <Historic> Heritage sites identified in Appendix 6 of consent.	<ul style="list-style-type: none"> • Negligible environmental consequences. 	<ul style="list-style-type: none"> • Historic Heritage Management Plan (EP-HHMP) • Section 10 (outline) • Master TARP.
Mine Workings	Performance Measure	Where Addressed
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	<ul style="list-style-type: none"> • SMP Section 1 (IEP concurrence proposed workings LTS and non-subsiding) • Land Management Plan (LMP) including Section 5 mine design. • SMP Section 10 (integrated monitoring program including underground mining control) • Master TARP

Notes:

- These performance measures apply to all mining taking place after the date of development consent.
- More detailed performance indicators (including impact assessment criteria) for each of these performance measures are required in the various management plans that are required under development consent SSD_5581 (including this SMP required by Condition 7 (Extraction Plan)).
- Measurement and/or monitoring of compliance with performance measures and performance indicators is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans. In the event of a dispute over the appropriateness of proposed methods, the Secretary of DP&E will be the final arbiter.

Table 3.6: Subsidence Impact Performance Measures – Built Features and Public Safety*(Table 2 Condition 3 in Schedule 3 of Development Consent SSD_5581)*

Built Features	Performance Measure	Where Addressed
Emergency services communication tower and associated sheds and infrastructure	<ul style="list-style-type: none"> Always safe and serviceable Damage must be fully repairable and must be fully repaired. 	Not applicable to current EP Area (located beyond the Cliff Line Zone and EP Area).
State Survey Mark (SSM) at Genowlan Trig Station, Telstra Copper Cable, Nissen Hut and Outbuilding	<ul style="list-style-type: none"> Always safe and serviceable, unless otherwise agreed with the owner Damage must be fully repairable and must be fully repaired. 	Not applicable to current EP Area (all these located beyond the Cliff Line Zone and EP Area). Telstra copper cable is within previously approved MOD3 EP Area and managed separately under the BFMP of that approval.
Other features including walking trails and 4WD tracks, fences and gates	<ul style="list-style-type: none"> Use should be maintained wherever practicable in consultation with OEH. Damage must be fully repairable and must be fully repaired. 	<ul style="list-style-type: none"> SMP Section 1 (IEP concurrence proposed workings LTS and non-subsiding) Land Management Plan (LMP) including Section 5 mine design.
Public Safety	Performance Measure	Where Addressed
Public Safety	<ul style="list-style-type: none"> Negligible additional risk, in consultation with DRE and OEH 	<ul style="list-style-type: none"> SMP Section 1 (IEP concurrence proposed workings LTS and non-subsiding) SMP Section 6 (Risk) SMP Section 10 (Monitoring, including 4WD trails traversing EP Area) Public Safety Management Plan (PSMP) Land Management Plan (LMP) including Section 5 mine design. Master TARP

Notes:

- These performance measures apply to all mining taking place after the date of development consent.
- More detailed performance indicators for each of these performance measures are required in the Built Features Management Plans or Public Safety Management Plan required under of development consent SSD_5581 (i.e. Condition 7 (Extraction Plan)).
- Measurement and/or monitoring of compliance with performance measures and performance indicators is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be 'fully described in the relevant management plans. In the event of a dispute over the appropriateness of proposed methods, the Secretary of DP&E will be the final arbiter.
- Requirements regarding safety or serviceability do not prevent preventative or mitigatory actions being taken prior to or during mining in order to achieve or maintain these outcomes.

3.6.2 Performance Indicators

To establish compliance with the performance measures as outlined above, Airly Mine has developed a monitoring program with several integrated components (refer section 10 of the supporting SMP) and an associated *Trigger Action Response Plan (Master TARP, see **Appendix 1**)*. These documents establish appropriate monitoring elements, parameters and associated trigger levels to demonstrate that the environmental performance satisfies the criteria.

Performance indicators have been established for key monitoring aspects with allocated trigger values which define the following key performance scenarios within the Master TARP.

Table 3.7: 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 SSD_5581 (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 this SMP.

An integrated system of underground, surface and aerial monitoring has been developed using escalating triggers and levels of investigation, including targeted surface inspection where triggers indicate it is required. These are detailed further in the supporting SMP, related environmental management plans (e.g. site Water Management Plan) and associated TARPs.

3.7 Subsidence Management Strategies

3.7.1 Avoidance

As discussed in Section 3.4.1 earlier, the workings have been designed specifically to avoid surface impacts. The workings are designed to be stable and self-supporting in the long term and, therefore, are expected to result in very low levels of subsidence at the surface (almost unmeasurable). It is noted that potential for sinkhole formation is avoided by restricting the formation of intersections underground to no less than 30 metres depth of cover. This provides sufficient overburden thickness to prevent any intersection failures underground from migrating to the surface. Further, a mining exclusion zone has also been conservatively adopted around and below creek lines where depth of cover is <40m as described further within Section 2.6 and illustrated on EP Graphical **Plan 2**. Further details on impact avoidance measures are provided within the component plans presented in **Volume 3**.

As such no specific subsidence related mitigation or remedial measures are required or proposed for the workings in the EP Area. The proposed workings can be managed through monitoring and management practices in place at Airly Mine. Management to prevent impacts is achieved by ensuring the stability of the workings, which is a function of the detailed mine design. An integrated Subsidence Monitoring Program incorporating an Underground Mining Control Program (among other aspects) has been developed to monitor and confirm measured parameters are within the nominated mine design levels and model predictions (including as pillar/roof/floor/rib movements, pillar condition and targeted stresses/strains in correlation areas).

Notwithstanding this, appropriate responses have still been considered for higher than predicted subsidence within the *Master Trigger Action Response Plan (Master TARP)* developed for the Extraction Plan, as presented in **Appendix 2**.

3.7.2 Adaptive Management

(i) 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.

(ii) Adaptive Management Strategy for Airly Mine

As the most effective form of management on the risk hierarchy, Airly Mine has gone through an extensive mine design process specifically to eliminate risks and **avoid** potential impacts to surface features (refer **Section 5**). 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 *Trigger Action Response Plans (TARP)* established for the extraction plan and supporting management plans (refer **Appendix 1**). Where performance indicators indicate increasing levels of risk (conditions green, amber then red being exceeded), escalating adaptive management measures are engaged in accordance with the 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 criteria and/or performance measures has occurred, 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.
- Changing the dimension of pillars or void widths / adjust roadway widths to ensure total

extracted span and pillar sizes are within appropriate limits.

- Review and upgrade operational control and communication systems (including Development and Extraction Control Procedures).
- Review and undertake appropriate 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. For clarity it is noted that other additional measures identified in the EIS and the previous MOD3 EP are appropriate for *secondary extraction areas*, and will be considered in separately Extraction Plans in future for other relevant mining zones. These include:

- Increasing the size of protection zones by commencing or stopping extraction further away from sensitive features than planned.
- Leaving additional pillars unmined.
- Reducing the size and extent of roadways.

3.7.3 Remediation / Rehabilitation of Potential Impacts

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 (refer details in Section 9.2 above), noting in particular the requirement to submit a report to DP&E describing remediation options and any preferred remediation measures or other course of action;
- Any relevant actions prescribed in the *Trigger Action Response Plan (TARP)* developed for relevant plans of management;
- The current Mining Operations Plan and 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.

3.7.4 Contingency Plan / Trigger Action Response Plan

A Master Trigger Action Response Plan (Master TARP) has been developed for the Extraction Plan to reflect the commitments of this EP and supporting management plans. Whilst impacts are not predicted nor expected, the Master TARP provides a process of tiered/escalating trigger levels for contingency measures should measurements and impacts be greater than predicted/approved.

Given the mine design specifically to avoid impacts, the TARP includes detailed measures for **Underground Mining Control** to ensure that the mining geometry is formed and executed as per the approved design specifications which determined 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 (EP-SMP) and incorporated into relevant aspects of the Master TARP. The Master TARP is contained in **Appendix 1**.

4 COMPONENT PLANS (VOLUME 3)

The following sections provide a summary of the risk-based approach in developing each management plan prepared to address the management of potential subsidence-related impacts within the EP Area. A copy of each management plan can be found in **Volume 3** of the EP. Centennial Airly have undertaken a dedicated subsidence and environmental risk assessment for the EP Area based on a considerable update of the one undertaken ahead of the MEP EIS (as detailed in Section 4.1 below), and has consulted with key stakeholders to determine the content of the EP including relevant component plans. A copy of the updated **EP Subsidence and Environmental Risk Assessment** (see Section 4.1) is included within Volume 3 of the EP along with the required component plans detailed below.

The following component plans have been prepared for this EP as required by Schedule 3, Condition 7 of the SSD_5581 consent and are outlined in the following sections:

Table 4.1: Component Plans, Consultation and Status at time of EP Submission

Management Plan	Consultation Status at time of EP Submission				Status at Submission Comments
	Consultation Required With: (Cond 7, Sch3)	Comments Invited from (and date)	Comments Requested By (Date)	Comments Received From	
Land Management Plan (EP-LMP)	IEP, DRE, OEH	IEP, DP&E, DRE, OEH, NPWS, DRG-ESU, 31/8/17	14/9/17	IEP (19/9/17) DRG-ESU (14/9/17)	Final comments from OEH & NPWS awaited
Public Safety Management Plan (EP-PSMP)	IEP, DRE, OEH	IEP, DP&E, DRE, OEH, NPWS, DRG-ESU, 31/8/17	14/9/17	IEP (19/9/17) DRG-ESU (14/9/17)	As above
Subsidence Monitoring Program (EP-SMP)	IEP, DRE, OEH	IEP, DP&E, DRE, OEH, NPWS, DRG-ESU, 31/8/17	14/9/17	IEP (19/9/17) DRG-ESU (14/9/17)	As above
Biodiversity Management Plan (EP-BMP)	DoE, OEH	OEH & NPWS (13/7/17); DoEE (18/7/17, 31/7/17)	4/8/17	No response from DoE (twice). OEH & NPWS awaited	As above
Historical Heritage Management Plan (EP-HHMP)	OEH*	OEH (19/7/17), Lithgow City Council (27/7/17)	11/8/17	OEH (3/8/17), Refer HHMP for LCC consultation.	Finalised
Mine site Water Management Plan (site WMP)	OEH, DPI Water	EPA, OEH, NSW Water 23/6/17 DPI Water 28/7/17	14/7/17	OEH 27/6/17 no comments 13/9/17 DPI Water comments	Finalised

* and relevant Aboriginal Stakeholders if/where ACH sites are relevant (no sites in EP Area).

Note that as agreed with DP&E and the IEP, a dedicated *Built Features Management Plan* is not required due to the lack of any significant built features within the EP Area (other than 4WD and walking trails and associated fences and gates).

There are **no known Aboriginal and Cultural Heritage sites within the EP Area** (specialist survey was completed for the EIS). Accordingly the EP-HHMP addresses Condition 7i (vi) of SSD_5581 in regards to relevant aspects for Historic Heritage. Notwithstanding this, should any previously unknown sites be encountered during mining, a formal process to manage them is provided via the existing approved *Western Region Aboriginal and Cultural Heritage Management Plan* (Western Region ACHMP), Appendix A (Airly Mine).

Figures showing environmental features and environmental monitoring relevant to the EP Area are provided within each component plan, the SMP and have been reproduced in **Appendix 3** (and **A0 Graphical Plan 2**). These include:

- Cliffs (minor and major) and pagodas
- Historic Heritage
- Aboriginal Heritage (no sites within current EP Area)
- Threatened flora and fauna locations
- Vegetation Communities (including EEC and GDE's)
- Surface Water Courses (including Airly Mine water quality monitoring and creek stability monitoring locations)
- Airly Mine Aquatic Ecology Monitoring Locations
- Airly Mine Groundwater Monitoring Locations
- Airly Mine Biodiversity Monitoring Locations

4.1 Updated Subsidence and Environmental Risk Assessment (EP Area)

The development of the management and monitoring programs described within this EP has been risk-based in accordance with development consent Condition 7(i)(i), the EP Guidelines (DP&E 2015) and the *Guide to Managing Risks of Subsidence* (Department of Industry Resources Regulator (Mine Safety), 2017). Key risks identified by the process below have informed the monitoring strategy and methodology described in Section 5.

Environmental risk assessment has been conducted extensively to identify subsidence-related hazards that may affect the environment and community as a result of proposed mining as part of the Airly MEP EIS process and the preceding Airly MOD3 Extraction Plans. Assessment of risk to sensitive landscape features such as cliffs and pagodas for the current EP Area has been informed and considered through the following processes:

- consultation with stakeholders (government agencies and the community)
- **Broad Brush Risk Assessment** conducted during the EIS preparation (refer Section 9.3.1 of Airly MEP EIS)
- **EIS Subsidence Risk Assessment** conducted to inform EIS preparation (September 2013)
- **EIS Subsidence Impact Assessment** undertaken by Golder Associates during preparation of the EIS (2014)
- **Environmental impact specialist assessments** for the EIS (various, 2014), including groundwater
- on-going review of long term environmental monitoring data
- government briefing meeting and site visit 17/18 October 2012
- **Airly MOD3 Extraction Plan (2015) and MOD3 Extraction Plan Variation (2016), which each included dedicated subsidence environmental risk assessments**
- **Planning Assessment Commission (PAC) Review (2015-2016)**
- **Independent Review Panel Report (IRPR, 2016)**
- **Revised pillar stability and subsidence assessment** for the EP Area CLZ (Golders 2017).
- Commitments to manage risk within Centennial Response to Submissions for the EIS, PAC Review and IRPR Report (2015-2016)
- **Independent Expert Panel (IEP) consultation** for the current Cliff Line Zone of First Workings (ML1331) Extraction Plan (2017), including review of long term stability design of pillars under the cliff line zone, proposed management and monitoring.
- **2017 Update to the EIS Subsidence Risk Assessment (2013) specifically for the Cliff Line Zone of First Workings component** (refer **Appendix 5** to this EP).

On 10/9/2013 a dedicated subsidence risk assessment for the Airly MEP EIS was held to specifically determine the potential risks associated with subsidence associated with the various Mining Zones and mining methods proposed in the Airly MEP EIS, including the Cliff Line Zone of First Workings.

The Cliff Line Zone of First Workings component of the risk assessment has been updated as part of the current Extraction Plan (EP) to accommodate the outcomes of the various above studies and approval processes since September 2013 to July 2017. For clarity other mining zones will be updated separately in due course as part of future staged extraction plans for those zones. The current update included, but was not limited to, consideration of revised subsidence predictions for the detailed mine plan submitted with the EP (which was lower than the EIS predictions) and feedback from the Independent Expert Panel (IEP). The updated risk assessment was completed in accordance with the requirements of DP&E's *Draft Guidelines for the Preparation of Extraction Plans* and the *Centennial Coal Risk Management Standard - Management Standard 004* (Centennial Coal, 2008), and has considered relevant aspects of the new *Guide to Managing Risks of Subsidence - WHS (Mines and Petroleum Sites) Legislation* (Department of Industry – Resources Regulator (Mine Safety), February 2017). Detailed aspects relating specifically to safety legislation and subsidence management as a principal hazard have been documented further in the Public Safety Management Plan (PSMP, refer for full details).

Risks were identified and assessed through the review of known surface and sub-surface features within the EP Area. 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 risks identified specifically relating to key landscape features and public safety (and the recommended controls) have been presented in **Appendix 3** to the LMP and PSMP respectively, and a full copy of the updated risk assessment is provided in **Appendix 5**. The highest risk ranking identified given the extensive controls identified was **Moderate (16)** and was associated with landscape features (cliffs and pagodas). Accordingly monitoring strategies for the supporting SMP have been developed around these risks including a focus on cliffs and pagodas within the EP Area.

Additional details regarding the monitoring and management of potential impacts to surface features within the EP Area have been detailed in **Section 5** and **Appendix 1** (Master TARP).

4.2 Assessment for High Risk Activity (WHS legislation)

Further to the above processes which have informed subsidence risk assessment, the following is noted for clarity in relation to the proposed first workings in the EP Area in relation to definition of High Risk Activities (HRA) under relevant WHS legislation (in particular Clause 33 and Schedule 3 of the WHSMP Regulation). The first workings pillars proposed within the EP Area are:

- **Not secondary extraction** (clause 16) – Proposed workings are **permanent first workings only** (no secondary extraction of any form at time following development, including any form of partial pillar extraction or reduction)
- **Not shallow workings** (clause 17) and are >50m depth of cover (minimum depth within EP Area is approximately 80m).
- Not highwall mining (clause 28)
- Have been assessed in consultation with the IEP as **long term stable and non-subsiding** and are not expected to experience any significant later settlement due to adverse conditions (e.g. no weak floor conditions identified by geotechnical assessment, no significant additional movement predicted by potential for flooding or additional loading by nearby later secondary extraction areas, average panel FOS significantly exceed design minima (Golder Associates, 2017)).
- **Accordingly, the proposed workings for the Cliff Line Zone of First Workings Extraction Plan are not considered High Risk Activities.**

4.3 Land Management Plan (EP-LMP)

The Land Management Plan (EP-LMP) has been developed as a component of the Extraction Plan in accordance with Schedule 3, Condition 7 (i) v of the SSD_5581 Consent. The purpose of the EP-LMP is to outline the monitoring and management measures to be implemented to manage key land features located within the EP Area, with a particular focus on cliffs and pagodas as key surface features for this EP.

The land features identified within the EP Area, and which are subject to the LMP include:

- **Sensitive Rock Features - cliffs, minor cliffs, and pagodas** as defined by development consent, detailed further in **Section 7** of the LMP.
- **Mugii Murum-ban SCA in general within the EP Area.** This is taken to include steep slopes and native vegetation cover that traverse the cliff line zone defined in this EP.
- **Unsealed 4WD and walking tracks** that traverse the EP Area within ML1331 (Mount Airly Track, Tramway Track, Genowlan Trail, Point Hatteras Trail).
- **SCA Fences** that traverse the EP Area any fences or gates that traverse the EP Area (Note: a dedicated Built Features Management Plan is not required due to the lack of built features within the EP Area, minor built features include unsealed 4WD trails and fences are managed within the LMP).

Figures illustrating key surface features are provided in **Appendix 3**.

4.4 Public Safety Management Plan (EP-PSMP)

The Public Safety Management Plan (EP-PSMP) has been developed as a component of the Extraction Plan in accordance with Schedule 3, Condition 7 (i) vii of the SSD_5581 consent. The purpose of the EP-PSMP is to outline the monitoring and management measures to be implemented to identify and manage all subsidence-related aspects potentially affecting public safety within the EP Area. The PSMP has also been developed to consider relevant requirements under WHS legislation (Mines & Petroleum Sites) as outlined in Section 3.3, including addressing relevant aspects of the recently released *Guide to Managing Subsidence Risks - WHS (Mines & Petroleum Sites) Legislation* (NSW Resources Regulator – Mine Safety, Feb 2017).

The features identified within the EP Area relevant to public safety have a direct relationship to the Land Management Plan, including:

- Rock features (cliffs, minor cliffs and pagodas as defined in the consent).
- Mugii Murum-ban SCA in general within the EP Area. This is taken to include steep slopes and native vegetation cover that traverse the cliff line zone defined in this management plan.
- Unsealed SCA Management Trails (4WD) that traverse the EP Area (Mount Airly Track, Tramway Track, Genowlan Trail, Point Hatteras Trail).

For clarity, the following features are located outside the EP area and are not addressed in the PSMP or LMP. The majority of these are located within the previously approved MOD3 EP Area:

- Airly Gap Trail (unsealed access, gazetted public road)
- Airly Campground
- Telstra buried phone line servicing the lessee at Centennial's Rock Bottom Cottage
- Mugii Murum-ban SCA outside the EP area.
- SCA Management Trails outside the EP area
- Stone Cottage (private) and Rock Bottom Cottage (Centennial owned, leased)

4.5 Subsidence Monitoring Program (EP-SMP)

An integrated Subsidence Monitoring Program has been developed as a component of the Extraction Plan (EP_SMP) in accordance with Schedule 3, Condition 7 (i) i of the SSD_5581 consent. The purpose of this SMP is to set out the program for monitoring the subsidence effects associated with first workings within the EP Area. The SMP is summarised in **Section 5**.

4.6 Historical Heritage Management Plan (EP-HHMP)

The EP-HHMP has been developed as a component of the Extraction Plan in accordance with Schedule 3, Condition 7 (i) vii of the SSD_5581 consent. The purpose of the EP-HHMP is to outline the monitoring and management measures to be implemented for Historical Heritage sites located within the EP Area. The plan was developed in consultation with OEH (Historic Heritage Division) and Lithgow City Council (LCC).

The features identified within the EP Area, and which are subject to the HHMP include Historic Heritage Sites 14, 16, 17, 18, 19, 20, 22, 23,25a,25b,26a,26b located in the Airly shale mining complex (historic New Hartley Shale Mine) at the northern base of the Mount Airly Mesa as illustrated in the figures in **Appendix 3**.

There are **no known Aboriginal and cultural heritage sites located within the EP Area** (specialist surveys were completed for the MEP EIS by RPS (2014)). Should any previously unknown sites be encountered during mining they will be managed in accordance with the existing approved Centennial *Western Region Aboriginal and Cultural Heritage Management Plan*.

4.7 Biodiversity Management Plan (EP-BMP)

The EP-BMP has been developed as a component of the Extraction Plan in accordance with Schedule 3, Condition 7 (i) iv of the SSD_5581 consent. The purpose of the EP-BMP is to outline the monitoring and management measures to be implemented to manage biodiversity values within the EP Area.

Key fauna resources contained within the CLZs include sandstone habitats such as pagodas, escarpments, caves and crevices. These habitats are suitable for threatened fauna species including the Large-eared Pied Bat (*Chalinolobus dwyeri*), Rosenberg's Monitor (*Varanus rosenbergi*) and the Broadheaded Snake (*Hoplocephalus bungaroides*). Other resources contained within habitats surrounding the CLZs include hollow-bearing trees, flowering and fruiting plants, logs and ground timber, and aquatic habitats.

It is important to note that various sensitive habitat features such as; Genowlan Mountain (including the *Pultenaea* sp. Genowlan Point and *Genowlan Point Allocasuarina nana* Heathland), the Grotto, and the Oasis do not occur within the EP Area. These habitat features are situated within a separate mining lease and are **not subject to first workings for this Extraction Plan**.

One threatened flora species occurs within the EP Area, being *Prostanthera stricta* (vulnerable under both the *Threatened Species Conservation Act* 1995 (TSC Act) and *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act)).

Two additional listed threatened species **which are not subject to first workings for this project** were identified within the overall Airly Mine Development Consent Area (RPS 2014), including:

- *Eucalyptus cannonii* (Vulnerable under the TSC Act); and

- *Pultenaea* sp. Genowlan Point (Critically Endangered under both the TSC Act and EPBC Act).

No Endangered Ecological Communities (EECs) occur within the EP Area, including the Genowlan Point Allocasuarina Heathland and/or White Box – Yellow Box – Blakey’s Red Gum Woodland EEC which occur elsewhere in the Development Consent area.

No Groundwater Dependent Ecosystems (GDE’s) were identified in the EP Area. **Three (3) vegetation communities** which occur within shallow aquifer zones (MU3, MU21 and MU40, as detailed in the EP-BMP) were found to be **‘facultative ecosystems’** as opposed to formal Groundwater Dependent Ecosystems (GDE’s), and potentially have some reliance on groundwater on a seasonal basis or only during extended drought periods.

The Airly Mine site BMP (whole of site plan) includes a broader biodiversity monitoring program within the Development Consent Area which also includes the current EP Area. Monitoring specifically for the EP Area is not required or proposed unless triggered under the TARP developed for the EP-BMP, which is cross-referenced by the Master TARP developed for the Extraction Plan (Appendix 1).

Figures illustrating the location of key biodiversity features and monitoring locations are provided in the EP-BMP and represented in **Appendix 3** to this EP.

4.8 Site Water Management Plan (WMP)

The Airly Mine site Water Management Plan (site WMP) was developed to meet broader relevant conditions of development consent for the mine including surface operations beyond the underground areas (Condition 15 of Schedule 4). In consultation with DP&E, Airly Mine has submitted the site WMP to also meet the requirements for the Water Management Plan required for the Extraction Plan in accordance with Condition 7 (i) iii of Schedule 3 in SSD_5581. The site WMP has been developed in consultation with relevant stakeholders.

The purpose of the site WMP is to detail monitoring and management measures to be implemented for surface and groundwater values (including creek geomorphic stability, aquatic ecology and stygofauna) within the Airly Mine Development Consent Area, including the EP Area. The plan includes detailed baseline monitoring information and a TARP developed specifically for the WMP which is cross referenced within the Master TARP for the extraction plan (Appendix 1). Monitoring within the WMP is also summarised within the *Subsidence Monitoring Program*.

Surface water features are confined to the small ephemeral upper drainage lines (primarily first order) located within the EP Area which are illustrated in the figures presented in **Appendix 3**. Aquifers and groundwater systems are outlined in the WMP. As noted earlier above, no Groundwater Dependent Ecosystems (GDE’s) have been identified within the EP Area. Three vegetation communities which occur within shallow aquifer zones (MU3, MU21 and MU40, as detailed in the EP-BMP) were found to be **‘facultative ecosystems’** as opposed to formal Groundwater Dependent Ecosystems (GDE’s), and potentially have some reliance on groundwater on a seasonal basis or only during extended drought periods.

The site wide WMP presents a broader environmental monitoring program within the Development Consent Area including the current EP Area, rather than monitoring specifically required or proposed for the EP Area. Surface and groundwater monitoring locations (including aquatic ecology) are illustrated in the Figures presented in **Appendix 3**.

5 MONITORING PROGRAM

5.1 Monitoring Strategy and Program Summary

A key aspect of this EP is the mine design specifically to **avoid** potential surface and sub-surface impacts within the EP Area through permanent first workings providing long term stable and effectively non-subsiding support to the surface, with no later secondary extraction proposed within the EP Area. The mine design and associated monitoring strategy have been developed in consultation with the Independent Expert Panel (IEP).

As detailed in section 3.5, negligible ground movements associated with pillar settlement/compression are predicted to result in no surface impacts (section 3.5 includes a summary table comparing the original approved EIS predictions for the Cliff Line Zone of First Workings against the current worst case and predicted movements assessed specifically for the detailed mine plan developed for the EP Area). **In all cases current predictions are below the approved EIS predictions.** It is expected that the negligible levels of pillar compression that may occur would typically be experienced over a period of less than three months.

Accordingly, the supporting *Subsidence Monitoring Program* provides an appropriate risk-based monitoring framework reflecting the above characteristics and potential impacts. The proposed monitoring strategy for the EP Area reflects a number of important considerations. An **integrated** approach to monitoring and inspections has been specifically developed in order to:

- Demonstrate mine development and extraction is undertaken as per approved designs (as the basis of impact avoidance predictions);
- Provide information to demonstrate statutory performance criteria and obligations are satisfied;
- Target monitoring of key sensitive surface features within the EP Area (particularly cliffs and pagodas);
- Recognise that predicted subsidence, tilts and strains are generally below the resolution of conventional subsidence measurements and natural ground movements (and well below levels expected to cause damage).
- Meet 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;
- Provide appropriate information required to assess against triggers within the Master TARP, including data for trend analysis to inform adaptive management (refer **Sections 11, 12**);
- To provide a suitable basis for future monitoring systems and Extraction Plans for ongoing mining within the lease including establishing correlation areas of conventional survey and trials of non-conventional survey for use in remote areas as discussed further below.

Given the above considerations (noting surface access restrictions), an **integrated system of underground, surface and aerial monitoring** has been developed using escalating triggers and levels of investigation, including targeted, trigger-based surface inspection if/where required. This is detailed in the Master Trigger Action Response Plan (Master TARP, refer **Appendix 1**). Environmental monitoring considerations are focused on protecting the key sensitive features of cliffs and pagodas and their associated habitats.

The proposed monitoring program and strategy is detailed within the dedicated ***Subsidence Monitoring Program*** document and outlined in **Section 5.3**. In summary, the integrated approach comprises the following key elements:

- **Underground Mining Control** - a key focus as noted above. Defined mine design parameters including final pillar dimensions, roadway width and mining height. Underground monitoring of first workings. Accurate as-built survey of selected pillars to confirm they have been formed as designed. Weekly statutory inspections of pillar conditions in accessible areas. Further details are provided in Section 10.2 of the SMP.
- **Monitoring of the surface environment using high definition LiDAR (4 returns/m²) and high resolution 3D photogrammetry (50mmx50mm pixels)** with a primary focus on cliffs and pagodas (including pre mining baseline surveys and six monthly surveys during mining for change relative to baseline and Performance Measures set by SSD_5581). Refer Section 10.4 of the SMP document for details.
- **Targeted and Trigger-based Surface Inspections where required** - where safely and readily accessible, such as where 4WD trails traverse cliff line zones, or are close to cliff line zones and otherwise where triggered by the Master TARP. Refer Section 10.3 of the SMP.
- **Data Analysis & Reporting** – given the Extraction Plan covers the life of mine operations within the Cliff Line Zone EP Area, whilst remote monitoring data is available for the entire EP Area, data analysis and reporting will monitor specifically for change and target:
 - **Any areas detected for significant change by high definition LiDAR or 3D photogrammetry results** (including pre and post mining areas), triggering further detailed analysis under the Master TARP, including a process for determining natural or mining-induced rock fall). The process for this detection is detailed further in the Subsidence Monitoring Program and Master TARP respectively. Data for natural rock falls in areas yet to be mined will also provide additional data to the baseline data set.
 - **Active Mining Areas** as detailed and defined within the Subsidence Monitoring Program, providing a reporting focus on active areas as mining progressively moves through the EP Area across the life of mine operations.

Due to the specific performance measures under SSD_5581 for long term stable and non-subsiding pillars within the *Cliff Line Zone of First Workings*, and acknowledging surface terrain and environmental sensitivities and landowner requests (OEH, NPWS), it has been proposed that monitoring of ground movements is not suitable or required specifically for first workings within the current EP Area, which has been concurred by the IEP. It is however noted that future Extraction Plans for secondary extraction in other mining zones will require monitoring of ground movements and a detailed system is currently under development for such in consultation with the IEP, DRE and other stakeholders. Where practicable this will consider sections of the current EP Area of first workings as per recommendations of the IEP.

An outline of baseline monitoring is provided in **Section 5.2**. Proposed monitoring for the EP Area (including locations, methods, parameters, frequencies and duration) is summarised in **Section 5.3**.

5.2 Baseline Monitoring and Locations

Baseline monitoring of landscape features within the EP Area has commenced and will be obtained by using a combination of methods as follows. Further details of relevant baseline are provided within **Section 8** of the Subsidence Monitoring Program and within related sub-plans for the Extraction Plan (including the EP-BMP and the site Water MP).

Baseline monitoring detailed within the SMP includes:

- **Landscape Features** (including cliffs and pagodas)
- **Minor Built Features** including SCA 4WD management trails and associate gates and fences
- **Environmental and Heritage features** including: surface water, geomorphic creek stability, groundwater, stream stability, biodiversity, aquatic ecology, and historic heritage
- **Subsidence Effects (ground movements)**

Figures illustrating environmental monitoring locations for Airly Mine are provided with each relevant component plan and are summarised in common **Appendix 3** to this EP and the SMP.

5.3 Monitoring of Subsidence Impacts and Environmental Consequences

Table 5.1 below provides a summary of the subsidence and environmental monitoring program that will be undertaken to manage natural and built features during first workings in the EP Area. Additional detail pertaining to subsidence monitoring methodology can be found in the *Subsidence Monitoring Program*.

Table 5.1: Monitoring Program Summary

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
Land				
Cliffs, minor cliffs & Pagodas. <i>(Refer LMP Figures 5A-5D and A0 Plan 2 for locations of these features, and App3 of LMP for full detailed mapping study (RPS, 2017))</i>	<p>Survey data for entire EP Area (including pre mining baseline areas and post mining areas)¹</p> <p>Reporting by exception (significant change) and for areas mined within each reporting period (refer Subsidence Monitoring Program for details).</p>	<p>Detailed High definition LiDAR (4m returns/m²) and high resolution 3D photogrammetry (50mm x 50mm pixel size) with a primary focus on cliffs and pagodas.</p> <p>Targeted visual ground inspection in active mining area if issues are identified from aerial work / underground monitoring as per TARP triggers (see Appendix 1).</p>	<p>Presence/absence of mine-induced damage or change to features (significant rock falls and surface cracking)</p>	<p><u>Baseline:</u> At least once prior to first workings development. Due to progressive mining through EP Area typically will be multiple.</p> <p><u>During mining:</u> Six monthly surveys during mining for change relative to baseline and Performance Measures.</p> <p><u>Post Mining:</u> No further detailed analysis after once post mining survey has indicated negligible impacts (in the undermined area)¹. Six monthly surveys continue with a focus on the next active mining area.</p> <p>Triggered targeted visual ground inspection will be undertaken if issues are identified from aerial / underground monitoring as per TARP triggers (Appendix 1).</p>
General Land Surface (excl. Cliffs) <i>Refer LMP Figures 5A-5D</i>	<p>Baseline – Entire EP Area</p> <p>Survey data for entire EP Area (including pre mining areas and post mining areas)¹</p> <p>Reporting by exception (significant change) and for areas mined within each reporting period (refer Subsidence Monitoring</p>	<p>Detailed High definition LiDAR and high resolution 3D photogrammetry with a primary focus on cliffs and pagodas.</p> <p>Targeted visual ground inspection in active mining area if issues are identified from aerial work / underground monitoring as per TARP triggers (see Appendix 1).</p>	<p>Presence/absence of damage or change to land surface (including topography, sinkholes, rock features, soil cover, vegetation cover, etc.)</p>	<p><u>Baseline:</u> At least once prior to first workings extraction.</p> <p><u>During mining:</u> Six monthly surveys during mining for change relative to baseline and Performance Measures.</p> <p><u>Post Mining:</u> No further detailed analysis after once post mining survey has indicated negligible impacts (in the undermined area)¹. Six monthly surveys continue with a focus on the next active mining area.</p> <p>Triggered targeted visual ground inspection will be</p>

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
	Program for details).			undertaken if issues are identified from aerial / underground monitoring as per TARP triggers (Appendix 1).
SCA Management Trails (Tramway Trail, Mt Airly Trail, Genowlan Trail, Point Hatteras Trail) <i>(Refer LMP Figures 5A-5D)</i>	Sections where trails traverse EP Area (Cliff Line Zone) during undermining of any marked trail/track (in front and behind). This equates to half the maximum depth of cover in EP Area. <i>(Refer LMP Figures 5A-5D).</i>	Visual Inspection (including photos as required) where trails/tracks coincide with the EP Area (Cliff line zone).	Surface cracking) and drainage change. (Note: sections of cliff lines and pagodas that are visible from the trail inspected for any observed rock fall to support aerial monitoring of those aspects).	<u>Baseline:</u> Once prior to undermining by first workings. <u>During mining:</u> <u>Fortnightly</u> inspection during mining for change relative to baseline and Performance Measures. <u>Post Mining:</u> Visual inspection at 3 months after undermining of the trail in EP Area. No further inspections after the post mining survey of recently undermined zone has indicated negligible impacts.
Underground Mining Control				
Underground Mining Control: Pillar Size / Roadway Width / Roadway Height / Rib Condition	<u>EP Area:</u> Active Panel Completed workings during development.	Conventional survey of workings as completed. Visual Inspection Overlay of 'as built' pillars as surveyed against designed pillars of mine plan by Mine Surveyor to confirm appropriate final pillar size achieved.	Roadway width, roadway height, final pillar area, final width to height ratio, final FOS as formed. Presence & depth of spalling (m)	<u>During Mining:</u> Inspections weekly in active working area during first workings, undertaken by mining official respectively. 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 3months. Accessible pillars in the cliff zone inspected during any adjacent second workings outside the cliff zone once during extraction.
Historic Heritage	Refer HHMP Figure 6-1			
Historic Heritage Sites 14, 16, 17, 18, 19, 20, 22, 23,25a,25b,26a,26b	Airly shale mining complex - northern base of the Mount Airly Mesa within the EP Area.	Visual Inspection using scaled plans, measurements, photographs and where appropriate 3D scanning.	Ruins structure condition (cracking or damage (beyond existing). Any surface cracking within 25m of Site.	<u>Baseline:</u> Once prior to first workings extraction (undertaken by RPS in 2013). <u>Post Mining:</u> Visual inspection within 3 months after extraction completed in EP Area (only if triggered by rock fall as per HHMP). No further surveys after any post mining survey has indicated negligible impacts.

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
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).				
Surface Water	Refer WMP Figure 4-1			
Site Water Management Plan (s4.2, 4.3) Gap Creek Genowlan Creek Airly Creek (including discharge monitoring) and Onsite locations (Airly Mine surface operations area)	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 by Airly Mine ECC.	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 and Genowlan Creek (data logged). A v-notch weir is planned to be installed at the Genowlan Creek 2 site, in mid-2017. 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.
Groundwater	Refer WMP Figure 4-2.			
Site Water Management Plan (s4.4) Groundwater Bores, Village Spring - Flow monitoring of seepage Stygofauna Transfers from Underground Workings	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 Stygofauna monitoring in 4 Bores: ARP05, ARP09, AM2-1 (production bore), ARP14, ARP15SP Underground 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. Village spring seepage flow by logged pressure transducer. Bore sampling and ID for stygofauna as per WA EPA guidelines (s4.4.3 of WMP for details) In-line flow metering of underground transfers	Water Level (mAHD) Water quality (monthly screening suite, annual ANZECC suite as per WMP). Seepage flow volume Identification of Stygofauna, associated groundwater quality per s4.4.3 of WMP. Transfer flow volume Refer WMP for parameter details (s4.4).	Continuous monitoring of piezometric head and groundwater levels. 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. Biannual monitoring in spring and autumn for stygofauna Daily monitoring of underground transfers to surface dirty water dam (109ML dam).

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
Biodiversity	Refer EP-BMP Figure 8-1			
<i>Prostanthera stricta</i>	Representative sample of known locations of <i>Prostanthera stricta</i> across the Airly MEP development consent area	Point intercept method and floristic density plots	Density/Percent cover Vegetation condition	Spring and Summer
<i>Eucalyptus cannonii</i> (Note: Not identified within the current EP Area)	Across the Airly MEP development consent area Note: This species is not located within EP Area.	Eight individual trees assessed for condition, crown extent, growth changes and associated species	Condition, crown extent, growth changes and associated species.	Spring and Summer
Capertee Rough-barked Apple – Redgum – Yellow Box Grassy Woodland (MU 20) EEC Note: No EEC is located within the current EP Area	Four permanently established plots in MU20 within the Airly MEP development consent area	Biometric plots to assess vegetation condition (OEH 2014)	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.	Spring and Summer
Glossy-black Cockatoos	Areas of She-oak (<i>Casuarina</i> and <i>Allocasuarina</i> sp., but specifically <i>Allocasuarina</i>	Percent cover of <i>Allocasuarina</i> species and the presence and quantity of orts was recorded.	Species presence /absence /abundance/ distribution	Summer

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
	<i>littoralis</i>) across the Airly MEP development consent area (see Figure 5 of EP-BMP)			
Large Forest Owls	Valleys and other areas of potential habitat within the Airly MEP development consent area	Targeted call-playback/spotlighting	Species presence /absence /abundance/ distribution	Spring and Summer
Diurnal Birds	Across the Airly MEP development consent area	30 minute surveys across permanent transects and 20 minute Diurnal surveys	Species presence /absence /abundance/ distribution	Spring and Summer
Cave-dwelling microbats	Foraging and roosting sites and flyways within the Airly MEP development consent area	Anabat units to detect presence of microbat species	Species presence /absence /abundance/ distribution	Spring and Summer
Vertebrate Census	Gully habitats and lower lying rocky habitats	Baited stationary infrared cameras to determine presence	Species presence /absence /abundance/ distribution	Spring and Summer
Aquatic Ecology and Stream Health	Refer WMP Figure 4-4. (Baseline sites refer EP-BMP Figure 6.4)			
Site Water Management Plan: (s4.5) Stream Health	<u>Third order</u> stream sections within the site boundary for Gap Creek, Genowlan Creek, Torbane 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.	Every two years, or where subsidence survey monitoring indicates greater than predicted subsidence.
Site Water Management Plan: (s4.5.2)	Reference site: Airly Creek Upstream. Dog Trap Creek will be used as a surrogate should Airly Creek upstream	Sampling, sorting and identification of macroinvertebrates, associated with pool edge habitat in accordance with the Australian Rivers Assessment	Species presence/absence	Biannually in spring and autumn.

Aspect	Location	Monitoring Method	Parameter	Frequency and Duration
Aquatic Ecology <i>(Note: see also Groundwater above for stygofauna)</i>	be dry in any sampling event. Baseline sites: – Torbane Creek. – Dog Trap Creek. – Gap Creek. – Genowlan Creek. – Genowlan Creek 2. Baseline monitoring to cease following the spring 2017. Impact site: Airly Creek. Refer Figure 4-4 of the WMP.	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.	Habitat condition DO, EC, pH, temperature and turbidity Sediment quality - selected parameters.	
Notes: 1. 'Six-monthly aerial survey of Cliff Line Zone EP Area will continue until 2 years after completion of any future secondary extraction in areas adjacent to a particular cliff unless otherwise agreed with regulators. This will provide data for post-mining areas. Whilst data is held for entire EP Area, reporting and detail analysis will be by exception (where significant change identified) as noted earlier above. 2. * Water quality monitoring for monthly 'screening suites' as per Site Water Management Plan (GHD, 2017b)				

6 IMPLEMENTATION

6.1 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 Guidelines for the Preparation of Extraction Plans ('EP Guidelines', DP&E, 2015). Additionally, *high potential incident* notifications for unexpected subsidence events in relation to the safety of other persons under WHS legislation has also been included (primarily managed under the supporting Public Safety Management Plan (EP-PSMP)). It is noted that notification requirements relating to injuries (if relevant) are managed separately under the Airly Mine Safety Management System (SMS).

As per Section 6 of the EP Guidelines, given the nature of the current EP Area is only for first workings with no predicted surface impacts and negligible ground movements, the frequency of reporting is proposed to be proportionate and reflective of this. The approach is also consistent with that undertaken by previously approved extraction plans.

Airly will submit the following reports as detailed in **Table 6.1** during first workings in the EP Area, as relevant to management of natural and built features, and public safety.

Complaints received (as relevant to this management plan) will be included in the established complaints register for the mine in accordance with protocols established under the Centennial Airly Environmental Management Strategy (EMS) and published on the Centennial Airly website, in accordance with Conditions 2(g) and 14(a) of Schedule 6 of development consent SSD_5581 respectively.

Table 6.1: Reporting and Notification Requirements

Report	Triggers	Relevant Statutory Conditions	Requirements
Notification of Controlled Action Commencement	Commencement of Controlled Action EPBC 2013/7076	<ul style="list-style-type: none"> Condition 2 of EPBC 2013/7076 	<ul style="list-style-type: none"> DoEE to be notified in writing of date of commencement of controlled action (including first workings), required within fourteen (14) days after commencement. Note: This condition has been satisfied by Centennial Airly as per details below in footnote 2).
Website Publication (of information relating to land)	<p>Approval of the management plan by the Minister (DP&E);</p> <p>Advice /reports received from the IEP (relevant to this management plan);</p> <p>Completion of the Annual Review</p> <p>Receipt of complaint relating to land</p>	<ul style="list-style-type: none"> Condition 7 of EPBC 2013 / 7076 (1 month) Schedule 6, Condition 14(a) of SSD_5581 Schedule 6, Condition 10 of SSD_5581 	<ul style="list-style-type: none"> 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 (DP&E). 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 (see below) to be published on Centennial Airly website, Complaints register updated monthly and published on website.
Incident ¹ , Reporting	<p>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_5581¹.</p> <p>Any incident¹ 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 Schedule 6, Condition 2 of SSD_5581).</p>	<ul style="list-style-type: none"> Consent condition 9 (Schedule 6) of SSD_5581. 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). EPL12374 condition R2 	<ul style="list-style-type: none"> Detailed report to be provided to DP&E on the incident within seven (7) days of the incident Secretary of DP&E and any other relevant agencies to be notified immediately (including DP&E, 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 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 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.

Report	Triggers	Relevant Statutory Conditions	Requirements
Duty to notify Resource Regulator of certain incidents - High Potential Incident' Reporting (WHS legislation)	<p>A High Potential Incident occurs defined by Clause 128 (5) (m) as: 'Any indication from monitoring data of the development of subsidence which may result in any incident referred to in the following clauses:</p> <p>179 (a) (xvi) - a failure of ground, or of slope stability control measures, or</p> <p>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'.</p> <p>Note: See requirements column for other triggers if injury occurs.</p>	<ul style="list-style-type: none"> WHS Regulation (Mines and Petroleum Sites, 2014) Clause 128 - <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) 	<p>Respond in accordance with Clause 128 (1):-</p> <ul style="list-style-type: none"> all reasonable steps must be undertaken to ensure that the regulator is notified after becoming aware of an incident (other than a <i>notifiable incident</i> defined by the Regulations -refer the Safety Management System for details): Notifications in accordance with the WHS Guide "<i>Notification of Incident and Injury</i>" (July 2016) as per '<i>Other Incident</i>' category, including: <ul style="list-style-type: none"> Incidents should be reported to the DP&E Resource Regulator 24hr centralised notifications hotline on 1300 814 609. Notifications in writing should also be sent to a centralised address provided when incidents are initially reported by phone. Written notification as soon as possible but no later than 7 days of becoming aware of the incident (whichever is earlier). Notify key stakeholders including OEH/NPWS as soon as practicable of the above. <p>Note: Whilst unexpected, should an incident actually occur which causes injury (as defined by Clause 13 Sch9) separate priority notifications apply in accordance with WHS requirements and the mine SMS.</p>
Subsidence Impacts and Environmental Monitoring Report	<p>Reporting of all impacts and environmental monitoring results initially every six months (i.e. following completion of aerial surveys). Reporting would be reduced to annually after the first two (2) years in consultation with relevant stakeholders if no mining induced impacts are observed as predicted (i.e. reporting would be included in the Annual Review).</p>	<ul style="list-style-type: none"> Condition 10, Schedule 6 of SSD_5581 Section 6 of DP&E EP Guidelines 	<p>This report will include:</p> <ul style="list-style-type: none"> a comprehensive summary of all impacts, including: <ul style="list-style-type: none"> A summary of integrated subsidence monitoring program results (aerial high definition LiDAR, high resolution 3D photogrammetry, and underground pillar surveys and inspections); Results of related environmental monitoring where applicable (refer Section 10); 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

Report	Triggers	Relevant Statutory Conditions	Requirements
			environmental monitoring results. <ul style="list-style-type: none"> Any revisions to the TARP undertaken in consultation with stakeholders. Any other adaptive management measures as relevant
Annual Review	Annual Review report required under development consent condition 11 (Schedule 6), SSD_5581.	<ul style="list-style-type: none"> Condition 11 (Schedule 6), SSD_5581 	Report to include: <ul style="list-style-type: none"> 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 EP Guidelines); The review is required to be submitted by 31 st March each year unless otherwise agreed by the Secretary (DP&E). 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	<ul style="list-style-type: none"> Condition 4 of EPBC 2013 / 7076. 	<ul style="list-style-type: none"> 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.

Notes:

1) 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 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".**

2) 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 approval area (not just the Cliff Line Zone of First Workings) and was satisfied for activities undertaken beyond the CLZ. No first workings have been undertaken within the EP Area/CLZ (which require prior approval of an Extraction Plan) since the activation of Development Consent SSD_5581 on 31 January 2017, following the expiry of permissible mining under the former consent DA162/91 on that date.

3). 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 (over 400 pagodas and over 150 major cliffs), although noting aerial monitoring survey data is held for such wherever required. Survey, analysis and reporting of post-mining areas for the required periods until monitoring ceases will be undertaken as described in Section 10.4 of the SMP.

Report	Triggers	Relevant Consent Condition	Requirements
Notification of Controlled Action Commencement	Commencement of Controlled Action wrt EPBC 2013/7076	<ul style="list-style-type: none"> Condition 2 of EPBC 2013/7076 	<ul style="list-style-type: none"> DoEE to be notified in writing of date of commencement of controlled action (including first workings), required within fourteen (14) days after commencement. Note: This condition has been satisfied by Centennial Airly as per details below in footnote 2).
Website Publication (of information relating to land)	<p>Approval of the management plan by the Minister (DP&E);</p> <p>Advice /reports received from the IEP (relevant to this management plan);</p> <p>Completion of the Annual Review</p> <p>Receipt of complaint relating to land</p>	<ul style="list-style-type: none"> Condition 7 of EPBC 2013 / 7076 (1 month), and Cond 14(a) of Schedule 6 of SSD_5581. Schedule 6, Condition 14(a) of SSD_5581 Schedule 6, Condition 14 of SSD_5581 Schedule 6, Condition 14 of SSD_5581 	<ul style="list-style-type: none"> 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 (DP&E). 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 (see below) to be published on Centennial Airly website, Complaints register updated monthly and published on website.
Incident ¹ , Reporting	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 Schedule 6, Condition 2 of SSD_5581).	<ul style="list-style-type: none"> Consent condition 9 (Schedule 6) of SSD_5581. 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). EPL12374 condition R2 	<ul style="list-style-type: none"> Detailed report to be provided to DP&E on the incident within seven (7) days of the incident Secretary of DP&E and any other relevant agencies to be notified immediately (including DP&E, 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 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. 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.

Report	Triggers	Relevant Consent Condition	Requirements
'High Potential Incident' Reporting (WHS legislation)	<p>A High Potential Incident occurs defined by Clause 128 (5) (m) as: 'Any indication from monitoring data of the development of subsidence which may result in any incident referred to in the following clauses:</p> <p>179 (a) (xvi) - a failure of ground, or of slope stability control measures, or</p> <p>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'.</p> <p>Note: See requirements column for other triggers if injury occurs.</p>	<ul style="list-style-type: none"> WHS Regulation (Mines and Petroleum Sites, 2014) Clause 128 - <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) 	<p>Respond in accordance with Clause 128 (1):-</p> <ul style="list-style-type: none"> all reasonable steps must be undertaken to ensure that the regulator is notified after becoming aware of an incident (other than a <i>notifiable incident</i> defined by the Regulations -refer the Safety Management System for details): Notifications in accordance with the WHS Guide "<i>Notification of Incident and Injury</i>" (July 2016) as per '<i>Other Incident</i>' category, including: <ul style="list-style-type: none"> written notification as soon as possible but no later than 7 days of becoming aware of the incident (whichever is earlier). Notify key stakeholders including OEH/NPWS as soon as practicable of the above. <p>Note: Whilst unexpected, should an incident actually occur which causes injury (as defined by Clause 13 Sch9) separate priority notifications apply in accordance with WHS requirements and the mine SMS.</p>
Subsidence Impacts and Environmental Monitoring Report	<p>Reporting of all impacts and environmental monitoring results initially every six months (i.e. following completion of aerial surveys). Reporting would be reduced to annually after the first two (2) years in consultation with relevant stakeholders if no mining induced impacts are observed as predicted (i.e. reporting would be included in the Annual Review).</p>		<p>This report will include:</p> <ul style="list-style-type: none"> a comprehensive summary of all impacts, including: <ul style="list-style-type: none"> A summary of integrated subsidence monitoring program results (aerial high definition LiDAR, high resolution 3D photogrammetry, and underground pillar surveys and inspections); Results of related environmental monitoring where applicable (refer Section 10); 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.

Report	Triggers	Relevant Consent Condition	Requirements
			<ul style="list-style-type: none"> Any other adaptive management measures as relevant

Notes: 1) SSD_5581 defines an incident as "a set of circumstances that:

- causes or threatens to cause material harm to the environment; and/or
- breaches or exceeds the limits or performance measures/criteria in this consent"

2) 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 approval area (not just the Cliff Line Zone of First Workings) and was satisfied for activities undertaken beyond the CLZ. No first workings have been undertaken within the EP Area/CLZ (which require prior approval of an Extraction Plan) since the activation of Development Consent SSD_5581 on 31 January 2017, following the expiry of permissible mining under the former consent DA162/91 on that date

6.2 Review

6.2.1 Review Triggered by Planning and Environmental Approval Requirements

In accordance with the requirements of Schedule 6, Condition 3 of Development Consent SSD_5518, **as a minimum** 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_5518.

Where this leads to revisions of the document, within four (4) weeks of the review the revised document must be submitted to DP&E 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 6.1) will document the effectiveness of this document (and the related component 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.

Additionally, to maintain consistency with existing management plans and previous Extraction Plans at the mine, this EP 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; or
- Monitoring or audit processes demonstrate that a review is warranted.
- Where otherwise triggered by the Master TARP.
- Where triggered by (or for) review of other related management plans (if applicable).
- Every three (3) years as a minimum (where not already triggered above);

Any amendments to the 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 EP will be forwarded to DP&E and the IEP.

6.2.2 Review Triggered by WHS Legislation Requirements

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 **Clause 10** of the *WHSMP Regulation (2014)*. Monitoring and review processes 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.

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.

In accordance with the recently released *Guide to Managing Risks of Subsidence (WHS Mines and Petroleum Legislation)*, February 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;**
Note: 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.
 - (2) **a significant change in the site-specific conditions is identified,**
Note: 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).
 - (3) **there are early warnings of abnormal subsidence where significant surface or subsurface features exist,**
Note: 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
 - (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?*

6.2.3 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 Mining Operations Plan / Rehabilitation Management Plan under Condition 29 of development consent SSD_5581.

Additionally, in accordance with clause 15(c) of the WHSMP Regulation (2014), 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.

6.3 Roles and Responsibilities

The responsibility for implementation, monitoring and review of the EP lies with the Mining Engineer. The ultimate responsibility for the implementation of the EP lies with the Mine Manager, who shall make appropriate resources available. The roles and responsibilities for the Airly Mine Cliff Line Zone of First Workings EP are outlined in **Table 6.2**.

Table 6.2: Key Personnel and Accountabilities

Position	Responsibility
Mine Manager	<ul style="list-style-type: none"> Ensuring that sufficient resources are available to implement and execute the requirements of this Plan; and Reporting triggers/non-conformances to external stakeholders.
Mining Engineer	<ul style="list-style-type: none"> Coordinate underground inspections and subsidence monitoring program associated with this EP; Coordinate implementation of the mine design and Master TARP. Determination of final roadway/pillar locations as determined by as built pillars (reported by Mine Surveyor) and panel design parameters. Reporting triggers/non-conformances internally to the mine manager as appropriate. Reporting to DP&E and DRE of subsidence and pillar system performance upon completion of specified monitoring intervals.
Production Manager	<ul style="list-style-type: none"> Implement mine design Establish and maintain underground monitoring and inspections program; Auditing as required
Mine Surveyor	<ul style="list-style-type: none"> Survey as built first workings development pillars Establish and maintain subsidence monitoring program; Internal reporting as required. Mark up centre lines for driveage Produce final mining plan for first workings to be carried out in consultation with the mining engineer.

Environment and Community Coordinator	<p>Implementation, monitoring and review of this plan, including:</p> <ul style="list-style-type: none"> • 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. • Consultation during the review process with relevant stakeholders and distributing this EP; • Coordinating any remediation work as required; • Inspecting areas susceptible to tensile and compressive strains and potential cracking as required; • Co-ordinating the generation and submission of formal reporting requirements outlined in this Plan; and • Reviewing this EP.
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7 GRAPHICAL PLANS (VOLUME 2)

The following graphical plans have been prepared for the EP Area in accordance with DP&E's Draft Guidelines for the Preparation of Extraction Plans (2015).

- **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** (including New Hartley Shale Mine workings). Historical Torbane Colliery workings are also shown (same seam)
- **Plan 5: Mining Titles and Land Ownership**
- **Plan 6: Geological Sections**
- **Plan 7: Proposed Subsidence Monitoring**

As required these plans have been submitted separately in A0 format. For ease of reference A3 copies are also included in **Appendix 3** of this Extraction Plan.

8 REFERENCES

- Centennial Coal (2008). *Centennial Coal Risk Management Standard (Management Standard – 004)*.
- Centennial (2014) Environmental Assessment: *Airly Mine Extension of Time Section 75W Modification to Development Consent DA 162/91 ("MOD3")*.
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- Department of the Environment (2014), *'Background: Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi*.
- GHD (July 2014), MOD3 Response To Submissions, *Airly Mine Extension Of Time Project: Groundwater Impact Assessment*
- GHD (July 2014), MOD3 Response To Submissions, *Airly Mine Extension Of Time Project: Surface Water Impact Assessment*
- GHD (2014a). *Airly Mine Extension of Mining Project: Surface Water Impact Assessment*.
- GHD (2014b). *Airly Mine Extension of Mining Project: Water and Salt Balance Assessment*.
- GHD (2014c). *Airly Mine Extension of Mining Project: Groundwater Impact Assessment*.
- GHD (2014d). *Airly Mine Extension of Mining Project: Hydrogeological Model Report*
- GHD (2017a) Airly Mine Water Management Plan. Prepared for Centennial Airly Pty Limited.
- GHD (2017b) *Airly Mine Aquatic Ecology monitoring: Spring 2016*, prepared by GHD Pty Ltd for Centennial Airly Pty Limited.
- Golder (2017) *The Adequacy Of Coal Pillars Planned For The Cliff Line Zone In ML1331*, Airly Mine. Project No. 127621105-313-R-Rev1.
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- Golder (2014b), *Subsidence Predictions and Impact Assessment for Airly Mine*, 127621105-003-R-Rev0, January 2014, Golder Associates.
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- 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*. Ken Mills (SCT), Ismet Canbulat (UNSW), Don Kay (MSEC).
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RPS (2013b). "Baseline Historic Heritage Assessment: Airly Mine, Capertee, NSW."

RPS (2014). "Airly Mine Extension Project Cultural Heritage Impact Assessment Airly Mine, Capertee, Lithgow Local Government Area."

RPS (2016). "Centennial's Historic Heritage Management Plan Western Region." Report to Centennial Coal.

RPS Australasia (2017a). Proposal for Aerial Mapping of Cliffs, Minor Cliffs and Pagodas with the Cliff Zone. Prepared for Centennial Coal, 25 May 2017.

RPS Australasia (2017b). Mining Lease ML1331: Identification of Cliffs, Minor Cliffs and Pagodas with the Cliff Zone. Prepared for Centennial Coal, 19 June 2017.

RPS Australasia (2017c). Historic Heritage Management Plan for Cliff Line Zone of First Workings Extraction Plan within ML1331.

RPS Australasia (2017d). Draft Biodiversity Management Plan for Cliff Line Zone of First Workings within ML1331 Airly Mine.

State of NSW through the Planning Assessment Commission (2015). Airly Mine Extension Project Review Report.

State of NSW and the Office of Environment and Heritage (2015). Mugii Murum-ban - State Conservation Area Draft Plan of Management

Washington, H. G. and Wray, R.A.L. (2011), *The Geoheritage and Geomorphology of the Sandstone Pagodas of the North-western Blue Mountains Region (NSW)* accepted for publication in Proc. Linn. Soc, 132: 131-141.

Appendix 1:

Extraction Plan Master TARP
(Trigger Action Response Plan)

Airly Mine Cliff Line Zone of First Workings Extraction Plan (ML1331) - Master Trigger Action Response Plan (MASTER TARP)

Aspect	Predictions (current EP)	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 within Cliff Line Zone EP Area designed long term stable and self supporting / non subsiding <i>Refer Level Green Triggers</i>	All First Workings within Cliff Line Zone to be long term stable and non- subsiding Design Parameters to achieve such as per Table 8.5 of the EIS <i>Refer Red Level Triggers</i>	TRIGGERS: <ul style="list-style-type: none"> Underground mine survey and inspections confirms dimensions as mined are within compliant specifications issued by the Airly Mining Engineer at Weekly Strata Review Meetings and in accordance with the Panel Design Standard (AIR-SS-9001). Triggers shall include: <ul style="list-style-type: none"> Roadway width ≤5.5m average across panel as mined. Rib height ≤3.0m average across panel as mined Minimum pillar size for isolated cases is greater than 1/10th Depth of Cover⁶ or greater than 10m. Minimum Pillar System Factor of Safety (FOS) >2.11 across the panel Nominal Pillar width/height ratio ≥8 average across panel Minimum width/height ratio ≥4 for isolated pillars Rib spall <300mm on both ribs Pillar conditions show no significant signs of deterioration/spalling during weekly statutory inspections. 	TRIGGERS <ul style="list-style-type: none"> Underground mine survey and inspections confirms minor variation in pillar/rib/roadway dimensions as mined compared to compliant specifications issued by the Airly Mining Engineer at Weekly Strata Review Meetings (and in accordance with the Panel Design Standard (AIR-SS-9001)). Triggers shall include: <ul style="list-style-type: none"> Isolated change in roadway width >5.5m as mined. Rib height >2.8 but <3.0m average across panel Isolated change in pillar size required due to avoidance of geological structure encountered or offline driveage occurs. Minimum Pillar Size for isolated cases is <1/10 depth of cover, with High Risk Activity notification undertaken as per WHS legislation. Minimum w/h ratio for isolated case pillars <4 Rib spall 300-500mm on both ribs Pillar condition deterioration/increased spalling observed. 	TRIGGERS <ul style="list-style-type: none"> Underground mine survey and inspections confirms significant variation in pillar/rib/ /roadway dimensions as mined compared to approved minimum design parameters described within the MEP EIS (refer Section 5.1 of Subsidence Monitoring Program) and /or related minimum statutory design requirements⁶, including: <ul style="list-style-type: none"> Roadway width >5.5m on average across panel as mined. Rib height >3.0m average across panel Nominal 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) Minimum Pillar System FOS <2.11 across the panel Minimum Pillar Size for isolated cases is <1/10 depth of cover or 10m, without High Risk Activity notification required under WHS legislation (with further controls required). Rib spall >500mm on both ribs <p><i>Note: Due to conservative approach to mine design, exceedance of approved mine design parameters above may not automatically cause a surface impact or environmental consequence. Appropriate responses to subsequently check if such occurs are accordingly triggered elsewhere below for all aspects.</i></p>
Roadway Width / Roadway Height/ Pillar Size			<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> No response required. Designs assessed and confirmed by Independent Expert Panel as long term stable and effectively non-subsiding. Continue Subsidence Monitoring Program to ensure implemented as designed. 	<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> Refer to and engage <i>Strata Management Plan</i> for additional roof support Review mining processes (including Panel Design Standard), confirm and implement any changes as required. Review subsidence predictions where appropriate. Implement adaptive management process components where appropriate. Retraining of development crews where required. Minor incident internal investigation process if offline driveage has occurred (where minor and non-reportable to Resource Regulator). Assess the likelihood for mining induced <u>surface impacts</u> (against all available information), and if such impacts are considered: <ul style="list-style-type: none"> Unlikely (L1) – Then undertake review of mining methods, operations and monitoring against mine design criteria, review correlation data/process, continue monitoring; Likely (L2) – Detailed review and analysis of high resolution aerial monitoring data where applicable, undertake further <u>targeted</u> aerial survey over surface area possibly impacted if required, and/or targeted surface visual inspection where safe and as appropriate, particularly within existing accessible areas. See further details for each individual surface feature below where L2 is triggered. 	<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> Notify and consult with relevant stakeholders as per requirements specified within the Extraction Plan/SMP/PSMP, Development Consent and related approvals. Undertake targeted surface investigations including detailed data analysis and targeted review of high resolution aerial monitoring information initially, followed by surface inspection if/where appropriate by suitably qualified personnel if safely accessible and where potential impact necessitates further ground assessment is required to quantify impacts. Cease mining in relevant areas if appropriate Review panel design and modify pillar designs to suit altered pillar dimensions Refer to and engage Strata Management Plan for additional roof support Review mining processes and Panel Design Standard. Implement <u>Adaptive Management process</u> in mine design as described within the Extraction Plan/SMP, including consideration of the following potential actions where applicable: <ul style="list-style-type: none"> 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; Implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary. Increase the size of protection zones by commencing or stopping mine workings further away from sensitive features than planned.

Aspect	Predictions (current EP)	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>
					<ul style="list-style-type: none"> ○ Avoid mining under sensitive surface features. ○ Changing the dimension of pillars or void widths / adjust roadway widths to ensure total extracted span and pillar sizes are within appropriate limits. ○ Review and upgrade operational control and communication systems (including Panel Design Standard). ○ Review and undertake appropriate additional monitoring ● Improve communication with development crews.
Cliffs, Pagodas, Steep Slopes and Rock Formations	<p>No adverse impact expected to all surface features including cliff lines, pagodas and steep slopes).</p> <p>No surface cracking</p>	<p>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:</p> <p><i>No greater subsidence Impacts or environmental consequences than predicted In the EIS:</i></p> <p><i>(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></p> <p>Pagodas within 26.5 degree AOD of the New Hartley Shale Mine Potential Interaction Zone:</p> <p><i>No greater subsidence impacts or environmental consequences than predicted in the EIS.</i></p> <p><i>(i.e. no additional surface cracking, no collapse of features to pagodas within CLZ. Pagodas within NHSMPIZ maximum approved impact in EIS was caused by shallow zone 2nd workings as “Minimal additional impact due to existing damage, reactivation of existing fractures and additional fracturing in areas of historical workings (Tables 8.3, 10.60 of EIS))</i></p> <p>Minor Cliffs and Steep Slopes:</p> <p><i>No greater subsidence impacts or environmental consequences than predicted in the MEP EIS.</i></p> <p><i>(i.e. negligible⁵ impact, no surface cracking, collapse of features or slope failure for CLZ of First Workings).</i></p>	<p>TRIGGERS:</p> <p>Integrated monitoring (underground, surface, aerial monitoring as per SMP) does not identify any mining induced impacts from first workings in the EP Area, including:</p> <ul style="list-style-type: none"> ● No Damage to Pagoda/Beehive formations (including visible cracking, rock fall). ● No Damage to cliff and minor cliff faces (e.g. no rock fall, cracking). ● Underground Mining Controls and Monitoring indicates all parameters are within design criteria / Level Green trigger levels. 	<p>TRIGGERS:</p> <ul style="list-style-type: none"> ● Underground Monitoring indicates potential for surface impact requiring further investigation/confirmation; and/or ● Impact observed but yet to be confirmed if mining induced or natural rock fall (Note: Any <i>confirmed</i> mining induced impacts will also be compared to relevant approved performance measure thresholds (condition Red trigger levels – refer RHS column)); and/or. ● The following mining-induced impacts occur but are within approved impacts of development consent SSD_5581: <ul style="list-style-type: none"> ○ <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, other than pagodas affected by the New Hartley Shale Mine Potential Interaction Zone</i> ○ Note: No new/additional mining induced cracking by first workings is to occur to Pagodas within 26.5 degrees of the New Hartley Shale Mine Potential Interaction Zone (to existing cracking from historical shale mine activities). ● Any indication from monitoring data of the development of subsidence which may result in the following (<i>High Potential Incidents</i> as per CI 128(5m) of the WHSMP Regulations 2014): <ul style="list-style-type: none"> ○ 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. <p>See also <i>Subsidence</i> and <i>Underground Mining Control</i> elements above for related triggers/responses that require further investigation to confirm any <i>potential</i> surface impacts.</p>	<p>TRIGGERS:</p> <p>Integrated monitoring (underground, surface, aerial monitoring as per SMP; targeted/trigger-based visual inspections) 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., which are summarised as follows:</p> <p>Impacts Exceeding Approved Performance Measures of (As per Table 2, Sch3 SSD_5581):</p> <ul style="list-style-type: none"> ● 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, other than pagodas affected by the New Hartley Shale Mine Potential Interaction Zone ● Mining-induced cracking from Airly first workings occurs to Pagodas in the CLZ/EP Area within 26.5 degree AOD of the New Hartley Shale Mine Potential Interaction Zone, in addition to existing cracking from historical shale mining (i.e greater subsidence impacts or environmental consequences than predicted in EIS). ● Minor Cliffs and Steep Slopes: Greater subsidence impacts or environmental consequences than predicted in the MEP EIS. (i.e. exceed negligible⁵ impact, e.g. fracturing or collapse of steep slopes) <p>Other Relevant Impacts:</p> <ul style="list-style-type: none"> ● Sinkhole / plug failure occurs ● 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. This is defined as cracks >20mm wide or where step formation occurs or where there is potential for instability of a rock formation (i.e. cliff pagoda, overhang or steep slope)
			<p>ACTIONS & RESPONSES:</p> <ul style="list-style-type: none"> ● No response required. ● Continue Subsidence Monitoring Program. 	<p>ACTIONS & RESPONSES:</p> <ul style="list-style-type: none"> ● Consider public safety risk of any observed rock falls / instability (regardless of natural or not). Notify NPWS and key stakeholders where public safety risk identified and consider warning signs/tape in affected areas; ● Further targeted detailed analysis and review of available high resolution aerial monitoring data where applicable. ● Review rock fall location against mine plan to identify if 	<p>ACTIONS & RESPONSES:</p> <ul style="list-style-type: none"> ● Notify and consult with relevant stakeholders as per Consent/related approvals as per relevant sections of the Land Management Plan, Subsidence Monitoring Program and EP. <ul style="list-style-type: none"> ○ Where impacts may present a risk to others on the surface this should also include incident notification for a principal hazard (WHSMP Regulations 2014) as detailed in the PSMP. ● Undertake targeted surface inspections (suitable personnel) if safely and readily accessible and potential impact necessitates further ground

Aspect	Predictions (current EP)	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>
				<p>mining was occurring in vicinity of the rock fall</p> <ul style="list-style-type: none"> Review against integrated monitoring program data including underground monitoring and inspections wrt signs of pillar instability to further assess potential as mine induced impact; Review climatic monitoring data (including for significant rainfalls or temperature changes) and available government seismic data to identify potential contributing conditions; Review all baseline and previous photographic evidence and monitoring data available of natural cliff/rock fall records to assess any observed disturbance against baseline trigger levels and mine impact predictions. . If there is insufficient data to clearly quantify the above responses, undertake further targeted investigations/monitoring (including detailed aerial survey or otherwise) over the relevant surface area as required to quantify the scale/extent/nature of potential surface impacts. Consider review of mining design / predictions against mine design criteria and consider whether a more conservative design criteria should be adopted. Where the above processes identify mining induced impact, refer Red Level impact triggers thresholds and responses. 	<p>assessment is required to quantify impacts, as determined in consultation with key stakeholders (OEH, NPWS, DP&E and the PSE).</p> <ul style="list-style-type: none"> Cease first workings in relevant areas where appropriate (consult PSE and DP&E); 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 (in consultation with PSE, DPE, OEH/NPWS). Review public safety risk. Notify relevant stakeholders and erect warning signs/ barrier tape or similar in affected area where public safety risk identified. Consider restricting public access if required (consult stakeholders); Investigate exceedance of subsidence prediction model. Review of mine design/predictions against mine design criteria. Identify and implement possible changes to mine design (to make more conservative) in consultation with relevant stakeholders. Key objective to prevent any further significant impacts / reoccurrence. 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; Implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary. Implement <u>Adaptive Management</u> process in mine design as per Extraction Plan/LMP/SMP, including consideration of the following potential actions where relevant: <ul style="list-style-type: none"> Avoiding mining under/moving around sensitive features changing the dimension of pillars or void widths Review and upgrade operational control and communication systems (including Development and Extraction Control Procedures). Review and undertake appropriate monitoring Written reporting to relevant agencies as per Consent/relevant approvals as detailed in Extraction Plan, LMP and SMP.
<p>Unsealed Access Roads and Tracks (SCA Management 4WD Trails: Mt Airly Track, Tramway Trail, Point Hatteras Trail, Genowlan Trail)</p>	<p>No adverse impact</p> <p>No surface cracking</p>	<p>No greater subsidence Impacts or environmental consequences than predicted In the EIS: (i.e. Negligible impacts for the Cliff Line Zone of First Workings, surface cracking is not expected, no impact on current land use).</p>	<p>TRIGGERS:</p> <ul style="list-style-type: none"> Scheduled monitoring (surface inspections of the SCA Management Trails) does not identify any mining induced impacts, such as: <ul style="list-style-type: none"> Visible soil cracking/fracturing. Change in grade/heaving/buckling Increased ponding Underground Mining Controls and Monitoring indicates all parameters are within design criteria / Level Green trigger levels. <p>Note: see also related elements above for other types of impacts (e.g. rock falls) that could affect these areas.</p>	<p>TRIGGERS:</p> <ul style="list-style-type: none"> Scheduled monitoring (surface inspections) of SCA Management Trails does not identify any mining induced impacts (refer examples in Condition Green); however underground monitoring or aerial monitoring systems trigger prompt further investigation/surface inspection of relevant access tracks and trails. Any indication from monitoring data of the development of subsidence which may result in the following (<i>High Potential Incidents</i> as per CI 128(5m) of the WHSMP Regulations 2014): <ul style="list-style-type: none"> 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. <p>See also <i>Subsidence</i> and <i>Underground Mining Control</i> elements above for related triggers/responses that require further investigation to confirm any <i>potential</i> surface impacts.</p>	<p>TRIGGERS:</p> <ul style="list-style-type: none"> Scheduled monitoring (surface inspections of SCA Management Trails identifies mining induced surface cracking/fracturing where: <ul style="list-style-type: none"> Cracking <5mm Wide = L1 Minor Cracking 5-20mm wide = L2 Moderate Cracking >20mm wide = L3 Significant Mining-induced changes in grade, heaving or buckling, increased ponding or other significant damage to SCA management trails are observed during monitoring.

Aspect	Predictions (current EP)	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>
			<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> No response required. Continue Subsidence Monitoring Program. 	<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> Airly ECM (or delegate) to undertake targeted surface inspection of accessible access roads and trails in relevant area to confirm if any impact at surface. If impact observed - refer Condition Red responses. If none observed - continue monitoring program. 	<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> <u>L1 Minor Road Cracking (<5mm Wide)</u>: Notify and consult with relevant stakeholders as per Consent/ related approvals. Continue monitoring program to confirm that cracks are adequately repaired naturally through sedimentation and infilling of vegetation and surface debris. <u>L2 Moderate Road Cracking (5-20mm wide)</u>: Notify and consult with relevant stakeholders as per Consent/ related approvals. Review public safety risk. Consider erecting warning signs/warning tape in immediate area. Repair by grading after subsidence is complete if required. Repairs completed in consultation with relevant stakeholders. Monitor cracking. <u>L3 Significant Road Cracking (>20 mm wide)</u>: Stop extraction mining in that area if appropriate (consult PSE⁴). Notify and consult with relevant stakeholders as per Consent/ related approvals. This includes <i>High Potential Incident Notification</i> (WHSMP Regulations) as detailed in Section 16 of the SMP. Assess public safety risk. Erect warning signs/warning tape as required and/ or close road access (consult stakeholders). Repair cracks that present safety risk immediately with excavation and compaction in consultation with relevant stakeholders. Field inspection by Airly Mine ECM with invitation to relevant stakeholders to attend. Monitor cracking. Undertake detailed review of subsidence model, pillar designs & the Extraction Plan for current & subsequent panels in consultation with PSE⁴, DPE. Engage adaptive management process as required as per Extraction Plan / LMP/ Subsidence Monitoring Program.
General Land Surface (excluding cliffs, minor cliffs, pagodas and steep slopes)	No adverse impact. No surface cracking	No greater subsidence impacts or environmental consequences than predicted in the EIS (i.e. Negligible impacts for the Cliff Line Zone of First Workings, surface cracking is not expected, no impact on current land use)	<u>TRIGGERS:</u> Integrated monitoring (underground, surface, aerial monitoring as per SMP, targeted surface inspections in existing accessible areas (e.g. in vicinity of SCA Management Trails during inspections) does not identify any mining induced impacts, such as any: <ul style="list-style-type: none"> Soil cracking/fracturing in vegetated areas (non-roads/tracks). Plug failure/Sinkholes Landslips or other geotechnical instability <ul style="list-style-type: none"> Underground Mining Controls and Monitoring indicates all parameters are within design criteria / Green trigger levels. 	<u>TRIGGERS:</u> <ul style="list-style-type: none"> Integrated monitoring (underground, surface, aerial monitoring as per SMP, and targeted inspections of SCA management Trails (see above) does not identify any mining induced impacts (refer Condition Green examples), however: Underground monitoring identifies potential for instability at the surface (e.g. pillar instability underground). Refer <i>Subsidence</i> and <i>Underground Mining Control</i> elements above for related triggers/responses that require further investigation to confirm any potential surface impacts. 	<u>TRIGGERS:</u> Routine integrated monitoring (underground, surface, aerial monitoring as per SMP, (or targeted inspections of SCA Management Trails – see above) identifies that there <u>are mining-induced surface impacts beyond approved levels</u> relevant to baseline, including any of the following: <ul style="list-style-type: none"> Soil cracking/fracturing.in vegetated areas (non-roads) Landslips or other geotechnical instability Plug failure/Sinkhole Change in grade/heaving/buckling
			<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> No response required. Continue Subsidence Monitoring Program. 	<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> Further targeted detailed analysis and review of available high resolution aerial monitoring data where applicable If there is insufficient data to clearly undertake the above response, undertake further targeted investigations / monitoring (including detailed aerial survey or otherwise as required) over the relevant surface area to quantify the scale/extent/nature of potential surface impacts. If/Where appropriate, safe and readily accessible, undertake a <i>targeted</i> surface inspection in consultation with NPWS to confirm any potential surface impacts. If impacts observed - refer Red Condition responses. If no impacts observed - continue monitoring program. 	<u>ACTIONS & RESPONSES:</u> <ul style="list-style-type: none"> Notify and consult with relevant stakeholders as per Consent/ related approvals as per EP/SMP and LMP. Undertake targeted surface inspections (suitably qualified personnel) if safely accessible and potential impact necessitates further ground assessment is required to quantify impacts. Assess relevant aspects for public safety risk, warning signs/tape/barricades put in place as soon as practicable. Investigate exceedance of subsidence prediction model. Review mine design/predictions against design criteria. Undertake detailed review of subsidence model, pillar designs & extraction plan for current & subsequent panels in consultation with PSE⁴. 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). Implement Adaptive Management process as noted earlier above and detailed within the EP, SMP and LMP. Written reporting to relevant agencies as per Consent / related approvals.

Aspect	Predictions (current EP)	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>
Surface water and Groundwater	-	-	-		
			<i>Refer dedicated TARP within the Airly Mine Water Management Plan (site WMP) – Appendix 1 (TARPs)</i>		
Biodiversity and Sensitive Vegetation: EEC / GDE, Threatened Species, Habitat, Aquatic Ecology	-	-	-		
	-	-	<i>Refer dedicated TARP within the Extraction Plan Biodiversity Monitoring Plan (EP-BMP) - Appendix 1 (TARP).</i>		
Historic Heritage (12 sites associated with Airly Village ruins / New Hartley Shale Mine)	No adverse impact	Negligible Environmental Consequences.	TRIGGERS: <ul style="list-style-type: none">Subsidence monitoring program (underground, surface, aerial monitoring as per SMP) is <u>within predictions</u>, no mining induced impact and/or underground instability issues.No mining induced impact compared to pre-mining baseline inspection.	TRIGGERS: <ul style="list-style-type: none">Subsidence monitoring program (underground, surface, aerial monitoring as per SMP), indicates <u>no mining induced impact</u> compared to pre-mining baseline assessments;Integrated Subsidence Monitoring Program detects a significant rock fall has occurred (natural or otherwise) within vicinity of known historic heritage sites.	TRIGGERS: <ul style="list-style-type: none">Subsidence monitoring (underground, surface, aerial monitoring as per SMP) or Amber Level investigations identifies mining induced impact.
	No surface cracking		ACTIONS & RESPONSES: <ul style="list-style-type: none">No response required.Continue Subsidence Monitoring Program (SMP).Continue Management of in accordance with Extraction Plan Historic Heritage Management Plan (EP-HHMP).	ACTIONS & RESPONSES: <ul style="list-style-type: none">Confirm rock fall as per actions for rock falls listed earlier above in TARP, determine if mining induced rock fall. .Undertake 'Phase 2' monitoring and management of relevant historic heritage sites as described within the EP-BMP.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 Historic Heritage sites in accordance with approved Extraction Plan.Notification and consultation with relevant agencies and stakeholders as required.	ACTIONS & RESPONSES: <ul style="list-style-type: none">Notify and consult with relevant stakeholders as per Consent/ related approvals as per Extraction Plan, SMP and EP-HHMP.Cease workings in relevant areas where appropriate (consult PSE⁴, NPWS/OEH, DPE);Erect warning signs/warning tape in immediate area if considered a public safety risk.Monitoring/Management of Historic Heritage sites in accordance with approved EP-HHMP and Extraction Plan.Investigate exceedance of subsidence prediction model.Review of mine 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 relevant Management Plans).Implement Adaptive Management process as noted earlier above and detailed within the Extraction Plan/SMP.Written reporting to relevant agencies as per Consent / relevant approvals as also noted within Extraction Plan /SMP.
Aboriginal and Cultural Heritage Sites	N/A	N/A	<i>No registered or known Aboriginal and Cultural Heritage sites located within EP Area. No TARP actions required.</i>		
			Note: The <i>Western Region Aboriginal and Cultural Heritage Management Plan</i> manages existing sites elsewhere within the Airly Mine development consent area, including actions for managing discovery of any new sites.		

Notes:

¹ An integrated *Subsidence Monitoring Program (SMP)* has been developed specifically for the current EP Area in consultation with the Independent Expert Panel (IEP), which systematically integrates information from underground, surface and aerial monitoring. This includes (but is not limited to) survey and routine inspection of underground workings to insure pillars are formed as designed, detailed aerial high resolution 3D photogrammetry (50mm x 50mm pixel size), high definition LIDAR (4 returns/m²), targeted surface inspections of publicly accessible trails during undermining, and targeted trigger-based investigation if where required as per above TARP. Refer to the Subsidence Monitoring Program document for further details.

² Detailed mine design parameters and associated subsidence predictions are provided within the Cliff Line Zone of First Workings Extraction Plan (2017) and supporting Subsidence Monitoring Program (Section 5), and the Airly Mine Extension Project EIS (2014).

³ Updated subsidence predictions for the Cliff Line Zone of First Workings Extraction Plan include worst case long term estimates of <53mm which is lower than EIS maximum predictions (65mm) and the assessment includes post mining flooding of workings and potential additional future loadings from adjacent mining zones (secondary extraction areas). Potential for flooding in some parts of the EP Area is not expected until future secondary extraction in adjacent areas is undertaken. Predictions for non-flooded (short term scenario) for first workings are for <30mm and typically below 20mm (below measurable limits) as assessed by Golder Associates (2017).

⁴ PSE – Principal Subsidence Engineer (Mine Safety), NSW Department of Planning and Environment - Division of Central Coast Coordination and Resource Regulation.

⁵ “**Negligible**” impact is defined by development consent SSD_5581 as “*Small and unimportant, such as to be not worth considering*”.

⁶ By law pillar sizes must conform to minimum requirements set by Schedule 3 (High Risk Activities), Part 3 of Clause 15 (Formation of Non-Conforming Pillars) of the WHS (Mines and Petroleum Sites) Regulations 2014

⁷ A Factor of Safety of 2.11 correlates to a panel failure probability of one in a million (Golder Associates, 2017)

⁸ CLZ = Cliff Line Zone of First Workings

Appendix 2:

Other Relevant Regulatory Requirements

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A2.1 Additional Requirements of Development Consent Conditions, EIS and Statement of Commitments

In addition to the key specific conditions of Development Consent SSD_5581 for the preparation of Extraction Plans and supporting sub-plans (identified in Section 4 of the SMP, PSMP and LMP), **Tables A2.2.1** and **A2.2.2** below describe 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 Panel Review Report.

Table A2.1.1: Other Relevant Conditions of Development Consent SSD_5581

Condition	Requirement	Section Addressed
Schedule 2, Condition 1 (<i>Obligation to minimise harm to the environment</i>)	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 and all supporting sub-plans.
Schedule 2, Condition 2	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.	App2 Tables A2.1.1, A2.1.2 (see below), Extraction Plan, all supporting sub-plans
Schedule 3, Condition 1 (<i>Restrictions on Mining</i>)	The Applicant must not: b) carry out any second workings <i.e. first workings only> within an angle of draw of 26.5 degrees plus 50 metres from the New Hartley Shale Mine Potential Interaction Zone.	Section 3 (Scope) Section 5 (Mine Design)
Schedule 4, Condition 11 (<i>Environmental Performance Conditions – General</i>)	The applicant must ensure that it has sufficient water for all stages of the development, <u>and if necessary, adjust the scale of operations to match its available water supply.</u> <i>Note: Under the Water Act 1912 and the Water Management Act 2000, the Applicant is required to obtain the necessary water licences for the development.</i>	Site Water Management Plan
Schedule 6, Condition 3 (<i>Revision of Strategies, Plans or Programs</i>)	Within 3 months of: a) The submission of an incident report under Condition 10 (Sch6); b) The submission of an annual review under Condition 12 (Sch6) c) The submission of an audit report under Condition 13 (sch6); or d) Any modification to the conditions of this consent (unless the conditions require otherwise) ...the Applicant must review the strategies, plans or programs required under this consent, to the satisfaction of the secretary. Where this leads to revisions in any such document, then within 4 weeks of the review the revised document must be submitted for the approval of the Secretary. Note: this is to ensure that strategies, plans and programs are regularly updated to incorporate any measures recommended to improve the environmental performance of the development	Section 15 (Review)

Schedule 6, Condition 4 (Updating and Staging of Strategies, Plans or Programs)	<p>...With the agreement of the Secretary, the Applicant may also submit any strategy, plan or program required by this consent on a staged basis....</p> <p><i>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.</i></p>	Section 3 (Scope)
Schedule 6, Condition 5 (Consolidation of Strategies, Plans or Programs)	<p>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.</p> <p><i>(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).</i></p>	Extraction Plan, all supporting sub-plans
Schedule 6, Condition 7 (Adaptive Management)	<p>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.</p> <p>...Where any exceedance of these criteria and/or performance measures has occurred, the Applicant must, at the earliest opportunity:</p> <ol style="list-style-type: none"> 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. 	<p><u>SMP</u>: Sections 6-17</p> <p><u>PSMP/LMP</u>: Sections 8—15, App3 (RA)</p> <p>Master TARP</p>
Schedule 6, Condition 10 (Incident Reporting)	<p>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></p>	SMP Section 16 LMP/PSMP Section 14 (Reporting and Notifications)
Schedule 6, Condition 10 (Regular Reporting)	<p>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.</p>	SMP Section 16 LMP/PSMP Section 14 (Reporting and Notifications)
Schedule 6, Condition 14 (Access to Information)	<p>The applicant must:</p> <ol style="list-style-type: none"> Make the following information publicly available on its website: <ul style="list-style-type: none">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 basisThe last five (5) Annual ReviewsAny report and/or advice issued by the IEP to the Applicant in respect of a draft or approved Extraction Plan. 	SMP Section 16 LMP/PSMP Section 14 (Reporting and Notifications)

Table A2.1.2: Relevant Requirements of the EIS, Statements of Commitment, and Supporting Documents

Relevant Section	Requirement / Commitment Details	Section Addressed
Statement Of Commitments (Revised SOC Section 6 of the RTS (2015) as added to EIS Chapter 11 (Sep, 2014))		
Subsidence	<ul style="list-style-type: none"> All subsidence impacts to surface sensitive features are minimised 	Section 2, 5, 6, 7 LMP/PSMP/SMP (no predicted surface impacts for 1 st workings)
	<ul style="list-style-type: none"> 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. 	Sections 5, 3 LMP/PSMP/SMP Pillar Stability Report
	<ul style="list-style-type: none"> A new extraction plan.....will provide detail around the management of subsidence impacts on the natural and built environment. 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. 	Sections 6-11 of LMP/PSMP, Sections 6-12 of SMP, Extraction Plan (main doc)
	<ul style="list-style-type: none"> The new <Extraction> plan will incorporate requirements for mine design criteria, implementation, monitoring, management of mining systems and response plans to manage impacts to landscape, surface water, groundwater, and ecology impacts identified in Chapter 8 and Sections 10.1-10.3 of the EIS. The plan will be developed in consultation with DTIRIS (DRE) and OEH (land owner). <p>The Plan will include subsidence management elements as follows.</p> <ul style="list-style-type: none"> Visual inspection of all mining areas prior, during and after mining activities will be undertaken. Subsidence monitoring of initial panel and pillar mining on Mount Airly to confirm mining system performance and establish correlation between surface subsidence and underground geotechnical monitoring. Ongoing underground geotechnical monitoring to demonstrate mining system performance will be undertaken. Implement where practical remote subsidence monitoring techniques 	Extraction Plan and supporting sub-plans including SMP, LMP, BMP, HHMP, WMP, PSMP
<i>Note: Statement of Commitments above included revised SOC presented in the RTS. Changes in red text.</i>		
Environmental Impact Statement – Airly Mine Extension Project (Sep 2014)		
Section 8.3.7.1 Proposed Mining Methods -Cliff Line Zone and Zone of First Workings	<p>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:</p> <ul style="list-style-type: none"> 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 5 of SMP, LMP, PSMP
Executive Summary Summary of Environmental Impacts	<p>Hazards Management</p> <p>No increased environmental or safety risk from hazardous materials, spontaneous combustion, bushfire or public safety will occur due to the Project.</p>	PSMP Sections 5, 6, 7.

Relevant Section	Requirement / Commitment Details	Section Addressed
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.	PSMP Section 7
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.	PSMP document
Centennial Response to the IRP report (8 July 2016)		
IRP Recommendation 1	<p><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></p> <p><u>Centennial Response Commitment:</u></p> <p>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.</p> <p>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.</p>	<p>Not Applicable for First Workings</p> <p>(Future Extraction Plans for second workings)</p>
IRP Recommendation 2 -	<p><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></p> <p><u>Centennial Response Commitment:</u></p> <p>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</p>	<p>Primarily associated with Future Extraction Plans for second workings with respect to valley closure and far field effects aspects on pinch points (e.g. deeply incised gorges).</p> <p>1st workings all long term stable</p> <p>Pillar Stability Assessment (Golder Associates 2017)</p>

Relevant Section	Requirement / Commitment Details	Section Addressed
IRP Recommendation 3	<p><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-quartering is proposed does not lead to loading conditions significantly higher than the tributary area loading used in the various assessments.</i></p> <p><u>Centennial Response Commitment:</u></p> <p>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-quartering is proposed.</p>	<p>Not Applicable for current EP 1st Workings</p> <p>Future Extraction Plans for second workings.</p>
IRP Recommendation 5	<p><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></p> <p><u>Centennial Response Commitments:</u></p> <p>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.</p>	<p>Not Applicable for current EP 1st Workings</p> <p>(relates to Future Extraction Plans for second workings, particularly Panel and Pillar mining).</p>
Centennial Response Additional Recommendations within the IRP Report (16 July 2016)		
IRP Additional Recommendation 1	<p><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></p> <p><u>Centennial Response Commitment:</u></p> <p>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.</p>	<p>Not Applicable for current EP 1st Workings</p> <p>(relates to Future Extraction Plans for second workings, particularly Panel and Pillar mining).</p>
IRP Additional Recommendation 2	<p><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></p> <p><u>Centennial Response Commitment:</u></p> <p>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 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</p>	<p>Not Applicable for current EP 1st Workings</p> <p>(relates to Future Extraction Plans for second workings, particularly Panel and Pillar mining).</p>

Relevant Section	Requirement / Commitment Details	Section Addressed
	<p>between surface movements and underground pillar stresses as well as proving the effectiveness of remote monitoring techniques.</p> <p>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.</p>	
IRP Additional Recommendation 3	<p><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></p> <p><u>Centennial Response Commitments:</u></p> <p>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.</p>	<p>Not applicable for first workings for current EP Area (long term stable pillars with negligible ground movements as concurred by IEP)</p> <p>Future Extraction Plans for second workings will detail proposed approach.</p> <p>IEP consultation meeting presentation 31/5/2017</p> <p>Subsidence Monitoring Program</p>
IRP Additional Recommendation 4	<p><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></p> <p><u>Centennial Response Commitments:</u></p> <p>This can be accommodated in the mine plan and addressed through the post approval Extraction Plan.</p>	<p>Not applicable for first workings for current EP Area</p> <p>Applies to future EPs for secondary extraction</p> <p>Reflected in consent conditions of SSD_5581</p>
IRP Additional Recommendation 5	<p><i>A probabilistic study to quantify the risks of sink hole formation is recommended in relation to mining in the shallow zone.</i></p> <p><u>Centennial Response Commitments:</u></p> <p>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.</p>	<p>Not applicable for first workings in EP Area (no shallow workings <50m DoC)</p>

Relevant Section	Requirement / Commitment Details	Section Addressed
	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.	Applies to future EPs for secondary extraction (Shallow Zone)
IRP Additional Recommendation 6	<p><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></p> <p><u>Centennial Response Commitment:</u></p> <p>This can be accommodated in the mine plan and addressed through the post approval Extraction Plan.</p>	<p>Section 5.1 of SMP Sections 3,5 of LMP/PSMP</p> <p>Figures 5A-D of LMP.</p> <p>A0 Graphical Plans (of the Extraction Plan)</p>
Additional Note	<p>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:</p> <ul style="list-style-type: none"> 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; <p>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).</p>	<p>Not applicable for first workings in EP Area (Applies to future EPs for secondary extraction)</p>
Centennial Response to the PAC Review Report (December 2015)		
Recommendation 5	<ul style="list-style-type: none"> All information relevant to the Independent Expert Panel's advice and recommendations is made publicly available on the Applicant's website 	Sections 14/16 (Reporting). EP Main Document

A2.2 WHS (Mines and Petroleum) Legislation

Table 2.2.1 below summarises key requirements of relevant Regulations under Work Health and Safety legislation application to mines and where these are addressed in the **Public Safety Management Plan** (PSMP) which forms the Principal Hazard Management Plan for subsidence in relation to WHS requirements for the EP Area. It is noted that related *Guidelines for Subsidence Risk Management (WHS Legislation)* (February 2017) are addressed separately below in Section A2.6.

Table 2.2.1: Summary of Additional WHS Regulations Relating to Mine Subsidence

WHS Legislation Clause	Requirement	Where Addressed in PSMP
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.	Sections 7 and 8, Appendix 3 - Risk Assessments, Extraction Plan
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.	Sections 5 and 8, 9.
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.	Sections 5 and 9
WHS Regulation 2011 Clause 37	Maintenance of control measures 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.	Sections 9, 10, 11
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:	Sections 8, 10, 11, 15 Appendix 1 Appendix 3 -Risk Assessments

WHS Legislation Clause	Requirement	Where Addressed in PSMP
	(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.	
WHS Regulation (Mines and Petroleum Sites) 2014 Clause 9	Management of risks to health and safety (cl 617 model WHS Regs) (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 (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): (a) if kept by a mine operator—forms part of the safety management system of the mine and the records of the mine, or (b) if kept by a contractor who has prepared a contractor health and safety management plan—forms part of the plan.	Sections 8 and Appendix 3
WHS Regulation (Mines and Petroleum Sites) Clause 10	Review of control measures (cl 618 model WHS Regs) (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 3, (c) an incident referred to in clause 128 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.	Sections 8, 10, 11,12, 15 and Appendix 1 Appendix 3 -Risk Assessments

WHS Legislation Clause	Requirement	Where Addressed in PSMP
	<p>(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.</p> <p>(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.</p>	
<p>WHS Regulation (Mines and Petroleum Sites) Clause 23</p> <p>Identification of principal mining hazard management plan</p>	<p>(1) The mine operator of a mine must identify all principal mining hazards associated with mining operations at the mine.</p> <p>(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.</p> <p>(3) The mine operator, in conducting a risk assessment under subclause (2), must:</p> <p>(a) use investigation and analysis methods that are appropriate to the principal mining hazard being considered, and</p> <p>(b) consider the principal mining hazard individually and also cumulatively with other hazards at the mine.</p>	<p>Section 8 Appendix 3</p> <p>Centennial Risk Management System – consistent with AS/NZS ISO 31000:2009</p> <p>Pillar Stability Assessment (Golder 2017) (including additional loadings from future workings in adjacent mining zones and potential for flooded workings post mining)</p> <p>Independent Expert Panel (IEP) Review</p> <p>Land Management Plan (EP-LMP)</p>
<p>WHS Regulation (Mines and Petroleum Sites) Clause 24</p> <p>Preparation of principal mining hazard management plan</p>	<p>(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.</p> <p>(2) A principal mining hazard management plan must:</p> <p>(a) provide for the management of all aspects of risk control in relation to the principal mining hazard, and</p> <p>(b) so far as is reasonably practicable, be set out and expressed in a way that is readily understandable by persons who use it.</p> <p>(3) A principal mining hazard management plan must:</p> <p>(a) describe the nature of the principal mining hazard to which the plan relates, and</p> <p>(b) describe how the principal mining hazard relates to other hazards associated with mining operations at the mine, and</p> <p>(c) describe the analysis methods used in identifying the principal mining hazard to which the plan relates, and</p> <p>(d) include a record of the most recent risk assessment conducted in relation to the principal mining hazard, and</p> <p>(e) describe the investigation and analysis methods used in determining the control measures to be implemented, and</p> <p>(f) describe all control measures to be implemented to manage risks to health and safety associated with the principal mining hazard, and</p> <p>(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</p>	<p>Extraction Plan and this Public Safety Management Plan</p>

WHS Legislation Clause	Requirement	Where Addressed in PSMP
	<p>(h) refer to any design principles, engineering standards and technical standards relied on for control measures for the principal mining hazard, and</p> <p>(i) set out the reasons for adopting or rejecting each control measure considered.</p> <p>(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:</p> <p>(a) the matters set out in Schedule 1 in respect of the principal mining hazard, and</p> <p>(b) any other matter relevant to managing the risks associated with the principal mining hazard at the mine.</p>	
<p>WHS Regulation (Mines and Petroleum Sites) Clause 67</p> <p>Subsidence</p>	<p>(1) In complying with clause 9, the mine operator of an underground coal mine must manage risks to health and safety associated with subsidence at the mine.</p> <p>(2) Without limiting subclause (1), the mine operator must ensure that:</p> <p>(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</p> <p>(b) monitoring of subsidence is conducted, including monitoring of its effects on relevant surface and subsurface features, and</p> <p>(c) any investigation of subsidence and any interpretation of subsidence information is carried out only by a competent person, and</p> <p>(d) all subsidence monitoring data is provided to the regulator in the form and at the times required by the regulator, and</p> <p>(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</p>	<p>This Public Safety Management Plan (including sections 5, 9, 10, 11, 15 and App 1)</p> <p>Subsidence Monitoring Program (EP-SMP)</p>
<p>WHS Regulation (Mines and Petroleum Sites) Clause 128</p> <p>Duty to notify regulator of certain incidents</p>	<p>(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:</p> <p>(a) results in illness or injury that requires medical treatment within the meaning of clause 13 of Schedule 9, or</p> <p>(b) is a high potential incident.</p> <p>(5) In this clause: <i>high potential incident</i> means any of the following:</p> <p>(m) 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</p> <p>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.</p>	<p>Section 14, Appendix 1 TARPs</p> <p>Airly Mine SMS</p>
<p>WHS Regulation (Mines and Petroleum Sites) Schedule 1</p> <p>Subsidence</p> <p>Clause 3C</p>	<p>Subsidence</p> <p>The following matters must be considered in developing the control measures to manage the risks of subsidence:</p> <p>(a) the characteristics of all relevant surface and subsurface features,</p> <p>(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,</p> <p>(c) the characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings,</p> <p>(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,</p> <p>(e) the predicted and actual nature, magnitude, distribution, timing and duration of subsidence,</p>	<p>Extraction Plan</p> <p>This PSMP Appendix 1</p> <p>Supported by Golder (2014b) MSEC (2015) IRP (2016) Golder (2017)</p>

WHS Legislation Clause	Requirement	Where Addressed in PSMP
Principal hazard management plans – additional matters to be considered	(f) the rate, method, layout, schedule and sequence of mining operations.	
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.	Extraction Plan This PSMP, Sections 7, 5 Appendix 1 Supported by Golder (2014b) MSEC (2015) IRP (2016) Golder (2017)
WHS Regulation (Mines and Petroleum Sites) Schedule 3 Clause 16 High Risk Activities	Secondary extraction or pillar extraction, splitting or reduction (1) 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, (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.	Not Applicable (This plan is for first workings only). Relevant for future Secondary Extraction Plans
WHS Regulation (Mines) 2014 Schedule 3 Clause 17 High Risk Activities	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 Applicable to current EP Area (DOC>50m for all first workings within CLZ EP Area within ML1331) Sections 4.2.2, 5, 8 and Appendix3

A2.3 Mining Leases

Approved mining authorities granted under the NSW mining Act 1992 held for Airly Mine include Mining Lease ML1331 and Authorisation A232. First workings under the current extraction plan will occur wholly within Mining Lease ML1331. A232 (which covers a significant portion of Genowlan Mountain) is not applicable to the current extraction plan, in accordance with the staged development of the mine.

ML1331 was renewed in May 2014. Following granting of the current Development Consent SSD_5581 in December 2016, an application to address consistency aspects to SSD_5581 will be undertaken.

A2.4 Environmental Protection Licence

Airly Mine operates under Environment Protection Licence (EPL) 12374 (as varied 2014) 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 management plan are listed in **Table A2.4.1**.

Table A2.4.1: Conditions of EPL12374 relevant to this management plan

EPL 12374 Requirements	Section Addressed
<p>R2 Notification of Environmental Harm</p> <p><i>General Note</i> - 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.</p> <p><i>R2.1</i> - Notifications must be made by telephoning the Environment Line service on 131 555</p> <p><i>R2.2</i> - The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.</p>	<p>SMP Section 16</p> <p>PSMP/LMP Section 14</p> <p>(Reporting and Notifications)</p>

A2.5 Extraction Plan Guidelines

The Extraction Plan Guidelines (Version 5) (NSW Department of Planning & Environment, 2015) identifies typical requirements for the Extraction Plan and supporting management plans. The requirements from the Guideline are presented in **Table A2.5.1** below.

Table A2.5.1: Extraction Plan Guideline Requirements

Extraction Plan Guideline Content Requirements for All Sub-Plans	Section Addressed
An overview of all landscape features, heritage sites, environmental values, built features or other values to be managed under the component plan	Section 7 of LMP/PSMP, Section 8 of SMP
Setting out all performance measures included in the development consent relevant to the features or values to be managed under the component plan	Section 6 of LMP/PSMP, Section 5 of SMP
Setting out clear objectives to ensure the delivery of the performance measures and all other relevant statutory requirements (including relevant safety legislation)	Sections 2, 3 and 6 of LMP, PSMP Sections 2,3 and 5 of SMP
Proposing performance indicators to establish compliance with these performance measures and statutory requirements;	Sections 6 and 12 of LMP/PSMP, Sections 5 and 14 of SMP, Master TARP (Appendix 1 to all above)
Describe the landscape features, heritage sites and environmental values to be managed under the component plan, and their significance. It should be noted that a full description of such features, sites and values would commonly have been provided and considered in a recent environmental impact assessment. Consequently, this section can be relatively brief, and focus on the presentation of appropriate figures and/or graphical plans;	MEP EIS (2014) Section 7 of LMP/PSMP, Section 8 of SMP
Describe all currently-predicted subsidence impacts and environmental consequences relevant to the features, sites and values to be managed under the component plan;	Section 7 of LMP/PSMP, Sections 8-12 of SMP
Describe all measures planned to remediate these impacts and/or consequences, including any measures proposed to ensure that impacts and/or consequences comply with performance measures and/or the Applicant's commitments;	Sections 5, 8, 9, 11 and 12 of LMP/PSMP Sections 5, 6-14 of SMP Master TARP
Describe the existing baseline monitoring network and the current baseline monitoring results, including pre-subsidence photographic surveys of key landscape features and key heritage sites which may be subject to significant subsidence impacts (such as significant watercourses, swamps and Aboriginal heritage sites);	Section 10 LMP/PSMP, Section 8 of SMP
Fully describing the proposed monitoring of subsidence impacts and environmental consequences;	Section 7-12 of SMP, Section 10 LMP/PSMP
Describe the proposed monitoring of the success of remediation measures following implementation;	Section 10-12 LMP/PSMP, Section 6-14 SMP Master TARP (Appendix 1 to all above)
Describe adaptive management proposed to avoid repetition of unpredicted subsidence impacts and/or environmental consequences;	Section 11 of LMP/PSMP, Section 13 of SMP
Describe contingency plans proposed to prevent, mitigate or remediate subsidence impacts and/or environmental consequences which substantially exceed predictions or which exceed performance measures;	Section 12 LMP/PSMP, Section 14 of SMP Master TARP (Appendix 1 to all above)

Extraction Plan Guideline Content Requirements for All Sub-Plans	Section Addressed
Listing responsibilities for implementation of the plan; and	Section 13 of LMP/PSMP, Section 15 SMP
An attached Trigger, Action, Response Plan (effectively a tabular summary of most of the above).	Master TARP (Appendix 1) and referenced TARPs of WMP and EP-BMP.

A2.6 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.

A2.6.1 EPBC Approval 2013/7076

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 Extraction Plan for the *Cliff Line Zone and Zone of First Workings* are listed in **Table A2.5** below, including conditions relating to bilateral agreement with NSW under Part 5 of the EPBC Act.

Table A2.6.1: EPBC Approval Requirements Relevant to the Extraction Plan and Supporting Plans

Condition	Requirement	Section Addressed
Compliance with Conditions of the NSW development consent (SSD_5581):		
Condition 1	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> :	-
	Schedule 2, Condition 1: General obligation to prevent environmental harm ¹ .	Extraction Plan and all supporting sub-plans
	Schedule 2, Condition 2: Requirement to undertake the action general in accordance with the EIS, mining schedule, independent expert panel advice, and the NSW Development Consent ¹ .	Refer Tables A2.1.1, A2.1.2 Sections 5,6 of PSMP, LMP, SMP
	Schedule 3, Condition 1: Restrictions on Mining in geologically sensitive areas ¹ .	Sections 5 and 3 of PSMP, LMP, SMP
	Schedule 3, Condition 2: Performance measures for the protection of identified commonwealth natural and heritage features ¹ .	Section 6 of LMP, PSMP Section 5 of SMP
	Schedule 3, Condition 7:	Extraction Plan and

	Preparation, approval and implementation of extraction plans, incorporating a range of relevant management sub-plans ¹ .	all supporting sub-plans
	<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 action⁴ , the person taking the action must advise the Department³ in writing of the actual date of commencement of the action.	Section 14 LMP/PSMP Section 16 SMP (Reporting and Notifications)
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 Departments ³ website. The results of audits may also be publicised through the general media.	Section 14 LMP/PSMP Section 16 SMP (Reporting and Notifications)
Condition 4	Within 3 (three) months of every twelve (12) month anniversary of the commencement of the action⁴ , 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 14 LMP/PSMP Section 16 SMP (Reporting and Notifications)
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 14 LMP/PSMP, Section 16 SMP (Reporting and Notifications) Section 15 LMP/PSMP, Section 17 SMP (Review)
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 Minister² .	Section 14 LMP/PSMP Section 16 SMP (Reporting and Notifications)

Notes: 1. Refer Table 2 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).

A2.5.2 Other Relevant Plans and Documents

Condition 2 of Schedule 6 of SSD_5581 requires all management plans required by consent to be prepared in accordance with any relevant guidelines. Specific guidelines relevant to the preparation of this management plan which have been referenced during its development include:

- **Mugii Murum-ban State Conservation Area draft Plan of Management (OEH/NPWS, 2015).** The draft POM has been considered during preparation of the Extraction Plan and supporting sub-plans including the LMP, PSMP and SMP. SCA management trail locations (mapping data) and naming conventions have been

used in the Extraction Plan. Planned access and locked gate locations shown in the EP and supporting sub-plans include those outlined in the POM.

- **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*.** This report has been considered in preparation of the Extraction Plan, supporting sub plans including revised subsidence predictions and monitoring considerations for the EP Area.

A2.5.3 Subsidence Risk Management Guidelines (WHS Legislation)

- **NSW Department of Industry –Resources Regulator (Mine Safety). *Managing Risks of Subsidence Guideline - WHS (Mines And Petroleum Sites) Legislation, February 2017.***

This recent 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 2014 (WHSMP Regulation)* as interpreted by the Department of Industry – Resources Regulator (Mine Safety) at the time of writing (February 2017).

The **Public Safety Management Plan (PSMP)** has been prepared in general accordance with the risk management principles outlined in the guideline as described in **Table A2.6.2** below.

Table A2.6.2: Requirements of the Guide to Managing Risks of Subsidence (WHS Mines and Petroleum Legislation), *NSW Department of Industry Resources Regulator (Mine Safety), 2017*

Referenced Section	Guideline Requirement	Where Addressed in PSMP
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: <ul style="list-style-type: none"> • 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 (SMS) – <i>refer separately to the PSMP / EP.</i>
	<ul style="list-style-type: none"> • 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. 	Public Safety Management Plan (PSMP) Section 8, Appendix 3
S1.3 Subsidence	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.	PSMP Sections 5-7, 11-12
s2.1 Managing Risks of Subsidence (Overview); and Scope of Subsidence Risk Management (s2.2)	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 relation to subsidence.	Section 8 App3 (EP Revised Subsidence Risk Assessment – land and public safety aspects)

Referenced Section	Guideline Requirement	Where Addressed in PSMP
s2.2 Scope of Subsidence Risk Management Mining Operations Where Risk Management Is Required (s2.2.1)	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.	N/A N/A N/A, DOC>50 N/A N/A – Negligible settlement predicted / weak floor conditions not expected (refer Pillar Stability Report – Golder Associates 2017)
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.	Not Applicable – Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding. No later secondary extraction in EP Area. (Refer s5 and s7 of PSMP) N/A State Conservation Area (see Section 7) N/A State Conservation Area, cliffs, pagodas and steep slopes. (refer Section 7.1)
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,	Not Applicable Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding. No later secondary extraction in EP Area. (Refer s5 and s7 of PSMP)

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	<p>(3) nature and magnitude of horizontal stress field,</p> <p>(4) geological structures, and</p> <p>(5) Complexities or anomalies in overburden geological or geotechnical conditions.</p> <p>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.</p>	<p>These features exist but no secondary extraction, no far field effect predicted (refer Section 7.2 and Pillar Stability Report, Golder Associates 2017)</p>
Period requiring risk management (s2.2.4)	<p>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.</p> <p>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.</p> <p>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:</p> <p>(1) overlying or underlying mine workings, in particular, old pillar workings,</p> <p>(2) topographic characteristics of the land,</p> <p>(3) nature and magnitude of horizontal stress field,</p> <p>(4) geological structures,</p> <p>(5) climate conditions,</p> <p>(6) water in the mine workings, and</p> <p>(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.</p> <p>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.</p>	<p>Not Applicable, no subsidence predicted. Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding. No later secondary extraction in EP Area. (Refer s5 and s7 of PSMP)</p>
s2.3 Identification and understanding of subsidence hazards	<p>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.</p> <p>To understand the identified subsidence hazards, the scope of investigation and analysis should include:</p> <p>(1) the nature of the hazards, including their magnitude, location, distribution, timing and duration,</p> <p>(2) the likelihood of the hazards affecting the health or safety of a person, and</p> <p>(3) the severity of the potential health and safety consequences.</p> <p>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</p>	<p>Section 7.2 (No predicted subsidence or surface impacts)</p> <p>Section 8</p>
Factors affecting subsidence hazards (s2.3.1)	<p>The following factors should be considered when identifying, investigating and analysing subsidence hazards:</p> <p>(1) the characteristics of all relevant surface and subsurface features as set out in section 2.2.2 above, including any known future developments (e.g. sub-divisions or other improvements) within the area where risk management is required,</p>	<p>Section 7, 8</p>

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	<p>(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,</p> <p>(3) the characteristics of any previously excavated or abandoned workings that may interact with any proposed or existing mine workings,</p> <p>(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),</p> <p>(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,</p> <p>(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</p> <p>(7) the predicted and actual nature, magnitude, location, distribution, timing and duration of subsidence.</p>	<p>Section 5</p> <p>Section 5, Pillar Stability Report (Golder Associates 2017)</p> <p>As above</p> <p>Pillar Stability Report (Golder Associates 2017) including consideration of potential long term flooding and additional pillar loading.</p> <p>.Not Applicable (LTS and effectively non-subsiding first workings)</p>
Uncertainty (s2.3.2)	<p>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.</p> <p>Generally, uncertainty occurs as a result of:</p> <p>(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,</p> <p>(2) the assumptions used during investigations, analysis or risk assessments, or</p> <p>(3) available information that:</p> <ul style="list-style-type: none"> (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. <p>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:</p> <ul style="list-style-type: none"> (1) multiple engineering or science disciplines, (2) multiple organisations or stakeholders, or (3) multiple phases of investigations with varying qualities. 	<p>Pillar Stability Assessment Report (Golder Associates 2017) including assessment of pillar failure probability.</p>

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	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 (2.3.3)	<p>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.</p> <p>Abnormal subsidence means the development of subsidence that is:</p> <ul style="list-style-type: none"> (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. <p>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.</p> <p>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.</p> <p>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.</p>	<p>Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding.</p> <p>No later secondary extraction in EP Area.</p> <p>Pillar Stability Assessment Report (Golder Associates 2017) including assessment of pillar failure probability and also considered factors that may increase movements such as potential weak floor conditions (based on drilling not expected, adequately competent floor).</p> <p><i>Refer sections for guideline conditions 2.3.3, 2.5 and 2.7 further below.</i></p>
	<p>Long Term or Delayed Subsidence (s2.3.3.1)</p> <p>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.</p> <p>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:</p> <ul style="list-style-type: none"> (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 example, interactions with the adjacent old workings or the presence of any spanning massive strata in the roof or overburden 	<p>As for 2.3.3 above.</p> <p>Section 5, and Pillar Stability Assessment Report (Golder Associates 2017)</p>

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	<p>Multi-seam mining involving old pillar workings (s2.3.3.2)</p> <p>In the context of managing the risks of subsidence, the old pillar workings refer to:</p> <ul style="list-style-type: none"> (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. <p>The interactions of the old pillar workings with any proposed or existing mine workings have a potential to cause:</p> <ul style="list-style-type: none"> (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. <p>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.</p>	<p>As for 2.3.3 above</p> <p>Section 5, and Pillar Stability Assessment Report (Golder Associates 2017)</p> <p>No significant first workings under the New Hartley Shale Mine Potential Interaction Zone within the EP Area (Cliff Line Zone of First Workings)</p>
	<p>Multi-seam mining involving previously extracted longwalls (S2.3.3.3)</p>	<p>Not Applicable</p> <p>No previous longwall mining in EP Area (or beyond)</p>
	<p>Massive Strata (s2.3.3.4)</p> <p>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:</p> <ul style="list-style-type: none"> (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. <p>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.</p>	<p>Not Applicable – Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding.</p> <p>No later secondary extraction in EP Area.</p> <p>Competent roof and floor, oversized pillars employed with conservative Factor of Safety (Refer s5 and s7)</p> <p>Pillar Stability Report (Golder Associates 2017) conservatively included additional potential future loading of pillars after future secondary extraction and potential flooded workings post mining.</p>
	<p>Creek crossings, valleys or gorges (s2.3.3.5)</p> <p>Underground coal mining beneath or in the vicinity of creek crossings, valleys or gorges, irrespective of their steepness, has a potential to cause:</p> <ul style="list-style-type: none"> (1) valley closure, and (2) upsidence of the valley floor. 	<p>Not Applicable for this current EP – Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding.</p>

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	<p>Valley closure and upsidence may develop outside the normal distribution limit of the vertical displacement.</p> <p>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.</p> <p>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.</p>	<p>No later secondary extraction in EP Area.</p> <p>(Refer s5 and s7 of PSMP, and Pillar Stability Report (Golder Associates 2017))</p>
	<p>Steep topography (s2.3.3.6)</p> <p>Underground coal mining in areas with steep topography has a potential to:</p> <ol style="list-style-type: none"> (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. <p>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.</p>	<p>Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding.</p> <p>No later secondary extraction in EP Area.</p> <p>(Refer s5, s7, s8 of PSMP), and Pillar Stability Report (Golder Associates 2017)</p>
	<p>Geological Features (2.3.3.7)</p> <p>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</p>	<p>Pillar Stability Report (Golder Associates 2017)</p>
	<p>Sinkhole Formations (2.3.3.8)</p> <p>Sinkholes, or potholes, are the most hazardous form of subsidence because:</p> <ol style="list-style-type: none"> (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. <p>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</p>	<p>No Shallow Workings, DOC >50m (minimum DOC ~80m in EP Area)</p> <p>Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding.</p> <p>No later secondary extraction in EP Area.</p>
	<p>Shear Strain (s2.3.3.9)</p> <p>Shear strain is one of the components of deformation. However, shear strain has not been recognised in the conventional subsidence engineering theories and the coal mining industry has not commonly considered it when managing risks of subsidence. Therefore, it has a potential to cause unplanned events.</p> <p>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</p>	<p>No dwellings or significant built features in EP Area.</p> <p>Permanent Long Term Stable pillars with negligible settlement and effectively non-subsiding,</p>

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	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	No later secondary extraction in EP Area.
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	Expert Pillar Stability Report (Golder Associates, 2017)
	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.	Section 8 (Risk Assessment facilitated by Senior Mining Engineer)
	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).	Refer also guideline s2.3.3 aspects. Sections 5, 7 and 8 Expert Pillar Stability Report (Golder Associates, 2017) Section 5,8 Sections 10,11,12, 15 SMP
S2.4 Assessment of risks of subsidence	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.	Section 8 , facilitated & reviewed by Senior Mining Engineer
	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.	Permanent Long Term Stable and Non-Subsiding First Workings, No Secondary Extraction. (Refer s5 and s7 of PSMP, and Pillar Stability Report (Golder 2017))
	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.	Section 1, 8

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	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.	Section 8
	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.	Section 8 Appendix 3 Section 8 Appendix 3
s2.5 Development & Selection of Risk Control Measures	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.	Section 5
	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.	Sections 5, 8 Appendix 3
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.	Methods A and B have both been employed for the EP Area (Refer Sections 5, 7, 8, 12) and Appendix 1
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.	Section 11, 12, 8 and Appendix 1

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	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.	
s2.6 Implementation and maintenance of risk control measures	<p>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:</p> <ol style="list-style-type: none"> (1) fit for purpose, and (2) suitable for the nature and duration of the work, and (3) installed, set up and used correctly. <p>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:</p> <ol style="list-style-type: none"> (1) ensure that the risk control measures are installed, set up and used correctly in terms of: <ol style="list-style-type: none"> (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: <ol style="list-style-type: none"> (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, (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. 	<p>This PSMP, including Section 5, 8-15, Appendices 1,3 (including Master TARP and subsidence risk assessment controls)</p>
Trigger Action Response Plan (TARP) (s2.6.2)	<p>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:</p> <ol style="list-style-type: none"> (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 	<p>Section 12, 11 Master TARP (Appendix 1)</p>

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	(3) it is feasible to implement the selected risk control measures in a timely manner to control the risks during the development of subsidence.	
s2.7 Continual Improvement & Change Management	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.	High level of certainty. (Long term stable and effectively non-subsiding pillar designs as concurred by IEP, permanent with no later 2 nd workings).
	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,	Section 10 Section 7, 5 Section 8, 15 Section 15, 11, 12 Section 10, 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, (c) implementing additional risk control measures or modifications to the existing risk control measures, as necessary, and (d) modifying the rate, method, layout, schedule and sequence of mining operations, as necessary,	Section 15, 10, 12, Appendix 1 Sections 5, 8 Section 8, Appendix 3 Section 12, 11, Appendix 1
	(3) regularly consult with stakeholders in relation to managing the risks of subsidence (refer to section 2.8 below),	Section 1, 15, 14
	(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	Section 10, 12, Appendix 1 (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	Section 12, 11, 8 Appendix 1 (Master TARP)
s2.8 Consultation, Co-operation and co-ordination	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 1, 15, 14
	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 1, Extraction Plan
	(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?	Section 15, 14, 1, 10, 8,

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	(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?	This PSMP, related SMP and LMP.
	(3) a mechanism to ensure effective communication between the mine operator and stakeholders, and	Section 14, 10
	(4) a process for obtaining stakeholder endorsement of the relevant risk management plans	This PSMP, Section 4.1, 1
s2.9 Monitoring and Review: 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>	Subsidence Monitoring Program (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:	SMP Section 10
	(1) ensuring that the mine operator has a current and correct understanding of the hazards of subsidence	SMP Section 6
	(2) ensuring that the risk control measures are maintained so that they remain effective,	SMP Section 6, 10.2
	(3) avoiding unplanned events.	SMP Sections 10, 13, 14
	(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,	SMP Sections 10, 6, 13, 14
	(5) identifying emerging new risks of subsidence, and	SMP Sections 10, 17
	(6) informing the continual improvement and change management.	SMP Section 17
Scope of Subsidence Monitoring (s2.9.1.2)	The scope of subsidence monitoring must include:	
	Monitoring of subsidence	SMP Section 10
	Monitoring of the effects of subsidence on relevant surface or subsurface features	SMP Section 10
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	SMP 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,	SMP Section 6, 10

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	(3) consider the results of stakeholder consultation	<i>SMP Section 1.1</i>
	(4) ensure that the monitoring activities are carried out by a competent person	<i>SMP Section 15, 16, 9-12</i>
	The subsidence monitoring program should specify:	
	(1) the individual monitoring activities of the subsidence monitoring program,	<i>SMP Sections 9-12</i>
	(2) the information to be captured from each of the individual monitoring activities	<i>SMP Sections 9-12</i>
	(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,	<i>SMP Sections 9-12</i>
	(4) the timing, frequency and duration of monitoring activities and reporting	<i>SMP Sections 9-12</i>
	(5) the monitoring methods, technologies, industry standards and codes of practice that apply when undertaking the monitoring activities	<i>SMP Sections 9-12</i>
	(6) the measures and procedures for quality assurance	<i>SMP Sections 9-12</i> <i>SMP Section 17</i>
	(7) the measures and procedures for detecting emerging new risks or early warnings of changes from the results of risk assessments	<i>SMP Sections 13,14,</i> <i>Master TARP</i>
	(8) the measures and procedures for recording and reporting monitoring results to the regulator and stakeholders	<i>SMP Section 16</i>
	(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	<i>SMP Section 13, Master TARP</i>
	(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)	<i>SMP Sections 5, 14, 17</i> <i>SMP Section 10.3</i> <i>Master TARP</i>
	(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	<i>SMP Section 10</i> <i>SMP Section 7</i>
	(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”).	Not Applicable <i>Not HRA within EP Area (see 6.2).</i> <i>Conventional subsidence lines not appropriate for first workings as concurred by the IEP (see SMP Sections 1, 10, Appendix 4)</i>
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	<i>SMP document (see 2.9.1.3 above)</i>
	(2) the collection of base-line subsidence data in accordance with the subsidence monitoring program	<i>SMP Section 8</i>
s2.9.2. Review (<i>Subsidence Monitoring</i>)	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 13,15, Subsidence Monitoring Program
	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	Section 15, Subsidence Monitoring Program

Referenced Section	Guideline Requirement	Where Addressed in PSMP
	<p>In undertaking the reviews, the stakeholders must, so far as is reasonably practicable, be consulted and the following questions should be addressed”</p> <ul style="list-style-type: none"> (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? 	<p>Section 15, Subsidence Monitoring Program</p>
PRINCIPAL HAZARD MANAGEMENT PLANS		
Principle Hazard Management Plan for subsidence (s3), s3.1 General)	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	Sections 2 and 3 of the guidelines have been considered as noted above.
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	As above.
Risk Assessment (s3.3)	<p>In satisfying Clause 23(2) of the WHSMP Regulation...The mine operator, in undertaking a risk assessment for a principal hazard of subsidence, must:</p> <ul style="list-style-type: none"> (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: <ul style="list-style-type: none"> (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). <p>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.</p>	<p>Section 8, 5, 1</p> <p>Section 8, 5, 1, expert pillar stability assessment report (Golder Associates 2017)</p> <p>No significant surface infrastructure or dwellings.</p> <p><i>Refer above for Section 2 of the guideline which has been considered.</i></p>

Referenced Section	Guideline Requirement	Where Addressed in PSMP
S3.4 Preparing a PHMP for subsidence	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.”	Public Safety Management Plan (PSMP) document, including Sections 8, 5 and Appendices 3 and 1.
	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	PSMP document, Section 8. See also matters earlier above (s2).
	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”.	PSMP document Section 13
	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, (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.	PSMP including supporting Appendices (including App1, App3)
	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.	First workings will not and cannot commence in the EP Area until approval of the Extraction Plan

Referenced Section	Guideline Requirement	Where Addressed in PSMP
		(and this PSMP supporting sub-plan) is granted by DP&E.
S3.5 Other matters relevant to managing risks associated with a principal hazard in relation to subsidence	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”.	Section 5
S3.5.1 Mining Operation as a risk control measure	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.	Section 5, Section 10, Section 12, Appendix 1. Subsidence Monitoring Program (Underground Mining Controls)
S3.5.2 Management Status reporting to assist with regular consultation	Appendix B of the guidelines provides an example. No requirement is specified.	N/A for first workings (no extraction, LTS non-subsiding). Notifications as per Section 14. Consultation as per Section 1 and 15.
S3.5.3 Other Examples of best industry practices relevant to PHMP	Appendix C of the guidelines provides an example for managing WHS aspects of dwellings and similar civil structures. No requirement is specified.	N/A to EP Area (no dwellings or significant surface infrastructure)
S3.6 Review, Audit & Maintenance (Of PHMPs):	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 15
S3.6.1 Review and Maintenance	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 15, 14
	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 15, Airly Mine SMS
	For further guidance notes in relation to maintenance and review, refer to sections 2.6 and 2.9 of this guideline	Refer for s2.6 and 2.9 earlier above
3.6.2 Audit	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 15, 14
	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 15, 6 Subsidence Monitoring Program

Referenced Section	Guideline Requirement	Where Addressed in PSMP
s4 High Risk Activity Notification in relation to subsidence	<p>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:</p> <p>(1) clause 16 - Secondary extraction or pillar extraction, splitting or reduction,</p> <p>(2) clause 17 - Shallow depth of cover mining, and</p> <p>(3) clause 28 - Highwall mining.</p> <p><i>Note: as not applicable further specific requirements of the guideline in relation to HRA's have not been included here.</i></p>	<p>Not Applicable</p> <p>(not an HRA. No shallow workings. DOC>~80m throughout EP Area)</p>
S5 Engineering Plans and Drawings	<p>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 high risk activity" for guidance notes on how to prepare and submit the engineering plans and drawings in relation to:</p> <p>(1) secondary extraction or pillar extraction, splitting or reduction,</p> <p>(2) shallow depth of cover mining, or</p> <p>(3) highwall mining.</p>	<p>Not Applicable (not HRA as above)</p> <p>All drawings as per DP&E EP Guidelines</p>
s6 Notification of Incident or Injury	<p><i>NOTE by Centennial Airly:</i> The following relates specifically to notification requirements in relation to subsidence where an injury has not occurred. Requirements where injuries are involved to any party within the Mining Lease are identified and managed in accordance with the Airly Mine SMS.</p> <p>For guidance notes on how to notify the regulator of subsidence-related incidents or injuries, refer to the NSW Department of Industry, WHS guide "Notification of incident and injury" Accordingly the following is provided:"</p> <p>Under Clause 128 of the WHSMP Regulations (Duty to Notify Regulator):</p> <p>(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:</p> <p>(a) results in illness or injury that requires medical treatment within the meaning of clause 13 of Schedule 9, or</p> <p>(b) is a high potential incident.</p> <p>(6) In this clause:.....high potential incident means any of the following:</p> <p>(n) any indication from monitoring data of the development of subsidence which may result in any incident referred to in clause:</p> <p>179 (a) (xvi)-a failure of ground, or of slope stability control measures, or</p> <p>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.</p>	<p>Section 14</p>
S7 Notification of Reportable Events	<p>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 "Notifying the regulator of reportable events factsheet".</p> <p>Accordingly notification requirements for high potential incidents are as per s6 of guideline immediately above.</p>	<p>Section 14</p>

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.

Extraction Plan and Subsidence Monitoring Program

Common Appendix 3: Figures

Natural Landscapes including Cliffs & Pagodas Locations

Existing Subsidence Monitoring Lines

Environmental Monitoring Locations

Historic Heritage Site Locations

Built Features

Land Ownership

Geological Structures

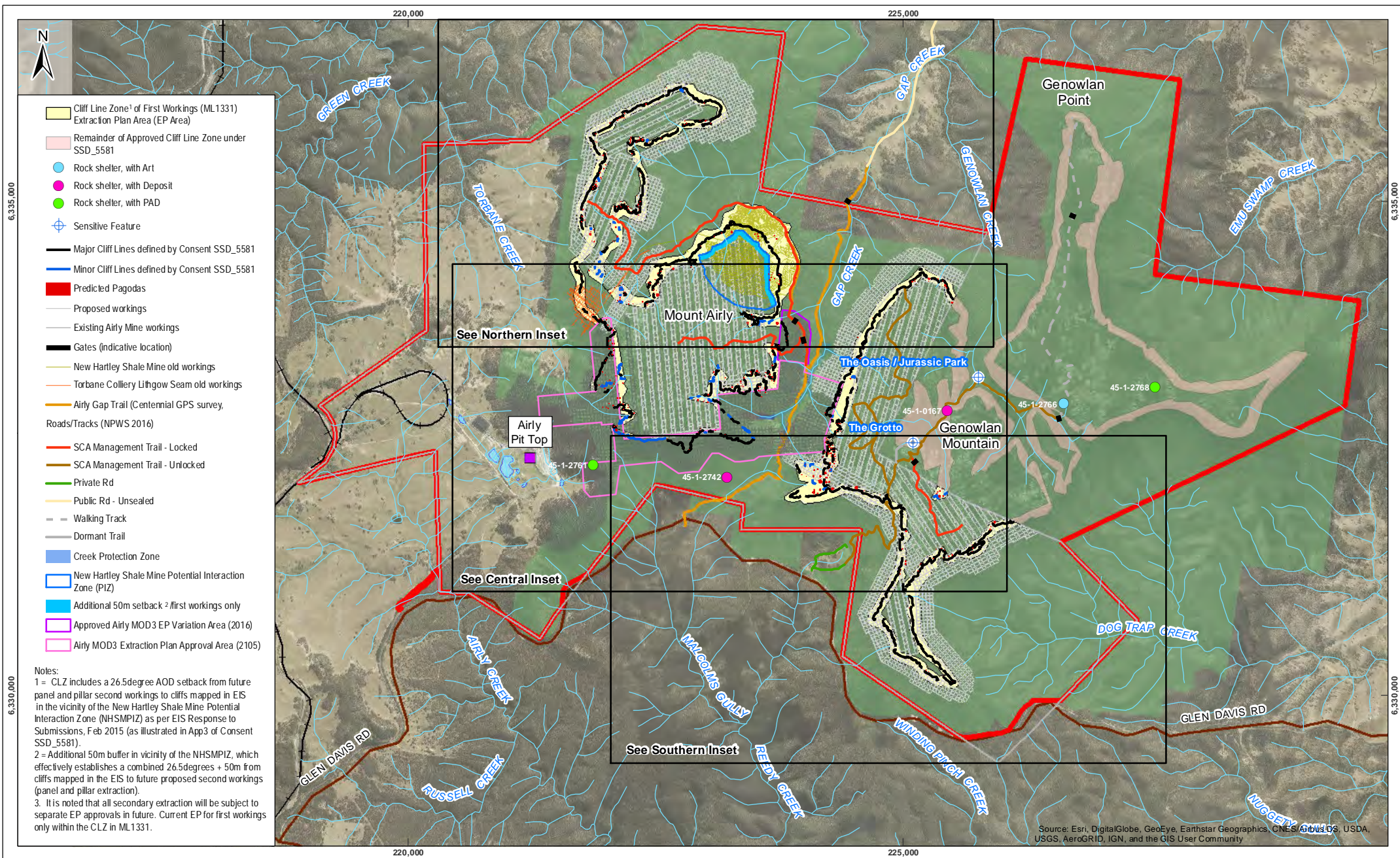
Mining Tenements

TABLE OF CONTENTS – Appendix 3

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A3.2 Existing Subsidence Lines	
A3.3 Environmental Monitoring – Surface and Groundwater Water Features	
A3.4 Environmental Monitoring - Biodiversity	
A3.5 Historic Heritage Site Locations	
A3.6 Built Features	
A3.7 Land Ownership	
A3.8 Geological Structures	
A3.9 Mining Tenements	

A3.1 Natural Landscapes including Cliffs & Pagodas

The following figures illustrate the location of natural landscape features including cliffs, minor cliffs and pagodas defined by consent as mapped by RPS (2017). Further detailed high resolution maps are available throughout the report by RPS which is available on request (very large document), and on A0 Graphical Plan 2 (Surface Features) within the Extraction Plan.



LEGEND	
	Mining Lease ML1331
	Development Consent Area SSD_5581 (Airly Mine Extension Project)
	Mugli Murum-ban State Conservation Area
	Dam
	Watercourse
	Rail
	Main Road

Coordinate System: GDA 1994 MGA Zone 56

Path: T:\spatial\project\2500\2529_Airly_MEP_EP\Map\report\2017\2529_Figure_Natural_Landscapes.mxd

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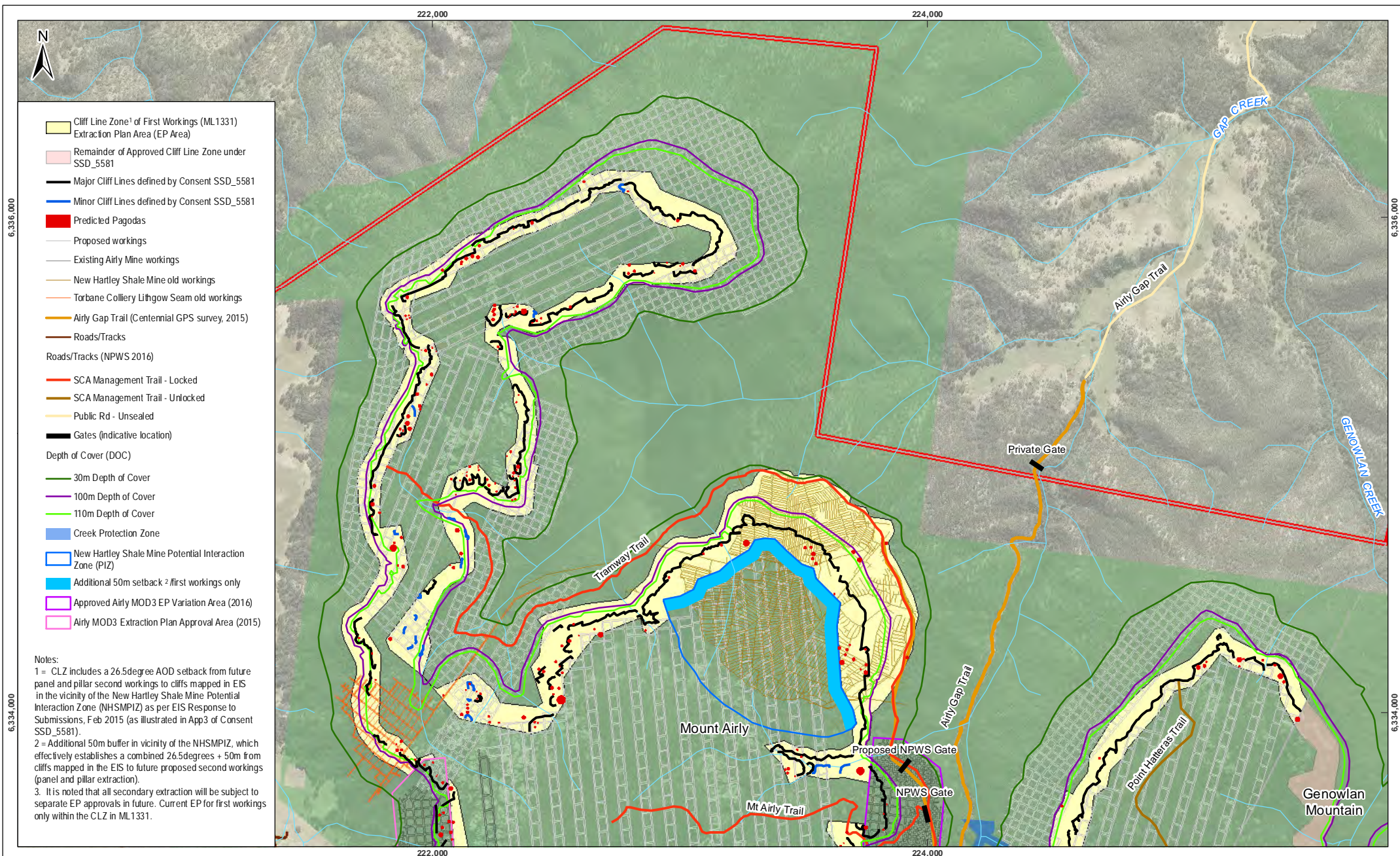
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REFERENCE	PREPARED BY:
SCALE	1:50,000





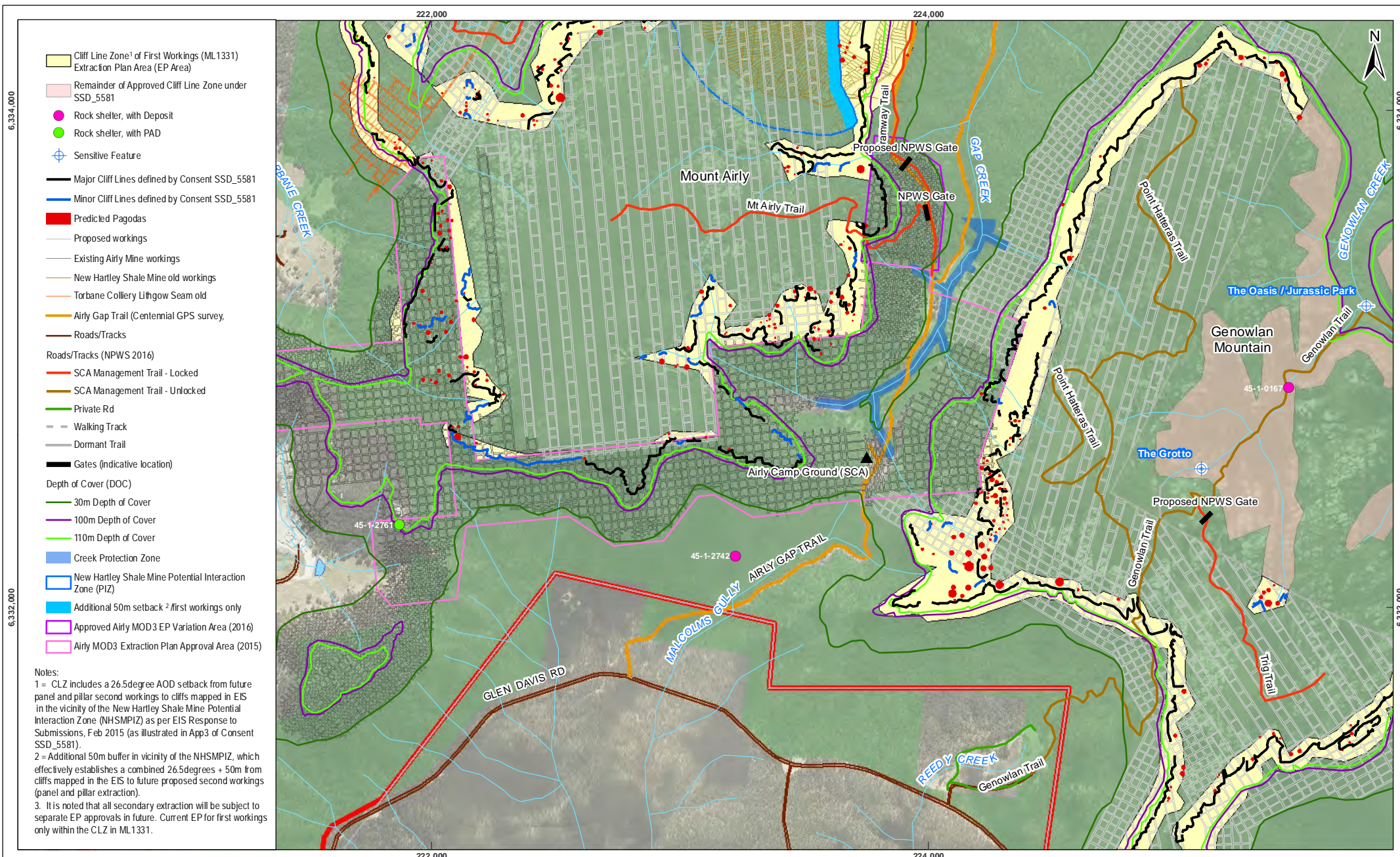
Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331):
Natural Landscapes and Land Management Features (Overview)

0 230 460 920 1,380 1,840 Metres

PLOTFILE No.	DRAFT
	Centennial Coal Airly
DRG No.	A4



<div>LEGEND</div> <div><div><div></div><div>Mining Lease ML1331</div></div><div><div></div><div>Development Consent Area SSD_5581 (Airly Mine Extension Project)</div></div><div><div></div><div>Mugli Murum-ban State Conservation Area</div></div><div><div></div><div>Watercourse</div></div></div> <div>Coordinate System : GDA 1994 MGA Zone 56</div>		<div>CENTENNIAL AIRLY PTY. LTD.</div> <div>THIS DRAWING IS COPYRIGHT</div> <div>NO PART OF IT IN ANY FORM</div> <div>OR BY ANY MEANS (ELECTRONIC,</div> <div>MECHANICAL, MICRO-COPYING,</div> <div>PHOTOCOPYING OR OTHERWISE)</div> <div>BE REPRODUCED, STORED IN A</div> <div>RETRIEVAL SYSTEM OR TRANSMITTED</div> <div>WITHOUT PRIOR WRITTEN PERMISSION</div>	<div>DATE</div> <div>27/07/2017</div> <div>SEAM</div> <div>LITHGOW</div> <div>REFERENCE</div> <div>PREPARED BY:</div> <div><div><div>niche</div><div>environmental design</div></div></div> <div>SCALE</div> <div>1:20,000</div>	<div></div>	<div>Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331):</div> <div>Natural Landscapes and Land Management Features (Northern Inset)</div> <div><div><div>0</div><div>90</div><div>180</div><div>360</div><div>540</div><div>720</div></div><div>Metres</div></div>	<div>PLOTFILE No.</div> <div>DRAFT</div> <div><div><div></div><div>Centennial Coal</div></div><div>Airly</div></div> <div>DRG No.</div> <div>A4</div>
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Notes:
1 = CLZ includes a 26.5degree AOD setback from future panel and pillar second workings to cliffs mapped in EIS in the vicinity of the New Hartley Shale Mine Potential Interaction Zone (NHSMPIZ) as per EIS Response to Submissions, Feb 2015 (as illustrated in App3 of Consent SSD_5581).
2 = Additional 50m buffer in vicinity of the NHSMPIZ, which effectively establishes a combined 26.5degrees + 50m from cliffs mapped in the EIS to future proposed second workings (panel and pillar extraction).
3. It is noted that all secondary extraction will be subject to separate EP approvals in future. Current EP for first workings only within the CLZ in ML1331.

LEGEND

Mining Lease ML1331

Development Consent Area SSD_5581 (Airly Mine Extension Project)


Mugli Murum-ban State Conservation Area

Dam

Watercourse

Coordinate System : GDA 1994 MGA Zone 56
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DATE	27/07/2017
SEAM	LITHGOW
REFERENCE	PREPARED BY: 
SCALE	1:20,000

**Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331):
Natural Landscapes and Land Management Features
(Central Inset)**

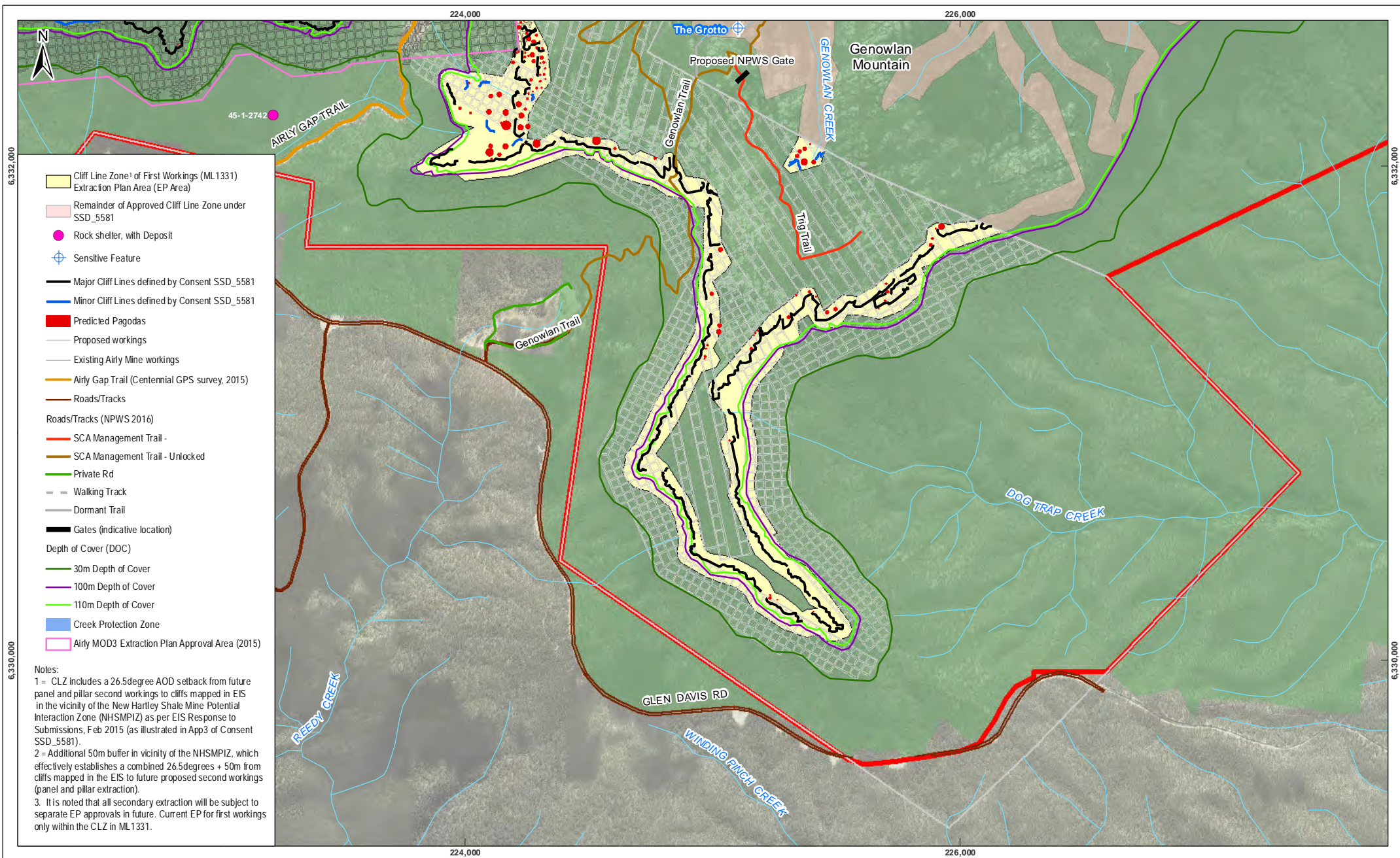
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 **Centennial Coal**
Airly

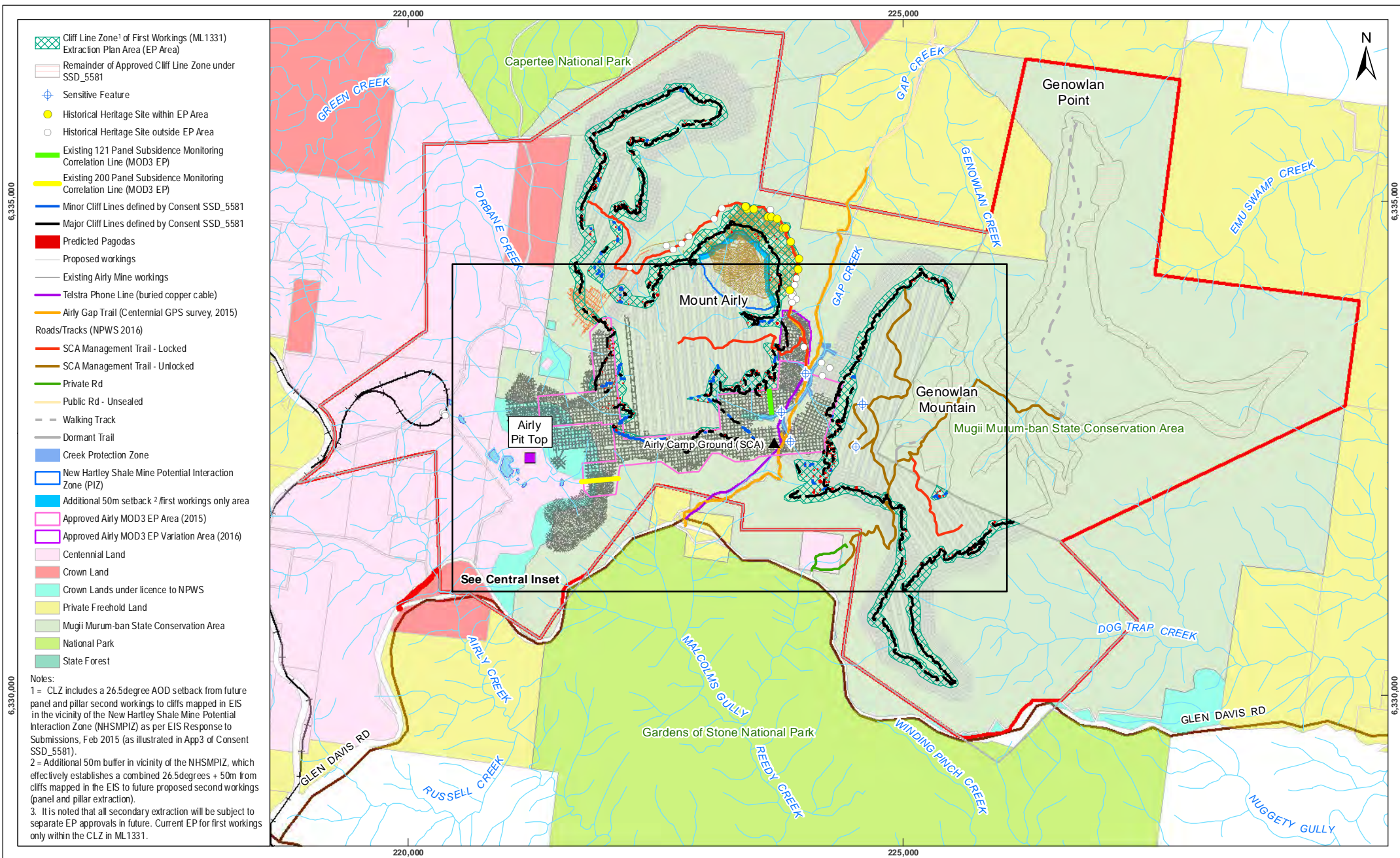
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<div>LEGEND</div> <div><div><div></div><div>Mining Lease ML1331</div></div><div><div></div><div>Development Consent Area SSD_5581 (Airly Mine Extension Project)</div></div><div><div></div><div>Mugli Murum-ban State Conservation Area</div></div><div><div></div><div>Watercourse</div></div></div> <div>Coordinate System : GDA 1994 MGA Zone 56</div>		<div>CENTENNIALAIRLY PTY. LTD. THIS DRAWING IS COPYRIGHT NO PART OF IT IN ANY FORM OR BY ANY MEANS (ELECTRONIC, MECHANICAL, MICRO-COPYING, PHOTOCOPYING OR OTHERWISE) BE REPRODUCED, STORED IN A RETRIEVAL SYSTEM OR TRANSMITTED WITHOUT PRIOR WRITTEN PERMISSION</div>	<div><div>DATE</div><div>27/07/2017</div></div> <div><div>SEAM</div><div>LITHGOW</div></div> <div><div>REFERENCE</div><div>PREPARED BY: <div>niche</div><div>environmental & heritage</div></div></div> <div><div>SCALE</div><div>1:20,000</div></div>	<div></div>	<div>Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331): Natural Landscapes and Land Management Features (Southern Inset)</div> <div><div><div>0</div><div>90</div><div>180</div><div>360</div><div>540</div><div>720</div></div><div>Metres</div></div>	<div><div>PLOTFILE No.</div><div>DRAFT</div></div> <div><div></div><div>Centennial Coal</div><div>Airly</div></div> <div><div>DRG No.</div><div>A4</div></div>
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A3.2 Existing Subsidence Lines

The following figures illustrate the location of the existing subsidence lines over 200 Panel and 121 Panel within the previously approved MOD3 Extraction Plan Area (as varied 2016).



LEGEND	
	Mining Lease ML1331
	Development Consent Area SSD_5581 (Airly Mine Extension Project)
	New Hartley Shale Mine old
	Torbanie Colliery Lithgow Seam old workings
	Dam
	Water course
	Rail
	Public Road (sealed)

Coordinate System: GDA 1994 MGA Zone 56

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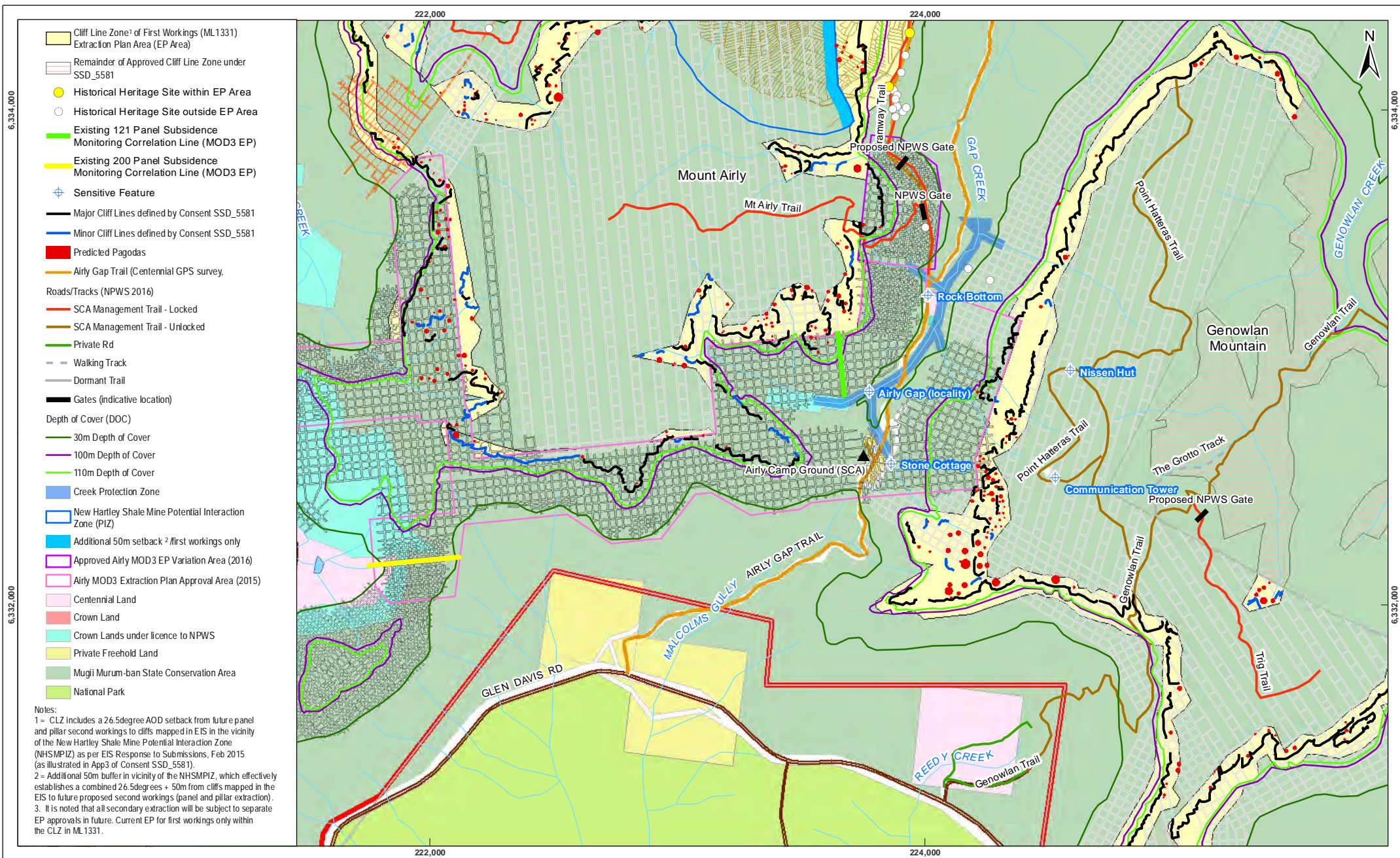
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REFERENCE	PREPARED BY:
SCALE	1:50,000



Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331): Existing Subsidence Monitoring (Overview)

0 230 460 920 1,380 1,840 Metres

PLOTFILE No.	DRAFT
	Centennial Coal Airly
DRG No.	A4



	Existing Airy Mine workings
	Proposed workings
	Dam
	Watercourse
	Roads/Tracks

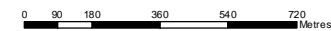
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DATE	27/07/2017
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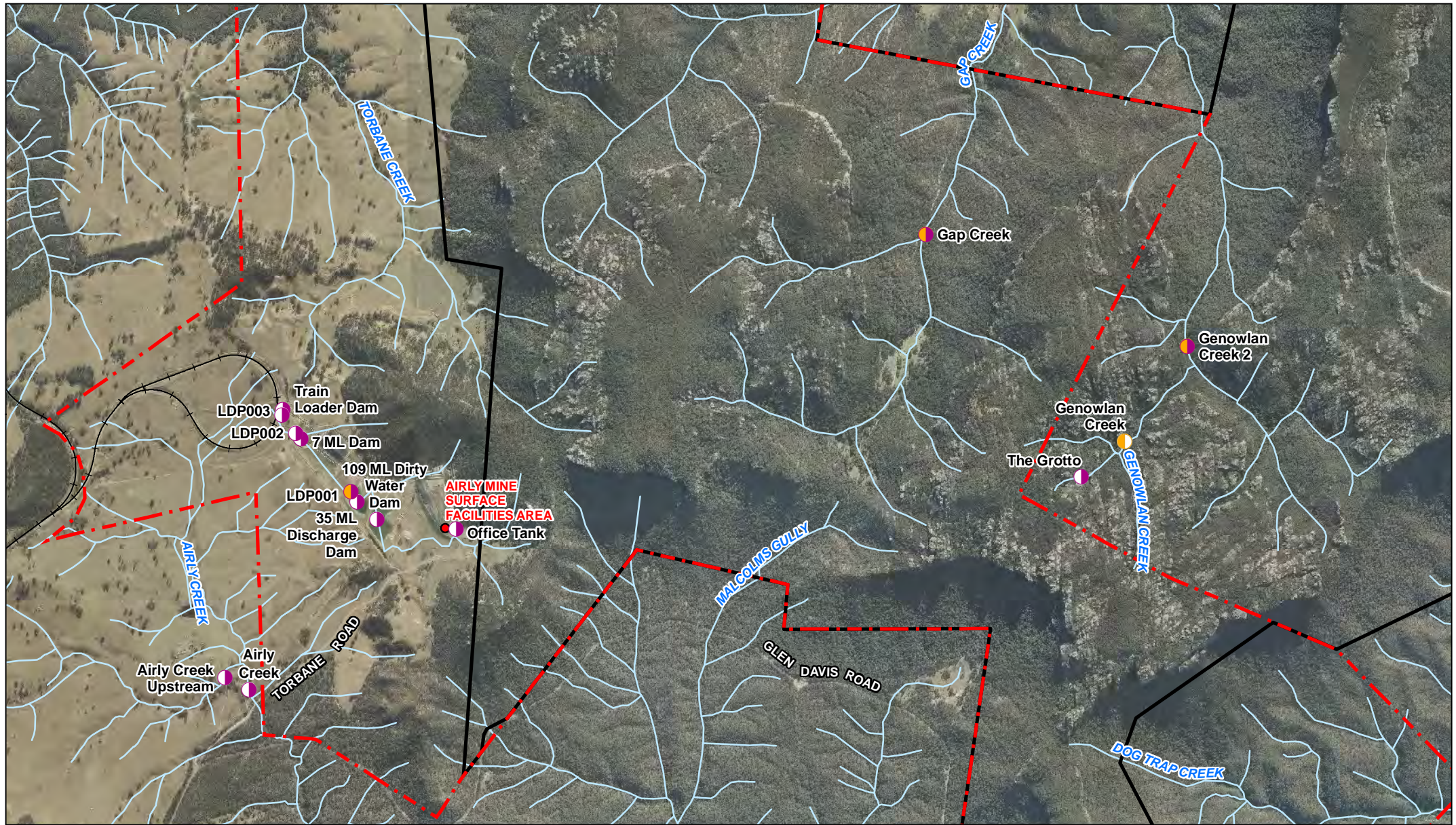
Airy MEP Cliff Line Zone of First
Workings Extraction Plan (ML1331):
Existing Subsidence Monitoring
(Central Inset)



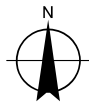
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A3.3 Environmental Monitoring – Surface and Groundwater Water Features

The following figures illustrate the location of surface and groundwater monitoring locations (including creek geomorphic stability monitoring) as detailed within the site Water Management Plan (GHD, July 2017). Refer the site WMP for details.



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

● Airly Surface Facilities Area

● Flow monitoring

● Flow and water quality monitoring

● Water quality monitoring

■ Mining Lease ML1331

■ Authorisation A232

— Waterway

— Railway



Centennial
Airly

Airly Mine
Water Management Plan

Surface water
monitoring locations

Job Number	22-18803
Revision	1
Date	09 Jun 2017

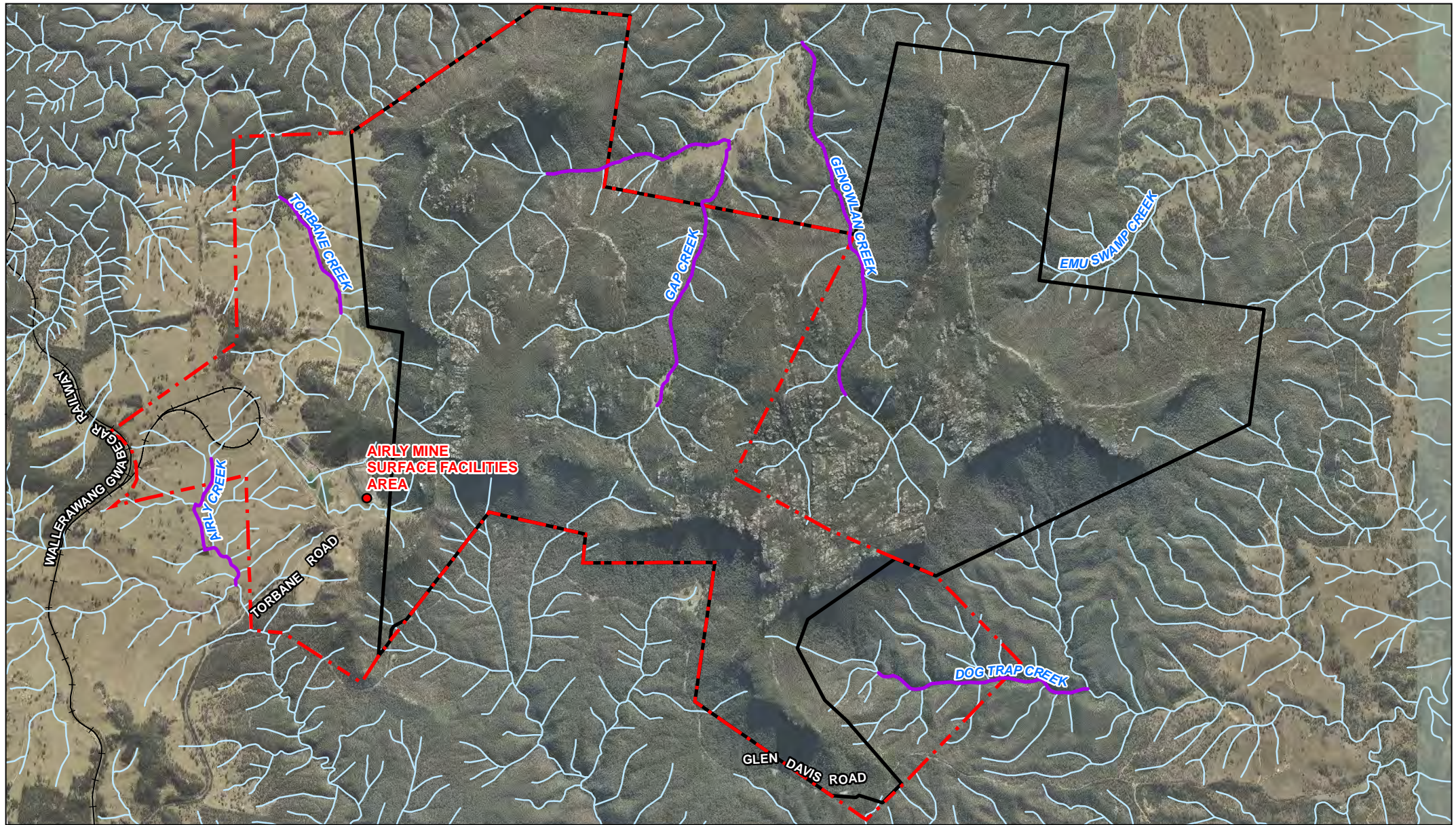
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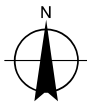
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Data source: LPI: DTDB 2012; Centennial: Aerial Imagery, boundaries, 2013, Monitoring Locations, 2017. Created by: fmacKay



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0 375 750 1,125 1,500
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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Airly Surface Facilities Area
- Mining Lease ML1331
- Authorisation A232
- Railway
- Waterway
- Watercourse stability monitoring



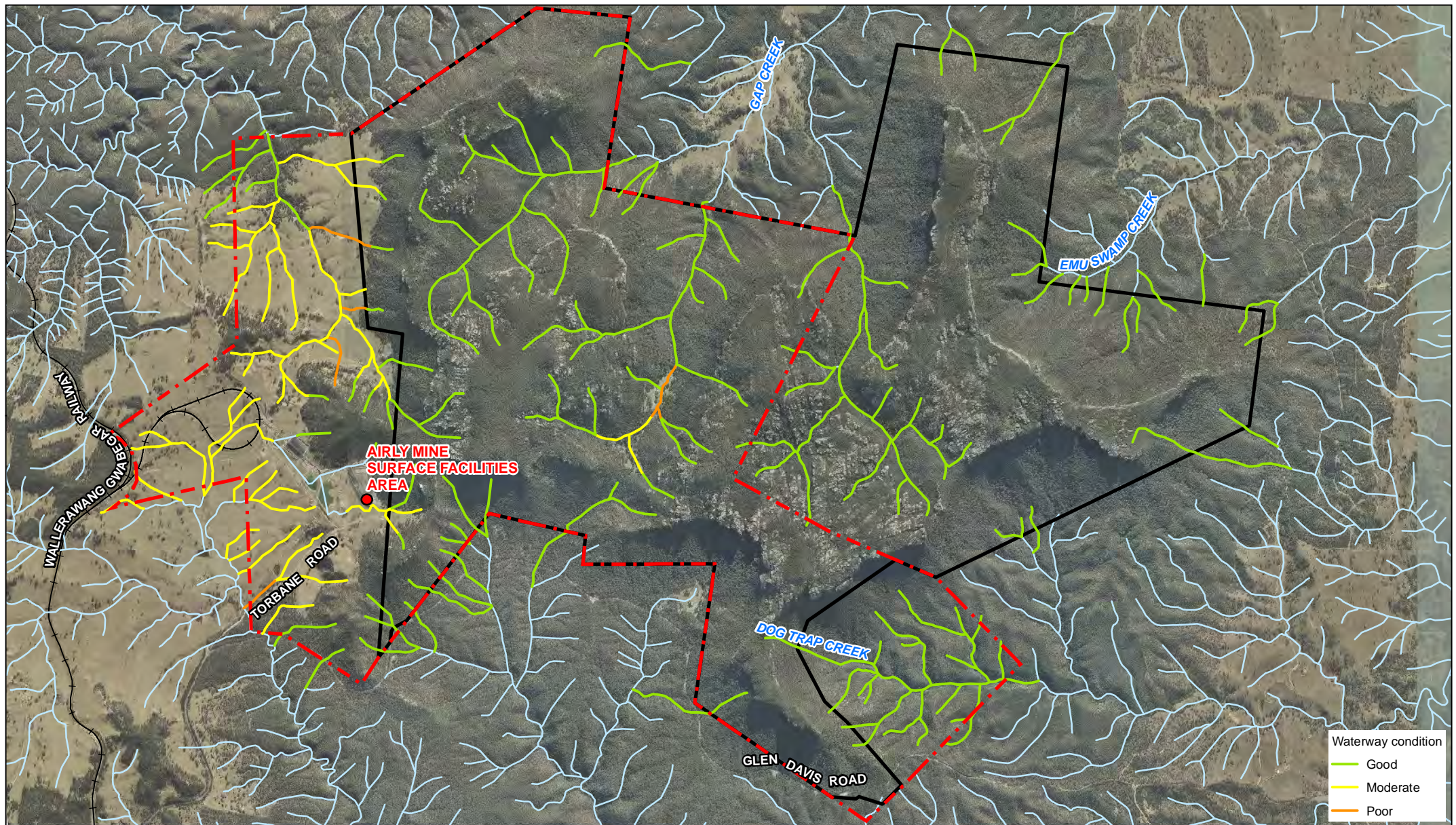
Centennial
Airly

Airly Mine
Water Management Plan

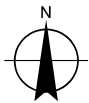
Job Number	22-18803
Revision	1
Date	09 Jun 2017

Watercourse stability
monitoring locations

Figure 4-3



Paper Size A4
0 375 750 1,125 1,500
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Airly Surface Facilities Area
- Mining Lease ML1331
- Authorisation A232

- Waterway
- Railway



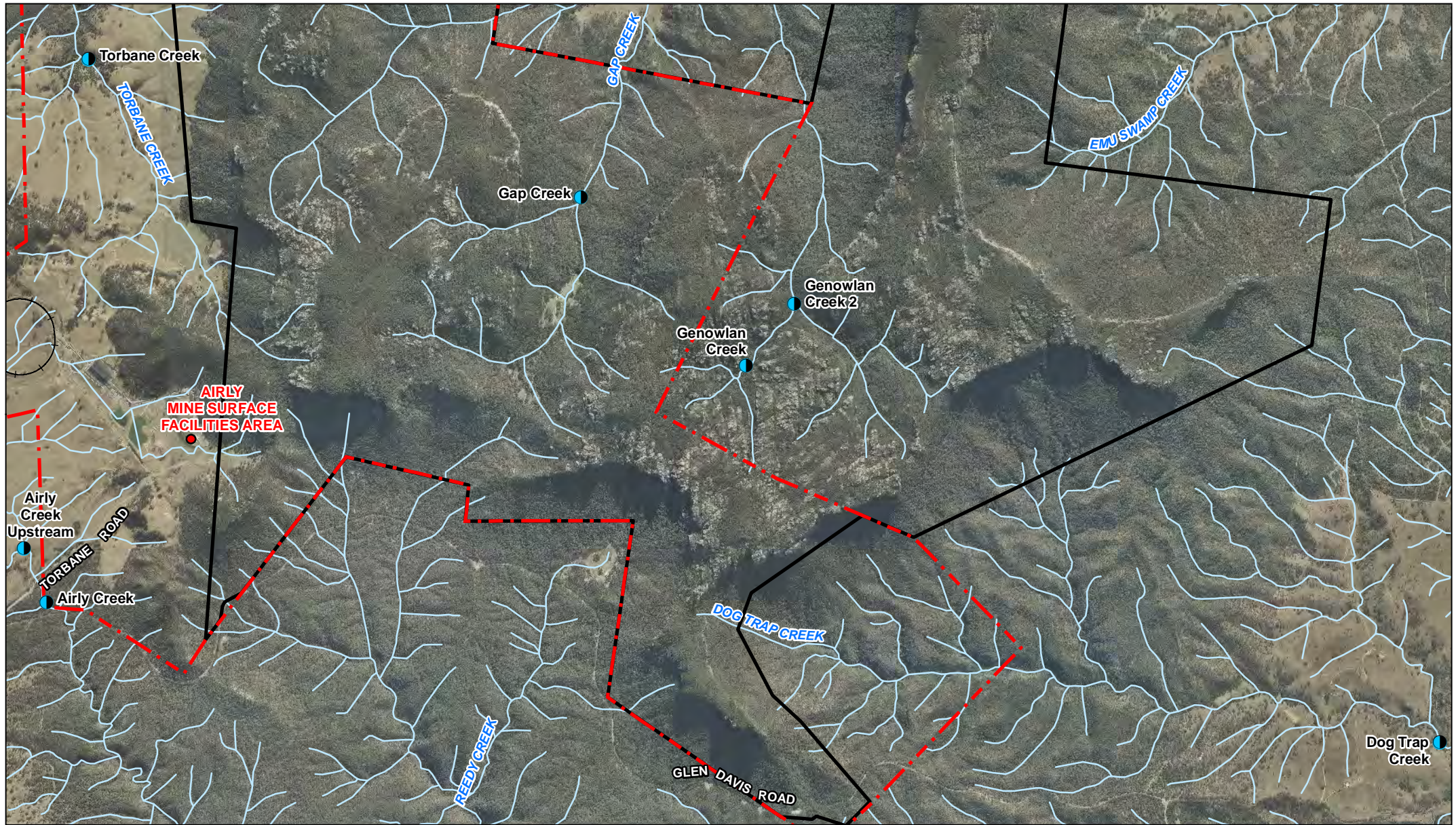
Centennial
Airly

Airly Mine
Water Management Plan

Geomorphic condition
of watercourses

Job Number	22-18803
Revision	1
Date	09 Jun 2017

Figure 5-5



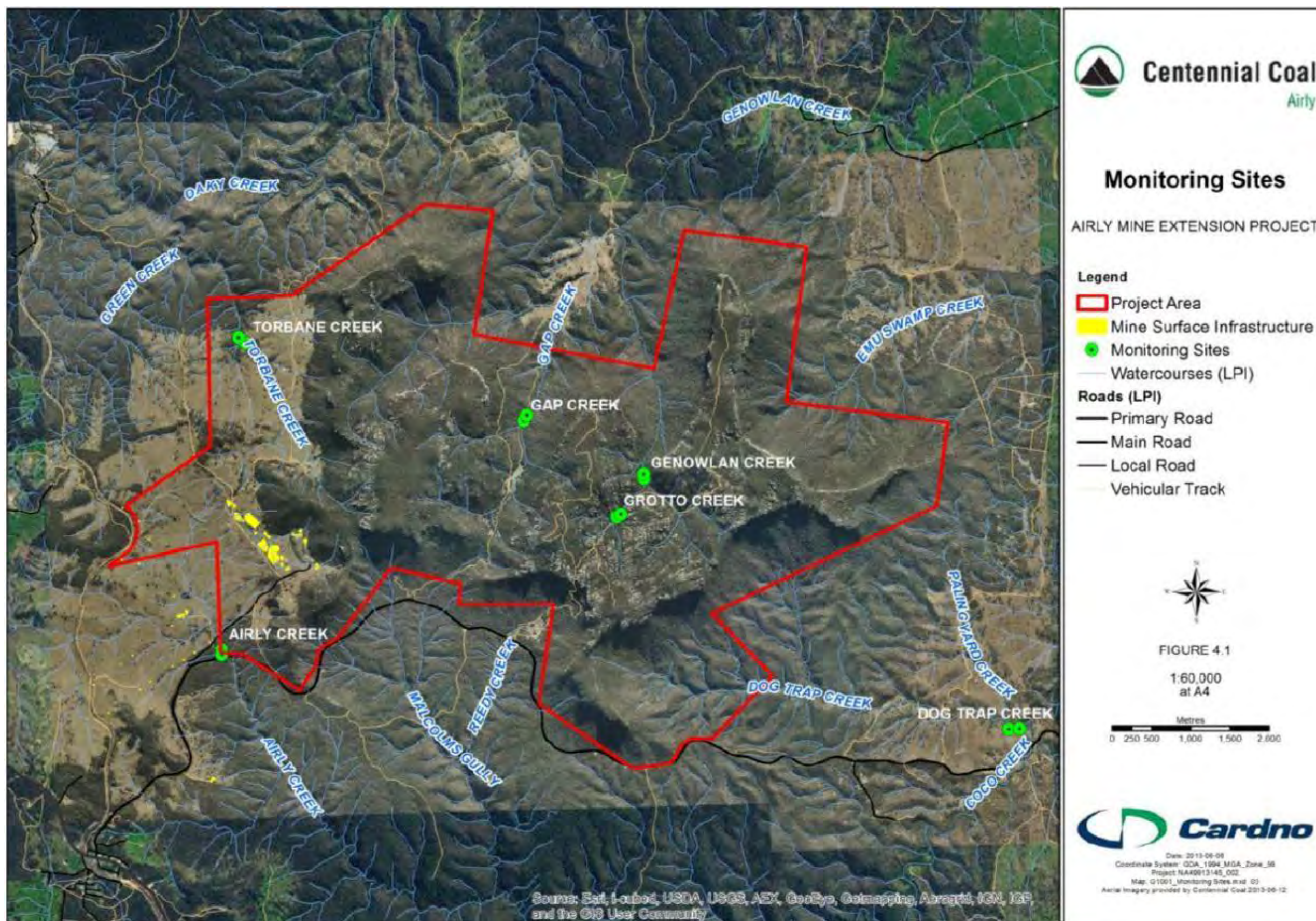
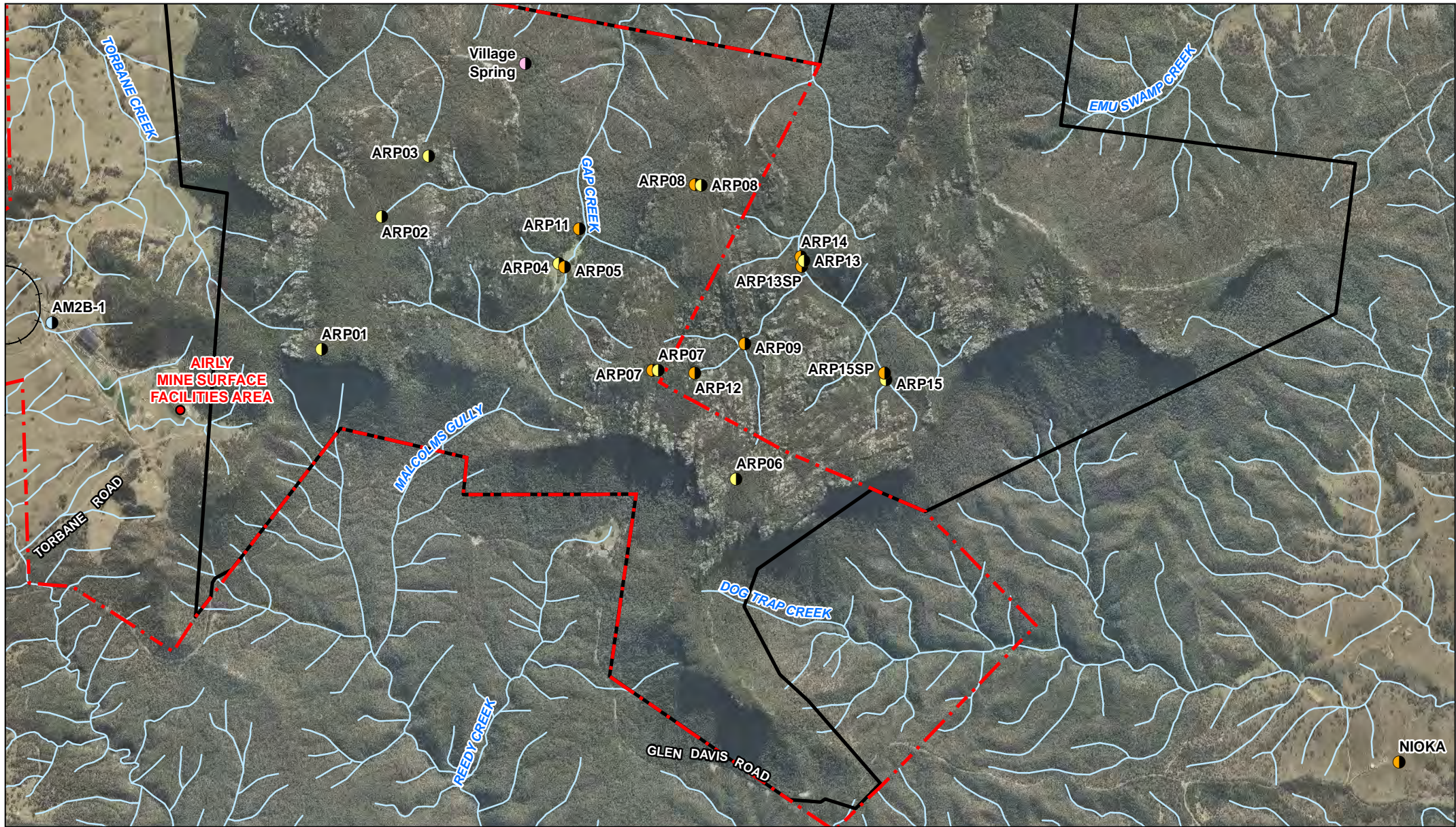
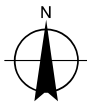


Figure 6.4 Baseline Aquatic Sampling Sites (Source: Cardno 2014)



Paper Size A4
0 250 500 750 1,000
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Airly Surface Facilities Area
- Groundwater seepage
- Production bore
- Standpipe monitoring bore
- Vibrating wire piezometer
- Mining Lease ML1331
- Authorisation A232
- Waterway



Centennial
Airly

Airly Mine
Water Management Plan

Groundwater
monitoring locations

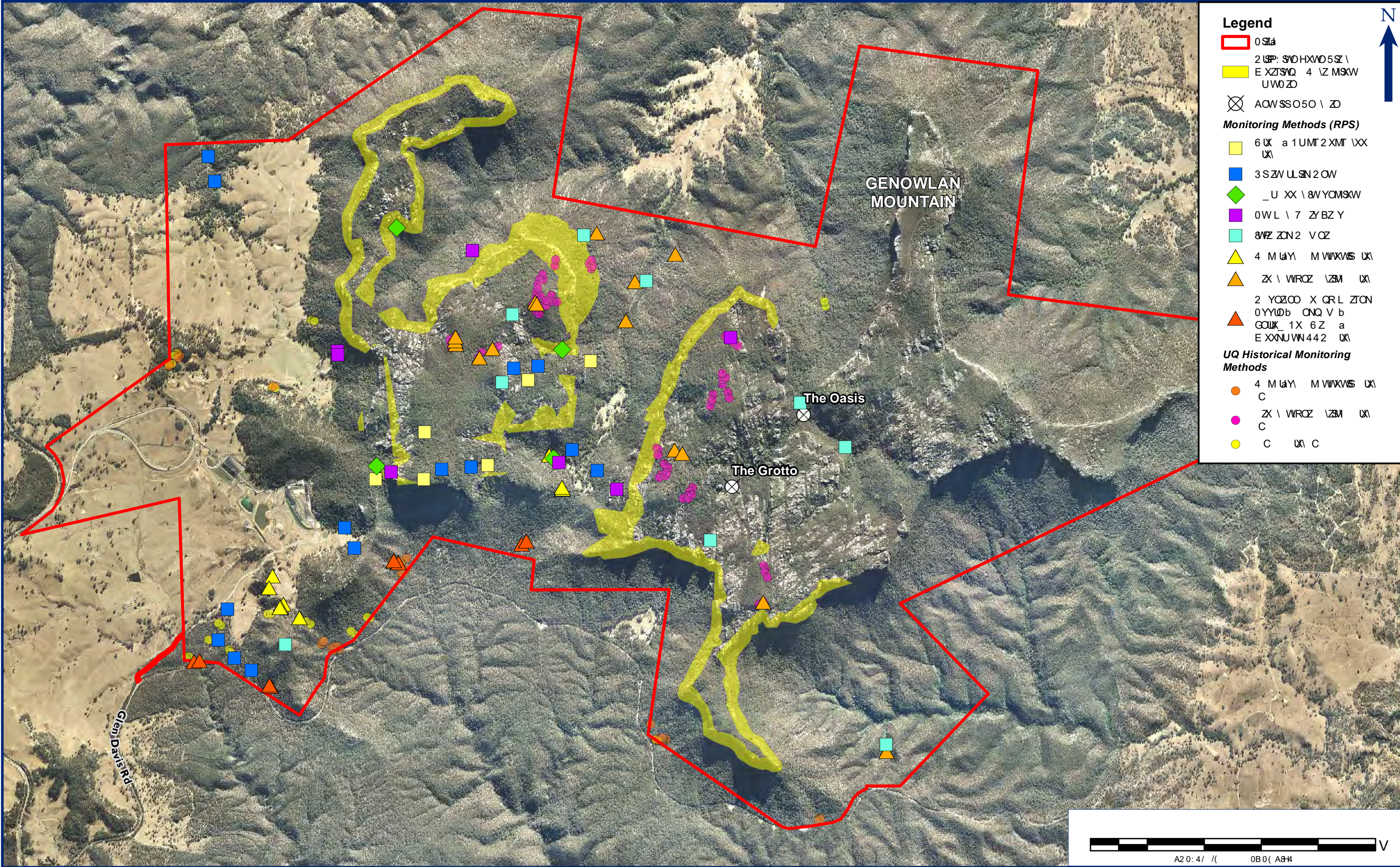
Job Number	22-18803
Revision	1
Date	09 Jun 2017

Figure 4-2

A3.4 Environmental Monitoring - Biodiversity

The following figure illustrates the location of the existing flora and fauna monitoring locations undertaken as part of the broader site Biodiversity Management Plan (refer EP-BMP for details).

Note: Refer **A3.3** above (Water Monitoring) for **aquatic ecology** monitoring locations.



BB: 4 / FIGURE 8.1: BIODIVERSITY MONITORING

: 20B8 / AIRLY

30BC /630 ..)

30B4 / 10/07/2017

D4 A8 :0 1G/10(\ SDE XXN

942B8 /630 ..) 60HXWD

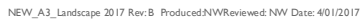
C A4/ BMP

0B7/ A12OWW6W0WXL I () 0S14 VZ MSW UW1 I 3Z RSVOZMS Y3XM VOW I4MM () 5S2 ZD-J 130S OZ Ss XV8XZVQ10 (, , V N

A3.5 Historic Heritage Site Locations

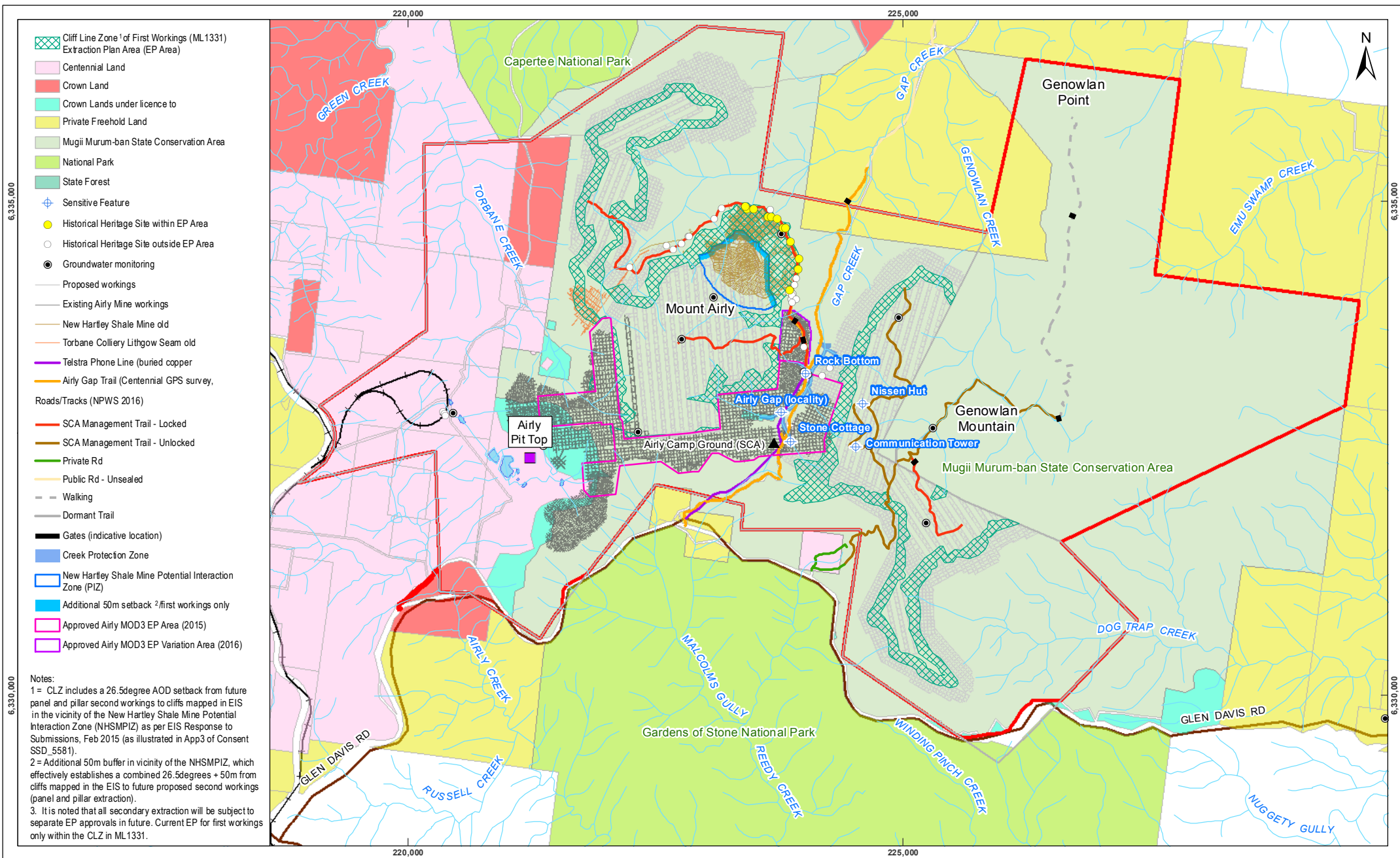
The following figure illustrates the location of Historic Heritage Sites in the vicinity of the New Hartley Shale Mine / Airly Village ruins (refer EP-HHMP for details).

4. The aerial photography used in this plan has not been rectified. This image has been overlaid as a best fit on the boundaries shown and position is approximate only.



A3.6 Built Features

The following figure illustrates the location of known built features surrounding the EP Area within the Development Consent Area. No significant built features are located within the EP Area (unsealed SCA 4WD management trails and fences only).



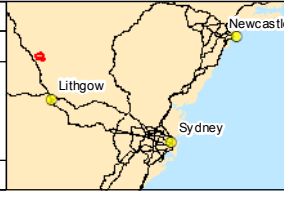
LEGEND	
	Watercourse
	Rail
	Public Road

Coordinate System: GDA 1994 MGA Zone 56

Path: T:\spatial\projects\2500\2529_Airly_MEP_EP\Maps\report\2017\2529_Figure_Built_Features.mxd

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SEAM	LITHGOW
REFERENCE	PREPARED BY:
SCALE	1:50,000



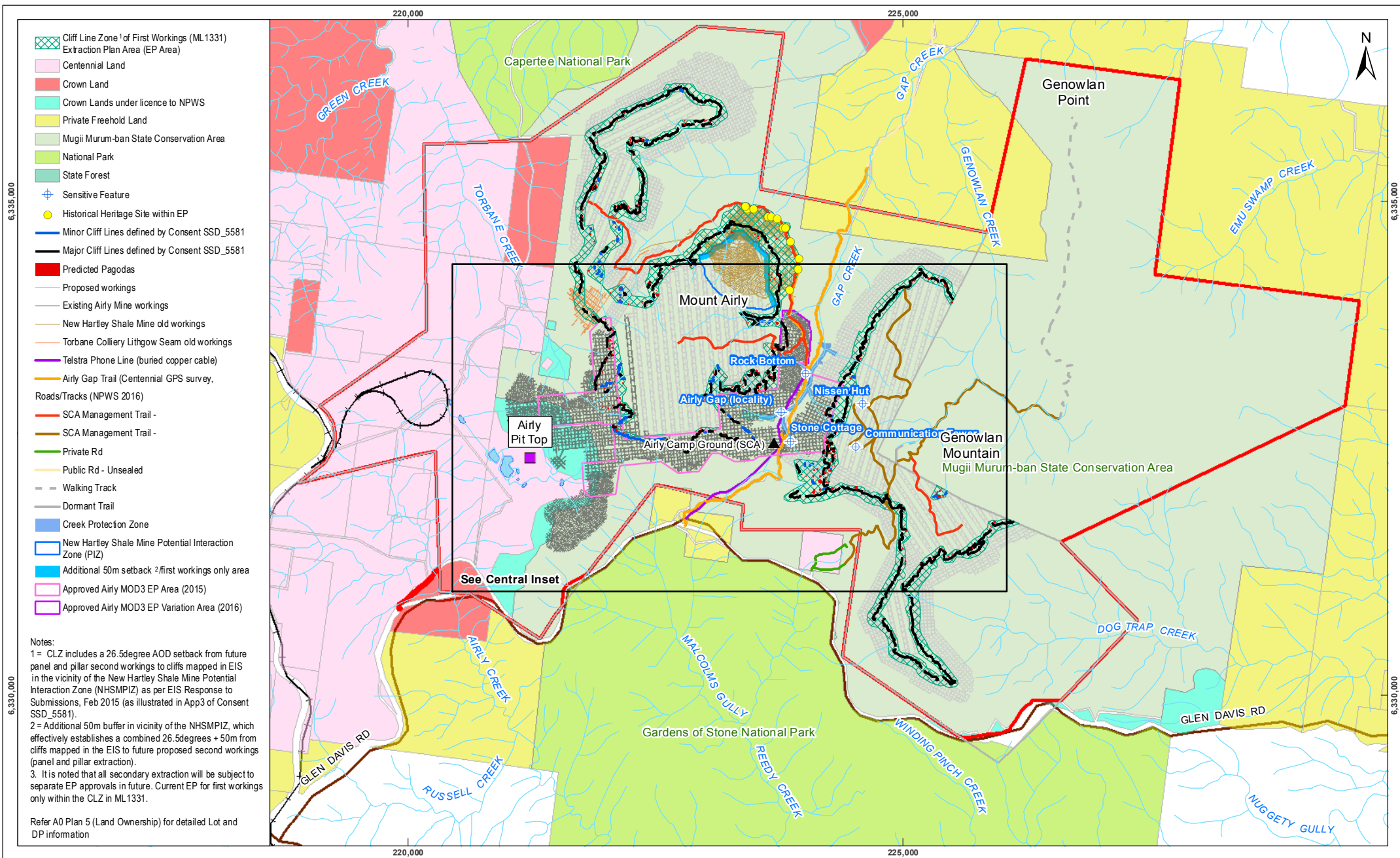
Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331):
Built Features (Overview)

0 230 460 920 1,380 1,840 Metres

PLOTFILE No.	
Centennial Coal Airly	
DRG No.	A4

A3.7 Land Ownership

The following figures illustrate land ownership within and surrounding the development consent area, including the EP Area.



	Mining Lease ML1331
	Development Consent Area SSD_5581 (Airly Mine Extension Project)
	Dam
	Watercourse
	Rail
	Public Road

Coordinate System: GDA 1994 MGA Zone 56

Path: T:\spatial\projects\2500\2529_Airly_MEP_EP\Maps\report\2017\2529_Figure_Ownership.mxd

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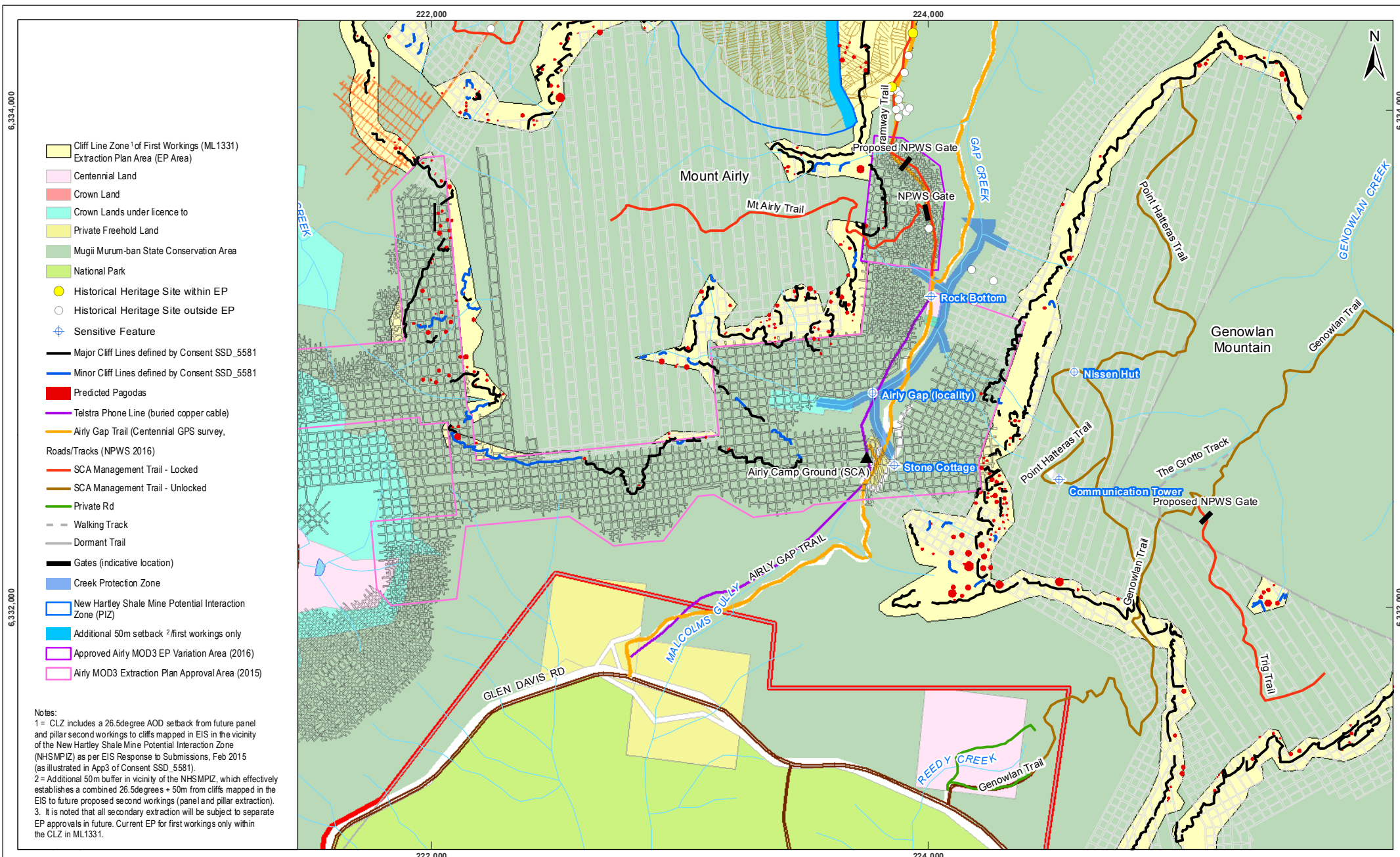
DATE	18/09/2017
SEAM	LITHGOW
REFERENCE	PREPARED BY:
SCALE	1:50,000



Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331): Private and Public Land Ownership (Overview)

0 230 460 920 1,380 1,840 Metres

PLOTFILE No.	
	Airly
DRG No.	A4



Notes:
1 = CLZ includes a 26.5degree AOD setback from future panel and pillar second workings to cliffs mapped in EIS in the vicinity of the New Hartley Shale Mine Potential Interaction Zone (NHSMPIZ) as per EIS Response to Submissions, Feb 2015 (as illustrated in App3 of Consent SSD_5581).
2 = Additional 50m buffer in vicinity of the NHSMPIZ, which effectively establishes a combined 26.5degrees + 50m from cliffs mapped in the EIS to future proposed second workings (panel and pillar extraction).
3. It is noted that all secondary extraction will be subject to separate EP approvals in future. Current EP for first workings only within the CLZ in ML1331.

LEGEND

Mining Lease ML1331

Development Consent Area SSD_5581 (Airly Mine Extension Project)

New Hartley Shale Mine old

Torban Colliery Lithgow Seam old workings

Existing Airly Mine workings

Proposed workings

Dam

Watercourse

Roads/Tracks

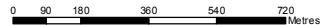
Coordinate System: GDA 1994 MGA Zone 56

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SEAM	LITHGOW
REFERENCE	PREPARED BY: 
SCALE	1:20,000



Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331): Private and Public Land Ownership (Central Inset)


0 90 180 360 540 720 Metres

PLOTFILE No.

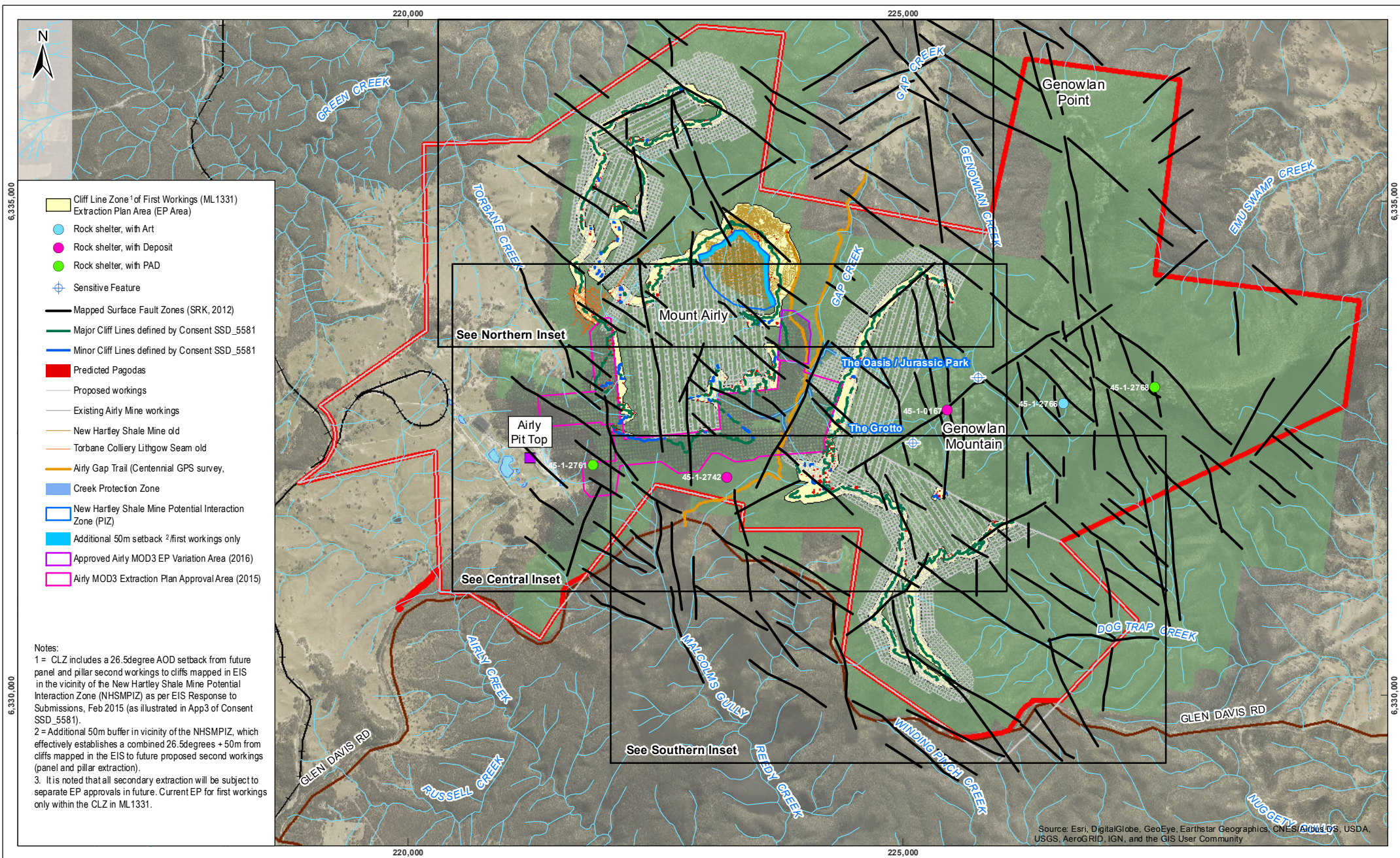
 **Centennial Coal**
Airly

DRG No.

A4

A3.8 Geological Structures

The following figures illustrate mapped geological structures within the development consent area in relation to key surface features.



LEGEND	
	Mining Lease ML1331
	Development Consent Area SSD_5581 (Airly Mine Extension Project)
	Mugil Murum-ban State Conservation Area
	Dam
	Watercourse
	Rail
	Main Road

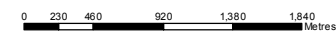
Coordinate System: GDA 1994 MGA Zone 56
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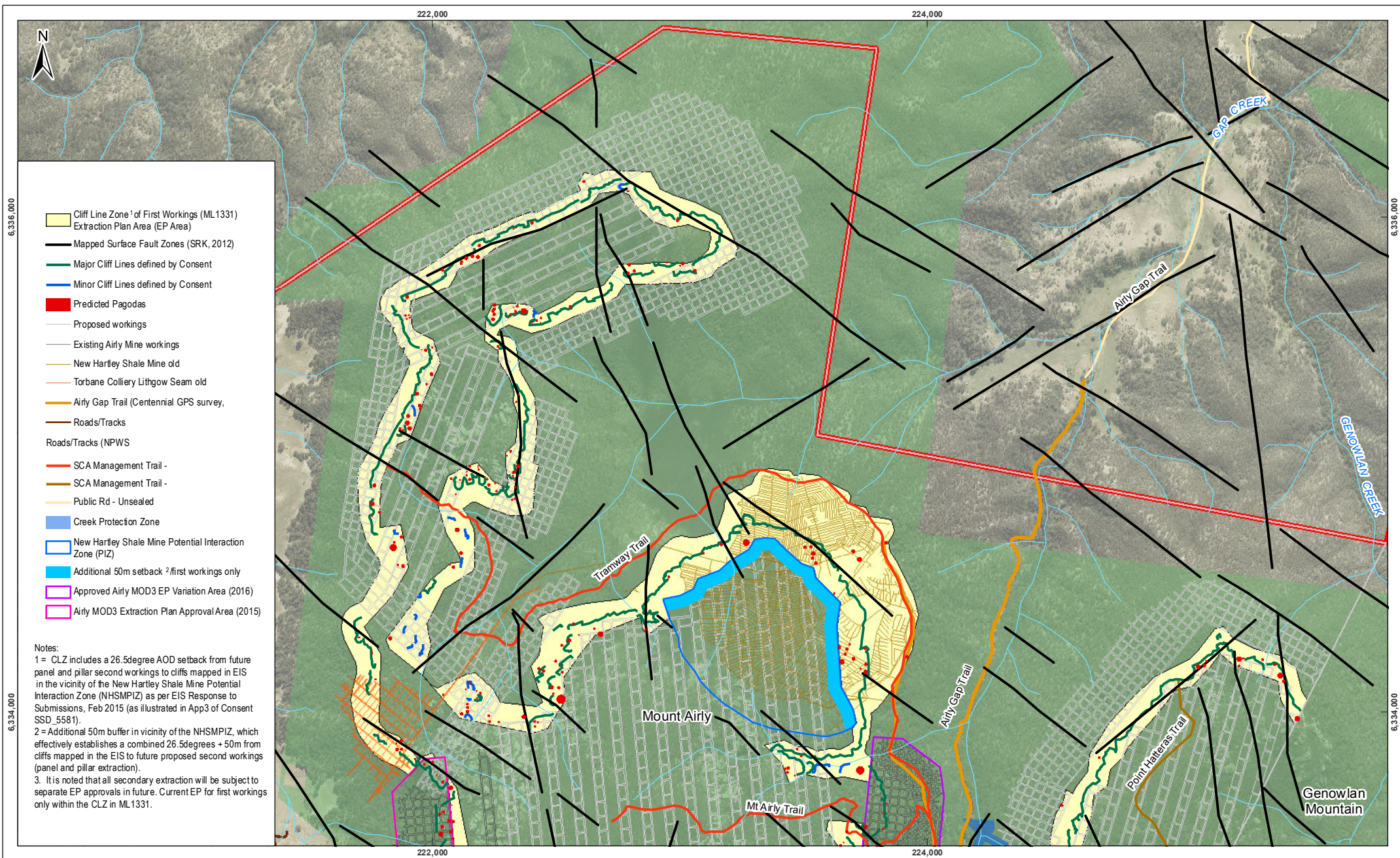
DATE	18/09/2017
SEAM	LITHGOW
REFERENCE	PREPARED BY:
SCALE	1:50,000



Airly MEP Cliff Line Zone of First
Workings Extraction Plan (ML1331):
**Geology
(Overview)**



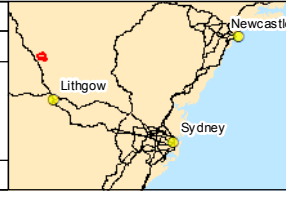
PLOTFILE No.	
Centennial Coal Airly	
DRG No.	A4



LEGEND	
	Mining Lease ML1331
	Development Consent Area SSD_5581 (Airly Mine Extension Project)
	Mugil Murum-ban State Conservation Area
Coordinate System: GDA 1994 MGA Zone 56	

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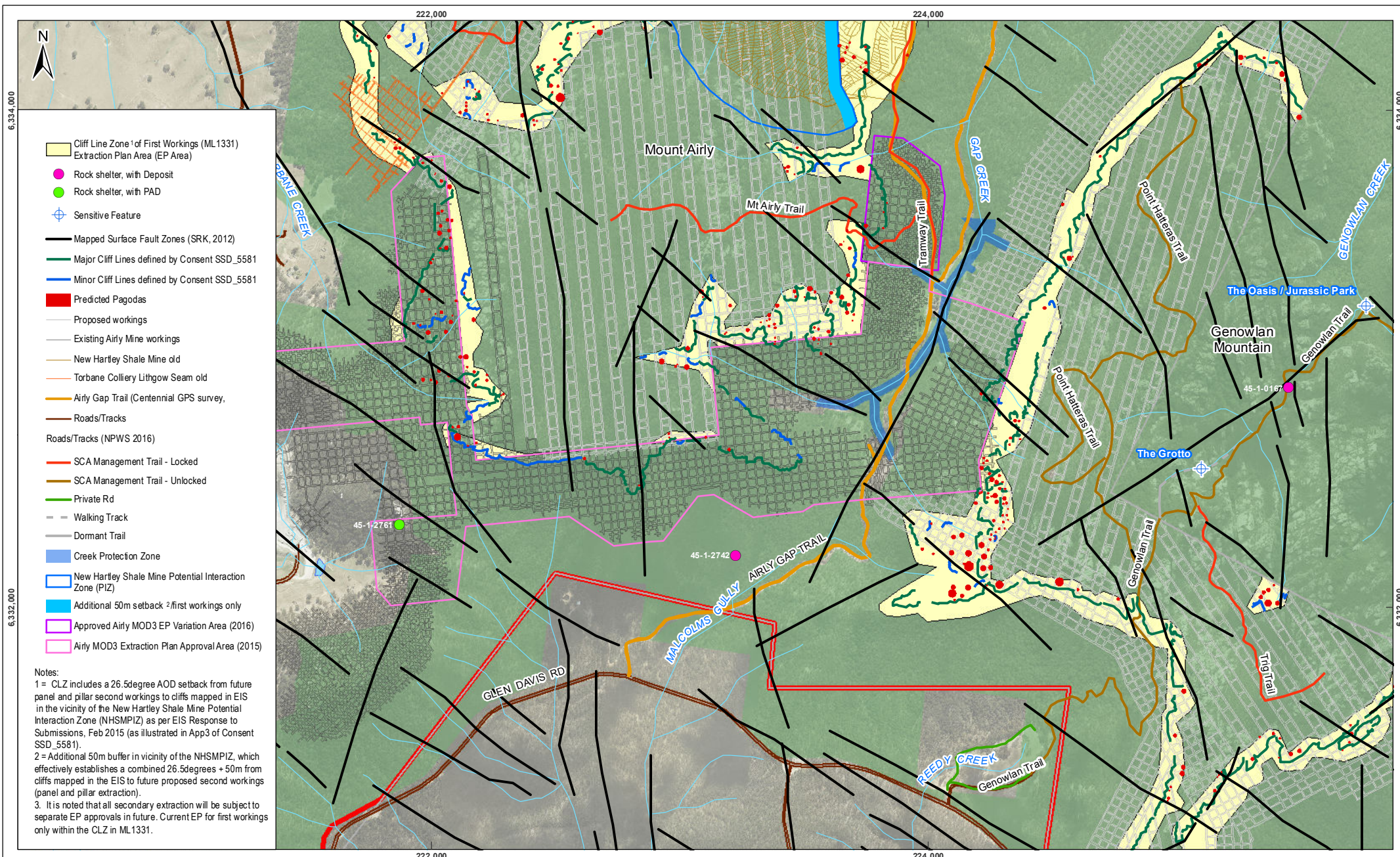
DATE	18/09/2017
SEAM	LITHGOW
REFERENCE	PREPARED BY:
SCALE	1:20,000



Airly MEP Cliff Line Zone of First
 Workings Extraction Plan (ML1331):
**Geology
 (Northern Inset)**

0 90 180 360 540 720 Metres

PLOTFILE No.	
Centennial Coal Airly	
DRG No.	A4



Notes:
1 = CLZ includes a 26.5degree AOD setback from future panel and pillar second workings to cliffs mapped in EIS in the vicinity of the New Hartley Shale Mine Potential Interaction Zone (NHSMPIZ) as per EIS Response to Submissions, Feb 2015 (as illustrated in App3 of Consent SSD_5581).
2 = Additional 50m buffer in vicinity of the NHSMPIZ, which effectively establishes a combined 26.5degrees + 50m from cliffs mapped in the EIS to future proposed second workings (panel and pillar extraction).
3. It is noted that all secondary extraction will be subject to separate EP approvals in future. Current EP for first workings only within the CLZ in ML1331.

LEGEND

Mining Lease ML1331

Development Consent Area SSD_5581 (Airly Mine Extension Project)

Mugil Murum-ban State Conservation Area

Dam

Watercourse

Coordinate System: GDA 1994 MGA Zone 56
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REFERENCE	PREPARED BY: 
SCALE	1:20,000



Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331):


Geology

(Central Inset)

090180360540720

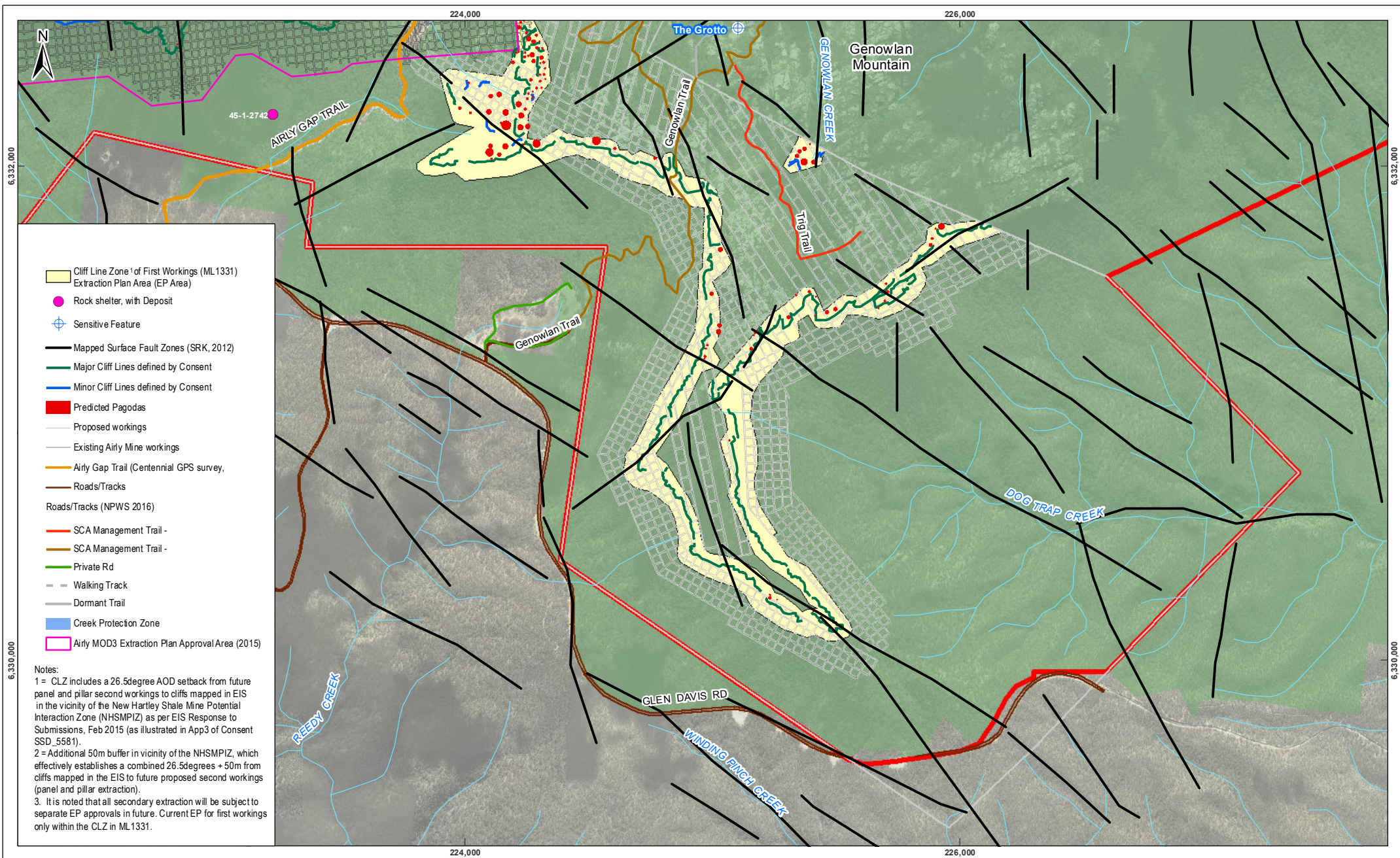
Metres

PLOTFILE No.

 **Centennial Coal**
Airly

DRG No.

A4



LEGEND	
	Cliff Line Zone of First Workings (ML1331) Extraction Plan Area (EP)
	Development Consent Area SSD_5581 (Airly Mine Extension Project)
	Mugil Murum-ban State Conservation Area
Coordinate System: GDA 1994 MGA Zone 56	

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SCALE	1:20,000



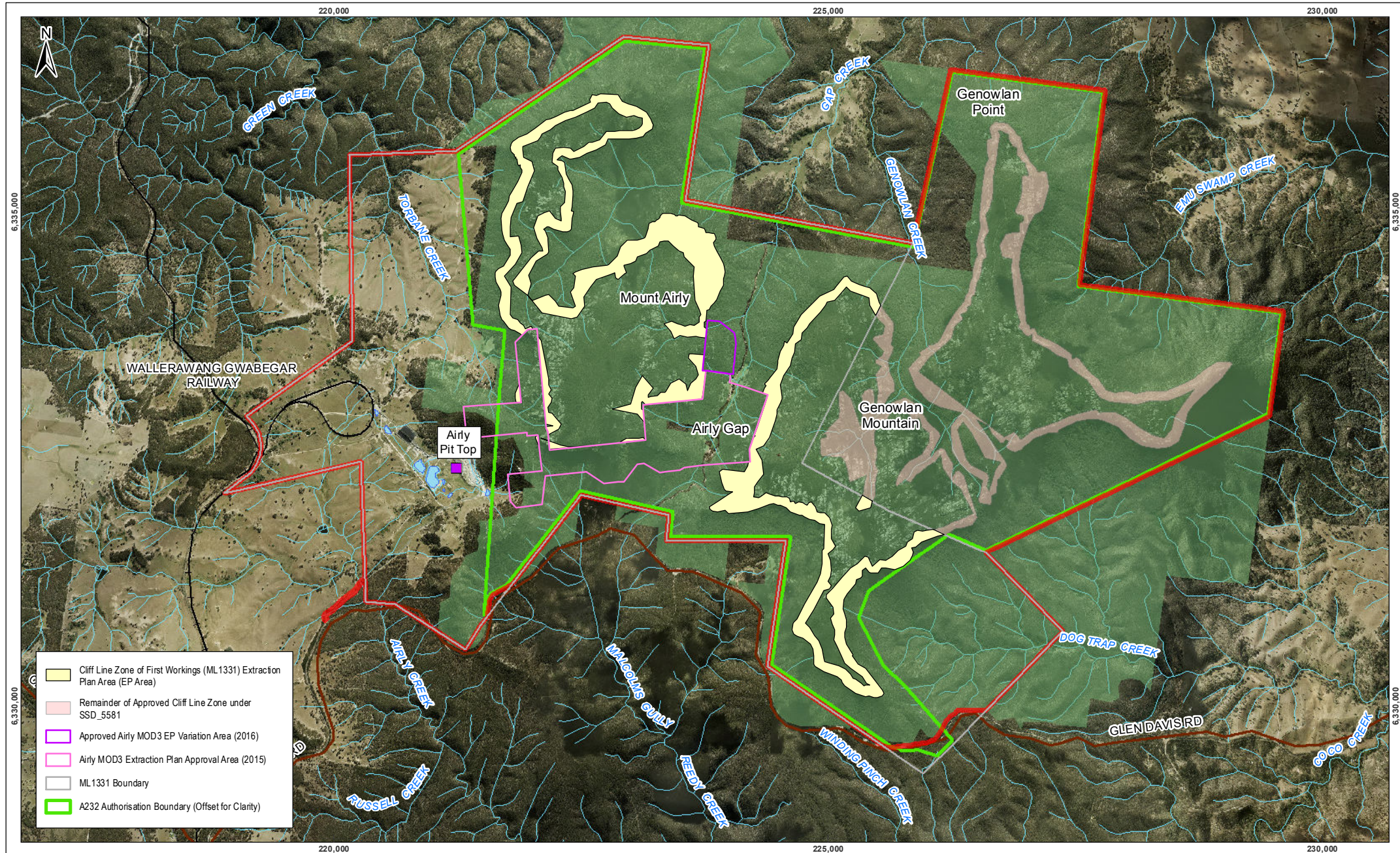
Airly MEP Cliff Line Zone of First Workings Extraction Plan (ML1331):
Geology (Southern Inset)

0 90 180 360 540 720 Metres

PLOTFILE No.	
Centennial Coal Airly	
DRG No.	A4

A3.9 Mining Tenements

The following figure illustrates approved consent and lease boundaries at Airly Mine in relation to the current and previously approved EP Areas.



LEGEND

- Airly Mine Extension Project Approval Area (SSD_5581 Development Consent)
- Mugi Murum-ban State Conservation Area
- Dam
- Watercourse
- +— Rail
- Main Road

Coordinate System: GDA 1994 MGA Zone 56

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Airly MEP Cliff Line Zone of First
Workings Extraction Plan (ML1331):
**EP Area and
Mining Tenements**

0 230 460 920 1,380 1,840
Metres

PLOTFILE No.

 **Centennial Coal**
Airly

DRG No.

A4

Appendix 4:

Stakeholder Consultation

(Extraction Plan and supporting SMP, PSMP and LMP)

TABLE OF CONTENTS – Appendix 4

A4.1 Detailed Summary of Stakeholder Consultation	A4-3
A4.2 Independent Expert Panel (IEP) and NSW Department of Planning & Environment (DP&E)	A4-7
A4.3 Principal Subsidence Engineer – Mine Safety Operations, Resource Regulator, DP&E (formerly DRE)	
A2.4 NPWS and OEH	

A4.1 Detailed Summary of Stakeholder Consultation

Table A4.1.1 below provides a detailed summary of aspects and issues raised during stakeholder consultation specifically undertaken for the Extraction Plan and supporting **SMP, LMP and PSMP sub-plans**, and where those have been addressed. It is noted that this is in addition to and builds upon previous and ongoing consultation with various key stakeholders as part of the recently approved EIS for SSD_5581 and existing operations at the mine (including previous Extraction Plans) as detailed in Section 1 of the SMP, PSMP and LMP. Copies of written correspondence with each stakeholder for the current Extraction Plan is also provided in the following sections below.

It is noted that stakeholder consultation for separate sub-plans for the **Environmental Management Plans** supporting the Extraction Plan (including the EP-BMP, site WMP and HHMP) is described separately within each of those documents and is not included below (it is also summarised within the Extraction Plan main document).

Table A4.1.1: Detailed Summary of Stakeholder Consultation for the Extraction Plan and Supporting Sub-Plans (SMP, LMP, PSMP)

Stakeholder	Date	Aspects/Issues Raised	Section Addressed
NPWS and OEH Threatened Species Division	14/3/17	Meeting at Mudgee NPWS office (Lisa Menke from NPWS and David Coote from OEH) 1. Explain requirements of the Extraction Plan for first workings in the Cliff Zone 2. Present proposed workings and pillar dimensions. 3. Present proposed monitoring strategy 4. Present proposed 'whole of site'/Regional Biodiversity and Heritage Management Plans for SSD5581	Extraction Plan SMP
NPWS	24/3/17	Changes to SCA Boundary for inclusion in LMP figures (NSW government Gazetted amendment to SCA) provided by email from Lisa Menke (A/Area Manager Mudgee, Blue Mountains Branch).	LMP All related figures A0 Graphical Plan 5 (Land Ownership) Appendix 4 (A4.4)
NSW Department of Planning and Environment (DP&E) and Independent Expert Panel (IEP)	26/5/2017, 30/5/2017	Letter from Centennial to DP&E to: 1. Seek endorsement from DP&E of the proposed team to prepare the Extraction Plan. 2. Clarify relevant management plans proposed for submission with the Extraction Plan. 3. Provide preliminary information for consultation with the Independent Expert Panel (IEP), including figures and plans, pillar stability and subsidence report, and outline of proposed monitoring of cliffs and pagodas.	Section 4, Appendix 4 (A4.2)
DP&E and Independent Expert Panel (IEP)	31/5/2017	Centennial meeting with IEP and DP&E which included project presentation advising staged implementation of mining zones in this EP, results of the pillar stability and subsidence review, and consultation on proposed management and monitoring. Issues jointly raised by Airly and the IEP during the meeting are noted below in correspondence 1/6/2017 and IEP reply 2/6/2017.	SMP, PSMP, LMP, Appendix 4 (A4.2)

Independent Expert Panel (IEP)	1/6/2017	<p>Email from Centennial Airly to DP&E seeking IEP response to the following their review of information provided and aspects discussed at the consultation meeting 31/5/17. The five key enquiries to the IEP are summarised below and are detailed in Appendix 4 :</p> <ol style="list-style-type: none"> 1. Clarification from IEP if proposed pillar systems are viewed as long term stable. 2. .Clarification from IEP if compressional settlement of first workings pillar systems and resultant negligible impacts as effectively non-subsiding. 3. Proposed management of minor built features (dirt tracks, fences, gates) in other management plans 4. IEP concurrence that surface subsidence monitoring of ground movements for first workings in the EP Area is not appropriate due to very low levels of pillar compression settlement and difficulty in measurement in given terrain. For clarity, appropriate monitoring of ground movements for secondary extraction areas will be developed in consultation with the IEP and DRE during subsequent extraction plans. 5. If IEP consider it appropriate to monitor for change in environmental consequences (i.e. physical changes to cliffs and pagodas) using proposed high definition LIDAR terrain modelling, three dimensional photogrammetry and underground pillar inspection regime. 	Appendix 4 (A4.2) SMP, LMP, PSMP (see also for IEP replies below)
IEP	2/6/2017	<p>IEP response to email from Centennial Airly 1/6/2017 with the following summarised clarifications (see A4.2 for full details):</p> <ol style="list-style-type: none"> 1. The IEP considers that the proposed pillars are long term stable as first workings 2. The IEP expects that the ground deformations associated with the first workings pillar system proposed will be in line with the widely accepted 20mm detection limits for subsidence monitoring. Refer Appendix 4 (A4.2) for further IEP comments and recommendations regarding monitoring. 3. IEP considers that a dedicated Built Features Management Plan is not required (can be addressed in other MPs) 4. IEP do <u>not</u> regard surface subsidence monitoring of ground movements to be required for compliance purposes, Recommendations for other strategic value of undertaking such are detailed in Appendix 4 (A4.2). 5. The IEP considered the proposed monitoring for change in environmental consequences to be appropriate <as described earlier above> and further viewed it as a critical component of the monitoring program for Airly Mine as the most practical methods to confirm mine performance and impact predictions across a large area of terrain with difficult access. IEP understood first surveys in coming months and repeat surveys conducted at about six monthly intervals. Establishing baseline for natural rock falls is considered important. Refer Appendix 4 (A4.2) for further details on IEP detailed response. 	<p>Appendix 4 (A4.2) SMP Sections 7-10</p> <p>LMP</p> <p>SMP</p> <p>SMP</p>
OEH and NPWS	28/6/2017	<p>Email from David King (Airly Mine) to OEH Regional Operations Division (Steven Cox, Senior Team Leader – Planning, Northwest Branch) and NPWS (Lisa Menke, A/Area Manager Mudgee Blue Mountains Branch) requesting a meeting as part of consultation on the EP/management plans. Reply from Steve Cox advising that due to heavy workloads a meeting (if required) would be determined following review of draft plans.</p>	<p>SMP, PSMP, LMP</p> <p>Appendix 4 (A4.4)</p>
NPWS	14/7/17 21/7/17	<p>Email from David King (Airly Mine) to Lisa Menke of NPWS requesting GIS files for gazetted land ownership changes to the SCA and Crown Land. Subsequent correspondence from Airly/Niche (CB) 21/7/17 to clarify queries regarding crown lands under licence to NPWS.</p>	<p>LMP</p> <p>See as for 14/3/17</p>

<p>DP&E – Division of Central Coast Coordination and Resources Regulation (Mine Safety Operations) <i>(formerly DRE and more recently Department of Industry Resources Regulator (Mine Safety))</i>-</p> <p>Note: For consistency with Consent terminology and ease of reference herein are referred to throughout this document as <i>DRE</i>.</p>	<p>19/7/2017</p>	<p>Email from Principal Subsidence Engineer (Dr Gang Li) to Airly Mining Engineer (D.King) confirming that a consultation meeting is not necessary at this stage and the following key points were re-iterated from teleconference 18th January 2017:</p> <ul style="list-style-type: none"> • Development and implementation of the Extraction Plan by the Airly Colliery in consultation with the IEP in accordance with Airly Colliery's Development Consent (SSD_5581) dated 15 December 2016; and • Development and implementation of risk controls by the Airly Colliery for the health and safety of the "other persons"* in accordance with the requirements of the WHS Laws** in relation to subsidence. To assist with work in this regard a copy of the Subsidence Guideline was sent to <Airly Mine> on 28 June 2017. • In addition, Airly Colliery is required to submit a Schedule to the Principal Subsidence Engineer, which documents the objective, scope (or agenda items), timing and venue for each of the IEP's main review meetings / activities. We will use the information documented in the Schedule to decide our participation in the IEP's review meetings / activities as an observer. <p>Notes: * 'Other persons' as defined in section 19 of the Work Health and Safety Act 2011</p> <p>** The WHS laws, as defined under Section 5 of Work Health and Safety (Mines & Petroleum Sites) Act 2013, means the WHS Act, WHS (Mines & Petroleum Sites) Act, WHS Regulations, and WHS (Mines & Petroleum) Regulations.</p>	<p>Appendix 4 (A4.2)</p> <p>SMP, LMP, PSMP Sections 1, 4, Appendix 2</p> <p>PSMP Section 4, 8 SMP Section 4, 6 Appendices 2 and 3</p> <p>DRE feedback to be provided to DP&E as coordinators of the IEP. Airly Mine will cc DRE (PSE) when future IEP meetings requested by the mine.</p>
<p>'DRE' (Principal Subsidence Engineer).</p>	<p>Phone consultation 19/7/2017</p> <p>Documented in email 20/7/17</p>	<p>Email from Airly Mining Engineer (D.King) to DRE (Dr Gang Li) documenting consultation by phone of 19/7/17 between DRE Principal Subsidence Engineer and Airly Mine Mining Engineer) – refer Appendix 4 for details. Due to DRE advice that a meeting was not required the following feedback would form the basis for consultation required from DRE for management plans under Cond7 of SSD_5581. DRE clarified that whilst feedback is provided, monitoring strategies are <u>not formally approved by DRE</u> - DRE will have an active regulatory role if they believe that monitoring and management processes do not address the Work Health and Safety (WHS) legislation and associated risks adequately.</p> <p><u>Subsidence Monitoring and Reporting:</u></p> <ul style="list-style-type: none"> • Any mine design, subsidence monitoring program and reporting program related to the consent must be approved by the IEP. Any variations from IEP recommendations must be justified and approved. • All data must be reviewed by the IEP and their recommendations followed. Any variations from IEP recommendations must be justified and approved. • DRE suggested that from a WHS perspective the new DRE Subsidence Risk Management/WHS guidelines should form the basis of the Management Plan for the Safety of Others (i.e. Public Safety Management Plan). DRE clarified that the DP&E EP Guidelines (2015) PSMP's are now dated and no longer reflect current WHS legislation. • DRE requested a schedule of the IEP involvement in Airly mining processes, including milestones that trigger meetings. This is both for the first workings EP and going forward for future EP. DRE would like to be given the opportunity to be involved as an observer at review meetings and/or receive minutes from the meetings. 	<p>Appendix 4 (A4.2)</p> <p>SMP, PSMP, LMP Sections 1, 4,, 5 Appendix 4 (A4.1)</p> <p>PSMP Section 4 SMP Section 4 Appendix 2 (guidelines noted in detail)</p> <p>Refer as for DRE email 19/7 above</p>

		<ul style="list-style-type: none"> DRE suggested commence monitoring well before secondary extraction to provide good baseline data. Airly confirmed the IEP had recommended this as well and this is being pursued. <p>First Workings EP</p> <ul style="list-style-type: none"> The IEP must concur that the workings are long term stable and non-subsiding. Mine first workings must be in the areas shown <on plan AM00684> and follow the dimensions that were previously approved by DRE <including under condition 13A of DA162/91> and have carried over into this new Consent. The EP must be clear that workings are not less than 50m depth of cover (i.e. not shallow workings) and will not have second workings associated with them in future. DRE receptive to a "monitor for change" strategy for first workings. DRE do not want to see a 'no monitoring' strategy (as is typical for 1st workings in NSW). <p>First Workings and WHS requirements</p> <ul style="list-style-type: none"> Airly Mine can propose that due to the workings being long term stable and non-subsiding, a specific subsidence related management plan for satisfying WHS is not required, provided Airly can demonstrate effective monitoring for change and involve DRE in the results and IEP review. The Public Safety Management Plan developed for meeting Condition 7 Sch3 (Extraction Plan) of consent must comply with WHS legislation. Airly should consider the new DRE Subsidence Management/WHS guidelines to assist in developing the format, and consider this as the first step in creating a life of mine Public Safety Management Plan. 	<p>SMP Section 8</p> <p>Appendix 4 (A4.1) (confirmed) SMP, LMP, PSMP Section 5 (same)</p> <p>SMP, LMP, PSMP Section 5, 4 (confirmed)</p> <p>SMP</p> <p>SMP, PSMP</p> <p>PSMP Section 4 Appendix 2</p>
NPWS	27/7/17	Email from Lisa Menke of NPWS in response to earlier enquiries by Airly Mine 14/7/17 and 21/7/17 regarding gazetted land ownership changes to the SCA and providing lot descriptions and a figure showing crown lands currently under licence to NPWS.	<p>LMP</p> <p>All related figures A0 Graphical Plan 5 (Land Ownership) Appendix 4 (A4.4)</p>
NPWS, DRE, IEP	31/8/17	<p>Draft PSMP provided for review and comment.</p> <p>Note: A summary of the proposed monitoring program described within the SMP was provided to OEH and NPWS within the draft <i>Biodiversity Management Plan (BMP)</i> and draft <i>Historic Heritage Management Plan (HHMP)</i> provided separately for review and comment in July 2017. FYI the HHMP was approved by OEH Heritage Division 3/8/17.</p>	Comments TBC

Copies of Supporting Detailed Correspondence: (refer over page)

A4.2 Independent Expert Panel (IEP) and NSW Department of Planning & Environment (DP&E)

The following section provides information on detailed consultation undertaken with the Independent Expert Panel via (and with) the NSW Department of Planning & Environment.

14 September 2017



Paul Freeman
Team Leader
Resource Assessments
Department of Planning & Environment
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DPE4541

Dear Paul

AIRLY MINE EXTRACTION PLAN CONSULTATION DRAFT: COMMENT ON THE ADEQUACY OF THE PROPOSED MECHANISMS AND CONTINGENCY ACTIONS TO MANAGE SURFACE IMPACTS

As requested in your email of 1 September 2017, please find herein comments of the Independent Expert Panel (IEP) on the Airly Mine Extraction Plan, Draft for Consultation.

The IEP considers that the various management plans reviewed are generally suitable to manage the unlikely event of surface impacts to cliffs, pagodas, steep slopes and other surface features from the proposed mining in the CLZ. The management approach adopted relies on the expectation of long term stability of the pillars as the primary control and with pillars of width to height ratios of 1:1 directly below the cliff lines this expectation is reasonable. The related Trigger Action Response Plan (TARP) is based around ensuring that the mining geometry is developed as planned. This TARP is expected to be effective.

As a general comment on the management approach proposed, the IEP would encourage Centennial Coal Company Limited (CCCL) to develop systems to closely monitor the cliff formations; even those that are not expected to move significantly. The IEP considers that such monitoring would be consistent with the Objectives of Subsidence Monitoring (s2.9.1.1) in the NSW Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 i.e. "ensuring that the mine operator has a current and correct understanding of the hazards of subsidence".

The monitoring would ideally be aimed to better understand the nature and magnitude of any natural changes, the nature and magnitude of any mining induced changes and the suitability of and accuracy/resolution of surface monitoring systems. These systems are proposed for compliance monitoring of the same features once extractive mining commences. Confidence in the base line experience is considered likely to be of significant benefit at this later, more critical stage.

Various monitoring systems are currently referred to in the EP, but the IEP was not able to determine the accuracy/resolution of any of these systems and therefore their likely effectiveness as potential controls.

1. INTRODUCTION

Airly Mine is an underground coal mine located 5km northeast of the village of Capertee and approximately 171km northwest of Sydney on the northern fringe of the Western Coalfields. CCCL, the owner of the mine, is required under Condition 7 in Schedule 3 of SSD_5581 to prepare an Extraction Plan (EP) for the proposed first workings within an area known as the Cliff Line Zone (CLZ). CCCL has lodged consultation drafts for a Subsidence Monitoring Program (SMP), a Land Management Plan (LMP) and a Public Safety Management Plan (PSMP) with the NSW Department of Planning and Environment (DPE). The DPE commissioned the IEP to comment on the adequacy of the proposed mechanisms and contingency actions to manage any impacts. This report presents the IEP's comments on the proposed plans in accordance with the conditions of consent for the Airly Mine requiring these documents to be prepared in consultation with the IEP.

The IEP was provided on 1 September 2017 by DPE with access to the following documents to review:

1. Airly Mine Cliff Line Zone of First Workings Extraction Plan
 - Common Appendix 1: Master Trigger Action Response Plan
 - Appendix 2: Other Relevant Regulatory Requirements
 - Appendix 4: Stakeholder Consultation – (EP and supporting SMP, PSMP and LMP)
2. Subsidence Monitoring Program: Cliff Line Zone of First Workings Extraction Plan (ML1331): Draft for Consultation, Rev No EP-SMP_Rev0
 - Appendix 3: Figures
3. Land Management Plan: Cliff Line Zone Extraction Plan (ML1331) Draft for Consultation, Rev No EP-LMP_Rev0
4. Public Safety Management Plan: Cliff Line Zone of First Workings Extraction Plan (ML1331) Draft for Consultation, Rev No EP-PSMP_Rev0
5. Updated Subsidence Risk Assessment (in App3 to LMP & PSMP_Subsidence RA extracts_Land & Public Safety_CLZ EP (ML1331)_Rev0.pdf)

The IEP has reviewed these documents as requested. Much of the detail is repeated in the various documents but the essential elements are the same in each. For the purposes of this review, the plans are considered as one. Specific reference is made to individual plans where necessary.

2. Review of Approach

The approach presented to managing the subsidence impacts is based on the expectation that the pillar systems are long term stable. The pillar geometries for the CLZ were reviewed by the IEP (2016). That review confirmed the expectation of long term stability as reasonable given the width to height ratio of pillars in the CLZ of greater than 10. The IEP is nevertheless mindful of the value of confirming that the subsidence outcomes are as expected through appropriate monitoring.

The TARP that describes the primary management response for the cliffs pagoda and steep slopes focuses on ensuring the pillars are mined consistent with the design geometry. This approach is expected to be an appropriate strategy to manage the mining of these pillars.

The pillar geometries within the CLZ are expected to lead to some low level ground movements based on experience elsewhere in the Western Coalfield, possibly up to a few tens of millimetres. A subsidence monitoring system that has the accuracy/resolution to detect these low level movements would give confidence that the ground movements are being successfully monitored with sufficient accuracy to be useful from protecting significant cliff formations both during this mining and subsequently once extractive mining commences nearby.

There is some allowance within the development consent conditions for SSD_5581 for some rock falls to occur.

Occasional rock falls, displacement or dislodgment of boulders or slabs of less than 30m³, 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° of any Airly mine workings in the EP Area, other than pagodas affected by the New Hartley Shale Mine Potential Interaction Zone.

This allowance is expected to be sufficient to accommodate any rock falls that may be of predominantly natural origin as well as any mining induced rock falls that could conceivably be associated with the proposed first workings.

3. Discussion

The IEP considers there are a number of challenges for CCCL in managing surface impacts and their consequences, particularly the consequences of rock falls from cliffs and pagodas. These include:

- differentiating impacts that might occur from substantially natural causes from those that are mining induced, both during the period of active mining and afterwards

- the accuracy and timeliness with which subsidence effects can practically be measured and mining plans modified relative to the timeframe in which subsidence impacts might be observed
- the nature of the surface terrain at the site complicating the accurate measurement of subsidence effects, particularly the low magnitude effects expected above the CLZ
- the suddenness with which pillar instability might occur in the unlikely event it were to occur and therefore the inability to effectively respond.

The approach outlined in the EP to meet these challenges is based primarily on the design of the coal pillars and the expectation that these will only lead to low level subsidence at the surface. This approach is considered reasonable and appropriate but the IEP encourages CCCL to develop a demonstrably effective way to monitor ground movements in the cliff line environment above Airly Mine when the ground movements are expected to be of low level.

On Page 39 of the Airly Mine Subsidence Monitoring Program - Cliff Line Zone of First Workings Extraction Plan, there is the following note.

Note: Surface Subsidence Effects Monitoring (Ground Movements) - Due to the permanent long term stable and non-subsiding pillars with negligible pillar settlement (which will be difficult to detect compared to natural movements as concurred by IEP (refer Section 1)), compliance monitoring of ground movements is not appropriate or required for the current EP Area.

The IEP considers that the expected long term stability of the pillars and low level subsidence does not justify abandoning monitoring of ground movements in the cliff line environment at Airly Mine. Long term stability of pillars and low levels of subsidence are expected but monitoring suitable to confirm the expected outcomes and to inform future mine planning decisions is nevertheless recommended, particularly around cliff line features that are likely to be sensitive to ground movements because of their size or previous mining impacts.

Should there be any perceptible surface impacts, the challenge for CCCL will be to confirm the magnitude and mechanics of the ground movements that caused the impacts and to determine whether these impacts are mining related or not. Multiple systems, including high accuracy/resolution three-dimensional subsidence monitoring systems and the understanding that they yield are considered likely to provide the strongest basis to differentiate impacts caused by natural processes from those caused by mining.

The management plans as outlined describe several systems for monitoring ground movements. The IEP had difficulty determining whether any of these systems would be practical for the purposes of monitoring subsidence

movements of the low magnitude expected. Although not necessarily critical for first workings within the CLZ, high confidence monitoring systems will be required when adjacent extractive mining is undertaken. It would be of benefit to CCCL to have demonstrated confidence in the use of ground movement monitoring systems prior to their use for critical management decisions.

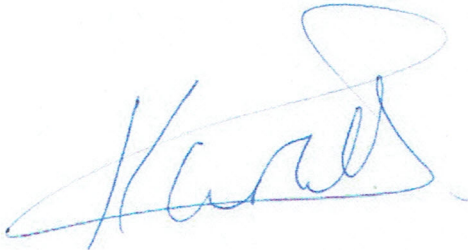
4. Conclusions

The IEP considers the various management plans that were reviewed are reasonable and appropriate to manage the unlikely event of surface impacts to cliffs, pagodas, steep slopes and other surface features from proposed first workings in the CLZ.

The IEP encourages CCCL to develop and demonstrate methods suitable to closely monitor sensitive cliff formations, even cliffs that are not expected to move significantly, so as to build confidence in the understanding of how they respond not only to mining but also to natural processes such as seasonal and diurnal temperature changes and rainfall events.

If you have any queries or require further clarification of any of the issues raised please don't hesitate to contact either Professor Ismet Canbulat or the undersigned.

Yours sincerely



Ken Mills

Principal Geotechnical Engineer (for and on behalf of the IEP)

Craig Bagnall

From: David King <david.king@centennialcoal.com.au>
Sent: Friday, 16 June 2017 3:02 PM
To: Craig Bagnall
Subject: Fw: Airly Cliff Zone First Workings Extraction Plan IEP Response

Follow Up Flag: Follow up
Flag Status: Flagged

Regards

David King
Senior Mining Engineer

p: +61 (0) 2 6359 2112 | f: +61 (0) 2 6359 2132



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----- Forwarded by David King/CentennialCoal on 16/06/17 03:01 PM -----

From: Paul Freeman <Paul.Freeman@planning.nsw.gov.au>
To: David King <david.king@centennialcoal.com.au>,
Cc: James Wearne <James.Wearne@centennialcoal.com.au>, Clay Preshaw <Clay.Preshaw@planning.nsw.gov.au>
Date: 02/06/17 11:38 AM
Subject: FW: Airly Cliff Zone First Workings Extraction Plan IEP Response

Hi David,
The Panel's responses are in the email below.

Kind regards

Paul Freeman
Team Leader, Resource Assessments
NSW Department of Planning & Environment
320 Pitt Street, Sydney NSW 2000
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From: Ismet Canbulat [<mailto:i.canbulat@unsw.edu.au>]
Sent: Friday, 2 June 2017 11:32 AM
To: Paul Freeman <Paul.Freeman@planning.nsw.gov.au>; Ken Mills <KMills@sct.gs>
Cc: Clay Preshaw <Clay.Preshaw@planning.nsw.gov.au>
Subject: RE: Airly Cliff Zone First Workings Extraction Plan IEP Response

Hi Paul,

Ken's and my combined comments are below in red:

1. Are the proposed pillar systems, as shown on the draft Plan 2 for the Extraction Plan and assessed by Golder Associates, considered to be long term stable?

The previous report of the Independent Review Panel found that the proposed pillars are long-term stable up to the maximum depth of 290m. Considering the dimensions of the pillars and the maximum depth of cover of the proposed workings are 200m, the IEP considers that the proposed pillars are long term stable as first workings.

2. Is the compressional settlement of the first workings pillar systems proposed and the resultant negligible impacts effectively non-subsiding?

The IEP expects that the ground deformations associated with the first workings pillar system proposed will be in line with the widely accepted 20mm detection limits for subsidence monitoring. The IEP understands that Airly Mine plan to undertake monitoring to confirm the magnitude of actual ground deformations in selected areas where monitoring is practical at a range of different overburden depths as part of their strategic monitoring program. The IEP endorses this monitoring as part of a strategic plan to confirm that the ground deformations are so small as to be less than normal subsidence detection limits.

3. Does the panel concur with the proposal not to include a Built Features Management Plan due to the minor nature of built features present (i.e. dirt tracks, fences, gates) and for these to be managed within the Land Management Plan and Public Safety Management Plan (including reference to the Performance Measures of Consent applicable to those minor built features)?

The IEP considers that a Built Features Management Plan is not required given the absence of significant built features other than those already, and more sensibly, covered in other Management Plans.

4. Due to the low levels of pillar compression expected and the difficulty of measuring and detecting them in the given environment, does the panel agree that surface subsidence monitoring of ground movements is not required for the first workings in the Cliff Zone of First Workings? For clarity, appropriate monitoring of ground movements for secondary extraction areas will be developed in consultation with the IEP and DRE during subsequent extraction plans.

The IEP considers, as per the response to Point 2 above, there would be strategic value to Airly Mine in confirming the actual magnitude of ground movements at the low levels anticipated as a basis to test the stability and repeatability of the various monitoring systems proposed and to provide data to support the premise to third party stakeholders that any natural rock falls that may occur during the period of mining and for a period afterwards are not related to mining deformations because the expected mining deformations are too small to be of practical significance. However, the IEP do not regard such monitoring to be required for compliance purposes.

5. Does the panel consider it is appropriate to monitor for change in environmental consequences (i.e. physical changes to cliffs and pagodas) using the proposed high definition LIDAR terrain modelling, three dimensional photogrammetry and underground pillar inspection regime?

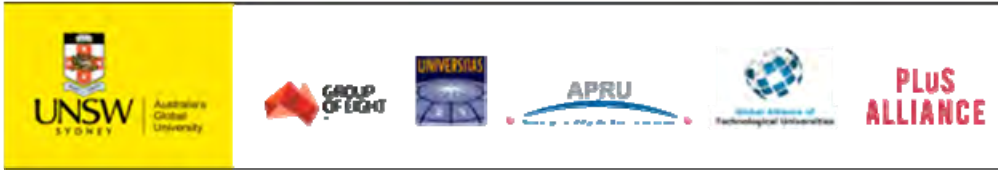
The IEP considers that the monitoring of changes in environmental consequences using the proposed high definition LIDAR terrain modelling, three dimensional photogrammetry and underground pillar inspection regime is a critical component of Airly Mine's monitoring programme because they are the most practical methods to confirm, across a large area of terrain that is difficult to access, assertions made in the various applications to Government that the proposed mining systems do not cause damage to the cliffs and pagodas. Establishing a base line of natural rock falls for the proposed area of mining and the broader area including areas that may be mined in the future is considered important. The IEP understands that the first surveys are commissioned in the next few months and repeat surveys will be conducted at about six monthly intervals. This monitoring regime is considered appropriate.

Should you require any further information please do not hesitate to contact either myself or Ken Mills.

Regards,
Ismet

Ismet Canbulat
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Kenneth Finlay Chair of Rock Mechanics
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From: Paul Freeman [<mailto:Paul.Freeman@planning.nsw.gov.au>]
Sent: Thursday, 1 June 2017 5:30 PM
To: Ismet Canbulat; Ken Mills
Cc: Clay Preshaw
Subject: FW: Airly Cliff Zone First Workings Extraction Plan IEP Response

Dear Ismet and Ken,
Centennial has asked a number of questions following yesterday's meeting (see email from David King below). I would appreciate it if you could provide me with responses as soon as possible, noting that Ken you will be away from next week. I can be contacted on 9274 6587 if you need to discuss further.

Kind regards

Paul Freeman
Team Leader, Resource Assessments
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From: David King [<mailto:david.king@centennialcoal.com.au>]
Sent: Thursday, 1 June 2017 4:38 PM
To: Paul Freeman <Paul.Freeman@planning.nsw.gov.au>; Clay Preshaw <Clay.Preshaw@planning.nsw.gov.au>
Cc: James Wearne <James.Wearne@centennialcoal.com.au>
Subject: Airly Cliff Zone First Workings Extraction Plan IEP Response

Paul and Clay,

Following the meeting yesterday with yourselves, the Independent Expert Panel and Centennial representatives, there are a number of questions for which Airly is seeking the response of the Panel in preparing the Extraction Plan for the Cliff Zone of First Workings.

Can the Independent Expert Panel please address the following questions relating to the Extraction Plan for First Workings in the Cliff Zone of First Workings within ML1331 at Airly Mine.

1. Are the proposed pillar systems, as shown on the draft Plan 2 for the Extraction Plan and assessed by Golder Associates, considered to be long term stable?
2. Is the compressional settlement of the first workings pillar systems proposed and the resultant negligible impacts effectively non-subsiding?
3. Does the panel concur with the proposal not to include a Built Features Management Plan due to the minor nature of built features present (i.e. dirt tracks, fences, gates) and for these to be managed within the Land Management Plan and Public Safety Management Plan (including reference to the Performance Measures of Consent applicable to those minor built features)?
4. Due to the low levels of pillar compression expected and the difficulty of measuring and detecting them in the given environment, does the panel agree that surface subsidence monitoring of ground movements is not required for the first workings in the Cliff Zone of First Workings? For clarity, appropriate monitoring of ground movements for secondary extraction areas will be developed in consultation with the IEP and DRE during subsequent extraction plans.
5. Does the panel consider it is appropriate to monitor for change in environmental consequences (i.e. physical changes to cliffs and pagodas) using the proposed high definition LIDAR terrain modelling, three dimensional photogrammetry and underground pillar inspection regime?

As Ken Mills is leaving for an extended absence on 6/6/17 and will be non-contactable for much of that time, I would appreciate your assistance to expedite this matter with the Panel. The response of the Panel is vital for our further consultations with other stakeholders.

I look forward to your response to this matter.

Regards

David King

Senior Mining Engineer

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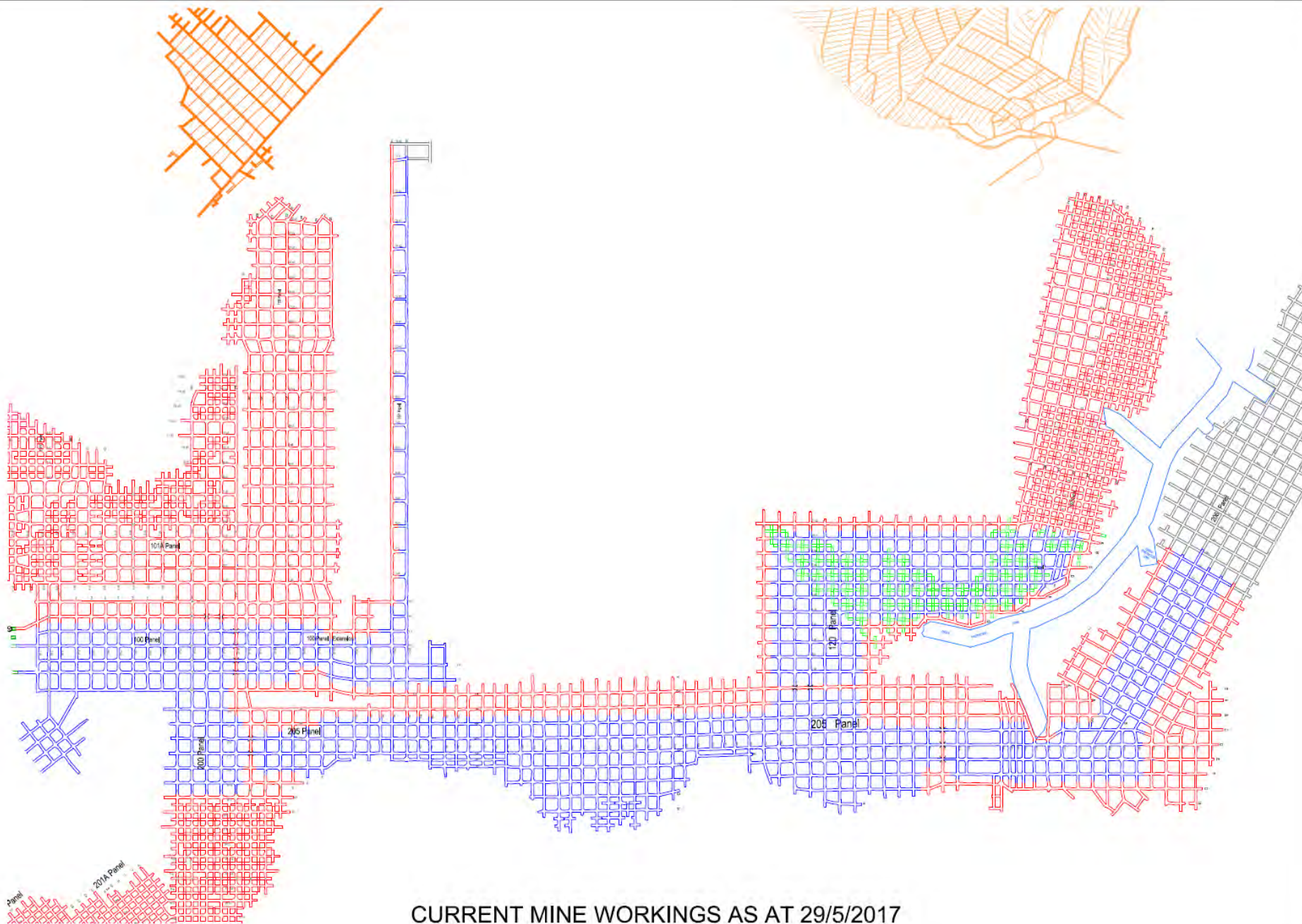


Centennial Coal



**Airly Mine
Cliff Line Zone First Workings Extraction Plan
Independent Review Panel Consultation
31st May 2017**

www.centennialcoal.com.au



CURRENT MINE WORKINGS AS AT 29/5/2017

Extraction Plan Requirements

- Schedule 3, Condition 7 (7a-7i)

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.

Notes:

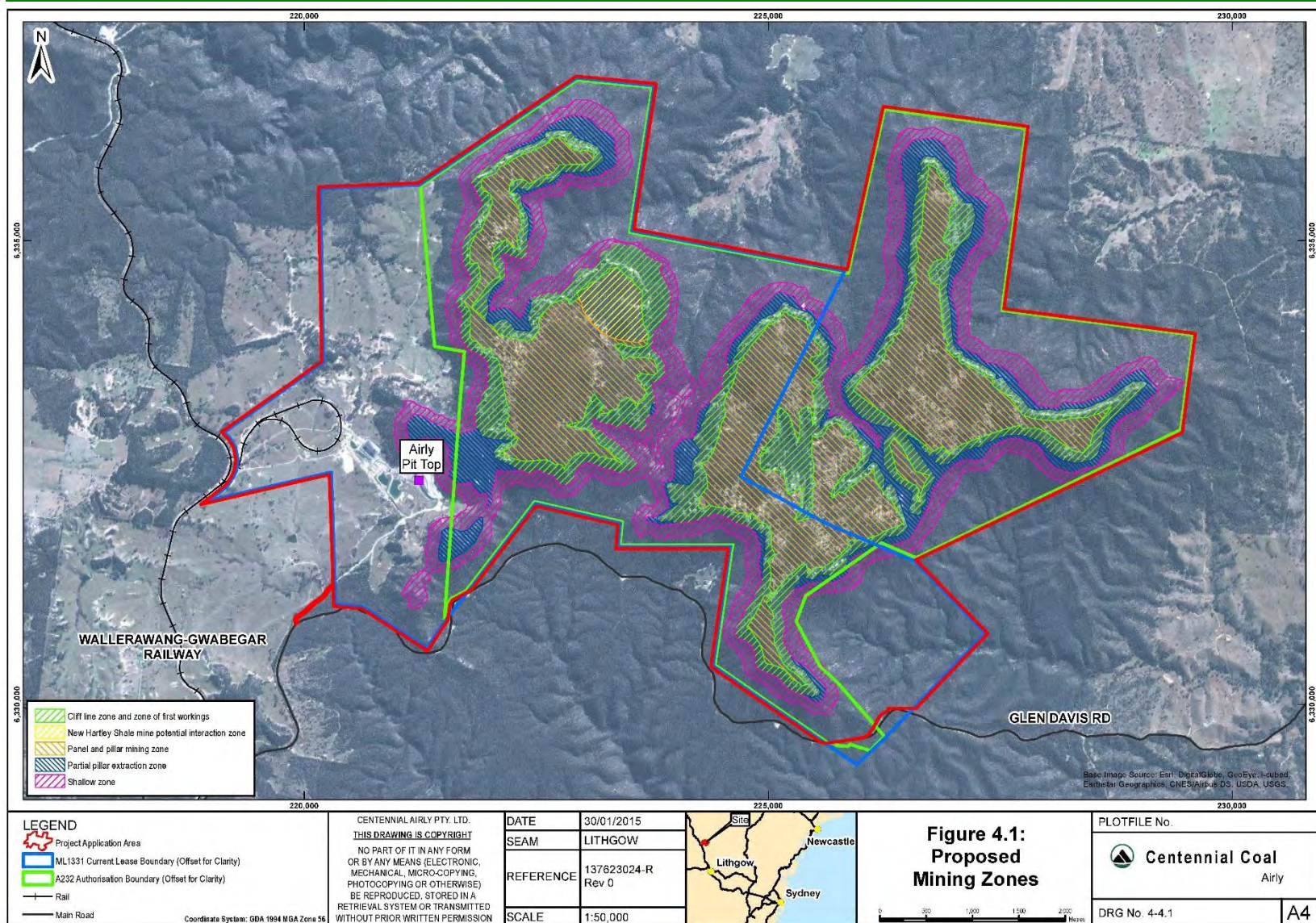
- *This condition does not apply to first or second workings which are covered by an Extraction Plan or SMP approved, or under assessment, as at the date of this development consent.*
- *In accordance with condition 4 in Schedule 6, the preparation and implementation of **Extraction Plans may be staged**, with each plan covering a defined area of underground workings. In addition, these plans are only required to contain management plans that are relevant to the specific underground workings that are being carried out.*
- *Due to the sensitive and rugged terrain of the Mugii Murum-ban State Conservation Area, the Applicant may propose remote subsidence monitoring techniques*

Cliff Line Zone and Zone of First Workings: The area of proposed mining shown in Figure 2 in Appendix 3, as may be modified by an approved Extraction Plan

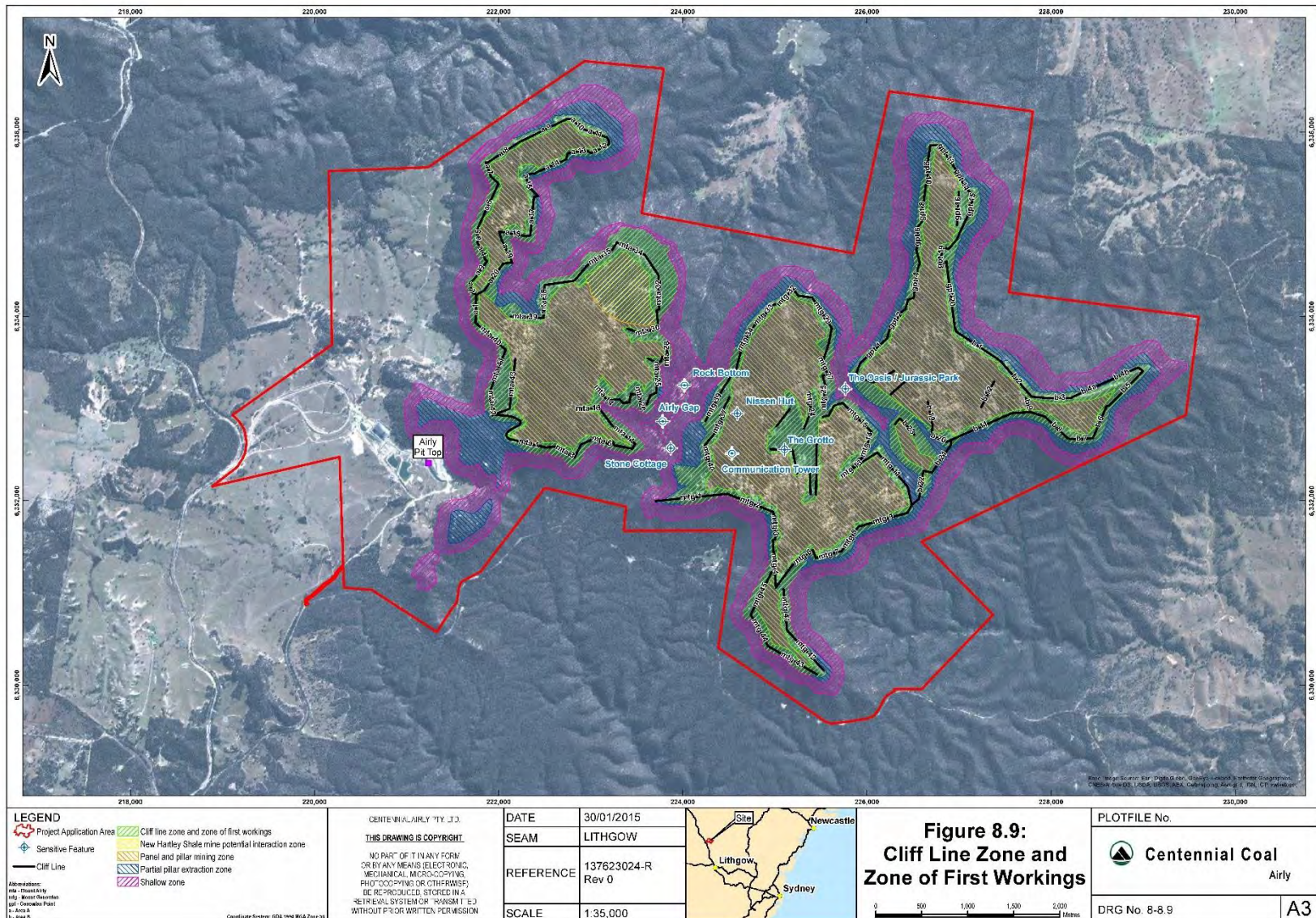
First workings: The extraction of coal by bord and pillar mining methods and from main headings and the like (but not including pillar splitting or quartering)



Mining Zones Approved by Consent (Fig2, App3)



Approved Mining Zones - Cliff Line Zone (EIS RTS)



First Workings Extraction Plan Area

- All proposed first workings within the Cliff Line Zone of First Workings (as defined in the SSD5581 EIS and modified by the Consent for the same) within ML1331, beyond existing approved MOD3 EP Areas (as varied).
- EP Application Area shaded green in the following plan





Cliff Line Zone Extraction Plan Area = proposed workings within the Cliff Line Zone within M.L.1331 beyond the existing approved MDD3 EP Areas (as varied).

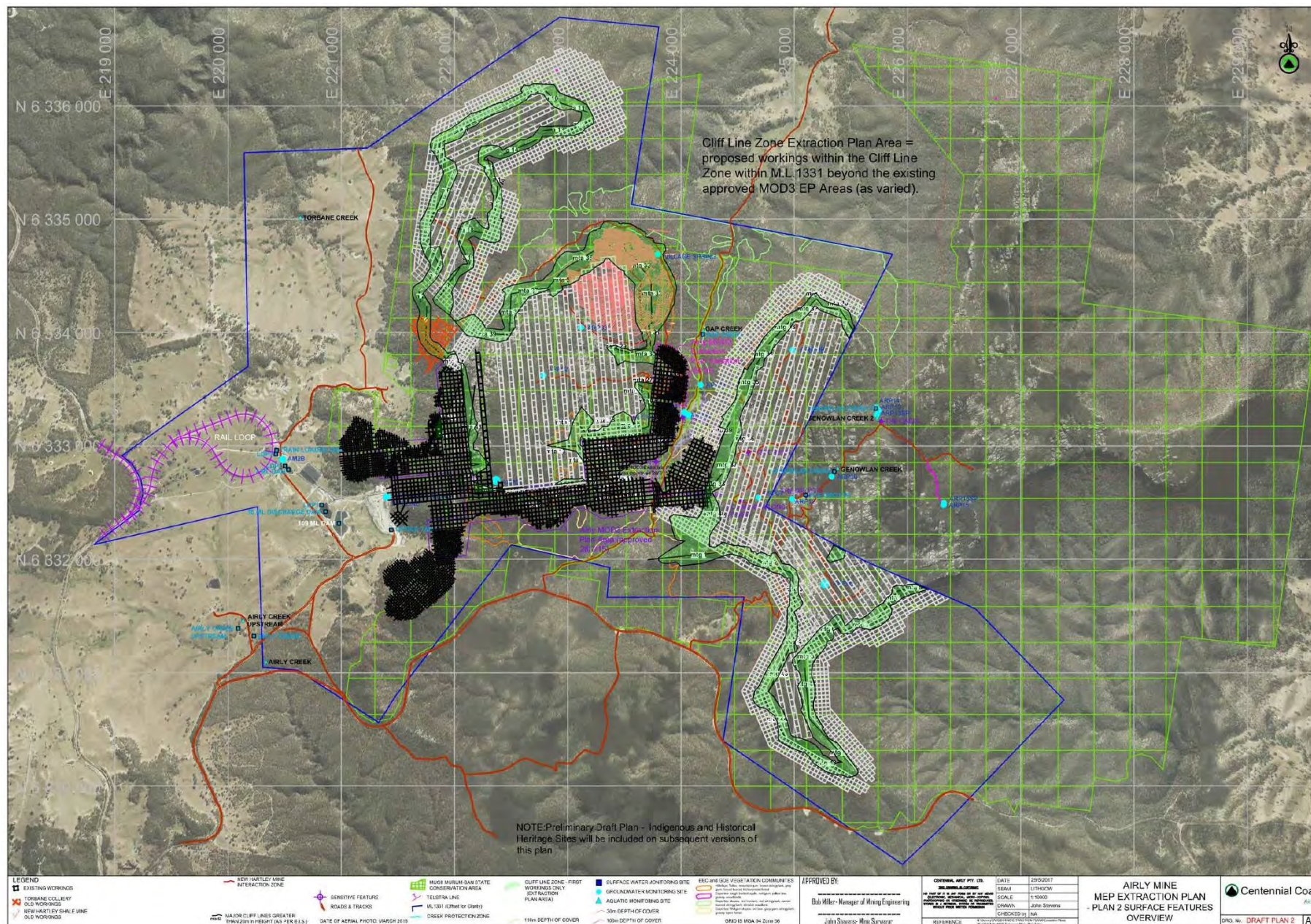
DATE	29.05.2017
SEAM	LITHGOW
DRAWN	JS
SCALE	N.T.S.
Mineplan up to date to 26/05/2017	

AIRLY MINE
EXTRACTION PLAN
- CLIFFLINE ZONE
FIRST WORKINGS
DRAFT



DRG. No AM00882A_Fev1	A3
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Cliff Line Zone of First Workings - Surface Features



Performance Measures

- Cond2 (Sch3) Table 1 - **Cliffs and pagodas** (other than pagodas affected by the New Hartley Shale Mine Potential Interaction Zone) 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.e. 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*), that in total do not impact more than 2% of the total area of such cliffs or pagodas
 - No greater subsidence impacts or environmental consequences than predicted in EIS for: minor cliffs, steep slopes, pagodas within NHSM PIZ, water quality and flow, bed and bank stability, indigenous & historic heritage, and biodiversity in this EP Area.
 - Table 1 also provides setbacks for Gap Creek, historic sites 3, 24



Performance Measures

- **Mine Workings:** First workings beneath any feature where performance measures in Table 1 require no or negligible environmental consequences and to all first workings beneath cliffs:
 - To remain long term stable and non-subsiding
- Cond3 (Sch3), Table 2:
 - **Built Features** (other features, including walking trails and 4WD tracks, fences and gates):
 - Use should be maintained wherever practicable in consultation with OEH
 - Damage must be fully repairable and must be fully repaired.
 - **Public Safety:** Negligible additional risk, in consultation with DRE and OEH.
 - *Note: Applicant will be required to develop more detailed performance measures for each of the measures in Table 2 in the BFMP or Public Safety MP.*



Subsidence Predictions and Impacts

- First workings pillar system (35 x 35m centres) have high FOS (>4) and high w/h ratio (>10)
- Probability of long term stability is 100% for first workings
- Pillar system has been assessed for second workings potential loading for mains and adjacent panels – virtually no additional impact due to maintenance of $>40\text{m}$ barrier from panel and pillar workings
- Maximum subsidence from first workings 26mm without flooding or 45mm if flooding is present (not likely)
- Additional 5mm subsidence from later second workings
- Predicted subsidence considered negligible at these levels and difficult to measure accurately at surface.



Subsidence Predictions and Impacts

- Impacts are less than those in the EIS due to lower maximum depth (i.e. 200m) in ML1331
- Pillars are long term stable
- Negligible impacts will be maintained in accordance with the EIS performance criteria for all cliffs and pagodas
- Negligible impact on surface and ground water systems due to no extraction voids being created
 - Minimal inflows noted to date in very few areas
 - No requirement to pump water out of the mine to date



Proposed Management Plans

- In accordance with Condition 7, only management plans which are directly relevant to first workings are proposed to be submitted:
 - **Built Features Management Plan** (Condition 7i (ii)) **not** considered relevant - no significant infrastructure items within proposed EP Application Area. Minor infrastructure such as tracks and trails managed within Land Management Plan and Public Safety Management Plan.
 - **Water Management Plan** for whole of mine operations already developed in consultation with DPI Water, EPA and the Commonwealth Department of Environment (Condition 15, Schedule 4). Intended that the document will be submitted as also satisfying technical requirements of Condition 7i (iii). WMP will be sent to OEH for final consultation to also meet requirements of Condition 7 (i).



Proposed Management Plans

- The remaining management plans identified in Condition 7 (i) of consent will be prepared as follows:
 - **Subsidence Monitoring Program** (specific requirements determined in consultation with IEP, DRE and OEH)
 - **Biodiversity** Management Plan.
 - **Land** Management Plan.
 - **Heritage** Management Plan.
 - **Public Safety** Management Plan.
 - Other relevant items in Condition 7(i) (e.g. contingency plan) will be addressed within the **Extraction Plan** main document and/or supporting appendices.

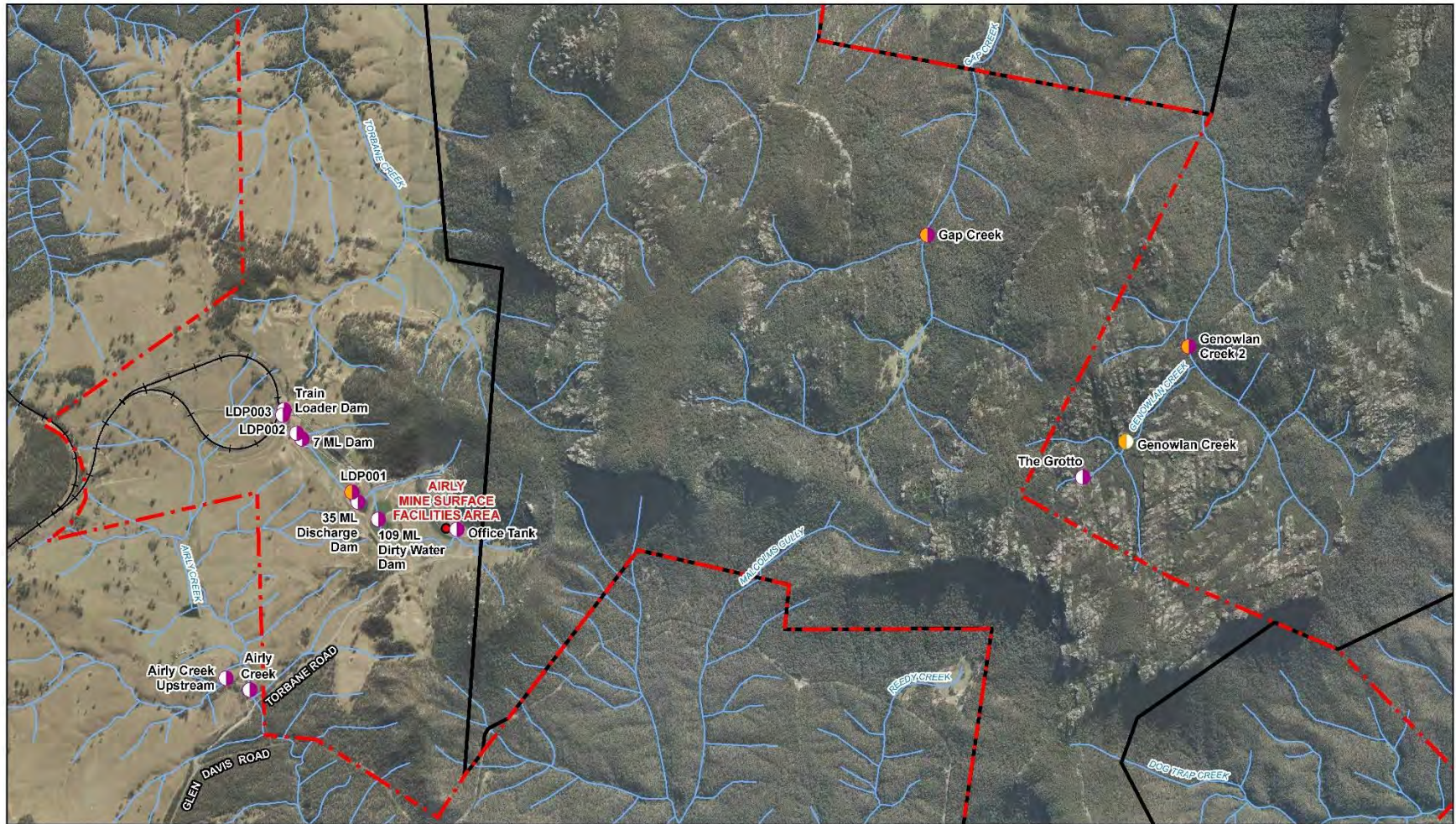


Proposed Subsidence Monitoring Program

- Airborne remote data gathering for all the Cliff Zone in ML1331
 - High definition LIDAR (4 returns per m²)
 - High resolution photogrammetry (50mm x50mm pixel size)
- Re-survey every 6 months, data analysis and reporting
- Monitors for change only due to low levels of subsidence
- Provides background data for future second workings extraction plans
- Underground pillar condition monitoring in accessible areas (statutory inspections once per week)



Airly Mine – Surface Water Monitoring Locations



Paper Size A4
0 240 480 720 960
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Airly Surface Facilities Area
- Flow monitoring
- Flow and water quality monitoring
- Water quality monitoring

- ▬ Mining Lease ML1331
- ▬ Authorisation A232
- Waterway
- Railway



Centennial
Airly

Airly Mine
Water Management Plan

Surface water
monitoring locations

Job Number 22-18803
Revision 0
Date 23 Mar 2017

Figure 4-1

2016 Groundwater Monitoring Bores

Monitoring Location	Monitoring Type	Final Depth	Completion Date
ARP11	Lithgow Seam water level & quality	15.29m	13/10/16
ARP12	Grotto surface/ alluvial water level & quality	2.6m	13/10/16
ARP13	Shoalhaven Group (120m bgl) & Devonian strata (280m bgl) water level & quality	310m	9/12/16
ARP13 SP	Lithgow Seam water level & quality	80m	25/11/16
ARP14	Oasis surface/ alluvial water level & quality	2.29m	13/10/16
ARP15	Lithgow Seam (125m bgl), Shoalhaven Group (200m bgl), Devonian strata (365m bgl) water level & quality	375m	12/1/17
ARP15 SP	Narrabeen sandstone water level & quality	22.2m	17/1/2017



Airly Mine – Groundwater Monitoring Locations



Paper Size A4
0 280 560 840 1,120
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Airly Surface Facilities Area
- Groundwater seepage
- Production bore
- Standpipe monitoring bore
- Vibrating wire piezometer
- Mining Lease ML1331
- Authorisation A232
- Waterway



Centennial
Airly

Airly Mine
Water Management Plan

Groundwater
monitoring locations

Job Number 22-18803
Revision 0
Date 23 Mar 2017

Figure 4-2

Stakeholder Consultation

- NPWS and OEH
 - Initial consultation undertaken and feed back included
- DP&E and Independent Expert Panel
 - Commenced
- Crown Lands, DRE
 - Soon to commence
- Note: no private land owners within EP Area



Discussion and Feedback



Craig Bagnall

From: James Wearne <James.Wearne@centennialcoal.com.au>
Sent: Tuesday, 30 May 2017 9:32 AM
To: Craig Bagnall; David King
Subject: Fw: Airly Extraction Plan
Attachments: Letter to DPE - Airly Extraction Plan.pdf; Appendix 1_CVs.pdf; Appendix 3_Pillar Stability and Subsidence Report.pdf; Appendix 4_Outline of Aerial Cliff Monitoring.pdf; Appendix 2_Preliminary Figures & Plans_rs2d.pdf

Regards

James Wearne

Group Manager Approvals

p: +61 (0) 2 4935 8944 | m: +61 (0) 407 207 530



Centennial Coal

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100 Miller Road, Fassifern NSW 2283 Australia

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----- Forwarded by James Wearne/CentennialCoal on 30/05/2017 09:31 AM -----

From: Paul Freeman <Paul.Freeman@planning.nsw.gov.au>
To: "i.canbulat@unsw.edu.au" <i.canbulat@unsw.edu.au>, Ken Mills <KMills@sct.gs>,
Cc: James Wearne <James.Wearne@centennialcoal.com.au>, Clay Preshaw <Clay.Preshaw@planning.nsw.gov.au>
Date: 30/05/2017 09:31 AM
Subject: FW: Airly Extraction Plan

Dear Ismet and Ken,
Please find attached further background information for the meeting on Wednesday 31 May.
If you wish to discuss further, please contact me on 9274 6587.

Kind regards

Paul Freeman
Team Leader, Resource Assessments
NSW Department of Planning & Environment
320 Pitt Street, Sydney NSW 2000
GPO Box 39, Sydney NSW 2001
(02) 9274 6587
www.planning.nsw.gov.au

Subscribe to the Department's e-news at www.planning.nsw.gov.au/enews

From: James Wearne [<mailto:James.Wearne@centennialcoal.com.au>]
Sent: Tuesday, 30 May 2017 9:20 AM
To: Paul Freeman <Paul.Freeman@planning.nsw.gov.au>
Cc: Clay Preshaw <Clay.Preshaw@planning.nsw.gov.au>
Subject: Fw: Airly Extraction Plan

Hi Paul,

Please find attached Appendix 2 to the letter submitted last week regarding Airly.

Can you please forward to the IEP in preparation of our meeting tomorrow afternoon.

Regards

James Wearne

Group Manager Approvals

p: +61 (0) 2 4935 8944 | m: +61 (0) 407 207 530



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From: James Wearne/CentennialCoal
To: Paul Freeman <Paul.Freeman@planning.nsw.gov.au>,
Cc: "Clay Preshaw" <Clay.Preshaw@planning.nsw.gov.au>
Date: 26/05/2017 04:15 PM
Subject: Airly Extraction Plan

Hi Paul,

Please find attached a letter and associated information regarding the Airly Extraction Plan.

Appendix 2 (figures) will be provided on Monday next week.

I am happy for you to pass the relevant information on to the Airly IEP to facilitate discussions next week.

26 May 2017

Mr Clay Preshaw
A/Director - Resource Assessments
NSW Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Dear Mr Preshaw

Airly Mine: Cliff Line Zone and Zone of First Workings Extraction Plan

Centennial Airly Pty Limited (Centennial Airly) is required to prepare and submit an Extraction Plan to the Department of Planning and Environment (DP&E) in accordance with Condition 7 of Development Consent SSD_5581 (December 2016) for first workings within the *Cliff Line Mining Zone and Zone of First Workings*.

This letter is provided to DP&E to:

1. Seek endorsement of the proposed team to prepare the Extraction Plan.
2. Clarify relevant management plans proposed for submission with the Extraction Plan.
3. Provide preliminary information for consultation with the Independent Expert Panel (IEP).

Details for each of the above are outlined separately below and in related Appendices as referenced.

1. Endorsement of proposed team to prepare the Extraction Plan

Condition 7(a) of Development Consent requires the Extraction Plan to be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the Secretary (DP&E). Accordingly, Centennial Airly seeks endorsement for the selected team presented in **Table 1** below. Copies of Curricula Vitae for key project team members are enclosed in **Appendix 1**. The proposed team members are experienced in the delivery of extraction plans and supporting management plans to address potential mine subsidence impacts. The lead consultant, Craig Bagnall, has been delivering SMPs and Extraction Plans since 2004 and has previously been endorsed by DP&E, including specifically for Airly Mine for the previous MOD3 Extraction Plan.

Table 1: Extraction Plan Project Team

Project Team Member	Project Role
Consultants:	
Craig Bagnall, Niche Environment & Heritage	<ul style="list-style-type: none"> Lead Consultant and Project Manager. Assist preparation of Extraction Plan, PSMP, LMP, Subsidence Monitoring Program, EP Risk Assessment.

Project Team Member	Project Role
Consultants:	
David Hill, Golder Associates	<ul style="list-style-type: none"> • Pillar Stability and Subsidence Assessment
Lachlan Hammersley, GHD	<ul style="list-style-type: none"> • Water Management Plan
Tessa Boer-Mah, RPS	<ul style="list-style-type: none"> • Heritage Management Plan
Arne Bishop, RPS	<ul style="list-style-type: none"> • Biodiversity Management Plan
Brian Hammonds and Jason Pollock, RPS	<ul style="list-style-type: none"> • Consultant surveyors assisting components of the Subsidence Monitoring Program including cliff and pagoda monitoring.
Centennial Coal Team Members:	
David King, Senior Mining Engineer, Centennial Airly Mine	<ul style="list-style-type: none"> • Mine engineering, planning and design • Centennial Project Manager for the EP. Assist preparation of Subsidence Monitoring Program, Extraction Plan, Public Safety Management Plan, Land Management Plan, EP Risk Assessment.
James Wearne, Group Manager – Approvals, Centennial Coal	<ul style="list-style-type: none"> • Project direction, QA review of Extraction Plan and EP Risk Assessment.

2. Relevant Management Plans

Centennial Airly is pursuing a staged approach to Extraction Plans (EP). Condition 7 requires an approved Extraction Plan prior to carrying out any first workings in the Cliff Line Zone and Zone of First Workings. Centennial Airly is currently preparing an EP for this which will be bound within existing Mining Lease ML1331 (A232 area excluded). For clarity no secondary extraction is proposed within this EP. Existing approved areas from the MOD3 Extraction Plan (as varied 2016) will be excluded, there are no changes proposed to the mine plan within those areas. The EP Application Area is illustrated on **Figure AM00882** enclosed in **Appendix 2**.

In accordance with Condition 7, only management plans which are directly relevant to first workings are proposed to be submitted within this EP, as follows:

- A dedicated Built Features Management Plan (Condition 7i (ii)) is not considered relevant to the current Extraction Plan and is not proposed to be submitted as no significant infrastructure items are located within the proposed EP Application Area. Minor infrastructure such as tracks and trails will be managed within the Land Management Plan and Public Safety Management Plan.
- The remaining management plans identified in Condition 7 (i) of consent will be prepared as follows:
 - Subsidence Monitoring Program (specific requirements determined in consultation with IEP, DRE and OEH).
 - Water Management Plan.

- Biodiversity Management Plan.
- Land Management Plan.
- Heritage Management Plan.
- Public Safety Management Plan.
- Other relevant items in Condition 7(i) (e.g. contingency plan) will be addressed within the Extraction Plan main document and/or supporting appendices.

Matters specifically relevant to the Cliff Line Zone and Zone of First Workings will be addressed within dedicated management plans for the EP Area developed for each of the above aspects, with the exception of the Water Management Plan for which the following is currently proposed:

- A site specific **Water Management Plan** for whole of mine operations has already been developed in consultation with DPI Water, EPA and the Commonwealth Department of Environment in accordance with Condition 15, Schedule 4 of Consent. It is intended that the document will be submitted as also satisfying the technical requirements of Condition 7(i) for the Extraction Plan. Additionally the WMP will be sent to OEH for final consultation in order to meet requirements of Condition 7 (i) prior to submission with the Extraction Plan.
- Clarification of expected water make (expected to be negligible) as a result of first workings in the EP Application Area will be provided within the Extraction Plan document to provide specific context to the Cliff Line Zone and Zone of First Workings.

3. Preliminary information for consultation with the Independent Expert Panel (IEP)

We understand all information to the IEP is to be sent through DP&E. Please find enclosed in Appendices 2-4 the following information for provision to the IEP as soon as possible:

- **Appendix 2: Figures and Plans**
 - EP Application Area Figure (**AM00882**) including proposed mine layout for first workings;
 - Draft version of Graphical Plan 2 (Surface Features) - detailed mine plan at A0 scale.
- **Appendix 3: Pillar Stability & Subsidence Report** for the final mine design (Golders Associates, May 2017)
- **Appendix 4: Outline of proposed remote monitoring for cliffs and pagodas** (RPS, 2017).
 - Note: Further details of an integrated monitoring program will be provided in a Subsidence Monitoring Program document to be developed (including monitoring of underground conditions), which will be discussed at the consultation meeting with the IEP and DP&E on 31 May.

If you have any further questions in regards to the above information, please contact me on my mobile 0407 207 530 or email james.wearne@centennialcoal.com.au.

Yours sincerely



James Wearne
Group Approvals Manager

Enclosed:

- **Appendix 1:** CV's of key project team personnel
- **Appendix 2:** Figures and Plans (draft)
- **Appendix 3:** Pillar Stability and Subsidence Report
- **Appendix 4:** Outline of proposed remote monitoring of cliffs and pagodas

APPENDIX 1: Curricula Vitae

**Education**

Management Development Programme, University of South Africa, 1992.

Graduate Diploma in Engineering, University of the Witwatersrand, Johannesburg, South Africa 1989

Chamber of Mines Rock Mechanics Certificate (Coal), South Africa, 1988.

Mine Managers Certificate (Coal), South Africa, 1986

Bachelor of Science (Hons) Mining Engineering, Nottingham University, Nottingham, United Kingdom, 1984

Affiliation

Member, South African Institute of Mining and Metallurgy

Publications

5 published ACARP research projects; 12 other peer reviewed publications.

Relevant Experience

*Pre-feasibility / feasibility studies
Underground coal mine design
Tunnel support design.
Longwall geomechanics
Geotechnical audits
Due diligence studies.*

Golder Associates Pty Ltd – Newcastle**Technical Director**

David has 36 years' experience in the coal mining industry, including 25 years as a geotechnical consultant, plus 8 years in coal mine production and planning. He demonstrates particular expertise in underground coal geotechnics. As Technical Director, David's role involves consulting and providing managerial support to the mining team in the Newcastle Office.

David has provided geotechnical advice to over 70 coal mining operations and projects in Asia, Australasia, Europe and South Africa. He has managed and authored industry research reports for five projects conducted for the Australian Coal Association Research Program (ACARP) and reviewed three others. David has assisted the New South Wales government by acting as the technical author of the Department of Trade and Industry's Code of Practice for Strata Control in Underground Coal Mines, as well as in the design of measures to address legacy issues associated with the remediation of old mine workings and subsidence-related damage to the surface and infrastructure.

Areas of Practice

- Concept, pre-feasibility and feasibility studies (South Africa, Asia and Australia).
- Underground access (tunnel and shaft) support design and monitoring (South Africa, Australia and Europe)
- Underground coal mine design (South Africa, Asia and Australasia)
- Underground roadway / tunnel roof and rib support design and monitoring (South Africa and Australia)
- Strata management (Australasia)
- Multi-seam interaction assessment (Europe, South Africa and Australia)
- Longwall geomechanics (Australia)
- Longwall recovery (Australia)
- Ground consolidation (Australia)
- Highwall mining design, including multi-seam design (Indonesia and Australia)
- Subsidence assessment and management (South Africa and Australia)
- Surface slope stability assessments (South Africa and Australia)
- Geotechnical system audits (Australia)
- Due diligence studies (Australia and Asia)
- Accident and incident investigation (South Africa and Australia)
- Cuttability studies (South Africa, Europe and Australia)



PROJECT EXPERIENCE

Glencore Coal Assets Australia NSW and QLD	External content expert for the 2015-2016 GCAA Underground Strata Failure Assurance Program, including underground inspections, strata management system review, reporting and follow-up auditing, covering seven Australian mines.
Clarence Colliery NSW, Australia	Principal Engineer for geotechnical aspects of underground layout design, including characterisation; pillar / tunnel design; ground support design; extraction planning and auditing; incident investigation; risk assessment and the analysis, prediction, monitoring and auditing of ground deformation, stress and subsidence (related partly to the protection of sensitive natural landforms), from 2005 (ongoing).
Airly Mine NSW, Australia	Principal Engineer for geotechnical aspects of underground layout design, including characterisation; highwall entry design; pillar / tunnel design; ground support design; extraction panel design; incident investigation; risk assessment and the analysis, prediction, monitoring and auditing of deformation, stress and subsidence (related partly to the protection of sensitive natural landforms), from 2009 (ongoing).
Bulga (Glencore): Blakefield South, Beltana No.1 and South Bulga Mines NSW Australia	Principal Engineer for geotechnical aspects of underground layout design, including characterisation; highwall entry and drift design; pillar and tunnel design; ground support design; longwall extraction panel and support design; strata management system development; training of operating personnel in strata control principles and ground deformation monitoring, incident investigation and risk assessment, from 2001 (ongoing).
Department of Trade and Industry NSW, Australia	Technical author of the DTI's Code of Practice for Strata Control in Underground Coal Mines, prepared on behalf of Safe Work Australia. The code covers risk management, the regulatory framework, geotechnical data collection and site characterisation, geotechnical design, monitoring, controls, audit and review (2012).
Polyak Eynez Turkey	Principal Engineer providing external review of geotechnical characterisation, ground support and management practices associated with squeezing ground in the main access drift, from 2015 (ongoing).
Ashton Mine Australia	Principal Engineer for underground geotechnics, including ground characterisation; initial highwall stability assessment; portal support design; shaft and drift ground characterisation, support design, monitoring and strata management; ground support design, monitoring / strata management; caveability and windblast assessment for longwall and partial extraction workings; subsidence analysis and design for critical infrastructure protection (shafts and the New England Highway); cuttability assessment for in-seam dirt bands and igneous intrusions; longwall recovery design, monitoring and strata management advice; multi-seam stress analysis and interaction assessment; pillar stability analysis, from 2005 (ongoing).
Glendell (Glencore) Australia	Principal Engineer for the design of proposed multi-seam highwall mining workings (2012).
Ravensworth (Glencore) Australia	Principal Engineer for underground geotechnics, including characterisation; drift stability assessment; ground support design, monitoring / strata management; caveability and windblast assessment for longwall extraction; cuttability assessment for in-seam igneous intrusions; longwall recovery design, monitoring and strata management advice; pillar stability analysis and training of operating personnel in strata control principles (2008-2012).
Integra Mine Australia	Principal Engineer for underground geotechnics, including ground characterisation; portal stability auditing and remedial support design; inter-seam drift mapping and monitoring; ground support design, monitoring / strata management; caveability and windblast assessment for longwall extraction; longwall recovery design, monitoring / strata management; pillar stability analysis and partial extraction design (2004-2013).

Craig Bagnall

BE (Env) (Hons), CEnv (IA Specialist)

Senior Environmental Engineer



"I aim to deliver practical, risk-based solutions for projects with effective front end loading to address key constraints. I enjoy working closely with clients and project teams to deliver projects that employ best practice."

- Project Manager for Major Approvals, Licencing and Compliance
- CEnvP (Impact Assessment Specialist)
- 20 years cross-disciplined experience in environmental profession
- Over 13 years specialising in Mine Subsidence Management
- Experienced lead consultant for Assessments, Compliance & Reporting
- Surface water and ESC specialist assessments, monitoring & management

Career overview



Craig has over 20 years environmental experience, including multi-disciplined experience in mining, heavy industry, agriculture and solid waste management. He assists clients with assessing constraints, approvals, implementation, regulatory compliance and reporting.

Craig is a Certified Environmental Practitioner (CEnvP) with advanced Impact Assessment accreditation, an experienced project manager and environmental engineer. Craig has substantial experience in environmental impact assessment for State Significant Developments (SSD), successfully managing and delivering primary and secondary approvals for major projects as well as smaller approvals (REF etc). Craig has been endorsed by NSW DP&E for various projects in NSW as a lead consultant to prepare detailed Extraction Plans (and formerly Subsidence Management Plans) which he has successfully delivered since 2004. As an environmental engineer Craig also provides specialist services in surface water management and has been an Expert Witness to the NSW Land and Environment Court. Craig is also a former officer of the NSW Waste Boards and has managed both state and regional waste programs across multiple disciplines from technical infrastructure to waste auditing. Craig's career has also included mine rehabilitation projects, assessment and management of contaminated lands, groundwater studies, air quality studies, and industrial waste water monitoring and management. Outside professional work Craig has also been a Director of a medical charity (Hunter & Northern Kidney Association) for over 10 years.

Employment history

2013–present	Senior Environmental Engineer, Niche Environment and Heritage
2012–2013	Principal, Environmental Management Planning and Approvals, and National Design Control Manager, SLR Consulting Australia
2004–2012	Senior Associate - Technical Manager / Associate / Team Leader / Senior Projects Manager, GSS Environmental (acquired by SLR Consulting)
2001	NSW Waste Boards – Recycled Products Development Officer (Contract)
1999–2003	Co-author of Ecotourism/Cycling Travel Guide with education focus. (included Great Barrier Reef MP Authority, National Parks field assistance).
1998–1999	NSW Waste Boards – Hunter Waste Board, Waste Programs Officer
1995–1998	HLA-Envirosciences (now part of AECOM), Environmental Engineer / Trainee Environmental Engineer, Mining and Industry (air quality, contaminated lands, surface and ground water)
1994	Geomorphology Group Assistant (Vol), ERISS (Environmental Research Institute of the Supervising Scientist), Ranger Uranium Mine
1993	Newcastle City Council – Hydrology Dept, Casual Cadet Engineer

Skills

- Project Management
- Subsidence Management – Environment & Infrastructure
- Regulatory compliance, auditing, environmental monitoring design and reporting

Craig Bagnall

BE (Env) (Hons), CPEnv (IA Specialist)

Senior Environmental Engineer

- Project approvals and licencing
- Integrated Environmental Impact and Risk Assessment
- Post-Approval Environmental Management
- Environmental & Infrastructure Management Plans
- Water management, erosion and sediment control & rehabilitation
- Government Agency and Stakeholder Consultation

Key Experience & Flagship projects:

Subsidence Management *(Environment & Infrastructure)*

Subsidence Approvals, Infrastructure and Environmental Management

Craig has been endorsed by NSW regulatory authorities as lead consultant and project manager for numerous SMP and Extraction Plan assessments across various NSW mines working closely with specialists since 2004. Craig has also recently been endorsed by the Commonwealth Department of Environment (DoE) as lead auditor for Commonwealth SMP conditions at a NSW mine. Projects range from bord and pillar partial extraction techniques to complex multi-seam longwall mining with detailed infrastructure and environmental management/monitoring requirements. Sensitive areas managed have included World Heritage Areas, National Parks, State Conservation Areas and State Forests. Natural features managed include surface water (including ponding and flooding), ground waters (including alluvium/GDEs and management of saline mine water make), terrestrial and aquatic/wetland ecology (including EPBC aspects and offsets), sensitive cliffs and pagodas, indigenous and historic heritage. Infrastructure management has included roads, pipelines, communications (optic fibre & copper), powerlines (up to 330kV), residences and private property, water bores, railways and other built environment. Craig managed the SMP for the first 400m wide longwall in Australia in 2004 and developed integrated SMP/EP approval applications prior to the phase in of Extraction Plans. Applications delivered for major mining companies have included Glencore Xstrata (Ulan Coal 2005, 2007, 2011; Bulga Underground / Blakefield South 2010-2013); Centennial Coal (Awaba 2008, 2009; Newstan 2012; Angus Place 2013; Airly Mine 2014-15, 2016, Mandalong Mine LW22-23 Extraction Plan 2016, and assistance with Springvale Mine LW420-422 EP 2016).

Compliance Reporting & Auditing

Regulatory Compliance – Monitoring, Reporting & Auditing

Patons Lane Quarry Void Dewatering Project 2016-2017, Annual/Quarterly Environmental reports and specialist reports (Bulga Complex 2010-2013), Kooragang & Port Waratah Coal Terminals, Coal & Allied HVO & MTW, ProTen Ltd, Wild Quarries. Detailed voluntary water management and regulatory compliance audits at two major underground mines (confidential client, 2012-13), Marys Mount Quarry water management design verification review to NSW EPA (2014), Environmental Audits RTA Western Region Works Depots (several depots in central & western NSW; Voluntary Waste Audits & Waste Reduction Plans for Commercial & Industrial Sector - Provision of waste audit guidelines and establishment of case studies in Hunter. Undertook hospitality industry waste audit (Club Phoenix) and Waste Reduction Plan. Craig assisted in Cleaner Production studies and in preparation of the NSW waste auditing guidelines and accreditation scheme for the C&I sector.

Mining Impact Assessments and Management Projects

Environmental Assessment and Approvals

Project Manager and lead consultant for Environmental Assessments for State Significant Developments (SSD) for Centennial Coal's Awaba Colliery Continued Operations Project (Part 3A, 2010); Project technical manager for key risk components for Part 4 SSD EIS for Marulan Mine (2014-16) including surface water, groundwater, soils and rehabilitation, AIS and SVC; Project Director for Consent/Project Approval modifications for Glencore Xstrata Blakefield North project under s75W including major mine gas recovery and power plant generation (2011-2012); s96 Mod Centennial Coal Cooranbong Coal Handling & Preparation Plant

**Mine Rehabilitation ,
Erosion and Sediment
Control, Surface Water
Management**

(2009); s96 Mod Muswellbrook Quarry (2006); s96 Mod Proten Taradale Broiler Facility (2005). Craig has substantial experience in leading major secondary approvals including Extraction Plans/SMPs, Mining Operations Plans (MOPs/RMPs) and REFs as detailed below.

Exploration Management and Infrastructure REF Approvals

Preparation of REF's in support of approvals for exploration drilling including pads and access roads and waste water & solids management, including to latest regulatory framework (eg Aquifer Interference Policy (AIP) and Strategic Regional Land Use Planning / Agricultural Impact Statements). Craig led a team which developed new area-based & risk-based methods for exploration REFs in 2007, now adopted widely in NSW. Craig has also completed REF approvals for infrastructure projects including high voltage powerlines under Part 5 of the EP&A Act. Key example REF projects include Awaba East Exploration Project and Modifications (2007-2009); Mandalong Mine Exploration Areas and Modifications (2009-2013), Clarence Colliery Exploration (2014 & 2015); West Wallsend 132kV powerline REF Amendment (2014); Harrington Back Channel Maintenance Dredging REF (2015); West Wallsend 132kV revised route full Part 5 EIA/REF approval (2015).

Rehabilitation Plans/ Life of Facility Plans / Security Deposit Calculation

Key projects include development of Kooragang and Carrington Coal Terminals LOF Plans (2006-7); Boral Peppertree Quarry Rehabilitation Management Plan (2017), EIS technical coordinator for soils and rehabilitation - Boral Marulan South Limestone Mine SSD project (2015-current), Rehabilitation Security Deposit calculations (including MOPs/AEMRs) for Ulan Coal (2004-6), Blakefield South (2010-12). Conceptual final landform capping for surface water management aspects – Orchard Hills Waste Management Centre (2010);

Surface Water Assessments / Erosion and Sediment Control

Surface water assessments (SWA) projects include lead consultant and expert witness to NSW Land & Environment Court for Orchard Hills Quarry Waste Management Project (2010-12); Project technical manager for key risk aspects for Marulan Mine Part 4 SSD project (2014-2016) including surface and ground water assessments, soils, rehabilitation; Project lead Pinedale Coal Mine Stage 1 SWA (2010) and Stage 2 SWA (2011/12); Marulan Limestone Mine SWA (2009); Project lead for water quality characterisation, flow regime review, treatment and dewatering management plan for 350ML flooded quarry (PLRRRC, 2015-2016); Erosion and sediment control and surface water monitoring review to Marulan Limestone Mine (2017), East Quarry review to EPA (2013/14); East Quarry EPL PRP Works (Engineering Design Review) to Blue Book V2 2015; Marys Mount Quarry EPL Dust and Water Monitoring and Management Review (2014); Marys Mount Quarry Sediment Dams Design Verification Report to EPA (2014); Bloomfield Colliery ESCP (2011-12); Blakefield South ESCP for major works on private property (2010/11); Introduction to Blue Book Volume 2E (Mines & Quarries) Training to Xstrata corporate environmental management team (2010); Muswellbrook Quarry ESCP (2004/5); HVO Rehabilitation Audit Report (2006); Dendrobium Vent Fan construction and access roads ESCP & water monitoring (2005); Newnes Quarry ESCP adjacent World Heritage Area (2004); ESC for numerous exploration programs (2007-2015, details below). Craig also works closely with leading experts in landform stability assessment using dynamic erosion and evolution models (eg Marulan SSD EIS 2015-current).

Further details including other disciplines and industries available on request.



Dr Stuart Gray

Senior Hydrogeologist



Qualified. PhD in Environmental Engineering, BE (Env) (Honours 1)
Relevance to project. Stuart is a Senior Hydrogeologist based in GHD's Newcastle office. He has had 15 years' experience in groundwater modelling and impact assessment, management of large environmental monitoring projects, geochemical modelling and site remediation projects in both the private and public sectors. In recent years, Stuart has had a technical leadership role in surface water and groundwater assessments for mining projects.

Examples of Past Experience in Mine Hydrogeology

Centennial Airly | Airly Mine Extension Project Surface Water and Groundwater Impact Assessment

Technical Lead role, hydrogeological modelling of groundwater inflows and drawdown, groundwater impact assessment against the Aquifer Interference Policy

Centennial Coal | Western Coalfield Water and Salt Balance

Technical Lead role in the development of a regional water and salt balance for the Western Coalfield, with a focus on Water Access Licence requirements throughout the life of mine

Centennial Coal | Newcastle Coalfield Water and Salt Balance

Technical Lead role in the development of a regional water and salt balance for the Newcastle Coalfield, with a focus on cumulative impacts of mining operations on Lake Macquarie

Centennial Mandalong | Mandalong South Extension Project Groundwater Impact Assessment

Hydrogeological modelling of groundwater inflows and drawdown, assessment of non-rainfall related effects on alluvial groundwater levels, groundwater impact assessment against the Aquifer Interference Policy

Centennial Mannering | Mannering Colliery Hydrogeological Model and Water Management Assessment

Technical Lead role in the preparation of specialist water studies to support a Section 75W Modification

Centennial Myuna | Myuna Colliery Hydrogeological Model and Water Management Assessment

Hydrogeological modelling and groundwater impact assessment to support a Part 3A Environmental Assessment for life of mine

Centennial Awaba | Awaba Colliery Hydrogeological Model and Water Management Assessment

Hydrogeological modelling and groundwater impact assessment to support a Part 3A Environmental Assessment for life of mine

Centennial Newstan | Newstan Colliery Subsidence Management Plan LW 101-103

Hydrogeological modelling and groundwater impact assessment to support a Subsidence Management Plan for additional longwalls at Newstan Colliery



Centennial Airly | Airly Mine Surface Water and Groundwater Monitoring Report 2013

Reporting and interpretation of surface water and groundwater monitoring data for 2013 at Airly Mine

Springvale Coal | Springvale Mine Hydrogeology Review

Review of hydrogeology data and COSFLOW model for Springvale Mine

Newcrest | Cadia Valley Operations Monitoring Data Review

Review of surface water and groundwater quality data to identify the source of elevated salinity in receiving waters

Western Desert Resources | Roper Bar Iron Ore Mine Groundwater Monitoring Program Review

Review of the proposed groundwater monitoring program for the proposed Roper Bar iron ore mine, as requested by the Northern Territory Department of Mines

Holcim Australia | Tuncurry Sand Quarry

Groundwater and surface water impact assessment for a Tuncurry sand quarry

Unimin | Tallawang Magnetite Mine

Investigation of seepage from a tailings dam and assessment of groundwater impacts

Springvale Coal | Geochemical Modelling of Mine Water

Geochemical modelling with PHREEQC to assess the alkalinity of underground water discharged at Springvale Coal and assessment of neutralisation options

Peabody Wambo Coal | Groundwater Monitoring Program Review

Review of the groundwater monitoring program at Wambo Coal and assessment of the source of salinity in alluvial groundwater

Centennial Mandalong | Subsidence Management Plans, LW 15-17 and 18-21

Hydrogeological modelling and groundwater impact assessment to support Subsidence Management Plans for additional longwalls at Mandalong Mine

Centennial Mandalong | Independent Environmental Audit – Groundwater Specialist

Groundwater specialist input to support the Independent Environmental Audits for Mandalong Mine in 2010 and 2013

Centennial Mandalong | Mandalong South Bore and Vibrating Wire Piezometer Installation

Project management of the installation of groundwater monitoring bores and vibrating wire piezometers throughout the Mandalong Southern Extension Area

Centennial Newstan | Newstan Colliery Aquatic Ecology Monitoring Program

Project management of the aquatic ecology monitoring program along LT Creek

Other related areas of interest

- Groundwater flow, contaminant transport and geochemical modelling.
- Groundwater impact assessment.
- Design, implementation and review of soil, surface water and groundwater monitoring programs.
- Groundwater remediation.



Curriculum Vitae

Lachlan Hammersley Senior Environmental Engineer



Qualified. Bachelor of Engineering (Environmental), CPESC, Diploma Project Management

Relevance to project. With over 8 years of experience, Lachlan has worked on a broad range of water related projects including roles as Project Manager, Lead Design Engineer, and environmental impact specialist water team member. Projects Lachlan has been a part of have included public and private sector engineering development projects, major linear infrastructure upgrade projects for both road and rail, and expansion projects for major NSW mining clients.

Lachlan is a certificated Professional in Erosion and Sediment Control as well as being skilled in programs such as 12d, HECRAS, XPRAFTS, DRAINS and Goldsim. Lachlan has recently been leading teams of 4 to 5 people to undertake a number of projects within the NSW mining sector.

Recent Experience in Surface Water Management in the Mining Industry

Tomingley Gold Operations | 2015 Water Management Plan, Alkane Resources

Development of an updated water management plan, strategies to improve water management, civil design of water management features and water balance assessments.

Cadia Valley Operations | Surface Water Management Improvements, Newcrest Mining

Hydrology modelling and civil design options to improve holding capacity of surface water storages and their reliance on pumping infrastructure.

Neubeck Coal Project | Water Studies, Centennial Western Regions

This current project involved project management, surface water assessment and design components for a green field open cut coal mine.

Gujarat NRE Coaking Coal | Independent Surface Water Audit, NRE Colliery No. 1

This project involved independent specialist input to an Independent Audit being undertaken on Gujarat's NRE No. 1 Project.

Santos Ltd | Grafton Range Dam

This project involved the investigation of how the hydraulics of a rare rainfall event of a 2000 year Average Recurrence Interval event could be mapped from the spillway of the Grafton Range Dam design. The project also involved the specification of drainage infrastructure for required Access Roads.

Centennial Newstan | Newstan Colliery Subsidence Management Plan

This project was the development of a specialist report focusing on management of subsidence impact in relation to surface water aspects. The project involved the preparation of a detailed 2d flood model, water quality assessment and groundwater components of the existing and proposed development.

Centennial Mannering | Mannering Colliery Water Assessment

This project was part of a preliminary environmental assessment of a proposed underground expansion of the mine workings. The project involved the preparation of a water balance, and assessment of the surface and groundwater components of the existing and proposed development.



Curriculum Vitae

Centennial Awaba | Awaba Colliery Water Management Plan

This project was the development of the Colliery Water Management Plan, for the purposes of documenting the current and future water management of the mine. The water management plan involved the update of the water balance, the development of a surface and groundwater monitoring program and a response plan.

Charbon Coal | Charbon Colliery Water Management Plan

This project was the development of the Colliery Water Management Plan, for the purposes of addressing approval conditions of the Department of Planning for the continuation of mining application. This Water Management Plan included a revision of the site water balance, the development of a salinity balance and the preparation of a surface and groundwater monitoring program.

Coal and Allied Hunter Valley Operations | Concept Design Upgrade

This project involved the concept design of a number of options to improve water quality and water management within the northern maintenance area of the mine. Design elements included drive-in sediment traps and oil/water separators.

Centennial Mandalong | Mandalong Mine

This project involved the development of a water balance of the existing mine configuration as part of the Annual Environmental Management Report,

Xstrata | Beltana HDD Rig Site Design

The project role for Lachlan required the management of sediment within the operations area of a new mine site, which included the design of a sediment capture device. The project was completed in accordance with DECCW guidelines for undertaking Erosion and Sediment control within mine sites.

Xstrata | Redbank Tunnel Deviation

Defined appropriate erosion and sediment control requirements for drainage infrastructure associated with the civil works for the rail line construction. Lachlan also prepared the detailed design of cross and longitudinal drainage for the proposed track deviation along with the hydrologic and hydraulic modelling, bridge flood studies and

road drainage made up the other drainage components of the project.

Centennial Coal | Myuna Colliery

This project involved the development of a Surface Water Assessment plan and water balances of the existing and proposed mine configurations. Lachlan has assisted in a team to assess the existing surface water management systems on site and providing advice on management options in association with improvements to the system.

Unimin | Concept Tallawang Creek Diversion

Design modelling of creek diversions. Modelling of creek hydrology and investigation into velocity mitigation works through the use of in-stream features.

Idemitsu | Boggabri Mine Upgrade Concept Design

The project was the concept design of an upgrade of the mines infrastructure area. This included the design and specification of on-site management for erosion and sediment control measures. These included the design of dirty and coal contact basins, the specification of surface protection measures and erosion and sediment control plans during the upgrades construction. The project was completed in accordance with DECCW guidelines for undertaking erosion and sediment control within mine sites.

Other related areas of interest

- Earthworks Modelling using 12d
- Erosion documentation
- Water Balance Modelling
- Drainage Design for Major Infrastructure
- Geomorphic/Stream Diversion Design



Curriculum Vitae

TESSA BOER-MAH

Cultural Heritage Manager

Newcastle, NSW

Bachelor of Arts with Honours, University of Sydney, 2002

Master of Philosophy (Archaeology), University of Sydney, 2008

AREAS OF EXPERTISE:

As Cultural Heritage Manager in the Newcastle Office, Tessa provides high level project co-ordination and delivery, ensures quality of services, provides high quality heritage advice and assists clients in negotiating good cultural heritage solutions for complex projects. Tessa has a suite of management and technical skills which is informed by over a decade of experience in cultural heritage management. Her technical expertise encompasses archaeological survey, excavation, stakeholder consultation, GIS, artefact analysis and technical reporting which is backed by a working knowledge of the legislative requirements. Having worked with an array of different clients, Tessa has a good understanding of client's needs across the infrastructure, mining, residential and government sectors and is able to identify project requirements so that projects are accurately scoped and appropriately resourced by the cultural heritage team. Tessa's strong familiarity with Australian heritage legislation, her capacity to ensure projects are delivered on time and client liaison skills ensure that all projects large or small are delivered with a high level of professionalism.

SELECTED PROJECT EXPERIENCE:

- **NWRL Aboriginal Heritage Excavation for Early Works East** – Co-ordination of required Aboriginal heritage works for the rail corridor for Transport for NSW. RPS was able to comply with all safety requirements and deliver the project in the required timeframes.
- **Mining NSW (Blue Mountains, Lake Macquarie, Lower and Upper Hunter)** – Over a dozen projects have been completed including the drawing together documentation for a complex Part 3A projects and recently for state significant developments (SSD). Tessa co-ordinated necessary field investigations, as well as, the compilation of previous Aboriginal and non-Indigenous cultural heritage assessments, Aboriginal consultation and other necessary documentation in order to meet legislative requirements for heritage.
- **Farley Assessment and Excavation for the Installation of Water Pipelines Adjacent to Rail Corridor**– Tessa co-ordinated this project from the initial archaeological survey, through to the AHIP application; as well as directing the excavation. This project involved high level negotiations with the client and regulatory bodies to ensure suitable heritage outcomes were reached. In addition, one of the challenges of the project was balancing Aboriginal stakeholder input with finding a practical path to the completion of the project.
- **NSW CHMPs and Aboriginal Community Consultation Frameworks (ACCF)** – Often large client require complex CHMPs to cater for complex and extensive heritage sites, as well as addressing potential impacts. Tessa is familiar in developing such CHMPs including developing workable monitoring methods and providing a workable document that meets the regulatory requirements, but can also be implemented by the client. Sometimes larger clients require documents/policies to guide their Aboriginal engagement which lie outside the standard Aboriginal consultation.
- **Mount Hope Stock and Domestic Scheme, Loddon Mallee, Victoria** – Tessa co-ordinated the standard assessment (survey) for a 30 kilometre pipeline and directed the complex assessment (excavation) for this activity. Aboriginal consultation undertaken with Barapa Barapa Nations Aboriginal Corporation and Yorta Yorta Nations Aboriginal Corporation. Tessa wrote the CHMP to AAV standards as well as co-ordinating the heritage induction and the required artefact collection in accordance with the approved CHMP.
- **Campaspe West CHMP, Loddon Mallee, Victoria** – This is within Jaara Jaara traditional owners boundaries, Tessa co-ordinated the Aboriginal consultation, wrote the CHMP and directed the standard and complex assessment.



Curriculum Vitae

- CONTINUED -

- **Hospital Spur CHMP, Loddon Mallee, Victoria** – This project involved standard and complex assessment in order to prepare the CHMP in consultation with the Jaara Jaara traditional owners.
- **Golf Club CHMP, Loddon Mallee, Victoria** – The activity (development) for this project was to install pipelines to provide stock and domestic water to properties including the golf club. In accordance with the Aboriginal Heritage Act 2006 a CHMP was required. Tessa co-ordinated the standard and complex assessment and wrote the CHMP.
- **Road Intersection Fern Bay** – Tessa co-ordinated the preparation of an Aboriginal due diligence assessment for a proposed intersection and Bayway Village Access Modifications for Worley Parsons and in accordance with RMS guidelines.
- **Tomago Road Widening** – Tessa provided technical direction and co-ordination for an Aboriginal heritage due diligence assessment prepared in accordance with Stage 1 of the RMS guidelines for upgrades at Tomago.
- **Muswellbrook Road Intersections**– This project involved the preparation of an Aboriginal due diligence assessment for a proposed intersection at Thomas Mitchell Drive and the New England Highway for Worley Parsons and in accordance with RMS guidelines.
- **Rutherford Roundabout** – This Aboriginal due diligence assessment was prepared for the Kyle Street roundabout, Rutherford for Anambah Business Park in accordance with RMS guidelines.
- **Glenn Innes Windfarm – Epuron, Completed November 2010**– This project involved the survey and assessment of Aboriginal heritage for a 900 hectare project area. In particular advise was tailored to ensure the placement of wind turbines avoided areas with heritage sensitivity and GIS mapping which was used by the client to meet their legislative requirements.
- **Williamstown Aerospace Park AHIP – Williamstown Aerospace Park, Completed July, 2010:** Prepared Aboriginal Heritage Impact Permit (AHIP) application for specialist radiocarbon dating techniques which were required as part of a larger project.

PREVIOUS EXPERIENCE:

Project Archaeologist – AMBS	2007 – 2010
Consultant Archaeologist - Freelance	2004 – 2007
Project Archaeologist – Susan McIntyre-Tamwoy Archaeological Consultant	2003
Consultant Archaeologist - Freelance	2000 – 2002

ACCREDITATIONS, MEMBERSHIPS & ACHIEVEMENTS:

- Australian Archaeological Association (AAA)
- Australia Association of Consulting Archaeologists Inc (AACAI)
- Rail Industry Safety Induction (RISI) Card
- Rail Industry Worker Induction Card
- White Card

Publications

- Boer-Mah, T. (2009). The Material Culutre: Stone Adzes. In the The Origins of the Civilization of Angkor, Volume 3, The Excavation of Ban Non Wat: Introduction. C.F.w Higham and A. Kijngam, Bangkok, The Thai Fine Arts Department: 187-196
- Boer-Mah, T. (2008) Reduction and Adze Form: Ground Stone Adzes from Ban Non Wat, Northeast Thailand. Bulletin of the Indo-Pacific Prehistory Association 28:44-51
- Ward I.A.K, R.L.K. Fullagar, T. Boer-Mah, L..M. Head, P.S.C. Tacon and K. Mulvaney (2006) Comparison of sedimentation and occupation histories inside and outside rockshelters, Keep River Region, Northwestern Australia. Geoarchaeology 21 (1): 1-27

Arne Bishop

Ecology Manager

Newcastle, NSW

Bachelor of Environmental Science, University of Canberra, 2009

Bachelor of Landscape Architecture, University of Canberra, 2009

Cert IV Horticulture (Landscape), Canberra Institute of Technology, 2003

Cert II Australian Land Conservation and Restoration, Conservation Volunteers Australia, 2001

Accredited BioBanking Assessor

Areas of Expertise

Arne has over 14 years experience in the environmental sector. In his position as Ecology Manager, Arne manages the Newcastle environment department including the day to day running of projects, verification of reports and other outputs and ensures clients are well informed of project progress and key findings.

Arne's current and previous roles have provided him with an extensive knowledge of a plethora of exotic and endemic NSW flora, fauna, ecological communities and migratory species. He primarily conducts ecological assessments and monitoring, which aim to identify the significance of any direct and indirect impacts upon threatened flora, fauna, populations and communities listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Threatened Species Conservation Act 1995* (TSC Act).

Arne is an accredited BioBanking Assessor and has conducted BioBanking assessments for Major Projects (State Significant Infrastructure and State Significant Developments) under the Framework for Biodiversity Assessment (OEH 2014) and assessments for smaller developments under the *BioBanking Assessment Methodology* (OEH 2014). He has also conducted EPBC Act offset calculations under the *Environmental Offsets Policy* (SEWPAC 2012).

During his career, Arne has project managed and/or participated in numerous large-scale land development, mining, energy and infrastructure projects. He subsequently possesses a firm understanding and working knowledge of local, state and federal government legislation and policies that underpin environmental assessments, environmental mitigation, management and offsetting techniques.

Selected Project Experience

Energy & Mining

Springvale Extraction Plan – Biodiversity Management Plans - Provided technical assistance and review of the production of the LW 419 Extraction Plan - Biodiversity Management Plan (BMP). Draft report for the LW 420-420 Extraction Plan - BMP is currently in production.

Springvale Swamp Monitoring Program - Assisted with the production of the flora components of the Swamp Monitoring Program documentation. Provided technical support in relation to the Independent Monitoring Panel meetings and advice.

Springvale Temperate Highland Peat Swamp (THPSS) Monitoring, Centennial Coal - Ecological field surveys on the Newnes Plateau utilising four different methodologies across approximately 16 swamps. Project managed and produced associated seasonal and annual monitoring reporting for Springvale underground mine.

Springvale Water Treatment Project - Project managed and conducted targeted seasonal threatened species surveys, client liaison and report development. Conducted BioBanking calculations to quantify



biodiversity impacts and offset requirements. Produced a Biodiversity Assessment Report (BAR) in line with the Framework for Biodiversity Assessment (FBA).

Angus Place Flora monitoring - Conducted and project managed an annual flora monitoring program and provides technical input and document review. The program spans across a state forest area through several ecological communities and floristic quadrats and threatened flora condition assessment methodologies.

Airly Seasonal Flora and Fauna Monitoring - Conducted and project managed an annual flora and fauna monitoring program and provided technical input and document review. The program spans across a large state conservation area and adjoining farm lands and involves seasonal bird surveys, habitat assessments, threatened flora condition assessments and fauna monitoring methodologies.

Mandalong South Powerline Relocation - Biodiversity Assessment, Centennial Coal – Project managed and conducted targeted seasonal threatened species surveys, client liaison and report development. Conducted BioBanking calculations to quantify biodiversity impacts and offset requirements. Produced a Biodiversity Assessment Report (BAR) in line with the Framework for Biodiversity Assessment (FBA).

Gunnedah Basin, Santos – Conducted multiple projects over approximately two years. These projects included ecological works for Santos within the Gunnedah Basin covering gas exploration and provision of infrastructure, including, gas pipelines and access tracks. Works included field survey, preparation of advice, impact assessments, EPBC referrals, preparation and implementation of well lease rehabilitation plans, liaison and negotiations with regulators and agencies.

Angus Place and Springvale Extension Projects, Centennial Coal – Ecological surveys were undertaken over a period of 1.5 years to aid in the production of a Flora and Fauna Report for both the Angus Place and Springvale underground mines. The project role included flora and fauna field surveys and assistance with associated reporting. Conducted notional BioBanking calculations for Springvale Extension Project to quantify biodiversity impacts and potential offset requirements.

Bulga Mine Annual Fauna Monitoring, Glencore – Conducted and project managed an annual monitoring program over a four year period. The program spans two operations and involves seasonal bird surveys, habitat assessments, and the full spectrum of fauna monitoring methodologies, provides technical input and document review.

Airly Coal Mine Flora and Fauna Surveys and Assessment, Centennial Coal – A range of flora and fauna surveys were undertaken to inform both the Airly Baseline Survey Report and the Airly Flora and Fauna Report. Project tasks included; review of specialist reports, interpretation of legislative requirements, targeted field survey, assessment of fauna habitat quality and value to threatened species, identification of project impacts and measures to avoid or mitigate potential impacts.

Mandalong Mine Extension Project, Centennial Coal – Project tasks included preliminary desktop assessment, interpretation of legislative requirements, targeted field survey, assessment of fauna habitat quality and value to threatened species, identification of project impacts and measures to avoid or mitigate potential impacts. Conducted notional BioBanking calculations to quantify biodiversity impacts and potential offset requirements

Beltana Underground Mine Bat Impact Assessment and Monitoring, Glencore – Conducted extensive fieldwork to identify potential habitat, assessed habitat using night vision technology and developed reporting.

Previous Experience

Environmental Consultant – Ecological Australia

2008 - 2010

Arne completed several contracts as an environmental consultant for Ecological Australia, assisting with threatened species identification and monitoring on a range of projects.



Field Assistant / Consultant – Alison Rowell

1999 - 2010

This role included working on flora and fauna surveys, and habitat / vegetation assessment and mapping.

Green Corps Traineeship – Conservation Volunteers Australia (CVA)

2001

Arne received accredited practical and theoretical training in; First Aid (Level 2, St Johns); Occupational Health and Safety and Environmental Concepts. This training contributed to Certificate II in Australian Land Conservation and Restoration.

Memberships & Achievements

Accredited BioBanking Assessor (accreditation number 161)

Snake and Spider Safety Awareness for Employees (SSSafe) Training

Four Wheel Drive Training and Certification

First Aid Certification

Member – Ecological Consultants Association

Member – Royal Zoological Society NSW

Member – Birds Australia

OH&S Induction Training (White Card)

Award for Excellence for First Place in Conservation Biology and Genetics, University of Canberra

Curriculum Vitae

Personal Details

Name: David **KING**

David has had 23 years experience in the underground coal mining industry both in Australia and the United States. He has been the Senior Mining Engineer responsible for the Technical Services Department at Airly since the construction of the mine in 2009.

His main achievements and expertise are as follows:

- Project management of the Airly Mine Extension Project (SSD5581)
- Management of Extraction Plans required under the former DA162/91 and current SSD5581
- Extensive experience in design implementation and monitoring of partial extraction mining systems at Clarence Colliery and Airly Mine
- Underground strata management
- Mine ventilation and gas management systems
- Short and long term mine planning
- Risk management and compliance management for both safety and environmental legislative requirements
- Community, regulatory and stakeholder engagement

Career History

Centennial Coal Pty Ltd (Airly Project and Mine) July 2009-Present

Title: Senior Mining Engineer

Centennial Coal Pty Ltd (Clarence) September 2006 – July 2009

Title: Senior Mining Engineer

Centennial Coal Pty Ltd (Angus Place) September 2005- September 2006

Title: Mining Engineer

Previous employment

1998 – 2005	Senior Mining Engineer Clarence Colliery
1994 – 1998	Springvale Coal Pty Ltd. Mining Engineer
1991 - 1994	Undergraduate training at Westcliff Colliery NSW, Rosebery base metals Tasmania, Angus Place Colliery NSW.

Qualifications and Recent Training

- 1994 Bachelor of Engineering (Mining) (Hons), University of New South Wales. Co-Op Scholar.
- 1995 Roadway and Pillar Mechanics Basic and Advanced Workshop (UNSW), Spontaneous Combustion Seminar Department of Mineral Resources.
- 1997 United States assignment with Cyprus Amax Coal Company in geotechnical engineering and operations analysis.
- 1999 Mines Rescue Emergency Preparedness Course.
- 2000 Undermanager's certificate of competency
- 2003 Graduate Diploma Mine Ventilation. Ventilation Officer certificate of competency (UNSW).
- 2005 Contractor management course (Minerals Council). Risk assessment facilitator's course (Mines Rescue)
- 2008 Coal Preparation Course (Coal Preparation Society)
- 2010 Minerals Industry Risk Management (G3) (University of Queensland)
- 2011 Diploma of Management
- 2012 Diploma of Project Management

JAMES WEARNE

10 George Street
Belmont NSW 2280

0407 207 530
James.wearne@centennialcoal.com.au

Industry Experience

January 2015 – Present

Centennial Coal

Group Approvals Manager

- Responsible for the delivery of environmental approvals at both State and Federal levels
- Development of Environmental Impact Assessments and supporting technical reports under Parts 3A, 4 and 5 of the NSW Environmental Planning and Assessment Act 1979
- Preparation of referrals in accordance with the Federal Environment Protection and Biodiversity Conservation Act 1999
- Preparation of post approval management plans and Extraction Plans
- Development and management of timelines and budgets
- Liaise with and assist mine site personnel on development of approval projects including mine design and supporting infrastructure
- Consultation with all levels of State and Federal governments on approval matters
- Coordinate and oversee contractor and consultant field operations
- Identify environmental risks and improvement opportunities for existing operations, methodologies and tasks and monitor and report outcomes
- Managing a team of 2 project approval coordinators

October 2008 – January 2015

Centennial Coal

Approvals Coordinator

- Responsible for the delivery of environmental approvals at both State and Federal levels
- Development of Environmental Impact Assessments and supporting technical reports under Parts 3A, 4 and 5 of the NSW Environmental Planning and Assessment Act 1979

- Preparation of referrals in accordance with the Federal Environment Protection and Biodiversity Conservation Act 1999
- Development and management of timelines and budgets
- Liaising with various local, state and federal regulatory authorities
- Liaising with community and Aboriginal groups
- Contract management and adherence to OH&S protocols

August 2006 - October 2008**Coal & Allied - Hunter Valley Services****Environment & Community Coordinator Projects**

- Responsible for the delivery of environmental approvals at both State and Federal levels
- Preparing Environmental Assessments for new mining projects or modifications to existing operations
- Development and management of timelines and budgets
- Liaising with various local, state and federal regulatory authorities
- Liaising with community and Aboriginal groups
- Contract management and adherence to OH&S protocols

October - 2005 to August 2006**Rio Tinto – Hail Creek Mine****Environmental Coordinator**

- Ensure the compliance with conditions of operational licences, permits and approvals
- Implement the Environmental Management System and monitor its effectiveness.
- Collection of monitoring data and statutory reporting.
- Contract management and adherence to OH&S protocols
- Identify environmental risks and mitigation improvement opportunities
- coordinating environmental monitoring activities
- Contract management and adherence to OH&S protocols

Professional Development

- Diploma of Leadership and Management Skills Set – Forsythes Training (2016)
- Banpu Global Leadership Program (2016)
- Diploma of Management - Vocational Institute of Australia (2011)
- Incident Investigation and Analysis – JK Tech (2011)
- G2 risk assessment course (2011)
- Think on Your Feet (2009)
- Diploma of Business - Frontline Management (2007)
- Auditing an Environmental Management System – SAI Global (2006)
- Lead Auditor Training - SAI Global (2006)

Education

- **BACHELOR OF ENVIRONMENTAL SCIENCE**
 - Newcastle University 2001-2005
- **HIGH SCHOOL CERTIFICATE**
 - St Francis Xavier's College Hamilton 1999 – 2000

Referees

Available on Request

APPENDIX 2: Preliminary Figures & Plans



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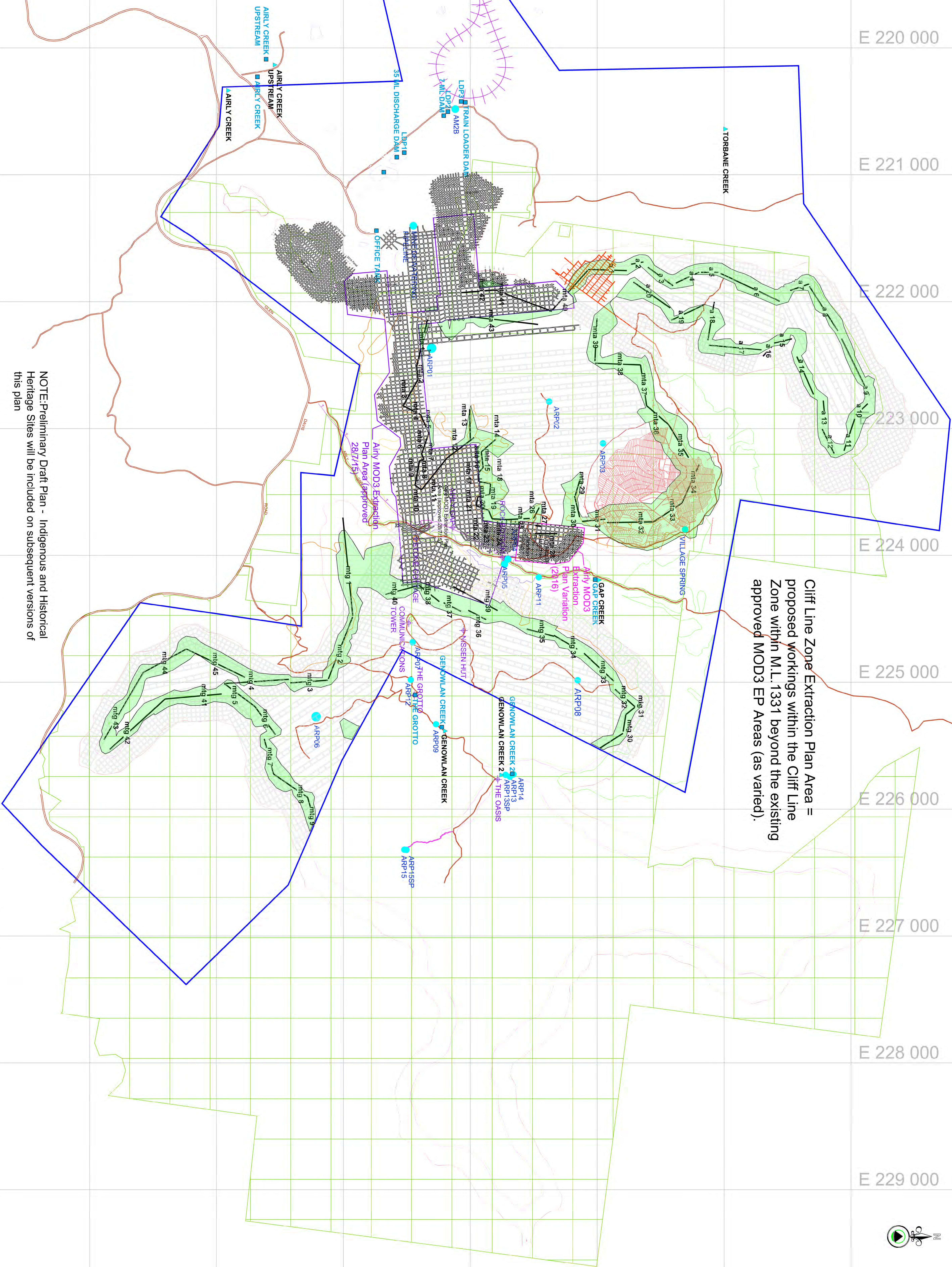
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Cliff Line Zone Extraction Plan Area =
proposed workings within the Cliff Line
Zone within M.L.1331 beyond the existing
approved MOD3 EP Areas (as varied).



NOTE:Preliminary Draft Plan - Indigenous and Historical
Heritage Sites will be included on subsequent versions of
this plan

- LEGEND**
- EXISTING WORKINGS
 - TORBANE COLLIERY
 - NEW HARTLEY SHALE MINE
 - OLD WORKINGS

- NEW HARTLEY MINE
- INTERACTION ZONE
- SENSITIVE FEATURE
- ROADS & TRACKS
- MAJOR CLIFF LINES GREATER THAN 20m in HEIGHT (AS PER E.I.S.)

- MUGI MURUMBAI STATE CONSERVATION AREA
- TELESTRA LINE
- CLIFF LINE ZONE - FIRST WORKINGS ONLY (EXTRACTION PLAN AREA)
- CLIFF LINE ZONE - FIRST WORKINGS ONLY (EXTRACTION PLAN AREA)
- GROUNDWATER MONITORING SITE
- EEC and GDE VEGETATION COMMUNITIES
- Historical Sites including gun towers, stonehenge, pyre, etc.
- Current and proposed roads and paths, water bodies, etc.
- Current and proposed roads and paths, water bodies, etc.
- Current and proposed roads and paths, water bodies, etc.
- GRID IS MGA 94 Zone 56

APPROVED BY:

Bob Miller - Manager of Mining Engineering

John Stevens - Mine Surveyor

DATE	SCALE	CHECKED BY
29/9/2017	1:10000	John Stevens
DATE	SCALE	CHECKED BY
29/9/2017	1:10000	John Stevens

AIRLY MINE

MEP EXTRACTION PLAN

- PLAN 2 SURFACE FEATURES

OVERVIEW

APPENDIX 3: Pillar Stability and Subsidence Report

24th May 2017

Project No. 127621105-313-R-Rev1

David King, Senior Mining Engineer
Airly Mine
Glen Davis Road
Capertee
NSW 2846

THE ADEQUACY OF COAL PILLARS PLANNED FOR THE CLIFF LINE ZONE IN ML1331, AIRLY MINE

Dear David,

1.0 INTRODUCTION

This report assesses coal pillar sizes for the Cliff Line Zone, as defined in the Subsidence Impact Assessment report (**Golder Associates Report No. 127621105-003-R-Rev2**). The stability of the pillars as first workings was addressed in **Golder Associates Report No. 127621105-235-R-Rev0** and is summarised again herein.

The primary issues addressed in this report are:

- loading effects of adjacent extraction operations and
- subsidence estimates associated with the workings in this zone.

Empirical design methodologies have been applied to derive pillar strength, load and associated stability criteria, as well as subsidence estimates. The review addresses the planned 'typical' pillars for the zone, as well as minimum pillar sizes to provide insight for localised situations that might require individual smaller pillars to be formed, such as those around intersections of panels with main headings.

2.0 PILLAR STABILITY CRITERIA

The assessment of pillar stability requires the determination of pillar stress, pillar strength and an appropriate Factor of Safety (FoS), which is defined as:

$$\text{Factor of Safety} = \frac{\text{Pillar Strength}}{\text{Pillar Stress}}$$

The FoS concept is commonly applied when the potential for pillar collapse or failure is analysed, as it can generally be related to the probability of failure occurring.

2.1 Coal Pillar Strength

The pillar stability assessment for Airly has utilised the most recent UNSW pillar strength equations (**Salamon *et al*, 1996**) for Australian coal pillars with w/h ratios of >5, as follows:



$$\sigma_p = \frac{27.63\Theta^{0.51}}{w^{0.22}h^{0.11}} \left\{ 0.29 \left[\left(\frac{w}{5h} \right)^{2.5} - 1 \right] + 1 \right\}$$

where:

σ_s	=	strength (MPa)
w	=	minimum pillar width (m)
h	=	roadway height (m)
Θ	=	a dimensionless 'aspect ratio' factor for rectangular pillars defined by Salamon <i>et al</i>, 1996

For pillars with width to height ratios of ≤ 5 , the pillar strength is determined as follows:

$$\sigma_s = 8.6 \frac{(w\Theta)^{0.51}}{h^{0.84}}$$

A standard pillar height of 2.8m and a roadway width of 5.5m have been applied in the analyses.

2.2 Pillar Stress

In regard to the vertical stress on the pillars at the first workings stage, it is common to make the conservative assumption that the pillars are loaded by the overlying column of rock to surface, see **Figure 1**. This is referred to as tributary area loading, T , and is defined as follows:

$$T = \frac{(w + B)(l + B) \rho g H}{wl}$$

where:

T	=	pillar stress (MPa)
l	=	pillar length (m)
B	=	roadway width (m)
H	=	depth of cover (m)
ρ	=	density of rock (taken as 2.5 t/m ³)
g	=	gravitational constant (taken as 10 m/s ²)

To derive the stress component related to secondary extraction, methodologies such as ALPS (**Mark, 1990**) and those outlined in the UNSW pillar design workshops (**UNSW, 1995**) utilise the abutment angle approach developed by **King and Whittaker (1971)** and **Wilson (1973)** for the estimation of pillar stress increases. This model has been incorporated into both numerical and empirical methodologies for pillar sizing. It should be noted that the abutment angle concept is a mathematical convenience and is only loosely connected to physical overburden deformation (e.g. any observable caving angle or subsidence phenomenon).

The abutment angle concept has been applied herein to estimate the load increase on the cliff zone pillars, referring again to **Figure 1**. Given that Airly will be utilising a partial extraction system involving sub-critical panels, the abutment load (A) is defined by:

$$A = \rho g (0.5HW - 0.125W^2/\tan\varnothing)$$

where:

\varnothing	=	abutment angle (degrees)
W	=	panel span (centres, m)

Pillar load is converted to stress by dividing by pillar area.

Field studies indicate that the abutment angle increases as pillar width increases, as stiffer pillars attract more load and the angle decreases with increasing depth, as the panels tend to become sub-critical and in part due to the overburden having more ability to transfer load to adjacent areas of solid.

The latest predictive “sliding-scale” abutment angle formula recommended by GA (**Hill et al, 2015**) is defined as follows:

$$\phi = 21.62 - 0.0221H + 0.0725w - 6.23C$$

where: C = Panel span “criticality”, defined by:
C = 1, when W/H < 0.75 (as in the case of Airly) and
C = 0, when W/H ≥ 0.75

The results obtained using this sliding-scale formula have been compared herein to those obtained using a fixed abutment angle of 21°, which is a conservative and commonly applied value in super-critical panel environments.

The load re-distribution decays in a parabolic fashion with distance from the extracted area. In the case of Airly, a significant proportion of the abutment load will report to the immediately adjacent combined chain and barrier pillar zone (≥40m wide), with only a remnant reporting to the actual cliff line zone pillars.

Abutment load apportionment between the pillars in the system is estimated using the load sharing factor ‘R’ defined in ALPS (**Mark, 1990**) as follows:

$$R = 1 - [(D-w-B)/D]^3$$

where: D = 5.13√H (after **Peng and Chiang, 1984**)

2.3 Factor of Safety and Probability of Stability Concepts

A Probability of Stability (PoS) of 99.9% is attained at a Factor of Safety of 1.63, see **Figure 2**, and further increases in FoS have minimal effect, as the PoS curve approaches 100% asymptotically. From a risk management perspective, increasing the FoS beyond 1.63 can only reduce the failure probability by <0.1%. It is emphasised that the FoS relates to the overall panel situation, rather than that of individual pillars.

The consequences of collapse are a primary consideration, as these determine the acceptable probability of failure, which in turn allows an appropriate FoS to be determined. For example, prudent risk management suggests that the probability of failure for long-term first workings panels beneath sensitive surface structures should be negligible. In Australia, long-life critical pillars (e.g. in main headings and for the protection of surface infrastructure) are often designed to a FoS of ≥2.11, which equates to a nominal failure probability of one panel in a million, based on the UNSW power law strength equation (**Salamon et al, 1996**). This reduces the probability of failure to a level that would be considered acceptable in other key fields of public interest.

It is important to note that the South African and Australian databases from which the UNSW pillar design formulae were derived cover a broad range of roof and floor materials, including mudrocks, coal, siltstones and sandstones. Therefore, these materials and the variability in pillar strength that may be associated with them are implicitly recognised and largely catered for in the FoS approach. Uncertainty associated with the natural variability in coal measures strata often prohibits design to low FoS values. Geological variability partly accounts for the scatter in the population of failed pillar cases and usually necessitates design to FoS values of >1.5, equivalent to low failure probabilities. Back analysis indicates that incidences of pillar instability traditionally associated with weak floor,

for example, can often be explained in terms of 'conventional' empirical design criteria, notably in terms of FoS and pillar w/h ratio, as will be discussed in **Section 2.4**.

Similarly, the database encompasses pillars in a significant number of seams involving different geological / geotechnical environments; consequently the existence of pillar weaknesses is very largely reflected and implicit within the variability in the failed and intact pillar cases, such that these weaknesses are again very largely catered for by adopting appropriate FoS values.

It should also be understood that the nominal probability of failure is related to the life-time of the database underpinning the empirical design methodology; currently this averages approximately fifty years (i.e. of the order of 100 years of coal pillar history is available). Annualised probability of failure (a concept more commonly applied in engineering practice) is therefore about one-fiftieth of the nominal failure probability.

In summary, it should be clear from **Figure 2** that provided the workings under consideration are designed to a minimum system FoS of around 1.6, it is necessary to look beyond this concept to obtain any further assurance of long-term stability that may be required. An issue warranting particular consideration is the w/h ratio of the pillars, which is discussed in detail in the following section.

2.4 The Importance of Pillar Width to Height (w/h) Ratio

The role of increasing w/h ratio in enhancing coal pillar stability has long been known. Back analysis of case histories from South Africa, Australia and elsewhere has shown that w/h ratio exerts a major influence on coal pillar strength. At low w/h ratios (<3) overloaded coal pillars tend to fail in a brittle, uncontrolled fashion, whereas at greater w/h ratios (>4) the overloaded pillars demonstrate a more plastic form of deformation: significant displacement may still take place in the form of roof to floor convergence, as well as rib spall, but the pillar core remains confined and tends to retain its load carrying ability, generally without failing in the commonly understood sense.

This was illustrated by **Madden (1987)** with laboratory UCS tests on sandstone discs during the initial practical development of the squat pillar formula (he used sandstone because coal samples are more heterogeneous and difficult to prepare). It was also shown by **Das (1986)** in tests on Indian coals, see **Figures 3a** and **3b**. The potential impact of localised geological structures, such as faults, also diminishes rapidly as pillar w/h ratio increases, as illustrated schematically in **Figure 4**. International coal industry experience confirms the importance of w/h ratio to stability; incidences of collapse are concentrated at low w/h ratios, even in known weak floor environments.

Furthermore, back analysis of the results of *in situ* coal pillar tests from South Africa indicates that the post-peak modulus (stiffness) of actual pillars becomes positive (i.e. suggesting strain hardening behaviour) once the w/h ratio exceeds 4.1, as seen in **Figure 5**. In other words, even if the coal is heavily fractured, the overall pillar does not fail in the commonly understood sense; a creep event becomes the likely worst-case scenario.

Pillar w/h ratio, applied in conjunction with other design criteria, such as FoS, is a useful indicator of design reliability. This is illustrated in **Figure 6**, which presents the FoS versus w/h ratio relationship for a combined database of failed South African and Australian bord and pillar panels, plus a database of highwall mining failed pillar cases (**Hill, 2005**).

These three databases are complementary in nature, reflecting the experiences of their respective industries. For example, the Australian data provides insight with regard to pillar behaviour at relatively high w/h ratios and furnishes the failed case at the w/h ratio of 8.2. In contrast, the South African industry has a high proportion of mining geometries with lower w/h ratios, which is partly reflected in the maximum w/h ratio of only 3.7 for a South African failed case. Similarly, the highwall mining failed pillar cases cover the lower end of the range of w/h ratios, from 0.6 to 1.4.

There are no failed cases in the combined database with a w/h ratio of greater than 8.2, even at a very low FoS, and there is only one failed case at a w/h ratio of >5. The highest FoS assigned to a bord and pillar collapse is 2.1 and this was associated with a w/h ratio of only 2.2. Although there are failed highwall mining pillars with Factors of Safety of >2, all of them have w/h ratios of <2.

A limit envelope can be defined for the database of failed cases, illustrated by the curve and given by the following equation:

$$w/h \text{ ratio} = 22.419e^{-1.148*(FoS)}$$

Beyond this envelope, there is no precedent for failure within the three databases. It is worth noting that the exclusion of the highwall mining pillar data would not materially change the shape of this limit envelope.

In the case of long life (>5 years) pillars, if it is reasonable to assume that the pillars are, or will at some point in the future, be subjected to full tributary area loading, then it is generally considered prudent to design the pillars to be outside (i.e. above) the envelope defined by this equation, even though there are many examples of stable pillars that fall within it.

Furthermore, in the case of critical, long-life pillars, it is considered prudent to allow an additional margin beyond this curve. GA generally suggests a 20% margin, which is defined by the second (i.e. outer) curve in **Figure 6** and the following equation:

$$w/h \text{ ratio} = 26.903e^{-0.957*(FoS)}$$

2.5 Summarised Composite Design Criteria based on FoS and w/h Ratio

As previously indicated, pillar design criteria should reflect the specific requirements and nature of the workings (e.g. short-term production panel, as opposed to long-life coal pillars with surface protection constraints). The approach adopted by GA in Australia can be summarised as follows (**Hill, 2005**):

- A. Short-term production workings, with considerable local knowledge: design may be within the failed pillar database limit envelope, under controlled circumstances.
- B. Short-term production workings (general): design on the basis of being beyond the failed pillar database limit envelope.
- C. Key underground workings (e.g. main headings), with medium to long-term serviceability / stability requirements: design on the basis of the limit envelope plus 20% (i.e. the outer database curve).
- D. Underground workings beneath critical, highly sensitive surface structures and / or features (e.g. key infrastructure, such as railways / waterways): design on the basis of a minimum w/h ratio of five (i.e. squat pillars) with a minimum nominal FoS of 2.11 according to the **Salamon et al 1996** formulae (i.e. a nominal probability of failure of ≤ 1 in a million).

These criteria are summarised in **Figure 7**. They are considered guidelines and it is important that specific attention be given to the geotechnical / mining environment, including historical experience of ground behaviour in the seam under consideration.

A subsequent review of long-term pillar stability issues and the associated design considerations concluded that these design criteria remain appropriate for Australian conditions (**Hill, 2010**). That review also noted that the NSW regulatory approach to pillar design (circa 2006) was rational, see **Figure 8**.

In **Strata Engineering Report 09-001-AIR-4 (SEA, 2010)**, the partial extraction situation at Airly Mine was considered analogous to “key underground workings” (i.e. Category C above); long-term stability is required for surface protection, although in this case the surface features were not in general considered in the highest category of “critical infrastructure”.

Subsequently, in the **GA SIA Report**, a minimum FoS of 2.11 was adopted for pillars in the “Cliff Line Zones” defined by GA, noting the following:

- As previously indicated, a FoS of 2.11 equates to a nominal probability of panel failure of one in a million.
- A geotechnical assessment of the Airly deposit for the purpose of assessing partial extraction options did not identify roof or floor materials that would be considered unusually weak and that might otherwise necessitate the adoption of alternative / more conservative pillar design criteria (**SEA, 2012**).
- Experience of mining the Lithgow Seam does not indicate that floor stability is likely to be an issue for pillar stability at the depths of cover involved at Airly.
- The impact of the varying topography in the context of practical bord and pillar design is the application of average panel Factors of Safety that significantly exceed the design minima.

3.0 PILLAR STABILITY ANALYSIS

3.1 First Workings

Depth is typically in the range of 100m to 200m. For pillar centre distances of <18m, a 6m roadway width has been assumed.

The results are summarised in **Table 1** (re-produced from **GA Report No. 127621105-235-R-Rev0**).

Table 1: First Workings Pillar Design Outcomes

Depth (m)	Pillar Width (solid, m)	Pillar w/h Ratio	Pillar Safety Factor	Probability of Stability (%)	Comments
80	9.7	3.5	2.20	99.99997443	Theoretical minimum square pillar; B = 6m
160	16.4	5.9	2.13	99.99992679	Theoretical minimum square pillar
250	22.4	8.0	2.12	99.99991497	Theoretical minimum square pillar
80	29.5	10.5	10.73	100.00000000	Planned Geometry A: 35m Square Centres
160	29.5	10.5	5.37	100.00000000	Planned Geometry A: 35m Square Centres
250	29.5	10.5	3.44	100.00000000	Planned Geometry A: 35m Square Centres
80	24.5	8.75	9.18	100.00000000	Planned Geometry B: 30m by 45m Centres
160	24.5	8.75	4.59	100.00000000	Planned Geometry B: 30m by 45m Centres
250	24.5	8.75	2.94	100.00000000	Planned Geometry B: 30m by 45m Centres

Note: Probability of Stability has been calculated to eight decimal places

The following comments are made regarding the results for the Cliff Line Zone:

- i) Current development practice relates to “Planned Geometry A” (35m square centres) and is associated with a Probability of Stability of effectively 100%.
- ii) The SIA report suggested an alternative geometry, based on 30m by 45m centres, referred to herein as “Planned Geometry B”. This is associated with a probability of stability of effectively 100%.

- iii) Significant reductions in pillar width are possible. Some of the reduced pillar widths are $<1/10$ depth or $<10\text{m}$ and would require exemption from the regulator. At the minimum zone depth of 80m , it would be feasible to adopt a minimum pillar width to height ratio of 3.5 (associated FoS of 2.20). The reduced pillar widths have Factors of Safety of ≥ 2.13 and acceptable associated probabilities of long-term stability of $\geq 99.9999\%$. Given that a reduction in pillar size would typically be isolated (i.e. a pillar or a few pillars of locally reduced size for operational reasons), this level of stability is considered adequate.
- iv) All of these geometries meet the GA design criteria for long-term stability.

3.2 Additional Pillar Loading due to Adjacent Future Partial Extraction

Reference to the current (March 2017) Life of Mine Plan indicates a great variety of Cliff Line Zone panel layouts across ML1331. For the purpose of this assessment, the analyses have addressed scenarios that cover:

- The depth range of the partial extraction (i.e. panel and pillar) layouts,
- a theoretical range of Offset Distances from the partial extraction operation (i.e. from the goaf edge to closest edge of the first Cliff Line Zone pillar, noting that a distance of 40m is currently being applied in the mine design),
- sliding scale and 21° abutment angle models,
- side abutment loading, given that this will be greater than end loading (i.e. worst case) and
- various pillar geometries, consistent with the design criteria outlined previously (in particular, a minimum final FoS of 2.11).

Consideration has also been given to the potential effects of future splitting and quartering in the adjacent shallow mining zone (**Section 5.2.4**).

3.2.1 Planned Cliff Line Zone Geometry 'A'

The results for Geometry 'A' (i.e. 35m square centres) are summarised in **Table 2** and illustrated in **Figure 9**. Note that a depth of 200m represents the worst case situation in the current mine plan. The stress increments due to adjacent extraction are very small and the GA design criteria for long-term pillar stability are consistently met. The pillar design is conservative.

Table 2: Geometry 'A' Stability Outcomes, assuming a 21° Abutment Angle

Depth (m)	Stress Increment due to Adjacent Extraction (MPa)			Final Pillar Stress (MPa)			Pillar Factor of Safety		
	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55
100	0.1	0.0	0.0	3.6	3.5	3.5	8.4	8.6	8.6
150	0.3	0.1	0.0	5.6	5.4	5.3	5.4	5.6	5.7
200	0.6	0.2	0.1	7.7	7.3	7.1	3.9	4.2	4.3
250	1.1	0.5	0.2	9.9	9.3	9.0	3.0	3.3	3.4

Note: 'OD' is the Offset Distance, in metres

3.2.2 Planned Cliff Line Zone Geometry 'B'

The results for Geometry 'B' (i.e. 30m by 45m centres) are summarised in **Table 3** and illustrated in **Figure 10**. Again, a depth of 200m represents the worst case situation in the current mine plan. The stress increments due to adjacent extraction are very small and the GA design criteria for long-term pillar stability are met. The pillar design is conservative.

Table 3: Geometry 'B' Stability Outcomes, assuming a 21° Abutment Angle

Depth (m)	Stress Increment due to Adjacent Extraction (MPa)			Final Pillar Stress (MPa)			Pillar Factor of Safety		
	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55
100	0.1	0.0	0.0	3.6	3.5	3.5	7.2	7.3	7.3
150	0.3	0.1	0.0	5.6	5.3	5.2	4.6	4.8	4.9
200	0.7	0.3	0.1	7.7	7.3	7.0	3.3	3.5	3.6
250	1.3	0.6	0.2	10.0	9.3	8.9	2.6	2.7	2.9

Note: 'OD' is the Offset Distance, in metres

3.2.3 Localised Small Pillars

The results for localised small pillars (none of which are currently planned) are summarised in **Table 4** and illustrated in **Figure 11**. Again, a depth of 200m represents the worst case situation in the current mine plan. **Table 4** provides the minimum pillar sizes required to meet the GA design criteria for long-term pillar stability. Significant localised reductions in pillar size are possible.

Table 4: Localised Small Pillar Stability Outcomes, assuming a 21° Abutment Angle

Depth (m)	Stress Increment due to Adjacent Extraction (MPa)			Final Pillar Stress (MPa)			Pillar Width (solid, m)		
	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55
80	0.2	0.0	0.0	5.4	5.2	5.1	9.7	9.7	9.7
100	0.4	0.0	0.0	6.1	5.9	5.9	11.8	11.3	11.3
150	0.8	0.3	0.0	7.4	7.1	6.9	17.0	16.0	15.5
200	1.2	0.6	0.2	9.1	8.7	8.4	21.3	20.3	19.6
250	1.6	1.0	0.5	10.9	10.5	10.1	24.6	23.8	23.1

Note: 'OD' is the Offset Distance, in metres

4.0 BEARING CAPACITY

Although the methodology and criteria for assessing pillar stability are applicable across a wide range of roof and floor types, it is still appropriate to consider roof and floor bearing capacity. To determine foundation failure potential, a methodology for estimating bearing capacity for shallow foundations with strip footings has been applied (**Das 2006**). Experience indicates that this method provides a useful estimate of foundation bearing capacity in rock. For calculation purposes, it has also been assumed that the rock shear strength is half the unconfined compressive strength (UCS) (**Budavari 1983**).

The possibility of long-term failure of the strata surrounding the pillars is analysed using Terzhagi's bearing capacity equation as follows:

$$q_u = 5.7c_u + q$$

where:

q_u = Ultimate Bearing Capacity (MPa)

q = Surcharge Loading (MPa, not applicable in this case)

c_u = Cohesion (MPa, shear strength of material substituted for cohesion)

Previous studies indicate that the UCS of both the roof and floor are typically 30 to 40MPa, see **Figure 12**. Using the above equation and taking a UCS of 30MPa, the bearing capacity is 85MPa. Furthermore, **Pells et al (1998)** suggests that the bearing capacity of sedimentary rock is 3 to 5 times the UCS, indicating a capacity of at least that determined using the Terzhagi equation.

Given that the stress on the Cliff Line Zone pillars is $\leq 10\text{MPa}$ for Geometries 'A' and 'B', the FoS against bearing failure is ≥ 8.5 . Even potential localised smaller pillars would involve final stresses of $< 11\text{MPa}$, such that the FoS would be ≥ 7.8 .

For all situations, the FoS exceeds the value of 3 typically suggested for long-term stability by a significant margin.

5.0 SUBSIDENCE ESTIMATES

As the pillars are designed to remain long-term stable, it is considered reasonable to estimate subsidence on the basis of elastic convergence. The methodology used to estimate the expected surface subsidence is based on the geomechanical properties of the strata and estimates of the average stress change using elastic theory. The predicted subsidence consists of 3 components, namely pillar, roof and floor compression. The equations used to determine these components are shown below.

$$\begin{aligned}\Delta_{\text{pillar}} &= \sigma_{\text{net}} h / E_{\text{pillar}} \\ \Delta_{\text{roof}} &= \sigma_{\text{net}} w / E_{\text{roof}} \\ \Delta_{\text{floor}} &= \sigma_{\text{net}} w / E_{\text{floor}} \\ \Delta_{\text{total}} &= \Delta_{\text{pillar}} + \Delta_{\text{roof}} + \Delta_{\text{floor}}\end{aligned}$$

Where:

Δ_{pillar} = pillar compression (mm)
 Δ_{roof} = roof compression above pillar (mm)
 Δ_{floor} = floor compression below pillar (mm)
 σ_{net} = net pillar stress increase (MPa)
 h = pillar height (2.8m)
 w = pillar width (m)
 E_{pillar} = Young's Modulus for coal (estimated at 2GPa)
 E_{roof} = Young's Modulus for immediate roof material (estimated at 7GPa)
 E_{floor} = Young's Modulus for immediate floor material (estimated at 5GPa)

5.1 Planned Geometry 'A' (35m Square Centres)

Given that the stress change is a function of Offset Distance, this also impacts subsidence.

5.1.1 Geometry 'A', Offset Distance = 35m

Using the methodology described previously, the estimated subsidence values are summarised in **Table 5**.

Table 5: Planned Geometry 'A' Subsidence Estimates (OD = 35m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.6	1.1	12
150	3.8	5.6	1.8	21
200	5.0	7.7	2.7	31
250	6.3	9.9	3.6	42

Hydrogeological studies have predicted that part of the Cliff Line Zone will become partially or fully flooded in the long-term following future secondary extraction activities (subject further extraction plans). The impact of flooding on subsidence has been accounted for using this analytical technique by reducing the modulus of the roof and floor strata by half. The results are summarised in **Table 6**.

**Table 6: Planned Geometry 'A' Subsidence Estimates (Long-Term Worst Case)
(OD=35m)**

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.6	1.1	24
150	3.8	5.6	1.8	39
200	5.0	7.7	2.7	58
250	6.3	9.9	3.6	79

5.1.2 Geometry 'A', Offset Distance = 45m

Using the methodology described previously, the estimated subsidence values are summarised in **Tables 7 and 8** (worst-case).

Table 7: Planned Geometry 'A' Subsidence Estimates (OD = 45m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	12
150	3.8	5.4	1.6	18
200	5.0	7.3	2.3	26
250	6.3	9.3	3.1	35

**Table 8: Planned Geometry 'A' Subsidence Estimates (Long-Term Worst Case)
(OD=45m)**

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	22
150	3.8	5.4	1.6	35
200	5.0	7.3	2.3	49
250	6.3	9.3	3.1	66

5.1.3 Geometry 'A', Offset Distance = 55m

Using the methodology described previously, the estimated subsidence values are summarised in **Tables 9 and 10** (worst-case).

Table 9: Planned Geometry 'A' Subsidence Estimates (OD = 55m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	12
150	3.8	5.3	1.5	18
200	5.0	7.1	2.1	24
250	6.3	9.0	2.7	32

**Table 10: Planned Geometry 'A' Subsidence Estimates (Long-Term Worst Case)
(OD=55m)**

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	22
150	3.8	5.3	1.5	33
200	5.0	7.1	2.1	45
250	6.3	9.0	2.7	59

It is worth noting that the subsidence estimates for an Offset Distance of 55m (**Tables 9 and 10**) approximate to those that would be expected in the first workings situation (i.e. there is negligible load or subsidence contribution related to the adjacent panel and pillar partial extraction operation).

5.2 Planned Geometry 'B' (30m by 45m Centres)

5.2.1 Geometry 'B', Offset Distance = 35m

Using the methodology described previously, the estimated subsidence values are summarised in **Tables 11 and 12** (worst-case).

Table 11: Planned Geometry 'B' Subsidence Estimates (OD = 35m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.6	1.1	10
150	3.8	5.6	1.8	18
200	5.0	7.7	2.7	27
250	6.3	10.0	3.7	37

Table 12: Planned Geometry 'B' Subsidence Estimates (Long-Term Worst Case) (OD=35m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.6	1.1	19
150	3.8	5.6	1.8	33
200	5.0	7.7	2.7	49
250	6.3	10.0	3.7	68

5.2.2 Geometry 'B', Offset Distance = 45m

Using the methodology described previously, the estimated subsidence values are summarised in **Table 13 and 14** (worst-case).

Table 13: Planned Geometry 'B' Subsidence Estimates (OD = 45m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	10
150	3.8	5.3	1.6	15
200	5.0	7.3	2.3	22
250	6.3	9.3	3.0	30

Table 14: Planned Geometry 'B' Subsidence Estimates (Long-Term Worst Case) (OD=45m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	18
150	3.8	5.3	1.6	28
200	5.0	7.3	2.3	41
250	6.3	9.3	3.0	56

5.2.3 Geometry 'B', Offset Distance = 55m

Using the methodology described previously, the estimated subsidence values are summarised in **Tables 15 and 16** (worst-case).

Table 15: Planned Geometry 'B' Subsidence Estimates (OD = 55m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	10
150	3.8	5.2	1.5	15
200	5.0	7.0	2.0	20
250	6.3	8.9	2.7	26

Table 16: Planned Geometry 'B' Subsidence Estimates (Long-Term Worst Case) (OD=55m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	18
150	3.8	5.2	1.5	27
200	5.0	7.0	2.0	37
250	6.3	8.9	2.7	49

It is worth noting that the subsidence estimates for an offset distance of 55m (**Tables 15 and 16**) approximate to those that would be expected in a first workings situation (i.e. there is negligible load or subsidence contribution related to the adjacent panel and pillar partial extraction operation).

5.2.4 Additional Subsidence related to Future Splitting and Quartering in the Adjacent Shallow Mining Zone

The preceding analyses relate to the effects of future adjacent panel and pillar extraction beyond the Cliff Line Zone. The potential effects of splitting and quartering in the Shallow Zone, downslope of the Cliff Line Zone, also require consideration.

Previous studies have shown that the split and quartered pillars remain long-term stable, with FoS values of ≥ 2.17 (**GA Report No. 127621105-235-R-Rev0**). The SIA report (**GA Report No. 12762-1105-003-R-Rev2**) estimated that expected subsidence related to the split and quartered pillars was <15mm and long-term, worst-case subsidence was <30mm. Subsidence monitoring above the 200 Panel indicates negligible subsidence, in line with expectations (i.e. a maximum of 7mm of subsidence at 80m depth, **GA Report No. 127621105-236-R-Rev0**). Also, the numerical modelling conducted for the SIA report and the monitoring for 200 Panel indicate negligible stress transfer or associated subsidence above the adjacent intact pillars due to the split and quartered pillars.

It is concluded that the Cliff Line Zone pillars are practically unaffected by splitting and quartering in the Shallow Zone.

5.3 Concluding Remarks regarding Subsidence

The following comments are made regarding the subsidence results:

- The pillar systems proposed for the Cliff Line Zone are considered long-term stable under all scenarios (i.e. prior to, and following, the proposed future adjacent partial extraction, both in the Panel and Pillar Mining Zone and in the Shallow Mining Zone).
- The representative maximum depth of cover for the Cliff Line Zone pillars in the current mine plan is 200m.
- The minimum planned Offset Distance from the extraction area in the Panel and Pillar Mining Zone to the Cliff Line Zone is 40m. Typical Offset Distances are >55m.

- iv) The SIA study (**GA, 2013**) estimated a long-term subsidence range of 10 to 65mm for the Cliff Line Zone pillars, across a depth range of 50 to 300m. These subsidence estimates related to the first workings situation (i.e. no adjacent partial extraction).
- v) The preparation of a mine plan with defined Offset Distances has aided the estimation of *post* adjacent partial extraction subsidence estimates herein.
- vi) The updated long-term subsidence range for the Cliff Line Zone pillars in the first workings situation (i.e. with no adjacent partial extraction) is 18 to 45mm. The reductions in both the range and maximum value (i.e. 45 versus 65mm previously) are directly due to the reduced depth range that applies in practice to the Cliff Line Zone pillars in the ML1331 area of interest (i.e. 100 to 200m, as opposed to 50 to 300m).
- vii) At the proposed Offset Distances of $\geq 40\text{m}$, the contribution of future adjacent Panel and Pillar mining operations to pillar loading and subsidence within the Cliff Line Zone is negligible (i.e. $< 5\text{mm}$). Essentially, the pillars within the Cliff Line Zone would not “see” the Panel and Pillar operation to any appreciable extent.
- viii) As a result, long-term subsidence estimates for the Cliff Line Zone, even allowing for a future adjacent Panel and Pillar partial extraction operation remain below those originally put forward in the SIA study (i.e. now $\leq 53\text{mm}$, versus $\leq 65\text{mm}$ in the SIA study).
- ix) The subsidence estimates relate to the closest pillars to the proposed Panel and Pillar partial extraction area. Due to load sharing, the actual subsidence across the panel would almost certainly be considerably less again.
- x) The subsidence estimates associated with the two planned geometries are virtually the same.
- xi) No subsidence estimates have been derived for potential localised small pillars, as (a) none are currently planned and (b) individual pillars of reduced size would have negligible effect on the overall outcome.
- xii) Additional subsidence in the Cliff Line Zone due to future proposed splitting and quartering operations in the Shallow Mining Zone would again be negligible.
- xiii) Short to medium-term subsidence is predicted to be $< 30\text{mm}$ and typically $< 20\text{mm}$. This would be very difficult to measure accurately on surface.
- xiv) Long-term, worst-case subsidence would be $\leq 53\text{mm}$ and typically $< 40\text{mm}$. This negligible level of subsidence would still be difficult to measure accurately.
- xv) The stress increment magnitudes associated with adjacent partial extraction are negligible and would also be practically impossible to measure underground.
- xvi) At the predicted subsidence levels, strains would be $< 0.5\text{mm/m}$ and tilts would be $< 1.0\text{mm/m}$.
- xvii) 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.
- xviii) A review of the updated geotechnical database is currently being undertaken. One component of that review relates to strata properties. Preliminary results indicate that an outcome will be an upgrade of the rock moduli values applied to-date, such that future subsidence estimates are again likely to be slightly reduced.
- xix) Additionally, further detailed assessment of the stability of cliff, pagodas and steep slopes will be undertaken as part of future Extraction Plans, when secondary extraction is proposed.

6.0 CONCLUDING REMARKS

The preceding stability analyses and associated subsidence estimates are consistent with previous findings. If anything, the current mine plan is associated with slightly lower subsidence magnitudes than originally envisaged. No surface impacts would be expected at these levels of subsidence.

Please contact me if you require anything further in this matter.

Kind Regards,

GOLDER ASSOCIATES PTY LTD

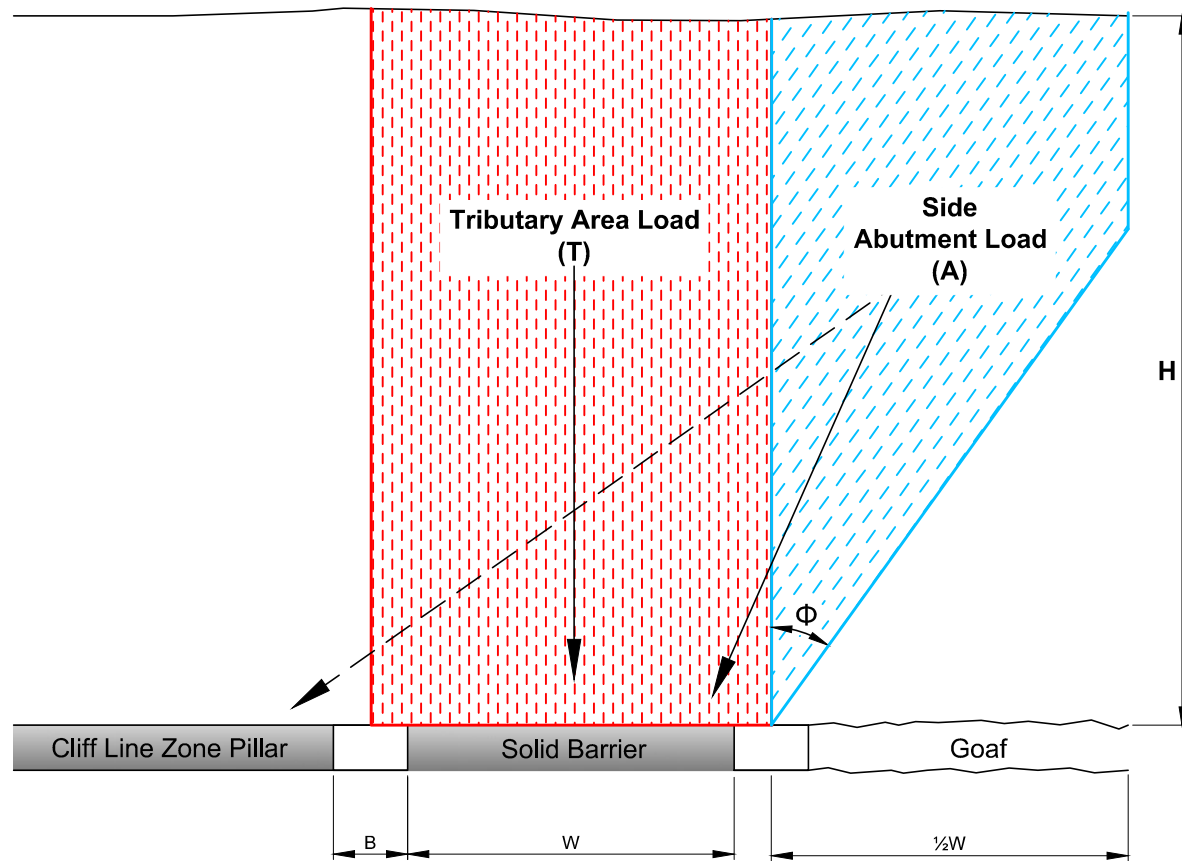


David Hill
Technical Director

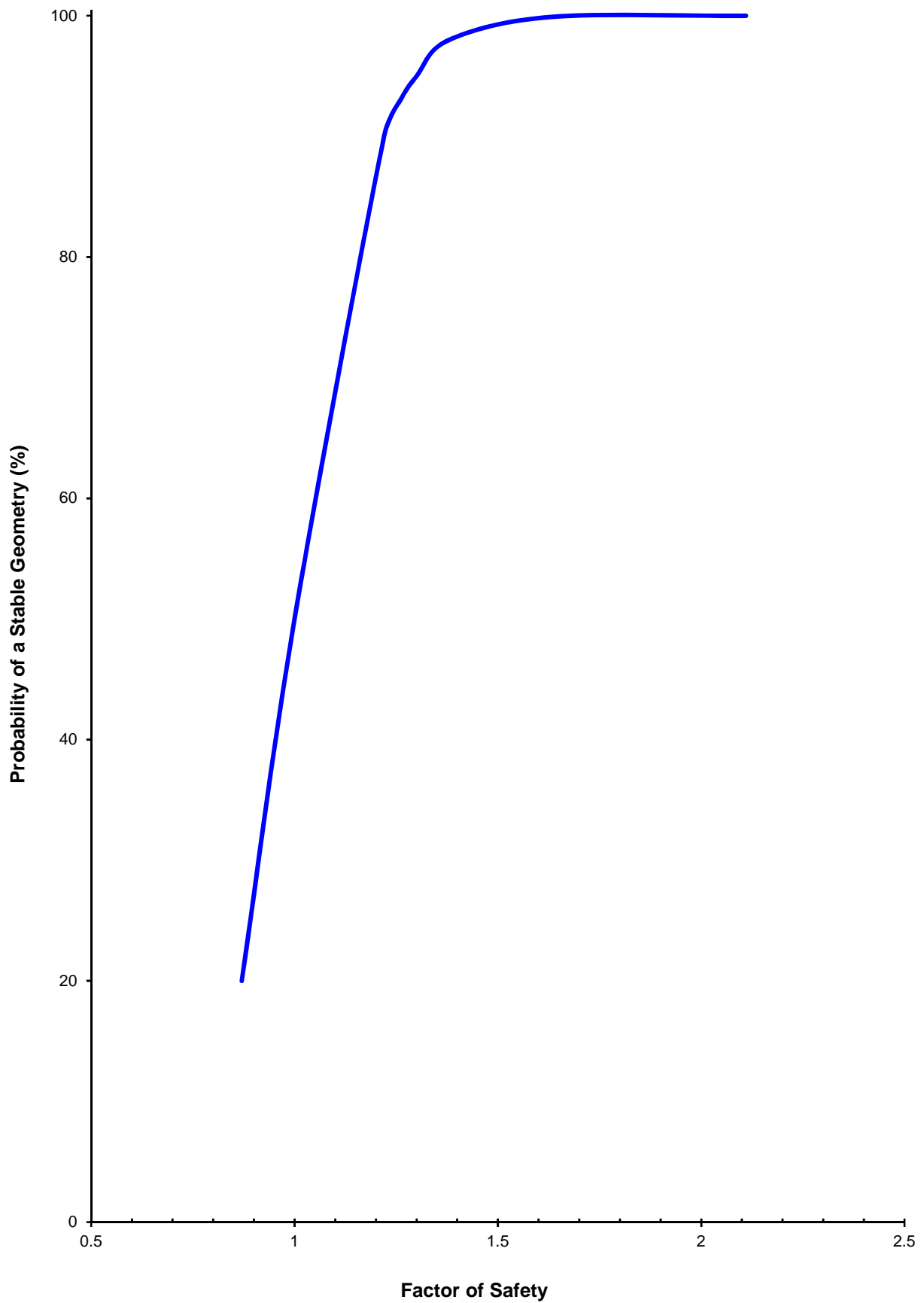
DH/RS/dh

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Engineer:	D. Hill	Client:	Airly Mine		
Drawn:	I. Saliamon	Title:	Loading Model for Sub-critical Panels ($H \tan \phi \geq 0.5W$)		
Date:	11.04.17				
GOLDER ASSOCIATES PTY. LTD. www.golder.com		Ref:	127621105-313-R	Revision No:	1
		Scale:	NTS	Figure No:	1




	Engineer: D. Hill		Client: Airly Mine		
	Drawn: D. Hill		Title: Illustration of Nominal Pillar Design Reliability Based on the Probabilistic Relationship to Factor of Safety (Salamon <i>et al</i> , 1996)		
	Date: 13.04.2017				
	GOLDER ASSOCIATES PTY. LTD. www.golder.com		Ref: 127621105-313-R	Revision No:	1
			Scale: N/A	Figure No:	2

Figure 3a: UCS Test Results on Sandstone Samples (**Madden, 1987**)

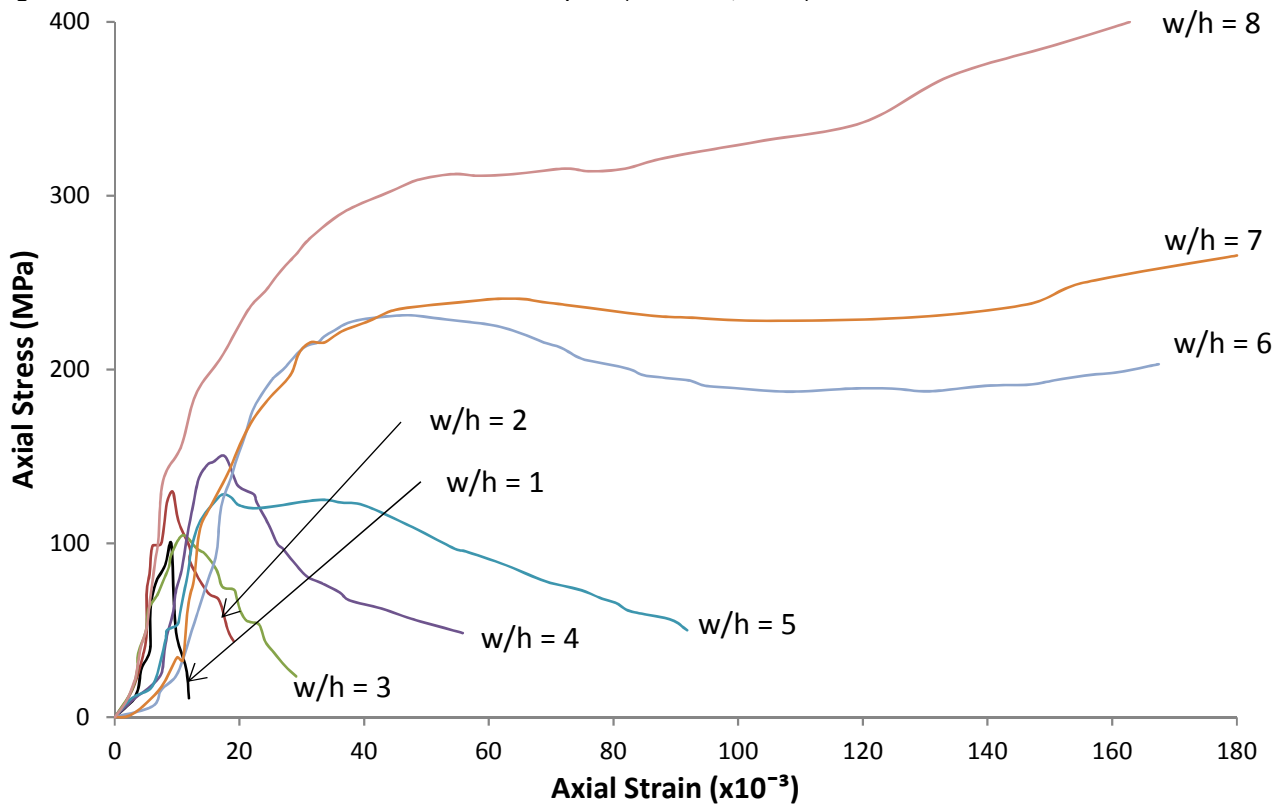
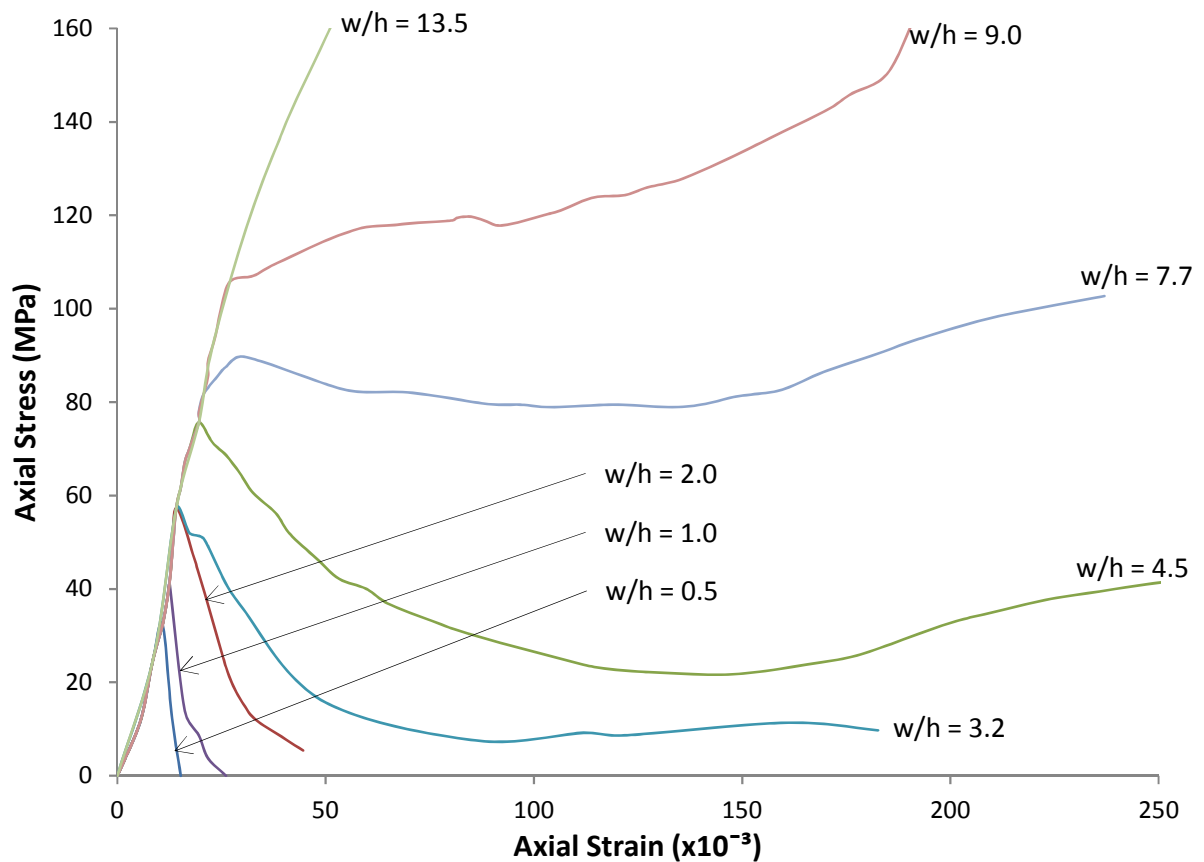
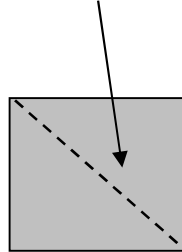


Figure 3b: UCS Test Results on Coal Samples (**Das, 1986**)



	Engineer:	D. Hill	Client:	Airly Mine		
	Drawn:	D. Hill	Title:	Laboratory Test Results on Sandstone and Coal Samples for a Range of Width to Height Ratios		
	Date:	13.04.2017				
	GOLDER ASSOCIATES					
	PTY. LTD.					
www.golder.com		Ref:	127621105-313-R	Revision:	1	
		Scale:	N/A	Figure No:	3a/b	

45° joint impacts significantly
on structural competency of pillar



Width to Height Ratio = 1

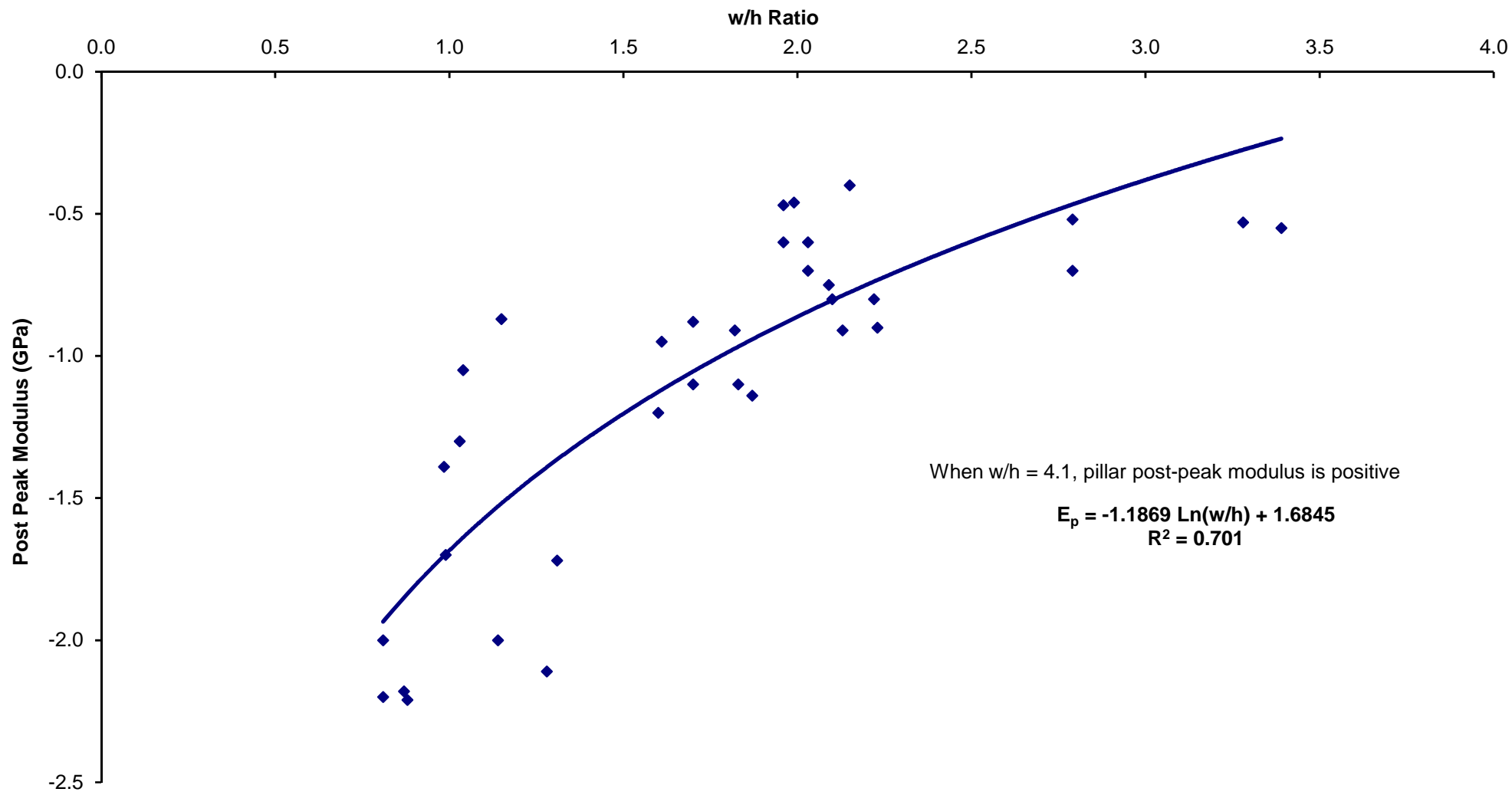
45° joint has minimal impact
on structural competency of pillar



Width to Height Ratio = 5



Engineer:	D. Hill	Client:	Airly Mine			
Drawn:	D. Hill		Title:	Increasing Pillar Width to Height Ratio Reduces the Impact of Unfavourably Orientated Structure		
Date:	13.04.2017					
GOLDER ASSOCIATES		Ref:	127621105-313-R	Revision No:	1	
PTY. LTD.						
www.golder.com						
		Scale:	N/A	Figure No:	4	



Engineer: D. Hill

Drawn: D. Hill

Date: 13.04.2017

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www.golder.com

Client: Airly Mine

Title: Variation of Pillar Post-Failure Modulus with Increasing Width to Height Ratio

Ref: 127621105-313-R

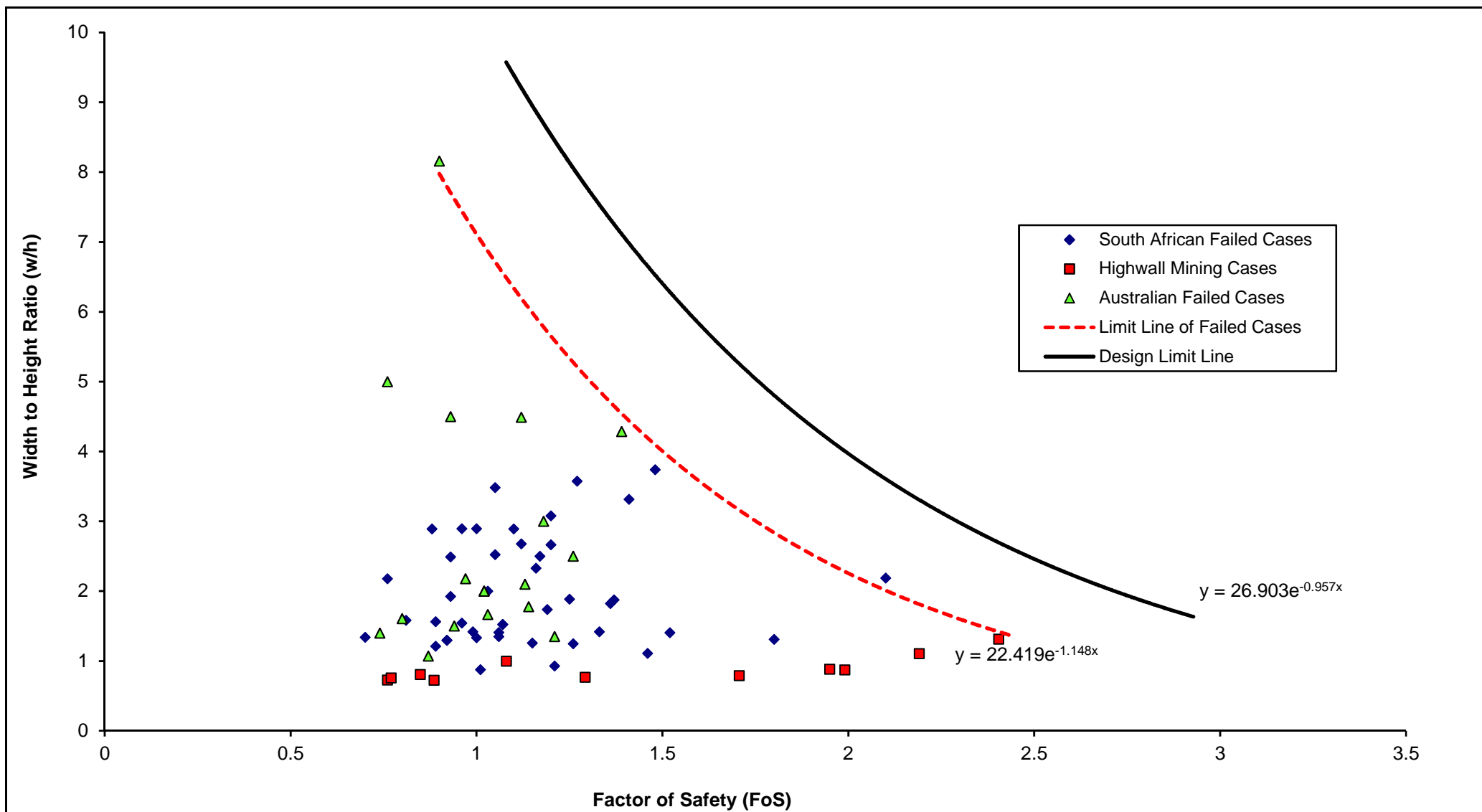
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Revision No.:

1

Figure No:

5



Engineer: D. Hill

Drawn: D. Hill

Date: 13.04.2017

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PTY. LTD.
www.golder.com

Client: Airly Mine

Title: Database of South African and Australian Failed Pillar Cases, Limit and Design Envelopes

Ref: 127621105-313-R

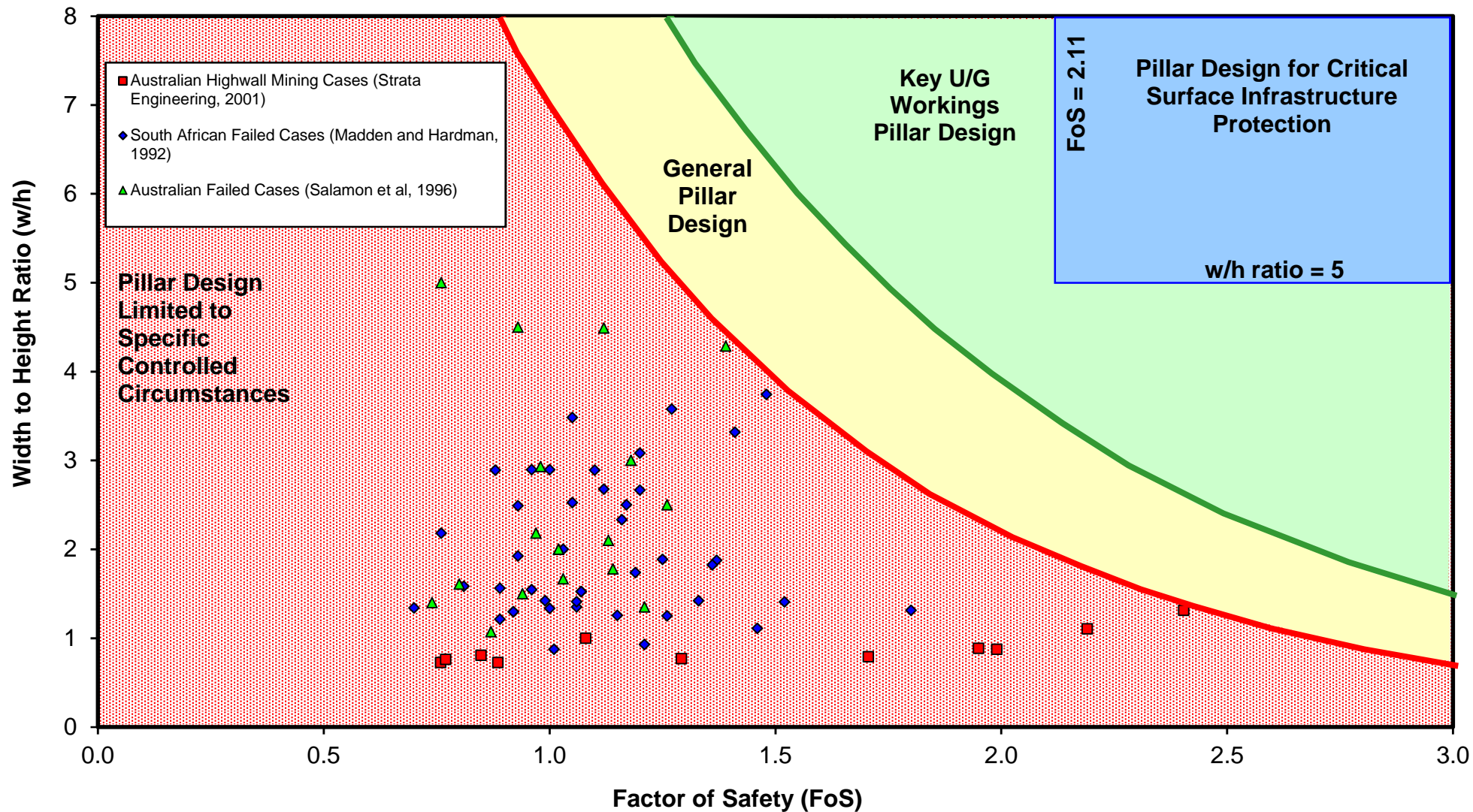
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Revision No:

1

Figure No:

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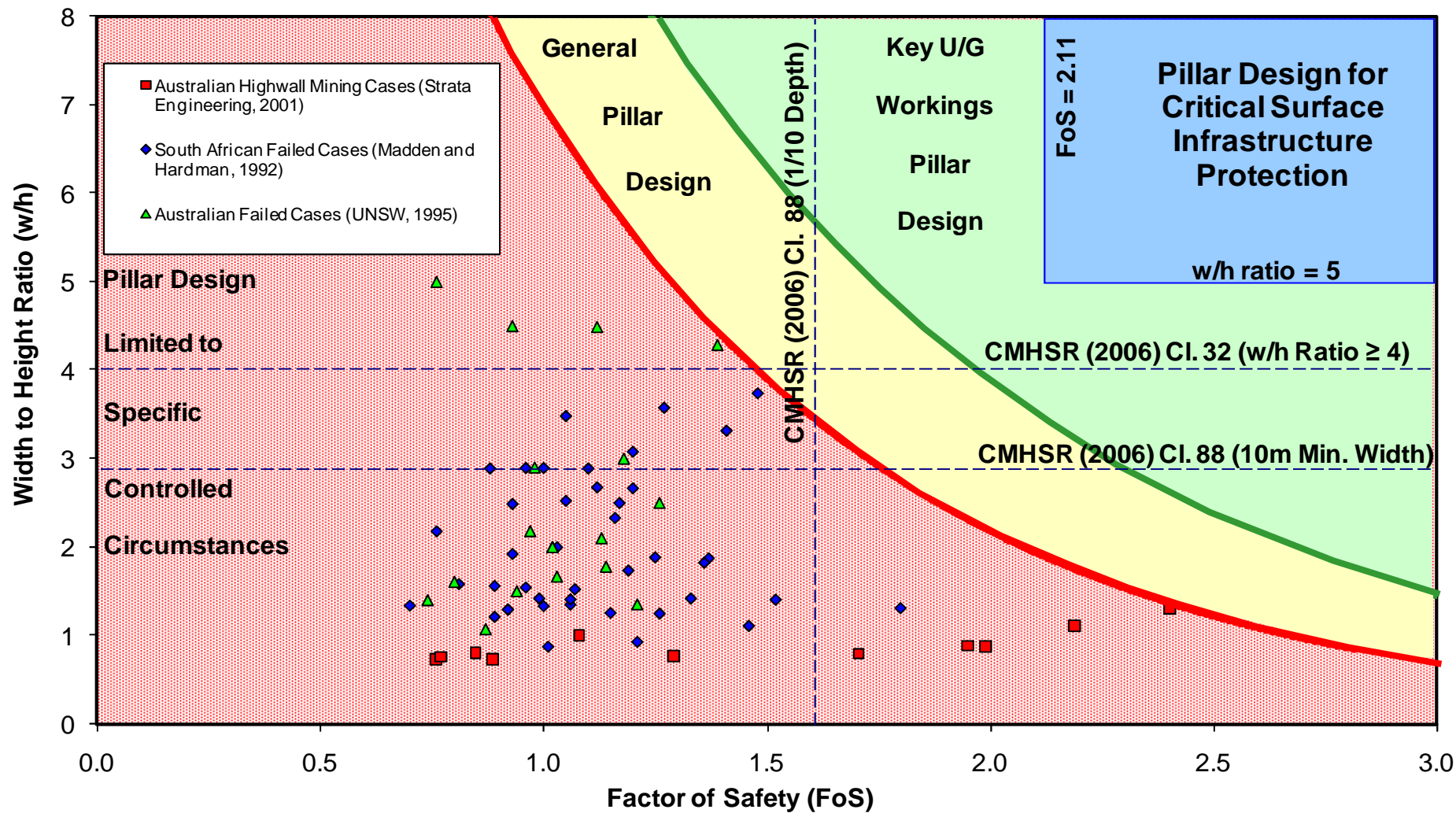
Engineer: D. Hill
 Drawn: D. Hill
 Date: 13.04.2017

GOLDER ASSOCIATES
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Client: Airly Mine
 Title: Database of South African and Australian Failed Pillar Cases and Design Regimes

Ref: 127621105-313-R
 Scale: N/A

Revision No: 1
 Figure No: 7



Note: Clause 32 was subsequently rescinded in the updated legislation (WHS Regulation 2014)



Engineer: D. Hill

Drawn: D. Hill

Date: 13.04.2017

GOLDER ASSOCIATES
PTY. LTD.
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Client: Airly Mine

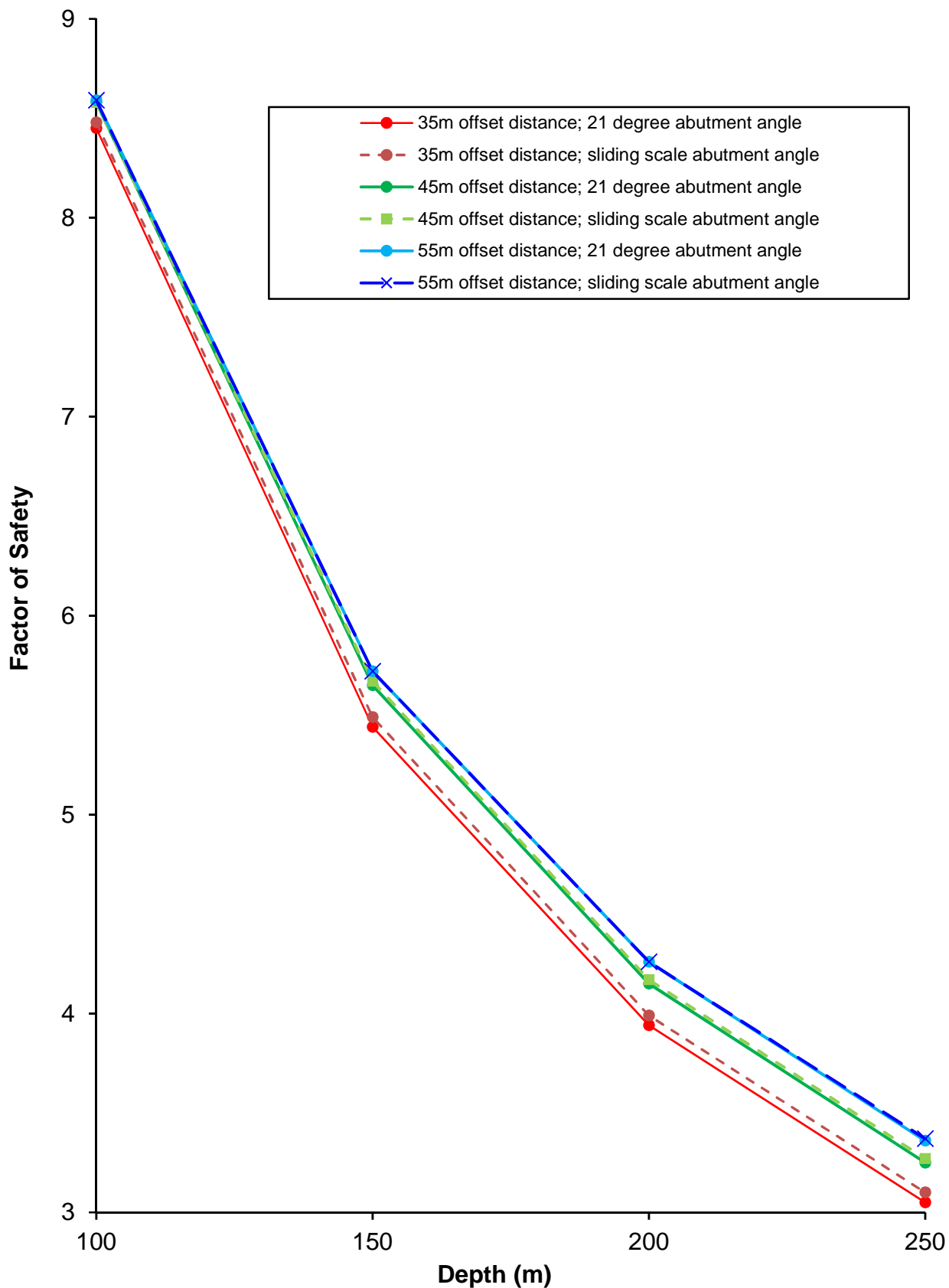
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Ref: 127621105-313-R

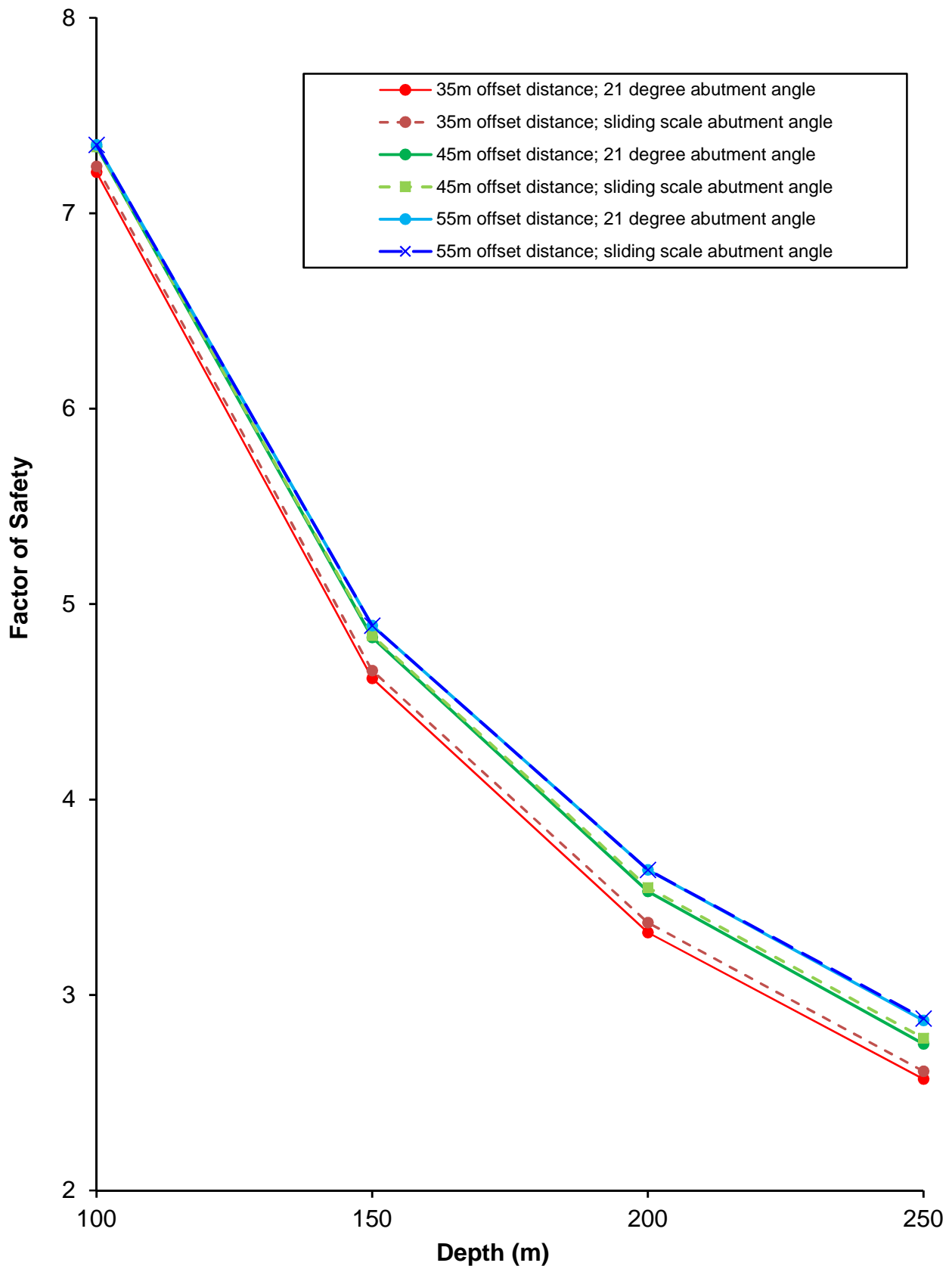
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Revision No: 1

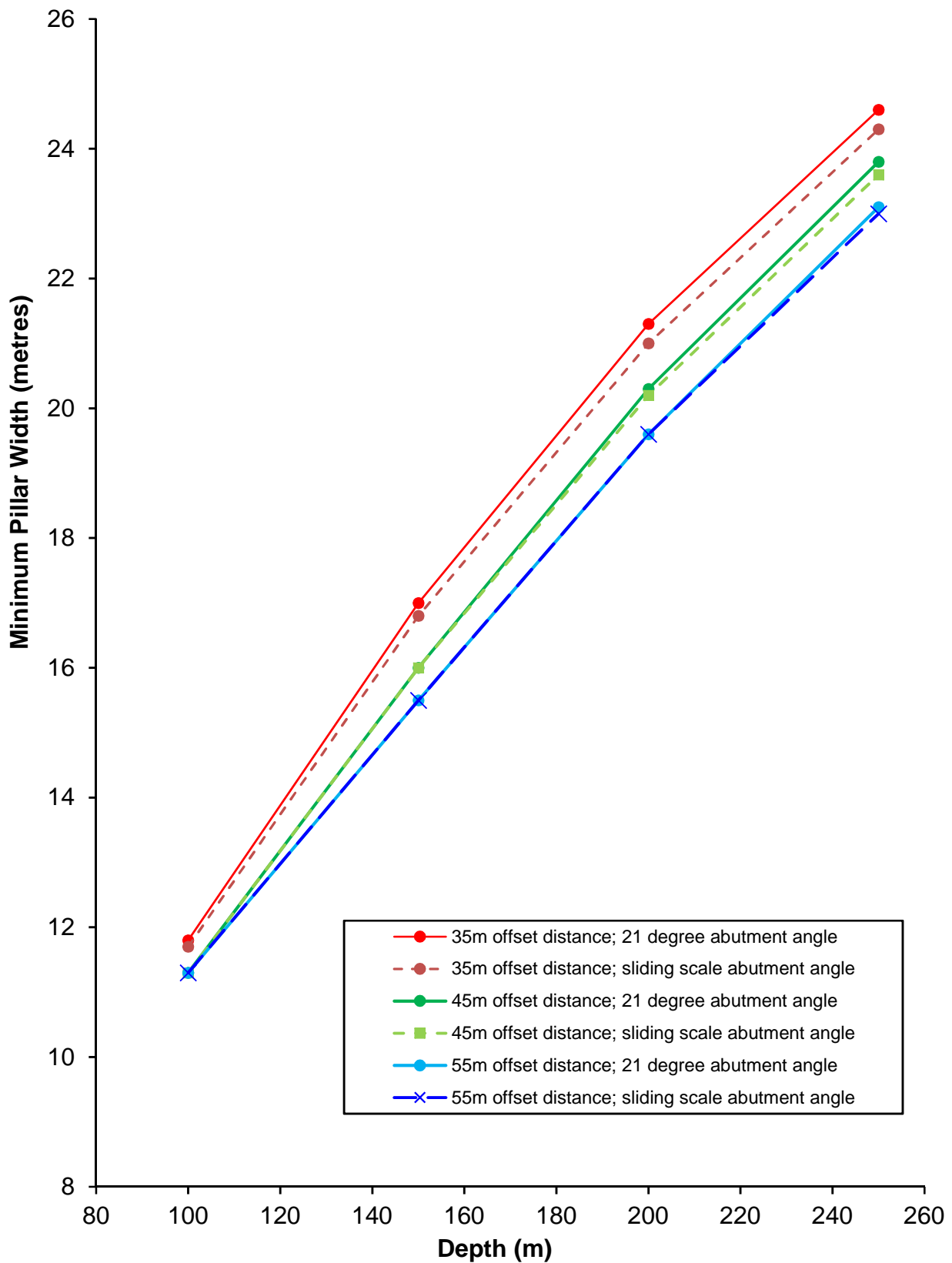
Figure No: 8



	Engineer:	D. Hill	Client: Airly Mine		
	Drawn:	D. Hill	Title: Cliff Line Zone Pillar Geometry 'A' (35m Square Centres): Factor of Safety versus Depth of Cover Relationship		
	Date:	13.04.2017			
	GOLDER ASSOCIATES PTY. LTD.		Ref:	127621105-313-R	Revision No: 1
	www.golder.com		Scale:	N/A	Figure No: 9



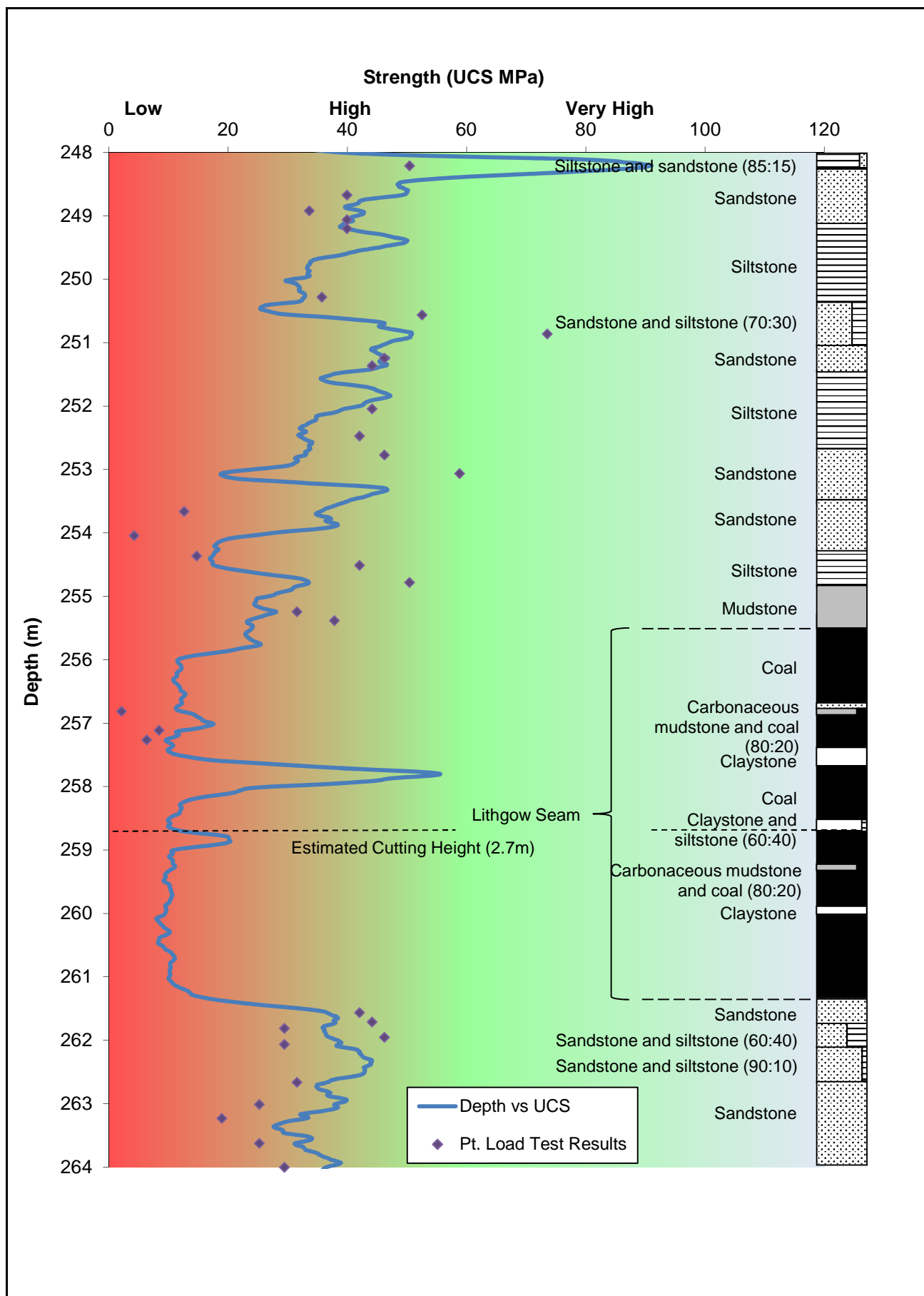
	Engineer:	D. Hill	Client:	Airly Mine		
	Drawn:	D. Hill	Title:	Cliff Line Zone Pillar Geometry 'B' (30m by 45m Centres): Factor of Safety versus Depth of Cover Relationship		
	Date:	13.04.2017				
	GOLDER ASSOCIATES PTY. LTD. www.golder.com		Ref:	127621105-313-R	Revision No:	1
			Scale:	N/A	Figure No:	10




Engineer: D. Hill
Drawn: D. Hill
Date: 13.04.2017
GOLDER ASSOCIATES
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Client: Airly Mine
Title: Cliff Line Zone Potential Smaller Pillars: Minimum Pillar Width versus Depth of Cover Relationship

Ref: 127621105-313-R	Revision No: 1
Scale: N/A	Figure No: 11



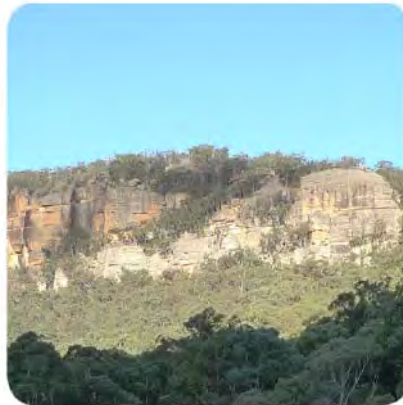
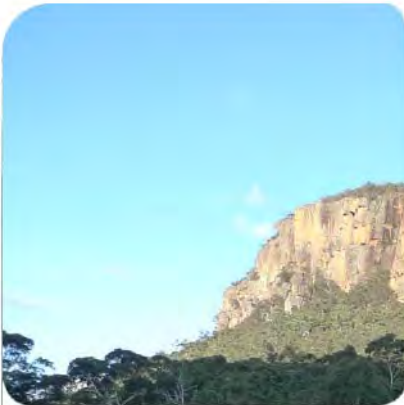
	Engineer: D. Hill	Client: Airly Mine	Title: Sonic-Derived UCS Profile for the Lithgow Seam Horizon (Borehole ARP 01)		
	Drawn: D. Hill	Ref: 127621105-313-R			Revision No: 1
	Date: 13.04.2017				
	GOLDER ASSOCIATES				
	PTY. LTD. www.golder.com				

FEE PROPOSAL – MINING LEASE MLI331

Aerial Mapping of Cliffs, Minor Cliffs and Pagodas with the Cliff Zone

Prepared for Centennial Coal

25 MAY 2017



Prepared by:

RPS AUSTRALIA EAST PTY LTD

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Broadmeadow NSW 2292

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E: Jason.pollock@rpsgroup.com.au

Client Manager: Jason Pollock
Project Number: PR135156
Date: 25 May 2017

Prepared for:

CENTENNIAL COAL COMPANY LIMITED

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Client Contact: David King

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Executive Summary

RPS Newcastle appreciates the opportunity to submit a fee proposal to Centennial Coal (Centennial) to undertake aerial mapping of the Cliffs, Minor Cliffs and Pagodas, within the Cliff Zone area of the First Workings within Mining Lease area ML1331, as defined by Airly MEP Development Consent, 15 December 2016.

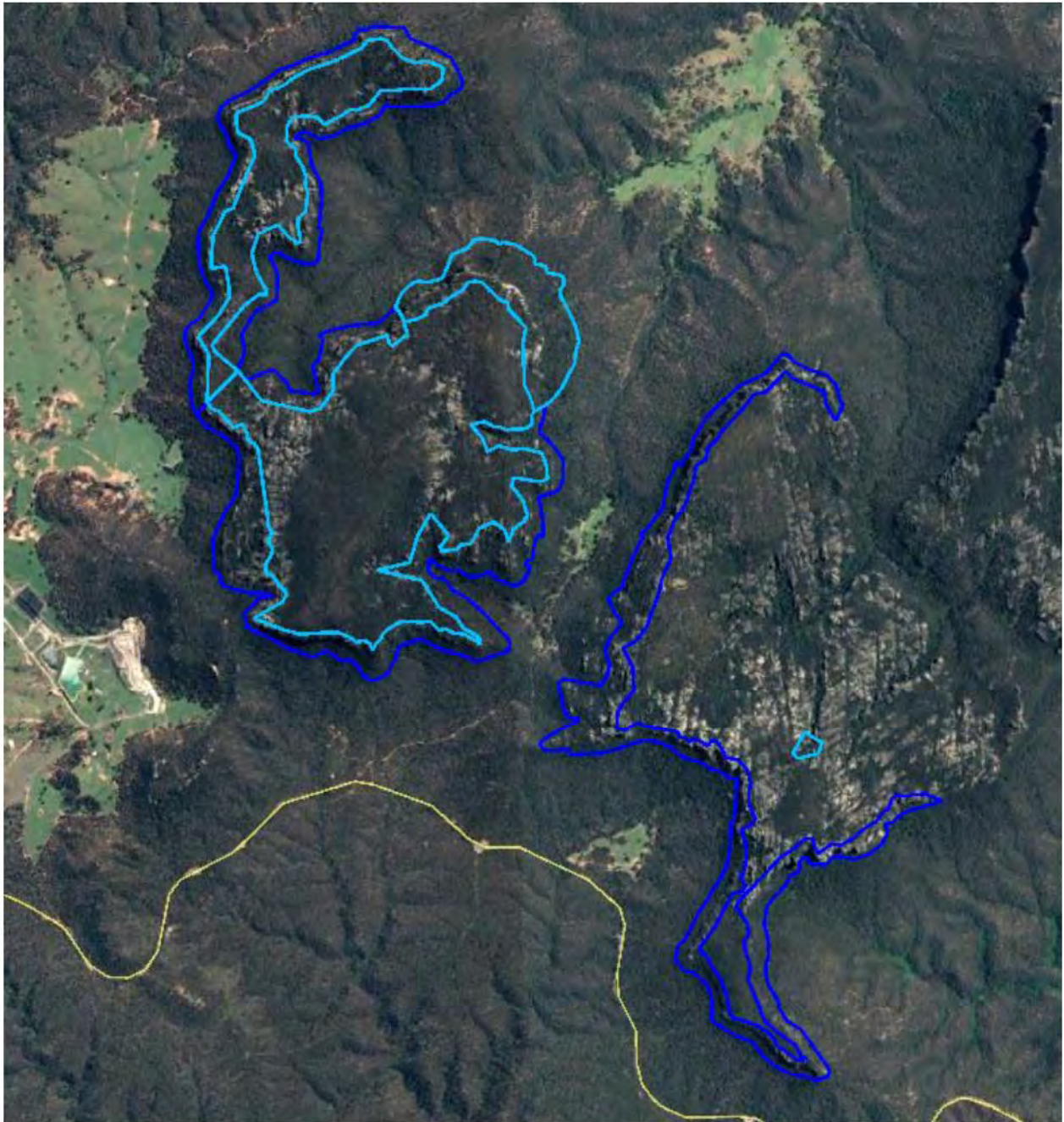
RPS understands that the purpose to establish baseline photographic archival documentation of the Cliffs, Minor Cliffs and Pagodas within the project area. This initial baseline data will enable the comparison of future aerial mapping to determine areas of subsidence impact, such as rock falls, displacement or dislodgement of boulders and identify sites where the total impact is greater than 2 % of the total cliff area. Lease ML1331 has approximately 24 km of escarpment cliffs approximately 6.5 km² of coverage.

The mapping is to be on a plane co-ordinate system, referenced to Map Grid Australia zone 56 (MGA56) coordinates and the Australian Height Datum (AHD).

As detailed throughout this tender, RPS has significant relevant experience and the required expertise to undertake such services for Centennial.

We are experienced in dealing with confidential information and matters requiring security protocols. As representatives of a wide variety of clients, matters of confidentiality are paramount. Accordingly, we have developed internal systems that facilitate appropriate levels of security and management of confidentiality for our clients. This service provision is part of our overall corporate strategy and quality management systems.

RPS is committed to assist Centennial in meeting its future delivery requirements by providing services on time and within budget.



Cliff Zone within First Working Area, Mining Lease 1331

1.0 Methodology

RPS proposes to undertake the project utilising high definition oblique aerial photography of the cliff faces in order to provide fully textured, geographically accurate and high-resolution 3D models which include all natural and man-made objects present in a scene, with the ability to interact and extract real 3D information in both natural and built environments, providing a valuable resource for monitoring change over time.

Due to the scale of the project, it is proposed to capture the cliff escarpments using aero3Dpro at 5 cm GSD, providing the photographic archival documentation of the Cliffs, Minor Cliffs and Pagodas within the project area. LiDAR survey produces a spatially accurate point cloud as the primary product, from which a Digital Elevation Model (DEM) can be generated and subsequently analysed, modelled and volumes calculated. The LiDAR data will be at a point density of 4 points per square metre. RPS anticipates a relative accuracy of approx. 50 mm from the aero3Dpro survey, which is sufficient for local comparison of movement.

This proposal has not allowed for ground field control to be undertaken, subsequent aerial mapping will identify common points between the surveys and clamp these points together as tie points assuming no shift in their absolute position. We believe this to be fit for the purpose to achieve the objective of identifying areas of subsidence impact, such as rock falls, displacement or dislodgement of boulders and identify sites where the total impact is greater than 2 % of the total cliff area.

Utilising GIS and survey software and the running of various queries, areas of subsidence impact can be identified and mapped. These areas can then be further investigated to calculate the volume of material displacement or dislodgement, together with the high definition photographic providing the visual documentation of the impact sites that can be presented within a report.

2.0 Scope of Works & Fee

RPS understands that the general scope of works includes:

Aerial Mapping and Capture of High Definition Oblique Aerial Photographical & LiDAR.

- Liaison and coordination aerial mapping.
- Capture of high definition oblique aerial photographical and LiDAR.
- Processing of high definition oblique aerial photographical and LiDAR.
- Generation of DEM from LiDAR point cloud data.
- Supply of 3D models in a 3D format compatible with (ESRI, Skyline, Bentley, OBJ, 3DS, KMZ, etc).
- Project management and reporting.

Our Fee

(Note: a cost saving of _____ can be achieved if the aerial mapping can be coordinated and flown in conjunction with the quarterly coal stock pile LiDAR mapping that RPS currently undertakes for Centennial.)

Analysis of Digital Photography and LiDAR

- Analysis of digital photography and LiDAR data and identification of subsidence impact, rock falls, dislodgement of boulders or slabs etc.
- Preparation and drafting of plans depicting the location of impacts.
- Calculation of volumes of impact sites.
- Preparation of report.
- Project management and reporting

Our Fee

2.1 Notes & Assumptions

- This fee tender is current as of 25th May 2017 and remains valid for sixty (60) days.
- This fee estimate is based upon _____.
- Any survey requirement not outlined / stated above is not included in the scope of works or fee proposal and subsequently will be treated as a variation. Additional works, above and beyond the scope of the consultancy services outlined above, will be subject to additional fees as outlined in the between Centennial Coal and RPS Australia East Pty Ltd.
- This fee does not make provisions for field verification and ground truthing.
- This fee does not make provisions for meetings; however allowances have been made for a reasonable level of project management, reporting and client liaison.

3.0 Additional Information

3.1 Insurances

A summary of RPS' insurances is listed below for ease of reference. Copies of RPS' current insurance certificates of currency can be provided upon request.

Insurances	Organisation	Policy No.	Expiry Date	Amount Covered
Professional Indemnity	Underwriters at Lloyd's	NS160457R / NS160474R	30/11/2017	\$10M
General and Products Liability (Public Liability)	Epsilon Underwriting Agencies (on behalf of Lloyds of London)	CV0560CGL / BER0630XL	31/05/2017	\$20M
Workers Compensation	Allianz	MWN6046034033	30/06/2017	Statutory Limit
Motor Vehicle	Allianz	61 1142020VFT	31/05/2017	\$30M

3.2 Workplace Health and Safety

RPS has a fully documented Health and Safety Management System. This system is in place to ensure the Health and Safety of our employees, contractors, visitors and the Public.

Our organisation strives for an incident free workplace. To achieve this, we are focused on conducting our activities in ways that protect the environment and the health, safety and security of our employees, contractors, customers, suppliers and the community. We have aligned our Health & Safety Management System to AS 4801:2001.

Our health & safety management system (which includes all policies and procedures) is available to all staff on our intranet. A copy of our Health, Safety & Environment (HSE) Policy can be provided upon request.

3.3 Quality Assurance

RPS is committed to providing the highest standard of advice and service to our clients. Our commitment to quality is clearly demonstrated in our Quality Management System which is QA accredited under AS/NZS ISO 9001:2000 Quality Management Systems. A copy of our certificate can be provided upon request.

3.4 Code Compliance

RPS Australia East is compliant with the National Code of Practice for the Construction Industry (the Code) and all versions of the Australian Government Implementation Guidelines.

Copies of RPS' National Code of Compliance letters from the Department of Education, Employment and Workplace Relations (DEEWR) can be provided upon request.

4.0 Conclusion

With one of Australia's largest surveying teams, the most up-to-date technology and a network of regional offices, we have the capacity, experience and expertise to service even the most complex requirements. Our surveying team has received recognition at the state, national and international level for its innovation and commitment to quality. RPS Newcastle has a highly skilled team who understand the issues, have experience in the locality and are well placed to undertake survey requirements for the project.

We look forward to the opportunity to assist you on this project. If there are any further queries, please do not hesitate to contact Newcastle General Manager, Darrell Rigby, or the undersigned.

Yours sincerely

RPS

A handwritten signature in blue ink, appearing to read 'J Pollock', is written over the RPS logo.

Jason Pollock
Survey Manager - Newcastle

A4.3 Principal Subsidence Engineer – Mine Safety Operations, Resource Regulator, DP&E (formerly DRE)

The following section provides copies of written correspondence with Dr Gang Li, Principal Subsidence Engineer (PSE) and Senior Inspector for the *Division of Central Coast Coordination and Resource Regulation (Mine Safety Operations)*, commonly referred to as the “Resource Regulator”, within the NSW Department of Planning and Environment (DP&E). Prior to recent restructuring in 2017 the PSE was formerly located within the NSW Division of Resources and Energy (DRE), NSW Department of Industry, as referenced in the Development Consent SSD_5581.

From: David King <david.king@centennialcoal.com.au>
Sent: Thursday, 20 July 2017 3:57 PM
To: Gang Li
Cc: Craig Bagnall; James Wearne
Subject: Notes from consultation phone call 19/7/18 re: Cliff Zone of First Workings Extraction Plan

Hello Gang,

I took some notes from the phone meeting we had regarding the Extraction Plan for the Cliff Zone of First Workings. Can you please review them and send me a written response. Please include any additional items or changes to the notes you feel are necessary .

The Extraction Plan (EP) for the Cliff Zone of First Workings is required under Condition 7 of Schedule 3 of SSD5581. We are required to consult with Division of Resources and Energy (DRE) in the development of the Subsidence Monitoring Program, the Land Management Plan and the Public Safety Management Plan.

The Cliff Zone of First Workings as defined in SSD5581 requires the Mine to only carry out first workings with pillars that are long term stable and non-subsiding and there will be no later secondary extraction of those pillars. This forms the basis for the consultation that took place. It should also be noted that none of the pillars proposed are to be formed at depths below 50m.

It was noted that Gang was unable to schedule a face to face meeting with us on the Extraction Plan due to high work load and limited resources in his area. Therefore the notes below represent the consultation Airly is required to do. I have tried to group them into subject areas, though the actual conversation ranged back and forth over a number of issues.

I took the time to explain our overall monitoring strategy both for this Extraction Plan and the secondary extraction planned in other parts of the deposit outside the Cliff Zone at a later date. Gang was interested at an Engineering level, but he made it clear that he doesn't approve monitoring strategies. DRE will have an active regulatory role if they believe that our monitoring and management processes do not address the Work Health and Safety (WHS) legislation and associated risks adequately.

Subsidence Monitoring and Reporting in General

- Any mine design, subsidence monitoring program and reporting program related to the consent must be approved by the SSD5581 Independent Expert Panel (IEP). If there are any variations from their recommendations, Airly will have to make the case and have it approved.
- All data must be reviewed by the IEP and their recommendations followed. If there are any variations from their recommendations, Airly will have to make the case and have it approved.
- From a WHS perspective the guidelines Gang previously provided should form the basis of the Management Plan for the Safety of Others (i.e. Public Safety Management Plan). Provided we address the issues in those guidelines he believes we have met our obligations under WHS and the Consent as the current DPE guidelines for Public Safety Management are very dated and no longer reflect current legislative requirements.
- Airly needs to provide a schedule of the IEP involvement in our mining processes to DRE including milestones that trigger meetings. This is both for this EP and going forward for later Extraction Plans for secondary extraction to show how they will be consulted for future EP. DRE would like to be given the opportunity to be involved as an observer at review meetings and/or receive the minutes from the meetings.
- It would be a good idea to commence our monitoring well before actual secondary extraction to provide good baseline data. I explained that is what we are doing and that the IEP recommended this as well.

First Workings EP

- Our first workings must be in the areas and follow the dimensions that were previously approved by DRE under DA162/91 and have carried over into this new Consent.
- The IEP must concur that the proposed workings are long term stable and non-subsiding.
- We must be clear that these workings are not less than 50m DOC and will not have any second workings associated with them in the future.
- Gang accepted a "monitor for change" strategy for first workings. He did not want to see a "no monitoring" strategy.

First Workings with respect to WHS requirements

- We can put a case forward that due to the workings being long term stable and non-subsiding, we do not need to provide a specific subsidence related management plan for WHS.
- Provided we are monitoring for change and involve DRE in the results and IEP review, that will suffice for first workings in the Cliff Zone of First Workings.
- The Public Safety Management Plan we develop for the consent must comply with WHS as mentioned above. Use the guideline to assist in developing the format. See this as the first step in creating a life of mine Public Safety Management Plan.

I look forward to your written feedback and any further comments.

Regards

David King

Senior Mining Engineer

p: +61 (0) 2 6359 2112 | f: +61 (0) 2 6359 2132 | m: +61 (0) 427 970 265



Centennial Coal

Centennial Coal Company Limited | Airly

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From: Gang Li <gang.li@industry.nsw.gov.au>
To: David King <david.king@centennialcoal.com.au>,
Cc: Mine Safety <mine.safety@industry.nsw.gov.au>, Phil Stuart <phil.stuart@industry.nsw.gov.au>
Date: 19/07/17 10:16 AM
Subject: Your proposed meeting to discuss Airly Cliff Zone Extraction Plan

David

My apology for the significant delay in responding to your e-mail dated 27 June 2017 and titled "*Proposed meeting to discuss Airly Cliff Zone Extraction Plan*".

We have been under very heavy workloads latterly.

Irrespective of our current workloads, my response to your e-mail is that your requested meeting is not necessary at this stage. In this case, I reiterate the following required actions by Airly Colliery as we discussed during a tele-conference meeting on 18 January 2017.

(1) Development and implementation of the Extraction Plan by the Airly Colliery in consultation with the IEP in accordance with Airly Colliery's Development Consent (SSD_5581) dated 15 December 2016, and

(2) Development and implementation of risk controls by the Airly Colliery for the health and safety of the "other persons" in accordance with the requirements of the WHS Laws in relation to subsidence. To assist with your work in this regard, a copy of the Subsidence Guideline was sent to you on 28 June 2017.

Note 1 - The WHS laws, as defined under Section 5 of *Work Health and Safety (Mines & Petroleum Sites) Act 2013*, means:

- *WHS Act*;
- *WHS (Mines & Petroleum Sites) Act*;
- *WHS Regulations*, and
- *WHS (Mines & Petroleum Sites) Regulations*.

Note 2 - Refer to section 19 of the *Work Health and Safety Act 2011* for the meaning of the "other persons".

In addition, Airly Colliery is required to submit a Schedule to the Principal Subsidence Engineer, which documents the objective, scope (or agenda items), timing and venue for each of the IEP's main review meetings / activities. We will use the information documented in the Schedule to decide our participation in the IEP's review meetings / activities as an observer.

Kind Regards

Dr. Gang Li | Principal Subsidence Engineer & Senior Inspector

Mine Safety Operations | Central Coast Coordination and Resources Regulation Division

NSW Department of Planning & Environment

516 High Street | Maitland NSW 2320 | PO Box 344 | Hunter Region MC NSW 2310

T: 02 4931 6644 | M: 0409 227 986 | F: 02 4931 6790 |

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Craig Bagnall

From: Gang Li <gang.li@industry.nsw.gov.au>
Sent: Friday, 14 July 2017 3:43 PM
To: David King
Cc: Craig Bagnall; Bob Miller; Mine Safety
Subject: Re: Proposed meeting to discuss Airly Cliff Zone Extraction Plan

David

My apology!

Did not forget but too busy at the moment.

Will DEFINITELY respond next week, if not Monday, Tuesday.

Kind Regards

Dr. Gang Li | Principal Subsidence Engineer & Senior Inspector

Mine Safety Operations | Central Coast Coordination and Resources Regulation Division

NSW Department of Planning & Environment

516 High Street | Maitland NSW 2320 | PO Box 344 | Hunter Region MC NSW 2310
T: 02 4931 6644 | M: 0409 227 986 | F: 02 4931 6790 |



On Fri, Jul 14, 2017 at 12:48 PM, David King <david.king@centennialcoal.com.au> wrote:
Gang,

Seeing as it is late on Friday, this is just a reminder that we would like to arrange a meeting as soon as you are able to discuss the Cliff Zone of First Workings Extraction Plan.

We are aiming to submit this Extraction Plan by the second week in August. So your input is not only very important, but now also quite urgent. Due to a number of earlier delays in the establishment of the Independent Expert Panel, the mine is currently experiencing a loss of some ability to develop roadways in the cliff zone in the 206 panel. Whilst we are managing this, it is our desire to be able to have an approved Extraction Plan as soon as possible.

Can you please advise us of a date for a meeting in a location of your choice to discuss our proposals and receive your input.

Thank you.

Regards

David King
Senior Mining Engineer

p: [+61 \(0\) 2 6359 2112](tel:+61263592112) | f: [+61 \(0\) 2 6359 2132](tel:+61263592132) | m: [+61 \(0\) 427 970 265](tel:+61427970265)



Centennial Coal

Centennial Coal Company Limited | Airly

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From: Gang Li <gang.li@industry.nsw.gov.au>
To: Craig Bagnall <cbagnall@niche-eh.com>,
Cc: David King <david.king@centennialcoal.com.au>, Mine Safety <mine.safety@industry.nsw.gov.au>
Date: 06/07/17 09:19 AM
Subject: Re: Proposed meeting to discuss Airly Cliff Zone Extraction Plan

Craig, David

At present, I am unable to provide a definite response due to our current heavy work loads.

I'll try to respond sometimes next week.

Regards

Dr. Gang Li | Principal Subsidence Engineer & Senior Inspector

Mine Safety Operations | Central Coast Coordination and Resources Regulation Division

NSW Department of Planning & Environment

516 High Street | Maitland NSW 2320 | PO Box 344 | Hunter Region MC NSW 2310
T: 02 4931 6644 | M: 0409 227 986 | F: 02 4931 6790 |

On Wed, Jul 5, 2017 at 3:22 PM, Craig Bagnall <cbagnall@niche-eh.com> wrote:
Hi Gang,

Thanks for sending through the guidelines last week, much appreciated.

David is away this week so Im just touching base on his email invitation below to confirm if you have a preferred date in the next week or two for a consultation meeting regarding the Cliff Line Zone of First Workings extraction plan?

Thanks again for your time, much appreciated.

Kind regards,

Craig

CRAIG BAGNALL BE(Env)(Hons) CEnvP (IA Specialist)
Senior Environmental Engineer
Newcastle

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A PO Box 2443 North Parramatta NSW 1750
E cbagnall@niche-eh.com W niche-eh.com

From: David King [mailto:david.king@centennialcoal.com.au]

Sent: Wednesday, 28 June 2017 12:29 PM

To: Craig Bagnall <cbagnall@niche-eh.com>

Subject: Fw: Proposed meeting to discuss Airly Cliff Zone Extraction Plan

hi Craig,

I haven't read these yet, but here they are straight from Gang.

Regards

David King

Senior Mining Engineer

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----- Forwarded by David King/CentennialCoal on 28/06/17 12:28 PM -----

From: Gang Li <gang.li@industry.nsw.gov.au>
To: David King <david.king@centennialcoal.com.au>,
Cc: Mine Safety <mine.safety@industry.nsw.gov.au>
Date: 28/06/17 11:33 AM
Subject: Re: Proposed meeting to discuss Airly Cliff Zone Extraction Plan

David

I'll respond to you re the proposed meeting towards the end of week.

As discussed, please find attached

1. Subsidence Guideline for the WHS law
2. Subsidence Monitoring Data Submission Form, which is part of the above guideline.

Regards

Dr. Gang Li | Principal Subsidence Engineer & Senior Inspector

Mine Safety Operations | Central Coast Coordination and Resources Regulation Division

NSW Department of Planning & Environment

516 High Street | Maitland NSW 2320 | PO Box 344 | Hunter Region MC NSW 2310
T: 02 4931 6644 | M: 0409 227 986 | F: 02 4931 6790 |

On Tue, Jun 27, 2017 at 10:57 AM, David King <david.king@centennialcoal.com.au> wrote:
Gang,

I writing to request a meeting with you in order to consult with you in relation to the preparation of the Management Plans described below. Could you please advise me of a time and location that would be suitable to meet with you. I would be happy to host you at the mine site if that suits your plans.

Airly Mine is currently preparing an Extraction Plan for first workings within the Cliff Zone of First Workings as defined in SSD5581 Schedule 3, Condition 7. We are required to consult with Division of Resources and Energy (DRE) in relation to the development of the Subsidence Monitoring Program, Land Management Plan and the Public Safety Management Plan. Note that consultation with DRE is normally required for the development of a Built Features Management Plan, but due to the minor nature of built features (i.e. dirt tracks, fences and gates), the Department of Planning and Environment has allowed the management of built features to be included in the Land Management Plan.

The Mine must also prepare a Management Plan for management of the safety of others that may be effected by the impacts of subsidence in accordance with the provisions of the Work Health and Safety Act 2011, Work Health and Safety Regulation 2011, Work Health and Safety Mines and Petroleum Sites Act 2013 and Work Health and Safety Mines and Petroleum Sites Regulation 2014.

I would like to cover the following items in the meeting:

- The proposed mine workings within the Cliff Zone of First Workings

- The geotechnical analysis of the proposed first workings
- The results of consultations with various stakeholders to date and in particular the consultations with the Independent Expert Panel constituted under SSD5581
- Outline the proposed monitoring of subsidence for the Cliff Zone of First Workings and appraise you of the concepts for subsidence monitoring of later secondary extraction
- Discuss any items you think the Mine needs to consider in the monitoring and management subsidence in relation to first workings within the Cliff Zone of First Workings from a both a Consent and Work Health and Safety perspective
- Conduct a surface inspection if you feel that is necessary

You also mentioned during our telephone conversation on the 15/6/17 that you had Guidelines relating to the preparation of WHS related Management Plans for Subsidence Impacts and the reporting of Subsidence Monitoring. Would you please send them through to me via email for my use in preparing the required plans.

I look forward to hearing from you and arranging this meeting at your earliest convenience.

Regards

David King

Senior Mining Engineer

p: [+61 \(0\) 2 6359 2112](tel:+61263592112) | f: [+61 \(0\) 2 6359 2132](tel:+61263592132)



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A2.4 NPWS and OEH

The following section provides copies of written correspondence with the National Parks and Wildlife Service (NPWS) and the NSW Office of Environment and Heritage (OEH) as relevant to the SMP, LMP and PSMP. It is noted that further consultation with other separate sections of OEH for the EP-Biodiversity Management Plan (EP-BMP) and the HHMP is described within those documents.

NATIONAL PARKS AND WILDLIFE ACT 1974

Notice of Reservation of a National Park

I, General The Honourable David Hurley AC DSC (Ret'd), Governor of the State of New South Wales, with the advice of the Executive Council, reserve the land described in the Schedule 1 below as part of **Mugii Murum-ban State Conservation Area**, under the provisions of section 30A (1) of the *National Parks and Wildlife Act 1974*.

Signed and sealed at Sydney this 14th day of September 2016.

DAVID HURLEY
Governor

By His Excellency's Command,

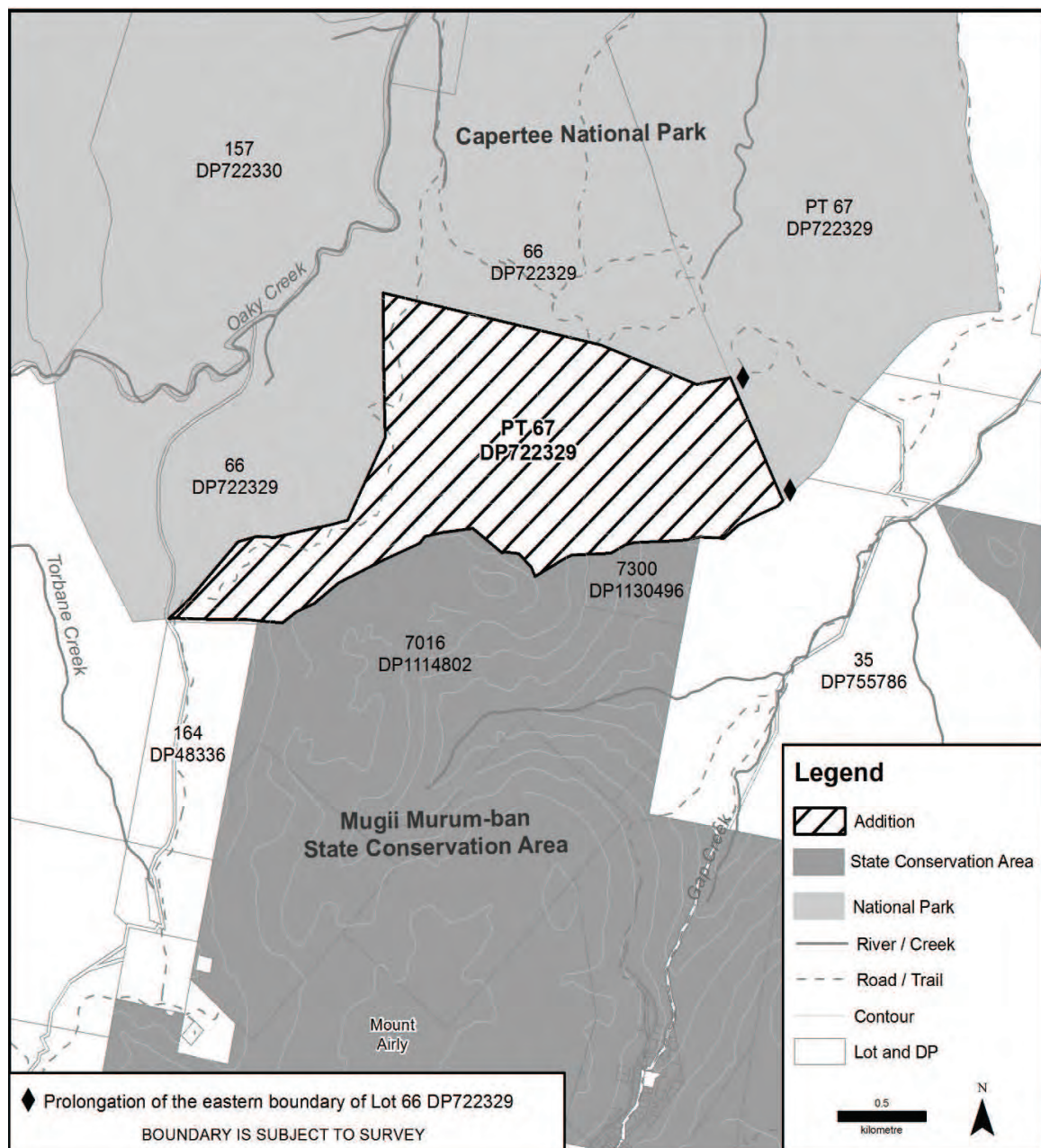
MARK SPEAKMAN SC, MP
Minister for the Environment

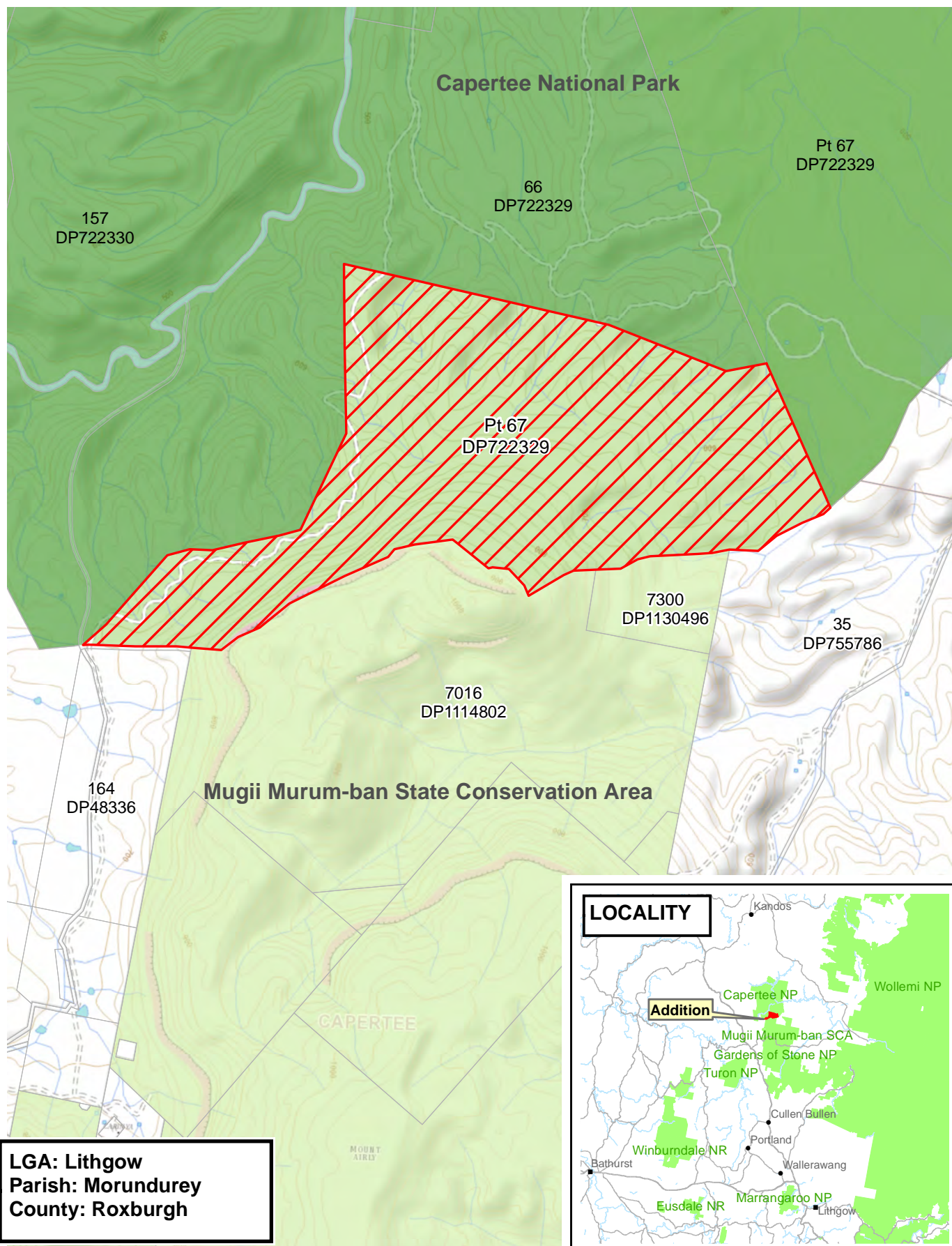
GOD SAVE THE QUEEN
Land District – Mudgee LGA – Lithgow

Schedule 1

County Roxburgh, Parish Morundurey, about 274.2 hectares being that part of Lot 67 DP 722329 as shown by hatching on the diagram below.

Diagram





Legend

-  Addition
-  State Conservation Area
-  National Park
-  Lot and DP

Addition of land to Mugii Murum-ban State Conservation Area



Office of
Environment & Heritage
NSW National Parks & Wildlife Service



0 0.25 0.5 1
Kilometers

EF16/9250
DOC16/383299

Printed by RET
3 August 2016

DESCRIPTION OF LANDS

PART 1

Local Govt. Area	LITHGOW		
County	ROXBURGH		
Parish	AIRLY, COCO, MORUNDUREY		
Suburb	ROUND SWAMP, CAPE TEE, GLEN ALICE		
Status:	Lot	Section	DP
Crown land being	7028		DP: 1029701
Crown land being	7003		DP: 1050959
Crown land being part	7012		DP: 1056868
Crown land being	7001		DP: 1057060
Crown land being	7015		DP: 1057714
Crown land being	7029		DP: 1075846
Crown land being	7038		DP: 1117632
Crown land being	7300		DP: 1126380
Crown land being	7301		DP: 1126380
Crown land being	7302		DP: 1130728
Crown land being	7303		DP: 1130728
Crown land being	7304		DP: 1130728
Crown land being	158		DP: 722293
Crown land being	13		DP: 755757
Crown land being	136		DP: 755757
Crown land being	18		DP: 755757
Crown land being	20		DP: 755757
Crown land being	24		DP: 755757
Crown land being	26		DP: 755757
Crown land being	40		DP: 755757
Crown land being	41		DP: 755757
Crown land being	70		DP: 755757
Crown land being	65		DP: 755786

PART 2

Plan/diagram: Schedule 3	Area: 1011ha
--------------------------	--------------

TEXT DESCRIPTION: Whole of Lots 13, 18, 20, 24, 26 & 136 in DP 755757 and Lot 7028 DP 1029701 (all being part of Reserve 80281 from sale or lease generally other than annual lease, notified 17 January 1958), Lot 40 in DP 755757 & 7029 DP 1075846 (both being part of Reserve 755757 for Future Public Requirements, notified 29 June 2007), Lot 41 in DP 755757 (being part of Reserve 62688 from sale or lease generally other than annual lease), Lot 70 DP 755757, Lot 7038 DP 1117632 & Lot 7015 DP 1057714 (all being part of Reserve 58609 from sale or lease generally other than annual lease, notified 26 February 1926), Lot 65 DP 755786 (Being Reserve 89682 for Future Public Requirements, notified 12 December 1975), Lot 7001 DP 1057060 (being part of Reserve 1012828 for Future Public

Licence No.: RI 573903

Page: 3

Requirements, notified 8 December 2006), Lot 7003 DP 1050959 (being Reserve 78613 for Future Public Requirements, notified 25 May 1956), Lots 7300 & 7301 in DP 1126380 and Lots 7302, 7303 & 7304 in DP 1130728 (all Reserve 755757 for Future Public Requirements, notified 29 June 2007), Lot 158 DP 722293 (R190027 for Public Recreation, notified 30 January 1987) and western-most part of Lot 7012 DP 1056868 (being part of Reserve 80281 from sale or lease generally other than annual lease, notified 17 January 1958), as shown by red edge in Schedule 3 Diagram.

Note - a Table of Contents appears at the end of this Licence (6.001)

***** End of Description of Land (Crown Land) *****

Craig Bagnall

From: Craig Bagnall
Sent: Thursday, 27 July 2017 12:52 PM
To: 'Lisa Menke'
Cc: John Stevens (John.Stevens@centennialcoal.com.au); Greg Tobin; John Maynard; David King; craig.tindall@centennialcoal.com.au; paul.duncan@centennialcoal.com.au; Alanna Ryan
Subject: Crown Lands under licence to NPWS near Airly Mine (Niche ref: 2529 Airly Cliff Line Zone Extraction Plan ML1331)
Attachments: Capertee Crown land licence description.jpg; Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA....pdf

Hi Lisa,

Thanks again for all your help, much appreciated. I have cc'd relevant key personnel at Centennial Coal in relation to this updated information for their information and awareness.

As per your advice, given current GIS layers are not yet available from NPWS in the interim the mine's data sets will be updated accordingly to reflect the info you have provided below and attached. Figures in the Extraction Plan documents being submitted to you very shortly for consultation as discussed (Land Management Plan etc) will reflect these changes. Those figures will also be provided to Kay Oxley at DPI Crown Lands for consultation and confirmation.

John S – please amend A0 Plan 5 (Land Ownership) accordingly and re-issue as final draft. Please see Lisa's figure and important clarifying comments in her emails below particularly at 11.08am this morning.

Greg T – Please amend our land management plan figures accordingly similar as per note to John above.

Kind regards,
Craig

CRAIG BAGNALL BE(Env)(Hons) CEnvP (IA Specialist)
Senior Environmental Engineer
Newcastle



Excellence in your environment

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A PO Box 2443 North Parramatta NSW 1750
E cbagnall@niche-eh.com W niche-eh.com



From: Lisa Menke [<mailto:Lisa.Menke@environment.nsw.gov.au>]
Sent: Thursday, 27 July 2017 12:27 PM
To: Craig Bagnall <cbagnall@niche-eh.com>
Subject: RE: Urgent query please - FW: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Hi Craig

No luck with our GIS guys – they know the data set is incorrect and haven't got it scheduled for update any time soon. I'll have to leave it with you.



Lisa Menke
A/Area Manager Mudgee
Blue Mtns Branch
NSW National Parks and Wildlife Service

27 Inglis street MUDGEE 2850
T 02 6370 9000 F 02 6370 9010
M 0429 687 331
W nationalparks.nsw.gov.au

From: Craig Bagnall [<mailto:cbagnall@niche-eh.com>]

Sent: Thursday, 27 July 2017 12:04 PM

To: Lisa Menke <Lisa.Menke@environment.nsw.gov.au>

Subject: RE: Urgent query please - FW: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Thanks Lisa ☺ If no luck with Karen we'll amend data sets at our end for use in draft figures on their way to you with the various docs for the Extraction Plan consultation.

Will be in touch, a huge thanks again.

Kind regards,
Craig

CRAIG BAGNALL BE(Env)(Hons) CEnvP (IA Specialist)
Senior Environmental Engineer
Newcastle



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E cbagnall@niche-eh.com W niche-eh.com



From: Lisa Menke [<mailto:Lisa.Menke@environment.nsw.gov.au>]

Sent: Thursday, 27 July 2017 11:55 AM

To: Karen Eardley <Karen.Eardley@environment.nsw.gov.au>

Cc: Craig Bagnall <cbagnall@niche-eh.com>

Subject: FW: Urgent query please - FW: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Hi Karen

The current Corporate GIS layer that depicts NPWS managed Crown land doesn't include all of the lands managed under licence for Capertee/MMBSCA. Do you have a GIS version of the Capertee managed Crown lands that I can forward to Craig Bagnall who is currently working on the extraction plan for Airly Mine.

Regards



Lisa Menke
A/Area Manager Mudgee
Blue Mtns Branch
NSW National Parks and Wildlife Service

27 Inglis street MUDGEE 2850
T 02 6370 9000 F 02 6370 9010
M 0429 687 331
W nationalparks.nsw.gov.au

From: Craig Bagnall [<mailto:cbagnall@niche-eh.com>]

Sent: Thursday, 27 July 2017 11:49 AM

To: Lisa Menke <Lisa.Menke@environment.nsw.gov.au>

Subject: re: Urgent query please - FW: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Thanks so much for your help and the clarification Lisa, much appreciated. Just to check too, would you have the GIS layers from that figure for the crown lands under management by any chance? If so could you send same email with those attached too and I'll also send it on to relevant parties in Centennial Coal to amend their data sets to match.

Kind regards,
Craig

CRAIG BAGNALL BE(Env)(Hons) CEnvP (IA Specialist)

Senior Environmental Engineer
Newcastle



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A PO Box 2443 North Parramatta NSW 1750
E cbagnall@niche-eh.com W niche-eh.com



From: Lisa Menke [<mailto:Lisa.Menke@environment.nsw.gov.au>]

Sent: Thursday, 27 July 2017 11:08 AM

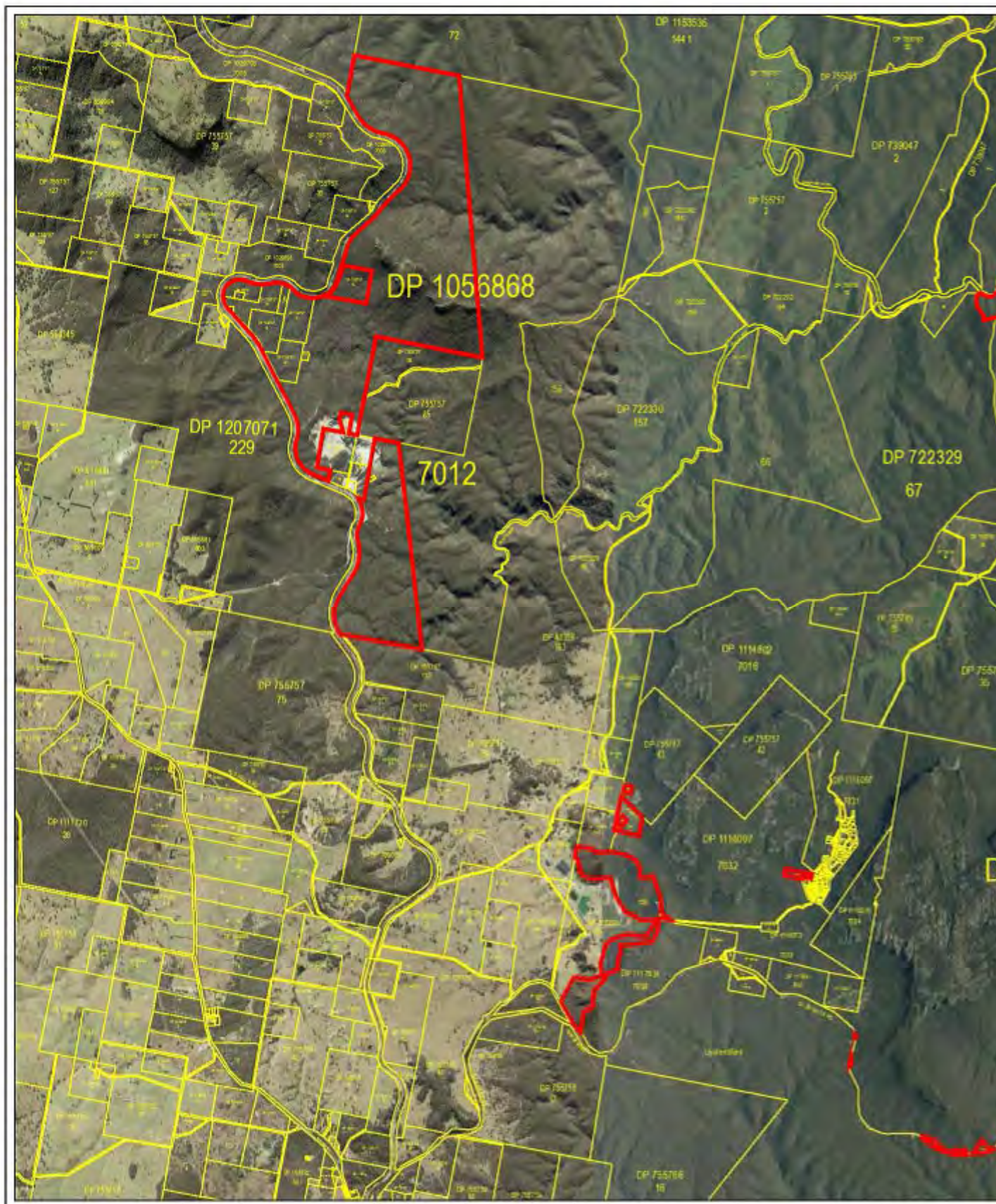
To: Craig Bagnall <cbagnall@niche-eh.com>

Subject: RE: Urgent query please - FW: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Hi Craig

Following our ongoing conversation about clarifying the NPWS managed Crown land and the MMBSCA boundary I can confirm :

- The Mugii Murum-ban SCA draft Plan of Management map depicting NPWS managed Crown Land is correct. However **NSW Government Gazette No 81 of 7 October 2016 has reserved** 274.2 hectares of Lot 67 DP 722329 per the Schedule 1 map in the gazette .(northern part of the reserve adjacent Capertee NP)
- The map below and the attached lot description above clearly identify the Crown lands currently managed by NPWS under licence.



- The NPWS managed Crown lands are under licence for 5 years from 31 March 2017. During the licence term, NPWS will be considering which parcels are of interest for addition to MMBSCA and will pursue reservation as needed.

Please disregard yesterdays emails. This is the correct, final advice.

Regards



Lisa Menke
A/Area Manager Mudgee
Blue Mtns Branch
NSW National Parks and Wildlife Service

27 Inglis street MUDGEE 2850
T 02 6370 9000 F 02 6370 9010
M 0429 687 331
W nationalparks.nsw.gov.au

From: Craig Bagnall [<mailto:cbagnall@niche-eh.com>]

Sent: Friday, 21 July 2017 6:28 PM

To: David King <david.king@centennialcoal.com.au>; Lisa Menke <Lisa.Menke@environment.nsw.gov.au>

Cc: John Stevens (John.Stevens@centennialcoal.com.au) <John.Stevens@centennialcoal.com.au>; Greg Tobin <gtobin@niche-eh.com>

Subject: Urgent query please - FW: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Hi Lisa,

Just touching base on David King's email earlier this week and with a couple of further queries if possible. Just wondering if you could advise on the following:

- If GIS files are available for the attached figures provided to David on 7/4/17 (see email trail from that date below):
 - Gazetted crown land (7/10/16)
 - figure called '*Crown Lands.pdf*'
 - The *Crown Lands.pdf* figure includes a breakdown of various types of crown land which is of key interest if GIS files are available?
 - Can the date of the "*Crown Land.pdf*" be confirmed too please? There appears to be some changes compared to the SCA PoM in 2015 (see Fig 1 discussion below) which we'd like to clarify.
- Also attached is a pdf of **Figure 1** from the SCA PoM (Sep 2015) which shows Crown Lands under management by NPWS at that time. Has this been superseded by the above figures by any chance or is it still accurate?
 - Again if a current GIS layer for these is available that would be greatly appreciated.
- Also attached is a zip file containing land ownership figures developed mid last year (2016) in consultation with Crown Lands (Kay Oxley) and David Crust at NPWS for the previous MOD3 Extraction Plan variation (one of them is a zoom on Zirly Gap area which was consulted closely with Kay at Crown Lands).
 - The Crown lands shown 'under licence to NPWS' (managed by NPWS) within the field of view shown also have some differences to the '*Crown Lands.pdf*' file supplied which would be good to verify. We can provide GIS files if needed just let us know.

If you could let us know as soon as possible next week that would be greatly appreciated as we are hoping to issue a draft revised plan for consultation.

Thanks again for your assistance, greatly appreciated. Please don't hesitate to call if any queries at all.

Kind regards,
Craig

CRAIG BAGNALL BE(Env)(Hons) CEnvP (IA Specialist)
Senior Environmental Engineer
Newcastle



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From: David King [<mailto:david.king@centennialcoal.com.au>]
Sent: Friday, 14 July 2017 12:51 PM
To: lisa.menke@environment.nsw.gov.au
Cc: Craig Bagnall <cbagnall@niche-eh.com>
Subject: Fw: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Hello Lisa,

Earlier you sent us some information on the updated boundaries of the SCA with the inclusion of some former Crown Land. Are you able to send us a GIS file of the current boundary for our use in preparing Management plans for the Consent?

Regards

David King
Senior Mining Engineer

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----- Forwarded by David King/CentennialCoal on 14/07/17 12:49 PM -----

From: Craig Bagnall <cbagnall@niche-eh.com>
To: 'David King' <david.king@centennialcoal.com.au>,
Date: 14/07/17 12:25 PM
Subject: FW: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

As discussed mate.

Kind regards,
Craig

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From: David King [<mailto:david.king@centennialcoal.com.au>]

Sent: Friday, 24 March 2017 12:36 PM

To: Craig Bagnall <cbagnall@niche-eh.com>

Subject: Fw: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Hi Craig,

The only Crown land transferred to NPWS was the parcel to the north of the SCA to link it to the Capertee NP. All the other crown land is the same as for previous work.

Note we may also need to consult with the private land owner in the lower reaches of Airly Gap

Regards

David King

Senior Mining Engineer

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----- Forwarded by David King/CentennialCoal on 24/03/17 12:32 PM -----

From: Lisa Menke <Lisa.Menke@environment.nsw.gov.au>
To: "david.king@centennialcoal.com.au" <david.king@centennialcoal.com.au>,
Date: 24/03/17 12:09 PM
Subject: HP TRIM OEH Electronic Document : DOC16/510172 : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

Here's the latest Crown land addition stuff. Doesn't look like there is anything that you were referring to in the Carinya and Airly Gap areas. The only additions have been Crown Lands that we were leasing



Lisa Menke
A/Area Manager Mudgee
Blue Mtns Branch
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-----< HP TRIM Record Information >-----

Record Number : DOC16/510172
Title : Government Gazette notice published 7 October 2016 - Mugii Murum-ban SCA

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Craig Bagnall

From: Steven Cox <Steven.Cox@environment.nsw.gov.au>
Sent: Wednesday, 28 June 2017 4:44 PM
To: David King; Lisa Menke
Cc: Craig Bagnall; alanna.ryan@centennialcoal.com.au
Subject: RE: Consultation Meeting for Airly Cliff Zone of First Workings Extraction Plan

Hi David,

As discussed, we are keen to see the draft plans before any meeting. Our review of the plans would then determine if there is a need for a meeting and if so, when it would be best to meet.

It is unlikely that we would be ready to meet by the week of 17 July due to current workloads, but we'll wait to see the plans and make a plan from there. Any meeting would likely need to be in Dubbo due to our current heavy workload.

Regards
Steven

Steven Cox
Senior Team Leader – Planning
North West Branch
Regional Operations Division
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From: David King [mailto:david.king@centennialcoal.com.au]
Sent: Wednesday, 28 June 2017 3:06 PM
To: Steven Cox <Steven.Cox@environment.nsw.gov.au>; Lisa Menke <Lisa.Menke@environment.nsw.gov.au>
Cc: cbagnall@niche-eh.com; alanna.ryan@centennialcoal.com.au
Subject: Consultation Meeting for Airly Cliff Zone of First Workings Extraction Plan

Steven and Lisa,

I writing to request a meeting with you both in order to consult with you in relation to the preparation of the Management Plans described below. I understand that both of you are unavailable until the week starting 17/7/17. Could you please advise me of a time and location that would be suitable to meet with you during that week. I would be happy to host you at the mine site if that suits your plans. The Mine would like to consult with the National Parks and Wildlife Service as the Land Owner as well as part of the Office of Environment and Heritage (OEH).

Airly Mine is currently preparing an Extraction Plan for first workings within the Cliff Zone of First Workings as defined in SSD5581 Schedule 3, Condition 7. We are required to consult with the OEH in relation to the development of the Subsidence Monitoring Program, Water Management Plan, Biodiversity Management Plan, Land Management Plan, Heritage Management Plan, and the Public Safety Management Plan. Drafts of these plans will be provided to you prior to the meeting for your consideration and comment prior to inclusion in the Extraction Plan.

I would like to cover the following items in the meeting:

- The proposed mine workings within the Cliff Zone of First Workings
- The geotechnical analysis of the proposed first workings
- The results of consultations with various stakeholders to date and in particular the consultations with the Independent Expert Panel constituted under SSD5581
- Outline the proposed monitoring of subsidence for the Cliff Zone of First Workings and appraise you of the concepts for subsidence monitoring of later secondary extraction
- Discuss the monitoring requirements for the other management plan areas in light of the limited subsidence of first workings

- Discuss any items you think the Mine needs to consider in the monitoring and management of the various management plan areas

I look forward to hearing from you and arranging this meeting at your earliest convenience.

Regards

David King

Senior Mining Engineer

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Appendix 5:

Updated EP Subsidence & Environmental Risk Assessment

Centennial Airly Mine

Cliff Line Zone of First Workings Extraction Plan (ML1331)

Updated Subsidence and Environmental Risk Assessment

Update of Original EIS Subsidence Risk Assessment (2013), As Revised August 2017

Summary of Recommended Addition Controls - Cliff Line Zone of First Workings (ML1331) EP Area

Recommended Controls	Allocated To	Required By Date	Status as at EP submission
	(Only one SITE person for each Recommended Control)		
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)	Senior Mining Engineer (DK)	30/9/2017	Completed (submitted with Extraction Plan)
2. Develop a mine 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.	Environment & Community Coordinator (SP)	30/9/2017	Completed (submitted with Extraction Plan)
3. 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.	Environment & Community Coordinator (SP)	30/9/2017	Completed (submitted with Extraction Plan)
4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).	Senior Mining Engineer (DK)	30/9/2017	In progress, to be completed by Target Date
5. Develop a Historical 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.	Environment & Community Coordinator (SP)	30/9/2017	Completed (submitted with Extraction Plan)
6. 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	Senior Mining Engineer (DK)	30/9/2017	Completed (submitted with Extraction Plan)
7. Develop a Public Safety Management Plan in consultation with stakeholders in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publically 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.	Senior Mining Engineer (DK)	30/9/2017	Completed (submitted with Extraction Plan)
8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.	Senior Mining Engineer (DK)	30/9/2017	Completed (submitted with Extraction Plan)

Dyadem Stature for Risk Management:

Risk Assessment Title: Cliff Line Zone and Zone of First Workings Extraction Plan (ML1331) - Subsidence & Environmental Impact Risk Assessment

Version: 1

Region: West

Site: Airly Mine

Department: Whole Site

Equipment / Process: Community

Stature Risk Assessment No.: 1000682006 (2014, revised August 2017 for cliff line zone aspects **only**, other mining zones excluded as N/A)

Study Lifecycle State: Updated Risk Assessment

Introduction and Background:

Environmental Risk Assessment has been conducted extensively to identify subsidence-related hazards that may affect the environment and community as a result of mining as part of the Airly Mine Extension Project (MEP) Environmental Impact Statement (EIS) and the preceding Airly MOD3 Extraction Plans (as varied). Assessment of risk to sensitive landscape features such as cliffs and pagodas have been considered through the following processes:

- Consultation with stakeholders (government agencies and the community);
- Broad Brush Risk Assessment conducted during the EIS preparation (refer Section 9.3.1 of Airly MEP EIS);
- Subsidence Constraints Risk Assessment during the EIS preparation (10/9/2013), which was formed a basis for the current updated risk assessment herein;
- Subsidence impact technical assessments during the EIS preparation;
- On-going review of long term environmental monitoring data;
- government briefing meeting and site visit 17/18 October 2012;
- Response to EIS submissions to DP&E and IRP (2015, 2016);
- Independent Review Panel (IRP) Report;
- Revised subsidence predictions as part of the Pillar Stability Assessment Report prepared specifically for the Extraction Plan (Golders & Associates 2017);
- Specialist advice on historic heritage, biodiversity, surface and ground waters provided during preparation of supporting environmental management plans for the Extraction Plan (Historic Heritage Management Plan (EP-HHMP), Biodiversity Management Plan (EP-BMP), site Water Management Plan (site WMP)).

On 10/9/2013 a risk assessment was held by Centennial Airly personnel specifically to determine the risks associated with subsidence due to the mining methods proposed in the (now approved) Airly MEP EIS. Specialist consultants who participated in the risk assessment were those who prepared the EIS technical assessments for subsidence, terrestrial ecology, aquatic ecology and stygofauna, Aboriginal and historical heritage, surface and groundwater and the EIS lead consultants. The assessment identified known mine characteristics and sensitive features within the Airly MEP development consent area, and assessed each mining zone (and relevant mining method) of the Airly Mine Extension Project, including the Cliff Line Zone of First Workings (CLZ). The above risk assessment has subsequently been updated specifically for the *Cliff Line Zone of First Workings* (CLZ) and within that, the current Extraction Plan Area (EP Area) within ML1331 which forms a sub-section of the entire approved CLZ as defined further below. The updated Subsidence and Environmental Risk Assessment incorporates current

subsidence predictions for the final detailed mine plan submitted for the Extraction Plan as presented in the supporting Pillar Stability Assessment Report by Golder Associates (2017), and also incorporates reviews and feedback from the pre-consent Independent Review Panel (IRP) and post-consent Independent Expert Panel (IEP). This risk assessment was completed in accordance with the requirements of DP&E's *Draft Guidelines for the Preparation of Extraction Plans* and the *Centennial Coal Risk Management Standard - Management Standard 004* (Centennial Coal 2008). For consistency in updating the previous EIS risk assessment (2014) the same version of the Centennial risk matrix has been applied.

This risk assessment also aims to address relevant aspects in relation to potential subsidence impacts to public safety in accordance with WHS Mines and Petroleum Sites Regulations (2014, as amended 2016) and the *Guide to Subsidence Risk Management (WHS Mines and Petroleum Sites) Legislation* issued by the Resources Regulator (Mine Safety Operations), February 2017,

Risks were identified and assessed through the review of known surface and sub-surface features within the Project Area. A risk ranking (low, moderate, significant, high or extreme) was assigned to each risk/hazard.

To further mitigate subsidence-related risks to land management, Airly Mine will implement the 'recommended controls' as outlined within this risk assessment. Additional details regarding the management and monitoring of subsidence related impacts to land within the EP Area have been detailed in the Extraction Plan and its sub-plans.

Note: Specific *subsidence-related* aspects for potential interaction with the overlying New Hartley Shale Mine existing workings (including public safety considerations on the surface) are included within this risk assessment. Whilst beyond the scope of this subsidence-focused environmental impact risk assessment, it is noted that under relevant WHS legislation for mines and petroleum sites, *Principal Hazard Management Plans* for **non-subsidence** aspects (including but not limited to water inrush and noxious and flammable gases) are also developed for Airly Mine including consideration of interactions with historic existing workings such as Torbane Colliery and the New Hartley Shale Mine Potential Interaction Zone. *High Risk Activity (HRA)* notifications (with appropriate supporting information) under WHS legislation will also be formally provided to government regulators ahead of commencement where any potential interaction with existing workings occurs (B.Miller pers.comm.).

Risk Assessment Process:

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, warning signs, 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, stickers, verbal warnings, etc.)

To identify, assess and control the risks to people, plant and environment associated with subsidence from the proposed mining at Airly mine, the following process will be undertaken:

- Determine the part of the Project Application Area that will be effected by subsidence within the scope of this risk assessment- i.e. The Cliff Line Zone and Zone of First Workings Extraction Plan Area (ML1331), herein referred to as the **EP Area** as defined further below).
- Discuss what the levels of subsidence will be and levels of physical impact in the various parts of the study area (Golders Pillar Stability Assessment Report 2017, IRP Report (2016), Golders Subsidence Impact Assessment (EIS) (2013) and MSEC Peer Review.
- Develop a full register of features that would potentially be impacted by subsidence over the EP study area.
- Determine the level of risk for each identified feature classification for the level of subsidence in each of the mining zones given current controls.

The primary current control is the **mine design** including permanent first workings only within the EP Area which are long term stable and experience very low levels of pillar compression subsidence which have been assessed as effectively non-subsiding (IEP, 2017), and subsequently result in protection of overlying strata and no impacts to sensitive landscape features. Notwithstanding this, additional controls are still identified where appropriate to ensure the effective implementation of the mine design and management of environmental features.

Scope of the Risk Assessment:

- Only the Cliff Line Zone and Zone of First Workings Extraction Plan Area (**EP Area**) will be assessed (refer definition below).
- Only those issues directly affected by subsidence are considered.
- Only the first workings mine development techniques that are designed to limit subsidence are considered (noting that other adjacent mining zones approved for partial or full secondary extraction are not the subject of the current EP Area (will be subject of separate future EPs)). However, the supporting Pillar Stability Assessment Report (Golder Associates 2017) conservatively also included assessment of potential for increased loading of first workings pillars by future mining in adjacent secondary extraction areas, as well as potential for flooded workings post-mining.
- Items/features for risk assessment were based upon those identified in the original EIS risk assessment and from subsequent documentation during the development consent process including IRP (and IEP) comments and EIS responses to submissions.

Definition of EP Area:

This risk assessment applies to the following Extraction Plan Area (EP Area) shown on Figure 1:

- The Cliff Line Zone of First Workings only within Mining Lease ML1331, excluding Authorisation area A232 (east of ML1331), and excluding existing approved Extraction Plan Areas as recognised by Condition 7 of SSD_5581 (MOD3 EP Area and MOD3 EP Variation Area).
- Includes all first workings proposed within the EP Area from the 31st January 2017 onward (activation date of SSD_5581 following expiry of permissible mining under former development consent DA162/91 on that date) for the duration of approval granted under SSD_5581, as detailed in the Extraction Plan

Register of Sensitive Natural and Built Features Potentially Impacted by Subsidence

The following Features have been considered within this risk assessment. Further information on these is provided within the supporting management plans for the current Extraction Plan (including the Subsidence Monitoring Program (SMP) and Land Management Plan (LMP)) and the Airly MEP EIS (2014) and related documents.

- Cliffs and Minor Cliffs
- Pagodas and rock formations
- Steep Slopes
- General Land Surface of the SCA
- Surface Water (including aquatic ecology)
- Groundwater (including potential for GDE's, stygofauna and any potential private bores)
- Terrestrial Ecology – including threatened flora and fauna, potential habitats, natural vegetation communities and any potential EEC's.
- Historic Heritage (including New Hartley Shale Mine / Airly Village ruins)
- Aboriginal and Cultural Heritage (if present)
- Any Built Features within EP Area (minor only, no significant built features)

Risk Assessment Details:

Yes/No	Method
Yes	Workplace Risk Assessment and Control (WRAC)
No	Fault Tree Analysis (FTA)
No	Safety Integrity Level Analysis to Australian Standard 61508 (SIL)
No	Bow Tie Analysis (BTA)
No	Failure Modes and Effects Analysis (FMEA)
No	Hazard and Operability Analysis (HAZOP)

Document Name	Title	Version	Referenced Document Date
Extraction Plan Subsidence and Environmental Risk Assessment	Cliff Line Zone of First Workings Extraction Plan (ML1331) – Updated Subsidence Impact Assessment	Revision A	August 2017

Date	Description	Location
1. 06-Sep-2013	Scoping	Airly mine site
2. 10-Sep-2013	Assessment	Fassifern Office
3. 5/7/2017	Review & Update for Cliff Line Zone of First Workings Extraction Plan	Airly mine site, Fassifern Office, Various Remote Locations
4.13/9/17	Final review by DK, JW for submission, discussions with BM (Mine Manager)	Airly Mine Site

Name	Title	Company	Industry Start Date	Yrs. of Exp.	Role	Attendance		
						1. 06-Sep-2013	2. 10-Sep-2013	3. Aug 2017 Update
David King	Senior Mining Engineer	Airly Coal P/L	14-Dec-1994	20	Risk Assessment Owner, 2017 Update Facilitator	P	P	P
Greg Brown	Environment & Community Coordinator (at time of original RA in 2014)	Airly Coal P/L	05-Apr-1999	16	(none)	P	P	
Nagindar Singh	Western Approvals Coordinator	Centennial Coal					P	
Mike Shelly	EIS Lead Consultant	Golder Associates			EIS Lead Consultant		P	
Rachael Dodd	EIS Consultant	Golder Associates			EIS Consultant		P	
Bob Trueman	EIS Subsidence Impact Assessment Author	Golder Associates					P	
Paul Hillier	EIS Terrestrial Ecology Consultant	RPS					P	
Darrell Rigby	EIS Heritage consultant Consultant	RPS					P	
Stuart Gray	EIS Ground and Surface Water Consultant	GHD					P	
Sally Callander	EIS Ground and Surface Water Consultant	GHD					P	
Peggy O'Donnell	EIS Aquatic Ecology Consultant	Cardno					P	
Max Best	EIS Aquatic Ecology Consultant	Cardno					P	
David Swan	Facilitator (original RA)	HMSC			Facilitator of original RA		P	
Mandy Holt	Administration (original RA)	Centennial Fossiliferous			Administrative Assistant			
Craig Bagnall	Senior Environmental Engineer	Niche		21	Extraction Plan Author			P
Chris McEvoy	Principal Environmental Approvals	Niche		12	Extraction Plan co-author			P

Approver	Scope Confirmation	Date	Comments
1. David King	Yes	12/9/17	

Figures *(see over page)*

Note – Additional relevant figures are provided within the Extraction Plan and supporting management plans, including the Subsidence Monitoring Program.

Figure 1: Extraction Plan Area (EP Area) – subject area for this risk assessment

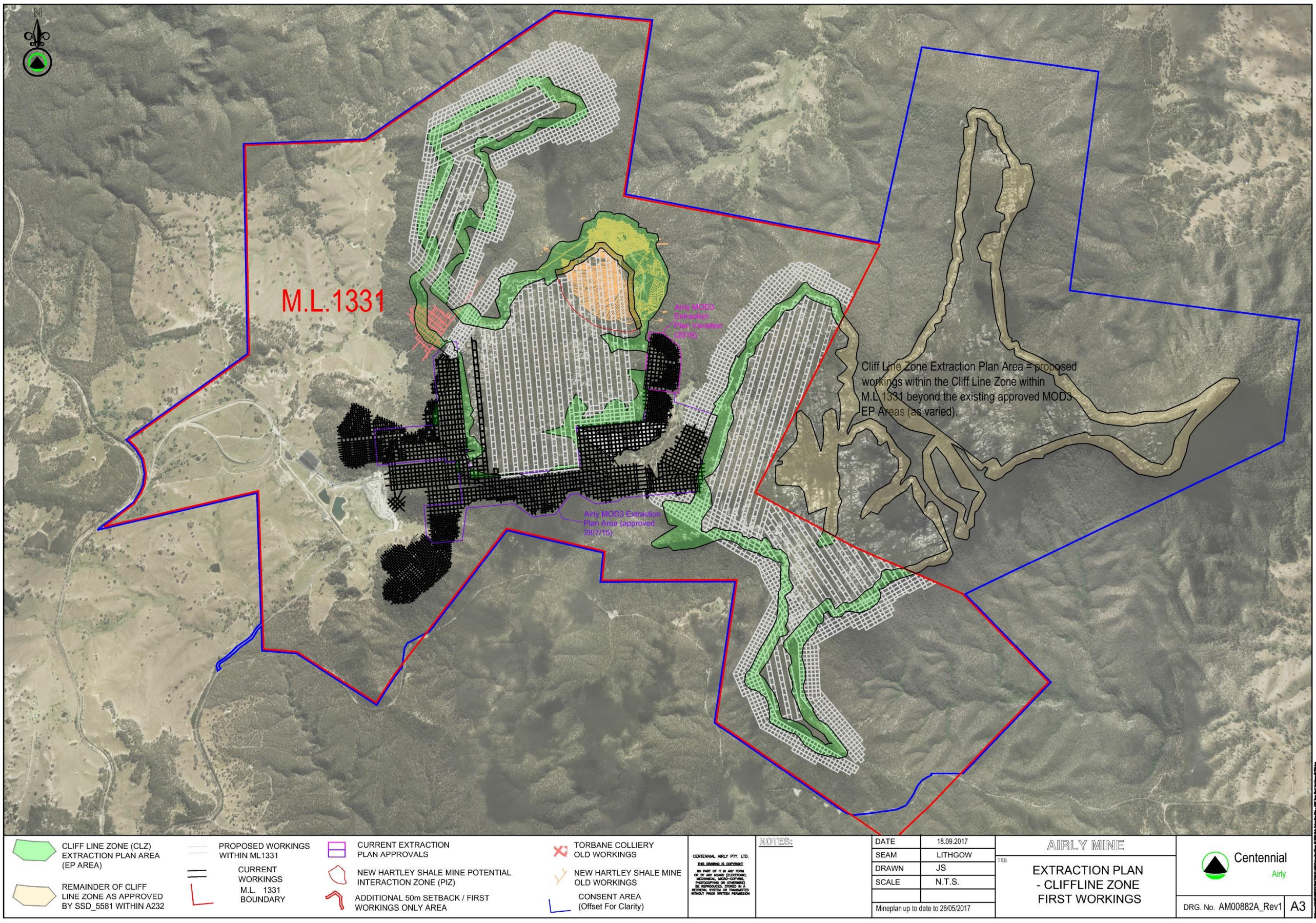


Figure 2: Context for All Mining Zones as approved by Development Consent SSD_5581 (including Cliff Line Zone of First Workings shown in green)

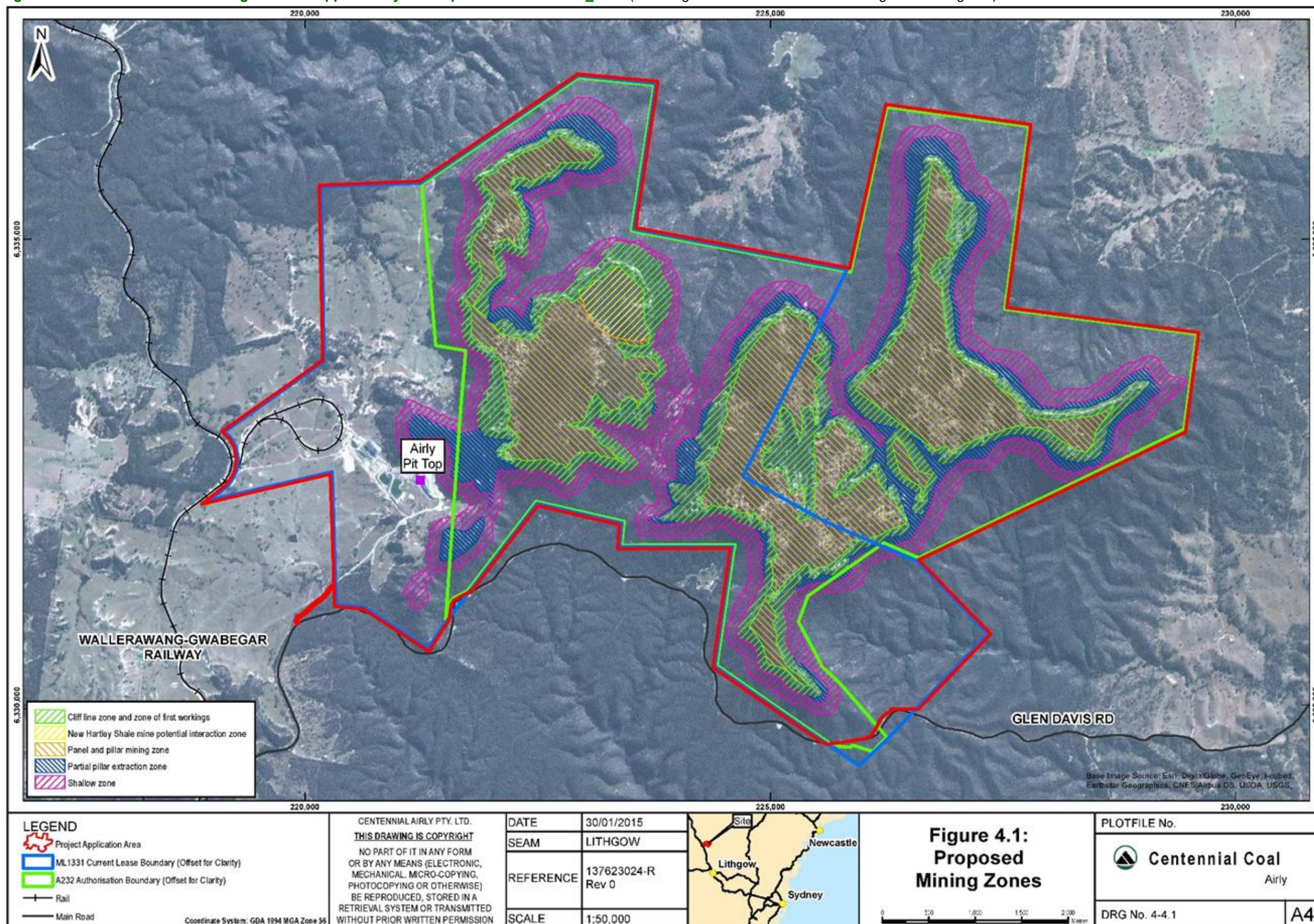


Figure 3: Land Ownership - EP Area and Development Consent Area

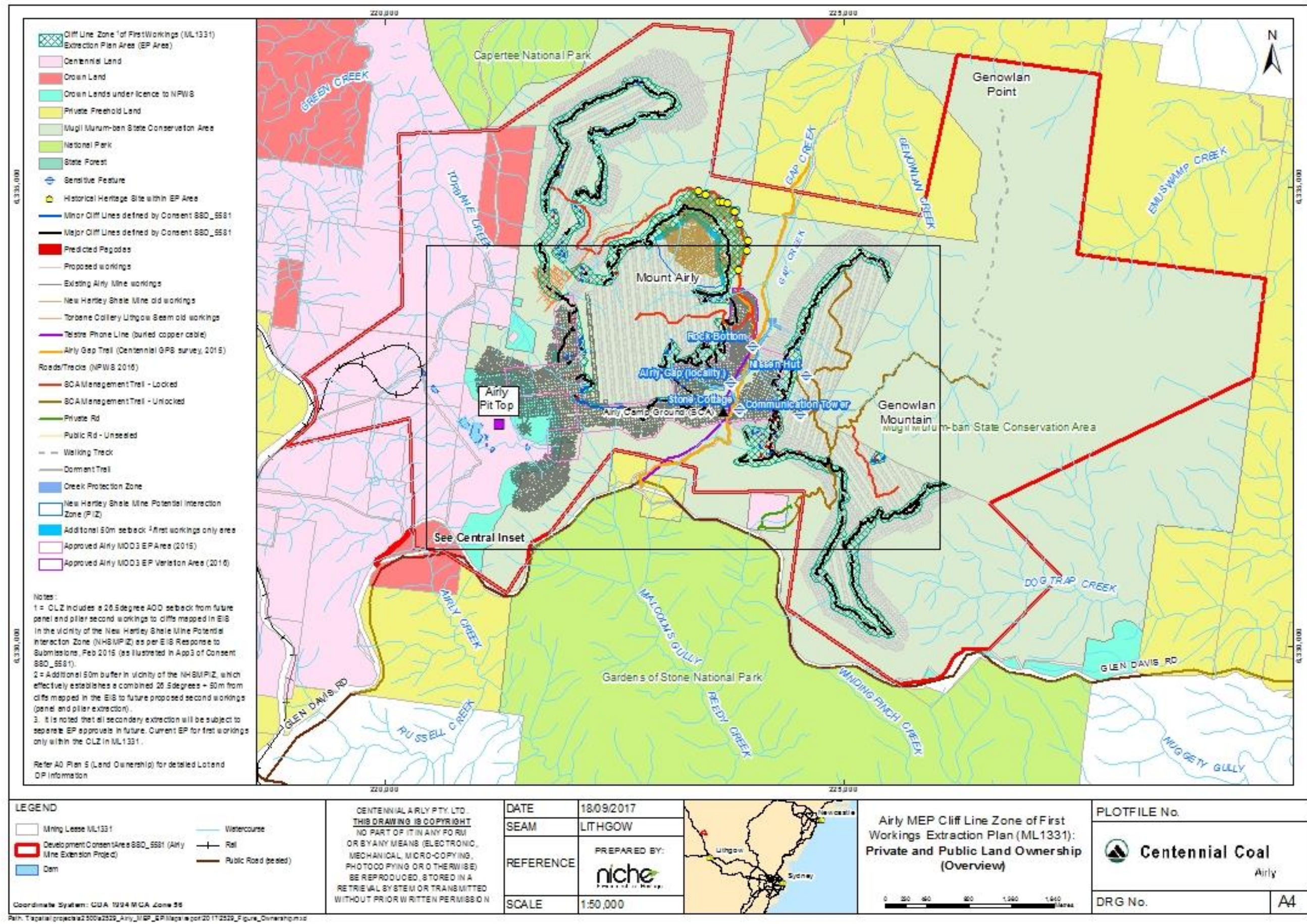
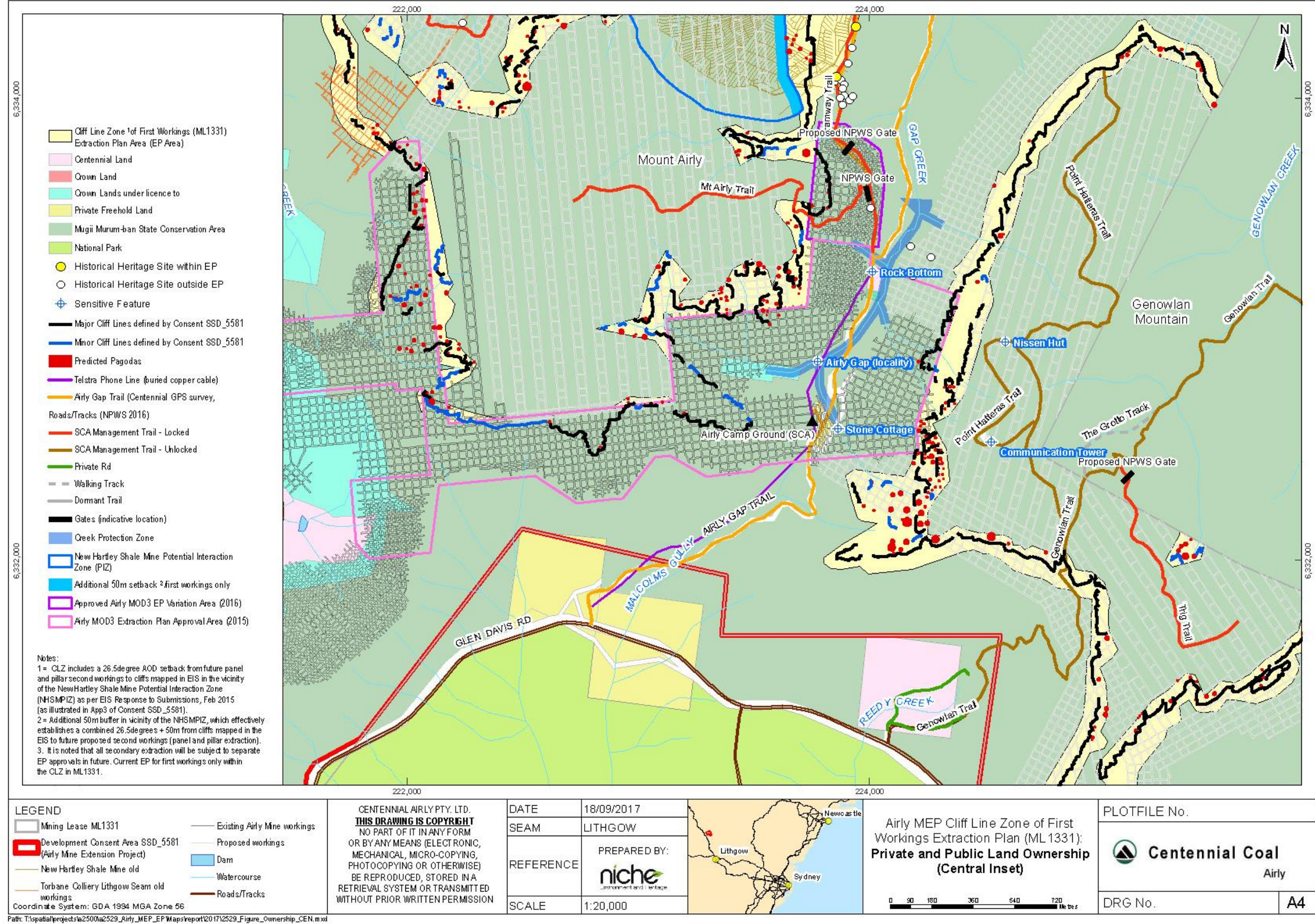


Figure 4: Land Ownership and Public Access Trails into the SCA (Central Insert Area, refer Figure 3) Note: Existing approved MOD3 EP Area (shown in pink/purple) is excluded, beyond scope of current EP Area and this RA.



Risk Register – Cliff Line Zone of First Workings Extraction Plan (ML1331):

Notes: * This risk register presents updated risks and controls for the EP Area only within the overall approved CLZ. The remainder of the CLZ (including the component within A232) and all other approved mining zones are beyond the scope of the updated risk register presented below and will be updated in due course as part of separate future extraction plans.
* *LTA = Less Than Adequate*

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 – ML1331) <i>(various locations– refer Potential Incident Column)</i>	There is potential for risk to Airly from ::: Mining induced impacts to cliffs, minor cliffs and pagodas in the cliff zone adjacent to the New Hartley Shale Mine Potential Interaction Zone beyond approved consent criteria/performance measures ::: Caused by: Mine design LTA (Less Than Adequate) or Mining method implementation LTA or Monitoring LTA or Set back distance LTA Resulting in: Cultural heritage impact or Environmental damage or Non compliance or Public safety hazard (personal injury PI) or Reputation or Social impact.	. a.. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts. b First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2) c. Increased set back distances to second workings (i.e. increased area of first workings only) from Cliffs in the New Hartley Shale Mine Potential Interaction Zone as per Independent Review Panel Report (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS d. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP). e. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017). f. 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)). g. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2). h. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017) i. Geological mapping during development advance j. Qualified mine surveyor and calibrated survey equipment k. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts. l. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. m. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. n. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014. o Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. p 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). q No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent r First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).	E (IF)	2 (PI)	16 (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) . 4. Review and update the <i>Airly Panel Design Standard</i> (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 6. 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 7. 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 publically 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. 8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.
	There is a potential risk to Airly from ::: Mining induced impacts to Cliffs or minor cliffs beyond approved consent criteria/performance measures in other remaining areas of the Cliff Line Zone. Caused by: Geological anomaly or Mine design LTA or Mining method implementation LTA or Monitoring LTA or Set back distance LTA or Survey LTA Resulting in: Business interruption or Cultural heritage impact or Environmental damage or Public safety hazard	a. Detailed mapping to identify cliffs, minor cliffs and pagodas within the CLZ within ML1331, as defined by consent SSD_5581 (RPS, 2017) b. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) c. Defined minimum 30m set back distances (first workings only area) from crest and toe of cliffs identified in the EIS d. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP). e.. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).				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) 4. Review and update the <i>Airly Panel Design Standard</i> (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 6. 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

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	(personal injury PI) or Non compliance or Reputation or Social impact.	<p>f. 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)).</p> <p>g. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2).</p> <p>h. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017)</p> <p>i. Geological mapping during development advance</p> <p>j.. Qualified mine surveyor and calibrated survey equipment</p> <p>k. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval.</p> <p>l. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>j. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects.</p> <p>k. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014.</p> <p>l. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>m. 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).</p> <p>n. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent</p> <p>o. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).</p>				<p>systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program</p> <p>7. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publically 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.</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.</p>
2. Pagodas / Rock Formations Located within the EP Area (Cliff Line Zone of First Workings – ML1331)	<p>There is a potential risk to Airly from</p> <p>::: Cracking of pagodas or rock formations:::</p> <p>Caused by: Geological anomaly or Mine design LTA or Mining method implementation LTA or Monitoring LTA or Set back distance LTA or Survey LTA</p> <p>Resulting in: Business interruption or Environmental damage or Public safety hazard (personal injury PI) or Non compliance or Reputation.</p>	<p>a. Detailed mapping to identify cliffs, minor cliffs and pagodas within the CLZ within ML1331, as defined by consent SSD_5581 (RPS, 2017)</p> <p>b. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE using detailed high resolution 3D photogrammetry (50mmx50mm pixel size)</p> <p>c. Defined minimum 30m set back distances (first workings only area) from crest and toe of cliffs identified in the EIS</p> <p>d. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than that as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).</p> <p>e. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).</p> <p>f. 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)).</p> <p>g. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2).</p> <p>h. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017)</p> <p>i. Geological mapping during development advance</p> <p>j. Qualified mine surveyor and calibrated survey equipment</p> <p>k. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval.</p> <p>l. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>m. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects.</p> <p>n. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014.</p> <p>o. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>p. 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).</p>	E (IF)	2 (PI)	16 (M)	<p>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)</p> <p>4. Review and update the Airly Panel Design Standard (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).</p> <p>6. 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</p> <p>7. Develop a Public Safety Management Plan in consultation with stakeholders that in accordance with Condition 7 (Sch3) of consent SSD_5581, which: identifies publically 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.</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.</p>

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		<p>q. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent</p> <p>r. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).</p>				
3. Steep slopes located within EP Area (Cliff Line Zone of First Workings – ML1331)	<p>There is a potential risk to Airly from ::: Mining-induced surface instability / land slip:</p> <p>Caused by: Geological anomaly or Mine design LTA or Mining method implementation LTA or Monitoring LTA or Set back distance LTA</p> <p>Resulting in: Environmental damage or Public safety hazard (personal injury PI) or Non compliance or Reputation loss.</p>	<p>a. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).</p> <p>b. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).</p> <p>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)).</p> <p>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).</p> <p>e. Geological mapping during development advance</p> <p>f. Qualified mine surveyor and calibrated survey equipment</p> <p>g. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval.</p> <p>h. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>i. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects.</p> <p>j. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>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).</p> <p>l. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent</p> <p>m. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).</p>	E (Pb)	3 (L)	20 (L)	<p>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)</p> <p>4. Review and update the <i>Airly Panel Design Standard</i> (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).</p> <p>6. 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</p> <p>7. 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 publically 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.</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.</p>
4. Surface Water Courses - first order, and limited 2nd Order (on Gap Creek) Located within the EP Area (Cliff Line Zone of First Workings ML1331)	<p>There is a potential risk to Airly from ::: Cracking of stream channel / localised loss of water flow :::</p> <p>Caused by: Geological anomaly or Mine design LTA or Mining method implementation LTA or Monitoring LTA or Survey LTA</p> <p>Resulting in: Environmental damage.</p>	<p>a. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts.</p> <p>b. First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2)</p> <p>c. Increased set back distances as per Independent Review Panel Report to second workings (i.e. increased area of first workings only)- from Cliffs in the New Hartley Shale Mine Potential Interaction Zone identified in the EIS (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS</p> <p>d. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).</p> <p>e. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).</p> <p>f. 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)).</p> <p>g. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2).</p> <p>h. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017)</p> <p>i. Geological mapping during development advance</p> <p>j. Qualified mine surveyor and calibrated survey equipment</p> <p>k. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts.</p> <p>l. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>m. 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.</p> <p>n. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014.</p>	E (Pb)	3 (E)	20 (L)	<p>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)</p> <p>2. Develop a 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. .</p> <p>3. 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.</p> <p>4. Review and update the <i>Airly Panel Design Standard</i> (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).</p> <p>6. 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</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.</p>

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		<p>o Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>p 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).</p> <p>q No first workings proposed within creek protection zones outlined in the performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent.</p> <p>r No surface cracking or surface water flow loss predicted in EIS.</p> <p>s No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent</p> <p>t Aquifers outside the coal seam predicted to be protected by the first workings mine design due to long term stable pillars, lack of caving and protection of strata</p> <p>u No first workings proposed below 80 m depth of cover (DOC)o mining will not constitute a High Risk Activity (where DOC<50 m).</p>				
	<p>There is a risk to Airly from</p> <p>::: Changes to creek habitat from changes to geomorphology :::</p> <p>Caused by: Geological anomaly or Mine design LTA or Mining method implementation LTA or Monitoring LTA or Survey LTA</p> <p>Resulting in: Environmental damage.</p>	<p>a. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts.</p> <p>b. First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2)</p> <p>c. Increased set back distances as per Independent Review Panel Report to second workings (i.e. increased area of first workings only)- from Cliffs in the New Hartley Shale Mine Potential Interaction Zone identified in the EIS (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS</p> <p>d. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).</p> <p>e. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).</p> <p>f. 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)).</p> <p>g. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2).</p> <p>h. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017)</p> <p>i. Geological mapping during development advance</p> <p>j. Qualified mine surveyor and calibrated survey equipment</p> <p>k. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts.</p> <p>l. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>m. 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.</p> <p>n. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014.</p> <p>o Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>p 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).</p> <p>q No first workings proposed within creek protection zones outlined in the performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent.</p> <p>r No surface cracking or surface water flow loss predicted in EIS.</p> <p>s No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent</p> <p>t Aquifers outside the coal seam predicted to be protected by the first workings mine design due to long term stable pillars, lack of caving and protection of strata</p> <p>u No first workings proposed below 80 m depth of cover (DOC)o mining will not constitute a High Risk Activity (where DOC<50 m).</p>	E (Pb)	3 (E)	20 (L)	<p>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)</p> <p>2. Develop a 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. .</p> <p>3. 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.</p> <p>4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).</p> <p>6 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</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.</p>
5. Water courses – The Grotto & The Oasis (upper Genowlan Creek)	Not Applicable	Not Applicable – The Grotto is <u>not</u> located within current EP Area (located within CLZ but beyond ML1331 inside A232, subject of future EPs).	E (Pb)	4 (E)	23 (L)	
6. Water courses - third order (e.g. Genowlan Creek, Gap Creek)	Not Applicable	Not Applicable – No 3rd Order streams located within current EP Area (if present are located beyond ML1331 inside A232 or within existing MOD3 EP Areas, subject of separate/future EPs).	E (Pb)	4 (E)	23 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
7. Groundwater - Aquifers in and above Lithgow seam – (including Shallow Quaternary Alluvial, Triassic & Permian and any associated GDE's) Located within the EP Area (Cliff Line Zone of First Workings ML1331)	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 or Mining method implementation LTA or Monitoring LTA Resulting in: Environmental damage or social impact.	a. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP). b. 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)). c. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017). d. 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). e. No registered bores using these aquifers as private water supply in the EP Area. f. EIS groundwater studies (GHD 2014) and biodiversity studies for the current extraction plan (RPS (2017) identified no high priority groundwater dependent ecosystems (either vegetation or stygofauna) as groundwater flows were considered too deep to have much interaction with potentially occurring GDE vegetation. g. RPS (2017) identify three vegetation communities (MU3, 21 and 40) potentially occurring on alluvium in the shallow aquifer zone are considered ' facultative ecosystems ' as opposed to GDE's, which are not entirely reliant on groundwater (potentially some seasonal reliance or in extended drought periods), however these veg communities are not located within the EP Area (located elsewhere and not reliant completely on groundwater). It is noted that The Grotto and The Oasis (which are located within Quaternary Alluvial) are not located within the EP Area (located beyond ML1331 within A232 - subject of future EP's). h. Baseline and ongoing monitoring of relevant groundwater monitoring bores to support the site Water Management Plan developed in consultation with stakeholders i. Independent Review Panel (IRP) peer review of subsidence predictions and impact assessment on sensitive features in the Cliff Zone and Zone of first workings prior to development consent. j. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval. k. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. l. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. m. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. n. 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).	E (Pb)	4 (E)	23 (L)	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) . 2. Develop a mine site <i>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. 3. 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. 4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.
	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: Existing mine design Resulting in: Impact to the business plan.	a. Inflows have been modelled and predicted in the EIS (negligible for first workings) b. Mine inflow water management systems are in place c.. Operational experience - since the commencement of operations at Airly Mine in 2009, seepage of groundwater water into mine workings has been negligible (i.e. not measureable or sufficient to require dewatering). Only minor ingress of water has been noted in seam low points and in a few discrete locations. No mine water has been discharged from the pit top operations at time of EIS. d. Topographic/hydrogeographic characteristics of local mesa strata which is effectively in isolation to surrounding geology for the Lithgow seam and overlying Triassic sandstones (noting surface outcropping of the Lithgow seam at mesa edges throughout the consent area). Existing historical workings of Torbane Colliery in Lithgow Seam not expected to be significantly flooded based on survey inspection circa 1982 by previous owners (several decades after cessation of mining). PHMPs (including inrush and gases) are also developed (B.Miller pers.comm) and HRA notifications to regulators undertaken prior to commencement. Existing historical workings in overlying seams of at New Hartley Shale Mine (approximately 25m above Airly Mine workings and in places >35-40m) will not be intersected and overlying strata not expected to be cracked, very limited workings proposed in NHSMPIZ (refer A0 Plans), and extended depressurisation of old workings via Village Spring minor seepage flows for over a century. PHMPs (including inrush and gases) are also developed (B.Miller pers.comm) and HRA notifications to regulators undertaken prior to commencement e. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP). f. 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)).				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) . 2. Develop a mine site <i>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. 3. 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. 4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		<p>g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).</p> <p>h. 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).</p> <p>i. No registered bores using these aquifers as private water supply in the EP Area.</p> <p>j. EIS groundwater studies (GHD 2014) and biodiversity studies for the current extraction plan (RPS (2017) identified no high priority groundwater dependent ecosystems (either vegetation or stygofauna) as groundwater flows were considered too deep to have much interaction with potentially occurring GDE vegetation.</p> <p>g. RPS (2017) identify three vegetation communities (MU3, 21 and 40) potentially occurring on alluvium in the shallow aquifer zone are considered '<i>facultative ecosystems</i>' as opposed to GDE's, which are not entirely reliant on groundwater (potentially some seasonal reliance or in extended drought periods), however these veg communities are not located within shallow alluvium within the EP Area (located elsewhere and not reliant completely on groundwater).</p> <p>h. Baseline monitoring of groundwater monitoring bores to support the site Water Management Plan developed in consultation with stakeholders</p> <p>i. Independent Review Panel (IRP) peer review of subsidence predictions and impact assessment on sensitive features in the Cliff Zone and Zone of first workings prior to development consent.</p> <p>j. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval.</p> <p>k. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>l. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects.</p> <p>m. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>n. 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).</p> <p>o. Established mine dewatering system with treatment dams (surface facilities – not expected to be required and not required to date for underground workings), with Licenced Discharge Point (LDP) regulated for water quality under the site Environmental Protection Licence (EPL).</p> <p>p. Baseline and ongoing monitoring of relevant groundwater aquifers (monitoring bores network) and surface waters (including receiving waters for any site discharges) to support the site Water Management Plan, developed in consultation with stakeholders.</p>				
8. Regional Groundwater – Regional Aquifers - Permian below the Lithgow seam and any associated GDEs Located within the EP Area (Cliff Line Zone of First Workings ML1331)	<p>There is a risk to Airly from</p> <p>::: Loss of ground water that impacts on regional ground water dependent eco system or water supply :::</p> <p>Caused by: Upwelling of ground water into mine workings due to mining activity</p> <p>Resulting in: Environmental damage (quality or quantity) or Impact to the business plan or Social impact.</p>	<p>a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014).</p> <p>b. EIS identified no high priority groundwater dependent ecosystems (either vegetation or stygofauna) or groundwater supply works in the areas of groundwater drawdown, the predicted impacts are less than the Level 1 minimal impact considerations under the Aquifer Interference Policy</p> <p>c.. EIS concluded the project would not affect the fresh-brackish regional groundwater system east of the Project Application Area that supplies the majority of registered groundwater users in the area and would maintain the beneficial use categories for all groundwater systems throughout all operations (all mining zones).</p> <p>d. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).</p> <p>e. 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)).</p> <p>f. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).</p> <p>g. 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).</p> <p>h. No registered bores using these aquifers as private water supply in the EP Area.</p> <p>i. EIS groundwater studies (GHD 2014) and biodiversity studies for the current extraction plan (RPS (2017) identified no high priority groundwater dependent ecosystems (either vegetation or stygofauna) as groundwater flows were considered too deep to have much interaction with potentially occurring GDE vegetation.</p> <p>j. RPS (2017) identify three vegetation communities (MU3, 21 and 40) potentially occurring on alluvium in the shallow aquifer zone are considered '<i>facultative ecosystems</i>' as opposed to GDE's, which are not entirely reliant on groundwater (potentially some seasonal reliance or in</p>	E (Pb)	4 (E)	23 (L)	<p>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) .</p> <p>2. Develop a mine site <i>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.</p> <p>3. 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.</p> <p>4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.</p>

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		<p>extended drought periods), however these veg communities are not located within shallow alluvium within the EP Area (located elsewhere and not reliant completely on groundwater).</p> <p>k. Baseline and ongoing monitoring of relevant groundwater monitoring bores to support the site Water Management Plan developed in consultation with stakeholders</p> <p>ll Independent Review Panel (IRP) peer review of subsidence predictions and impact assessment on sensitive features in the Cliff Zone and Zone of first workings prior to development consent.</p> <p>m. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval.</p> <p>n. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>o. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects.</p> <p>p. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>q. 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).</p>				
	<p>There is a risk to Airly from</p> <p>::: Depressurisation of Permian aquifer leading to ground water inflow to mine workings :::</p> <p>Caused by: Upwelling of ground water into mine workings due to mining activity</p> <p>Resulting in: Impact to the business plan.</p>	<p>a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below).</p> <p>b. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher that as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).</p> <p>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)).</p> <p>d. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).</p> <p>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).</p> <p>f. No registered bores using these aquifers as private water supply in the EP Area.</p> <p>g. EIS groundwater studies (GHD 2014) and biodiversity studies for the current extraction plan (RPS (2017) identified no high priority groundwater dependent ecosystems (either vegetation or stygofauna) as groundwater flows were considered too deep to have much interaction with potentially occurring GDE vegetation.</p> <p>h. RPS (2017) identify three vegetation communities (MU3, 21 and 40) potentially occurring on alluvium in the shallow aquifer zone are considered '<i>facultative ecosystems</i>' as opposed to GDE's, which are not entirely reliant on groundwater (potentially some seasonal reliance or in extended drought periods), however these veg communities are not located within shallow alluvium within the EP Area (located elsewhere and not reliant completely on groundwater).</p> <p>i. Baseline and ongoing monitoring of relevant groundwater monitoring bores to support the site Water Management Plan developed in consultation with stakeholders</p> <p>j. Independent Review Panel (IRP) peer review of subsidence predictions and impact assessment on sensitive features in the Cliff Zone and Zone of first workings prior to development consent.</p> <p>k. Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval.</p> <p>l. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>m. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects.</p> <p>n. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>o. 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).</p>	E (Pb)	4 (E)	23 (L)	<p>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) .</p> <p>2. Develop a mine site <i>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.</p> <p>3. 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.</p> <p>4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.</p>
9.	<p>Groundwater-Centennial surface water monitoring bores</p> <p>Located within the EP Area (Cliff Line Zone of First Workings ML1331)</p> <p>There is a risk to Airly from</p> <p>::: Reduction or loss of monitoring capacity :::</p> <p>Caused by: Mine design LTA or Mining method implementation LTA or Monitoring LTA</p>	<p>a. Detailed Groundwater Impact Assessment conducted in EIS (GHD, 2014), insignificant mine water inflows predicted from first workings (from Lithgow seam, above or below).</p> <p>b. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher that as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).</p> <p>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)).</p>	E (D)	3 (E)	20 (L)	<p>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)</p> <p>2. Develop a 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</p>

Step	Potential Incident	Current Controls		L	MRC	RR	Recommended Control
	Resulting in: Impact to the business plan or Non compliance.	d.	Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).				monitoring and management measures including TARPs for potential impacts on watercourses and aquifers. .
		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).				3. 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.
		f.	No registered bores using these aquifers as private water supply in the EP Area.				4. Review and update the <i>Airly Panel Design Standard</i> (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).
		g.	EIS groundwater studies (GHD 2014) and biodiversity studies for the current extraction plan (RPS (2017) identified no high priority groundwater dependent ecosystems (either vegetation or stygofauna) as groundwater flows were considered too deep to have much interaction with potentially occurring GDE vegetation.				6. 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
		h.	RPS (2017) identify three vegetation communities (MU3, 21 and 40) potentially occurring on alluvium in the shallow aquifer zone are considered ‘ <i>facultative ecosystems</i> ’ as opposed to GDE’s, which are not entirely reliant on groundwater (potentially some seasonal reliance or in extended drought periods), however these veg communities are not located within shallow alluvium within the EP Area (located elsewhere and not reliant completely on groundwater).				8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.
		i.	Baseline and ongoing monitoring of relevant groundwater monitoring bores to support the site Water Management Plan developed in consultation with stakeholders				
		j.	Independent Review Panel (IRP) peer review of subsidence predictions and impact assessment on sensitive features in the Cliff Zone and Zone of first workings prior to development consent.				
		k.	Expert peer review (MSEC) of subsidence predictions and predicted impacts during EIS approval.				
		l.	Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.				
		m.	Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects.				
		n.	Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.				
		o.	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).				
10	Groundwater bores – Private bores Located within the EP Area (Cliff Line Zone of First Workings ML1331)	a.	Not Applicable – no private bores within EP Area nor potentially impacted beyond EP Area (closest registered bores are at least 1km from Development Consent boundary, noting no predicted strata cracking as detailed earlier above). Notwithstanding this, the MEP EIS also provides further detailed assessment of private bores if required (Section 10.1).	E (Pb)	4 (E)	23 (L)	Private bores are also addressed within the site Water Management Plan (refer elsewhere above)
11.	Groundwater –Stygo fauna (potential habitat most likely in Triassic and alluvial aquifers) Located within the EP Area (Cliff Line Zone of First Workings ML1331)		There is a risk to Airly from ::: Loss of base ground water flow-degradation or loss of species or habitat ::: Caused by: Mine design LTA or Mining method implementation LTA or Monitoring LTA Resulting in: Environmental damage or Non compliance or Reputation.				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) .
		a.	Identification - EIS Aquatic Ecology & Stygofauna Impact Assessment (Cardno, 2014) – no stygofauna found in eight bores sampled but potential habitat identified Under precautionary principle assumed may be present.				2. Develop a mine site <i>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.
		b.	Identification - Ongoing site stygofauna monitoring as part of the site Water Management Plan (site WMP) and site Biodiversity Management Plan (BMP). Not detected in any samples to date.				3. 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.
		c..	Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts.				4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).
		d.	First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2)				6. 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
		e.	Increased set back distances to second workings (i.e. increased area of first workings only) from Cliffs in the New Hartley Shale Mine Potential Interaction Zone as per Independent Review Panel Report (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS	E (D)	3 (E)	20 (L)	8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.
		f.	Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than that as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).				
		g.	Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).				
		h.	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)).				
		i.	Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2).				
		j.	Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017)				
		k.	Geological mapping during development advance				

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		l. Qualified mine surveyor and calibrated survey equipment m. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts. n. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. o. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. p. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014. q. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. r. 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). s. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent t. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).				
12. Groundwater Dependent Ecosystems (GDE's)		<i>Refer Groundwater Aquifers information above which includes information on GDE's and facultative ecosystems.</i>				
13. Threatened AQUATIC FAUNA & potential habitat (e.g. dragon fly, Macquarie perch) Located within the EP Area (Cliff Line Zone of First Workings ML1331)	There is a risk to Airly from ::: Loss of stream flow - degradation or loss of species or habitat ::: Caused by: Mine design LTA or Mining method implementation LTA or Monitoring LTA Resulting in: Environmental damage or Impact to the business plan or Non compliance or Reputation.	a. Identification - EIS Aquatic Ecology & Stygofauna Impact Assessment (Cardno, 2014). b. Identification - Ongoing site aquatic ecology monitoring program as part of the site Water Management Plan (site WMP) and site Biodiversity Management Plan (site BMP). c.. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts. d. First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2) e. Increased set back distances to second workings (i.e. increased area of first workings only) from Cliffs in the New Hartley Shale Mine Potential Interaction Zone as per Independent Review Panel Report (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS f. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP). g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017). h. 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)). i. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2). j. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017) k. Geological mapping during development advance l. Qualified mine surveyor and calibrated survey equipment m. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts. n. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. o. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. p. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014. q. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. r. 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). s. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent t. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).	E (D)	3 (E)	20 (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) . 2. Develop a 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. 3. 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. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 6. 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 8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.

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14. Threatened FLORA One (1) species (<i>Prostanthera stricta</i>) Located within the EP Area (Cliff Line Zone of First Workings ML1331) <u>Note:</u> Other recorded threatened flora species at Airly Mine are located beyond the current EP Area. E.g. <i>pultenaea</i> sp. <i>Genowlan Pt</i> is <u>not</u> located within current EP Area (located in A232).	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: Mine design LTA or Mining method implementation LTA or Monitoring LTA Resulting in: Environmental damage or Impact to the business plan or Non compliance or Reputation.	a. Identification - EIS specialist ecological impact assessment (RPS, 2014) b. Identification - Ongoing site ecological monitoring program as part of the site Biodiversity Management Plan (site BMP); c.. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts. d. First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2) e. Increased set back distances to second workings (i.e. increased area of first workings only) from Cliffs in the New Hartley Shale Mine Potential Interaction Zone as per Independent Review Panel Report (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS f. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP). g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017). h. 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)). i. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2). j. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017) k. Geological mapping during development advance l. Qualified mine surveyor and calibrated survey equipment m. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts. n. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. o. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. p. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014. q. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. r. 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). s. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent t. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).	E (D)	3 (E)	20 (L)	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) . 3. 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. 4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 6 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 8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.
15. Threatened FAUNA – & potential habitat (bats, birds, rock wallaby and reptiles) Located within the EP Area (Cliff Line Zone of First Workings ML1331)	There is a risk to Airly from ::: Degradation or loss of species or habitat ::: Caused by: Mine design LTA or Mining method implementation LTA or Monitoring LTA Resulting in: Environmental damage or Impact to the business plan or Non compliance or Reputation.	a. Identification - EIS specialist ecological impact assessment (RPS, 2014) b. Identification - Ongoing site ecological monitoring program as part of the site Biodiversity Management Plan (site BMP); c.. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts. d. First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2) e. Increased set back distances to second workings (i.e. increased area of first workings only) from Cliffs in the New Hartley Shale Mine Potential Interaction Zone as per Independent Review Panel Report (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS f. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP). g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan,2017).	E (D)	3 (E)	20 (L)	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) . 2. Develop a mine site <i>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. 3. 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. 4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 6 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

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		<p>h. 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)).</p> <p>i. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2).</p> <p>j. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017)</p> <p>k. Geological mapping during development advance</p> <p>l. Qualified mine surveyor and calibrated survey equipment</p> <p>m. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts.</p> <p>n. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent.</p> <p>o. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects.</p> <p>p. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014.</p> <p>q. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size.</p> <p>r. 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).</p> <p>s. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent</p> <p>t. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).</p>				<p>pagoda systems and the minimal built features within the cliff line zone, cross referencing the subsidence monitoring program</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.</p>
16. Endangered Ecological Communities (EEC) – (including but not limited to Genowlan Pt Heathland) Located within the EP Area (Cliff Line Zone of First Workings ML1331)	<p>There is a risk to Airly from</p> <p>::: Changes in species diversity or extent within EECs :::</p> <p>Caused by: Mine design LTA or Mining method implementation LTA or Monitoring LTA</p> <p>Resulting in: Environmental damage or Loss of biodiversity or Loss of intergenerational equity or Reputation.</p>	Not Applicable – No Endangered Ecological Communities (EECs) located within the current EP Area. Genowlan Point Allocasuarina Heathland and White Box – Yellow Box – Blakey’s Red Gum Woodland EEC located elsewhere beyond EP Area (RPS, 2017).	E (Pb)	3 (E)	20 (L)	
17. Natural vegetation – (General, including sheltered gullies) Located within the EP Area (Cliff Line Zone of First Workings ML1331)	<p>There is a risk to Airly from</p> <p>::: Changes in species diversity or extent :::</p> <p>Caused by: Mine design LTA or Mining method implementation LTA or Monitoring LTA</p> <p>Resulting in: Environmental damage or Reputation.</p>	<p>a. Identification - EIS specialist ecological impact assessment (RPS, 2014)</p> <p>b. Identification - Ongoing site ecological monitoring program as part of the site Biodiversity Management Plan (site BMP);</p> <p>c.. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts.</p> <p>d. First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2)</p> <p>e. Increased set back distances to second workings (i.e. increased area of first workings only) from Cliffs in the New Hartley Shale Mine Potential Interaction Zone as per Independent Review Panel Report (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS</p> <p>f. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP).</p> <p>g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017).</p> <p>h. 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)).</p> <p>i. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2).</p> <p>j. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017)</p> <p>k. Geological mapping during development advance</p>	E (Pb)	3 (E)	20 (L)	<p>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) .</p> <p>2. Develop a mine site <i>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.</p> <p>3. 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.</p> <p>4. Review and update the Airly Panel Design Standard. (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section).</p> <p>6. 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</p> <p>8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment,</p>

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		l. Qualified mine surveyor and calibrated survey equipment m. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts. n. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. o. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. p. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014. q. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. r. 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). s. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent t. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).				monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.
18. Unsealed Roads, four wheel drive tracks and trails Located within the EP Area (Cliff Line Zone of First Workings – ML1331)	There is a potential 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 or Mining method implementation LTA or Monitoring LTA Resulting in: Public safety hazard (personal injury PI) or Reputation or Social impact.	a. Unsealed Roads, Tracks and Trails mapped in consultation with OEH/NPWS consistent with the SCA Plan of Management; b. Existing and Proposed restricted access areas (locked gates and fencing) c. Appropriate warning signage developed in consultation with OEH/NPWS d. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for impacts. e. First workings proposed for the current EP Area within the NBSMP (Airly Village Ruins / Tramway Trail) are very limited – little if any workings in this area (refer A0 Plan 2) f. Increased set back distances as per Independent Review Panel Report to second workings (i.e. increased area of first workings only)- from Cliffs in the New Hartley Shale Mine Potential Interaction Zone (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS) g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017). h. 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)). i. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2). j. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017) k. Geological mapping during development advance l. Qualified mine surveyor and calibrated survey equipment m. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts. n. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. o. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. p. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014. q. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. r. 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). s. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent t. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).	E (IF, Pb)	3 (PI)(I)	20 (L)	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) 4. Review and update the <i>Airly Panel Design Standard</i> (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 3. 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, including unsealed roads, 4WD tracks and trails. 7. 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 publically 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. 8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.
19. Aboriginal and Cultural Heritage Sites (including rock shelters)	Not Applicable	Not Applicable - No known Aboriginal and cultural heritage sites located within EP Area (all known sites are beyond the current EP Area, including elsewhere in CLZ including rock shelter 45-1-0167). MEP Mining Zones (including EP Area) subject of detailed surveys for the approved EIS.	E (Pb)	4 (E)	23 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
Located within the EP Area		Process for managing any new/currently unknown sites if encountered during mining is already adequately addressed within the Centennial <i>Western Region Aboriginal and Cultural Heritage Management Plan</i> as referenced within the current Extraction Plan.				
20. Historic Heritage / Archaeological heritage significance - Airly Village sites (associated with the former New Hartley Shale Mine) Located within the EP Area (Cliff Line Zone of First Workings ML1331)	There is a potential 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 or Mining method implementation LTA or Monitoring LTA or Set back distance LTA Resulting in: Cultural heritage impact or Reputation or Social impact.	a. No registered historic heritage sites within the EP Area to be directly undermined by first workings (12 occur within EP Area and additional immediately adjacent – refer EP/HHMP). b. Only potential for ‘secondary’ impact with respect to first workings is if a local rock fall occurs. c.. Only first workings within CLZ with permanent long term stable pillars under cliffs (no secondary extraction in CLZ at any stage) in order to avoid potential for cliff impacts. d. First workings proposed for the current EP Area within the NHSMPIZ are very limited (refer A0 Plan 2) e. Increased set back distances to second workings (i.e. increased area of first workings only) from Cliffs in the New Hartley Shale Mine Potential Interaction Zone as per Independent Review Panel Report (no second workings within angle of draw of 26.5 degrees (half depth of cover) plus 50m from crest and toe of cliffs identified in the EIS f. Mine design using large pillars within the CLZ with Factors of Safety and Width to Height Ratios higher than as approved in EIS. Long-term stable under all scenarios as concurred by the Independent Expert Panel (IEP). g. Mining method and design reviewed by geotechnical engineering experts (Pillar Stability Assessment including revised subsidence predictions for specific mine plan prepared by Golder Associates for the Extraction Plan, 2017). h. 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)). i. Consent conditions require first workings only under cliffs, pillars to remain long term stable and non-subsiding, with- negligible impact (Sch 3, Cond 2). j. Detailed updated mapping of cliffs, minor cliffs and pagodas within ML1331, as defined by consent SSD_5581 (RPS, 2017) k. Geological mapping during development advance l. Qualified mine surveyor and calibrated survey equipment m. Expert peer review (MSEC) during EIS of subsidence predictions and predicted impacts. n. Planning Assessment Commission (PAC) Review and expert Independent Review Panel (IRP) assessment reports prior to granting development consent. o. Independent Expert Panel (IEP) required by consent to be established (<i>post-consent</i>) to review Extraction Plans and nominated management plans required for approval prior to mining, including pillar stability, mine design and monitoring aspects. p. Baseline monitoring of cliffs and pagodas methodology developed in consultation with IEP and DRE, using detailed high resolution 3D photogrammetry (50mmx50mm pixel size) in addition to studies undertaken for the EIS pre-2014. q. Strata Control Management Plan limits roadway width and intersection sizes which have a direct bearing on pillar size. r. 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). s. No greater impact permitted than outlined in performance measures of Table 1 Schedule 3, Condition 2 of SSD_5581 consent t. First workings in EP Area all above 80m depth of cover (DOC), mining will not constitute a High Risk Activity (where DOC<50m).	E (Pb)	3 (R)	20 (L)	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) . 4. Review and update the <i>Airly Panel Design Standard</i> (AIR-SS-9001) if/where required consistent with the Master TARP. Pillars surveyed and audited as formed against design, referencing the Master TARP for actions if criteria not met. Reference the standard in the Subsidence Monitoring Program (underground mining control section). 5. Develop a <i>Historical Heritage Management Plan (HHMP)</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. 6. 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 8. Independent Expert Panel (IEP) review of nominated management plans (including LMP, PSMP, SMP noted above), including mine design parameters, revised subsidence predictions and impact assessment, monitoring and management measures as per Condition 7 (sch3) of SSD_5581 consent.
21. Other Significant Built Features (e.g. telecommunications) if located within the EP Area (Cliff Line Zone of First Workings ML1331)	Not Applicable	No significant built features within current EP Area (only SCA fences and unsealed 4WD management trails as addressed elsewhere above managed within the Land Management Plan). Refer LMP and SMP for details.				
22. Geological Structures (including faults) Located within the EP Area (Cliff Line Zone of First Workings ML1331)	There is a potential risk to Airly from ::: increased subsidence / impacts arising from potential effects of geological structures::: Caused by: Mine design LTA or Mining method implementation LTA or Geological Data LTA or Monitoring LTA or Set back distance LTA Resulting in: Public safety hazard (personal injury PI) or Environmental Damage or	a. Detailed assessment and mapping of geological structures (including faults) within the MEP EIS (2014), including (but not limited to) high resolution aeromagnetic scans (SRK 2012) b. Specific assessment in mine design and Pillar Stability Assessment Report (Golder Associates 2017) c. Detailed within Extraction Plan (Mine Planning and Design section) and A0 Graphical Plan 3. d. No known igneous intrusions, no faults of >2m displacement encountered during mining to date (but identified as possible and accordingly considered in mine design). e. Potential impact of localised geological structures, such as faults, also diminishes rapidly as pillar w/h ratio increases (Golder Associates 2017). f. Even if coal is heavily fractured, the overall pillar does not fail in the commonly understood sense; a creep event becomes the likely worst-case scenario which is considered highly unlikely for the current EP Area (and not predicted) given the relatively high width to height ratios employed in combination with Factors of Safety beyond 2.11 and up to 4.0 within the EP Area.				

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Reputation or Social Impact or Cultural heritage impact or Social impact.	<p>g. Pillar w/h ratio, applied in conjunction with other design criteria, such as FoS, is a useful indicator of design reliability (Golder Associates, 2017). There are no failed cases in the combined database with a w/h ratio of greater than 8.2, even at a very low FoS, and there is only one failed case at a w/h ratio of >5. The highest FoS assigned to a bord and pillar collapse is 2.1 and this was associated with a w/h ratio of only 2.2. Although there are cases of failed highwall mining pillars with Factors of Safety of >2, all of them have w/h ratios of <2</p> <p>h. Weak floor conditions not expected or predicted (moderate to strong floor rating, silty sandstone UCS ~40MPa, underlain by medium grained sandstone UCS 20-30MPa with little to no sensitivity to moisture.)</p> <p>i. Subsequently, given the above factors, the influence of geological structures and/or faulting is not expected to significantly impact the proposed workings in the EP Area.</p> <p>j. See also mine design controls as per used for all entries elsewhere above.</p>				

Note: Common Appendix 2 to the PSMP, SMP and LMP for the current Extraction Plan provides a detailed checklist of additional WHS risk considerations and where these are addressed (if applicable), in accordance with the *Guide to Subsidence Risk Management (WHS Legislation)*, February 2017 (NSW Resource Regulator – Mine Safety Operations). This includes (but is not limited to) additional aspects such as potential for horizontal movements, valley closure, sinkhole formation, and uncertainty analysis.

Note: For consistency with the previous EIS risk assessment (which has been updated) the same version of the Centennial Risk Matrix has been used

RISK MANAGEMENT STANDARD

Management Standard-004

CENTENNIAL RISK MATRIX							Likelihood					Description (D)
Rating	Consequence						A Certain	B Probable	C Possible	D Remote	E Improbable	
	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.						Common"	Has Happened within Centennial"	"Could Happen & has happened in non-CEY operations	Not Likely	"Practically impossible	Probability (Pb)
	Impact to Annual Business Plan (F)	Personal Injury (PI)	Business Interruption (BI)	Legal (L)	Reputation (R)	Environment (E)	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)
1. Catastrophic	>\$50m	Multiple Fatalities	> 1month	Prolonged litigation, heavy fines, potential jail term	Prolonged International media attention	Long term impairment habitats/ ecosystem	1 (E)	2 (E)	5 (H)	7 (H)	11 (S)	
2. Major	\$10m - \$50m	Single Fatality	1 week to 1 month	Major breach/ major litigation	International media attention	Long term effects of ecosystem	3 (E)	4 (E)	8 (H)	12 (S)	16 (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	6 (H)	9 (H)	13 (S)	17 (M)	20 (L)	
4. 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	10 (S)	14 (S)	18 (M)	21 (L)	23 (L)	
5. Insignificant	<\$100k	First Aid Treatment Only	< 12 hrs	Low level compliance issue	Local complaints	Limited physical damage	15 (S)	19 (M)	22 (L)	24 (L)	25 (L)	

Risk Rating	Risk Category		Generic Management Actions
1 to 4	E	Extreme	Immediate intervention required from senior management to eliminate or reduce this risk
5 to 9	H	High	Imperative to eliminate or reduce risk to a lower level by the introduction of control measures. Management planning required at senior levels
10 to 15	S	Significant	Corrective action required, senior management attention needed to eliminate or reduce risk
16 to 19	M	Moderate	Corrective action to be determined, management responsibility must be specified
20 to 25	L	Low	Monitor and manage by corrective action where practicable

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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	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

Appendix 6:

**Pillar Stability and Subsidence
Assessment Report (Golder Associates
2017)**

24th May 2017

Project No. 127621105-313-R-Rev1

David King, Senior Mining Engineer
Airly Mine
Glen Davis Road
Capertee
NSW 2846

THE ADEQUACY OF COAL PILLARS PLANNED FOR THE CLIFF LINE ZONE IN ML1331, AIRLY MINE

Dear David,

1.0 INTRODUCTION

This report assesses coal pillar sizes for the Cliff Line Zone, as defined in the Subsidence Impact Assessment report (**Golder Associates Report No. 127621105-003-R-Rev2**). The stability of the pillars as first workings was addressed in **Golder Associates Report No. 127621105-235-R-Rev0** and is summarised again herein.

The primary issues addressed in this report are:

- loading effects of adjacent extraction operations and
- subsidence estimates associated with the workings in this zone.

Empirical design methodologies have been applied to derive pillar strength, load and associated stability criteria, as well as subsidence estimates. The review addresses the planned 'typical' pillars for the zone, as well as minimum pillar sizes to provide insight for localised situations that might require individual smaller pillars to be formed, such as those around intersections of panels with main headings.

2.0 PILLAR STABILITY CRITERIA

The assessment of pillar stability requires the determination of pillar stress, pillar strength and an appropriate Factor of Safety (FoS), which is defined as:

$$\text{Factor of Safety} = \frac{\text{Pillar Strength}}{\text{Pillar Stress}}$$

The FoS concept is commonly applied when the potential for pillar collapse or failure is analysed, as it can generally be related to the probability of failure occurring.

2.1 Coal Pillar Strength

The pillar stability assessment for Airly has utilised the most recent UNSW pillar strength equations (**Salamon *et al*, 1996**) for Australian coal pillars with w/h ratios of >5, as follows:



$$\sigma_p = \frac{27.63\Theta^{0.51}}{w^{0.22}h^{0.11}} \left\{ 0.29 \left[\left(\frac{w}{5h} \right)^{2.5} - 1 \right] + 1 \right\}$$

where: σ_s = strength (MPa)
 w = minimum pillar width (m)
 h = roadway height (m)
 Θ = a dimensionless 'aspect ratio' factor for rectangular pillars defined by **Salamon et al, 1996**

For pillars with width to height ratios of ≤ 5 , the pillar strength is determined as follows:

$$\sigma_s = 8.6 \frac{(w\Theta)^{0.51}}{h^{0.84}}$$

A standard pillar height of 2.8m and a roadway width of 5.5m have been applied in the analyses.

2.2 Pillar Stress

In regard to the vertical stress on the pillars at the first workings stage, it is common to make the conservative assumption that the pillars are loaded by the overlying column of rock to surface, see **Figure 1**. This is referred to as tributary area loading, T, and is defined as follows:

$$T = \frac{(w + B)(l + B) \rho g H}{wl}$$

where: T = pillar stress (MPa)
 l = pillar length (m)
 B = roadway width (m)
 H = depth of cover (m)
 ρ = density of rock (taken as 2.5 t/m³)
 g = gravitational constant (taken as 10 m/s²)

To derive the stress component related to secondary extraction, methodologies such as ALPS (**Mark, 1990**) and those outlined in the UNSW pillar design workshops (**UNSW, 1995**) utilise the abutment angle approach developed by **King and Whittaker (1971)** and **Wilson (1973)** for the estimation of pillar stress increases. This model has been incorporated into both numerical and empirical methodologies for pillar sizing. It should be noted that the abutment angle concept is a mathematical convenience and is only loosely connected to physical overburden deformation (e.g. any observable caving angle or subsidence phenomenon).

The abutment angle concept has been applied herein to estimate the load increase on the cliff zone pillars, referring again to **Figure 1**. Given that Airly will be utilising a partial extraction system involving sub-critical panels, the abutment load (A) is defined by:

$$A = \rho g (0.5HW - 0.125W^2/\tan\phi)$$

where: ϕ = abutment angle (degrees)
 W = panel span (centres, m)

Pillar load is converted to stress by dividing by pillar area.

Field studies indicate that the abutment angle increases as pillar width increases, as stiffer pillars attract more load and the angle decreases with increasing depth, as the panels tend to become sub-critical and in part due to the overburden having more ability to transfer load to adjacent areas of solid.

The latest predictive “sliding-scale” abutment angle formula recommended by GA (**Hill et al, 2015**) is defined as follows:

$$\phi = 21.62 - 0.0221H + 0.0725w - 6.23C$$

where: C = Panel span “criticality”, defined by:
C = 1, when W/H < 0.75 (as in the case of Airly) and
C = 0, when W/H ≥ 0.75

The results obtained using this sliding-scale formula have been compared herein to those obtained using a fixed abutment angle of 21°, which is a conservative and commonly applied value in super-critical panel environments.

The load re-distribution decays in a parabolic fashion with distance from the extracted area. In the case of Airly, a significant proportion of the abutment load will report to the immediately adjacent combined chain and barrier pillar zone (≥40m wide), with only a remnant reporting to the actual cliff line zone pillars.

Abutment load apportionment between the pillars in the system is estimated using the load sharing factor ‘R’ defined in ALPS (**Mark, 1990**) as follows:

$$R = 1 - [(D-w-B)/D]^3$$

where: D = 5.13√H (after **Peng and Chiang, 1984**)

2.3 Factor of Safety and Probability of Stability Concepts

A Probability of Stability (PoS) of 99.9% is attained at a Factor of Safety of 1.63, see **Figure 2**, and further increases in FoS have minimal effect, as the PoS curve approaches 100% asymptotically. From a risk management perspective, increasing the FoS beyond 1.63 can only reduce the failure probability by <0.1%. It is emphasised that the FoS relates to the overall panel situation, rather than that of individual pillars.

The consequences of collapse are a primary consideration, as these determine the acceptable probability of failure, which in turn allows an appropriate FoS to be determined. For example, prudent risk management suggests that the probability of failure for long-term first workings panels beneath sensitive surface structures should be negligible. In Australia, long-life critical pillars (e.g. in main headings and for the protection of surface infrastructure) are often designed to a FoS of ≥2.11, which equates to a nominal failure probability of one panel in a million, based on the UNSW power law strength equation (**Salamon et al, 1996**). This reduces the probability of failure to a level that would be considered acceptable in other key fields of public interest.

It is important to note that the South African and Australian databases from which the UNSW pillar design formulae were derived cover a broad range of roof and floor materials, including mudrocks, coal, siltstones and sandstones. Therefore, these materials and the variability in pillar strength that may be associated with them are implicitly recognised and largely catered for in the FoS approach. Uncertainty associated with the natural variability in coal measures strata often prohibits design to low FoS values. Geological variability partly accounts for the scatter in the population of failed pillar cases and usually necessitates design to FoS values of >1.5, equivalent to low failure probabilities. Back analysis indicates that incidences of pillar instability traditionally associated with weak floor,

for example, can often be explained in terms of 'conventional' empirical design criteria, notably in terms of FoS and pillar w/h ratio, as will be discussed in **Section 2.4**.

Similarly, the database encompasses pillars in a significant number of seams involving different geological / geotechnical environments; consequently the existence of pillar weaknesses is very largely reflected and implicit within the variability in the failed and intact pillar cases, such that these weaknesses are again very largely catered for by adopting appropriate FoS values.

It should also be understood that the nominal probability of failure is related to the life-time of the database underpinning the empirical design methodology; currently this averages approximately fifty years (i.e. of the order of 100 years of coal pillar history is available). Annualised probability of failure (a concept more commonly applied in engineering practice) is therefore about one-fiftieth of the nominal failure probability.

In summary, it should be clear from **Figure 2** that provided the workings under consideration are designed to a minimum system FoS of around 1.6, it is necessary to look beyond this concept to obtain any further assurance of long-term stability that may be required. An issue warranting particular consideration is the w/h ratio of the pillars, which is discussed in detail in the following section.

2.4 The Importance of Pillar Width to Height (w/h) Ratio

The role of increasing w/h ratio in enhancing coal pillar stability has long been known. Back analysis of case histories from South Africa, Australia and elsewhere has shown that w/h ratio exerts a major influence on coal pillar strength. At low w/h ratios (<3) overloaded coal pillars tend to fail in a brittle, uncontrolled fashion, whereas at greater w/h ratios (>4) the overloaded pillars demonstrate a more plastic form of deformation: significant displacement may still take place in the form of roof to floor convergence, as well as rib spall, but the pillar core remains confined and tends to retain its load carrying ability, generally without failing in the commonly understood sense.

This was illustrated by **Madden (1987)** with laboratory UCS tests on sandstone discs during the initial practical development of the squat pillar formula (he used sandstone because coal samples are more heterogeneous and difficult to prepare). It was also shown by **Das (1986)** in tests on Indian coals, see **Figures 3a** and **3b**. The potential impact of localised geological structures, such as faults, also diminishes rapidly as pillar w/h ratio increases, as illustrated schematically in **Figure 4**. International coal industry experience confirms the importance of w/h ratio to stability; incidences of collapse are concentrated at low w/h ratios, even in known weak floor environments.

Furthermore, back analysis of the results of *in situ* coal pillar tests from South Africa indicates that the post-peak modulus (stiffness) of actual pillars becomes positive (i.e. suggesting strain hardening behaviour) once the w/h ratio exceeds 4.1, as seen in **Figure 5**. In other words, even if the coal is heavily fractured, the overall pillar does not fail in the commonly understood sense; a creep event becomes the likely worst-case scenario.

Pillar w/h ratio, applied in conjunction with other design criteria, such as FoS, is a useful indicator of design reliability. This is illustrated in **Figure 6**, which presents the FoS versus w/h ratio relationship for a combined database of failed South African and Australian bord and pillar panels, plus a database of highwall mining failed pillar cases (**Hill, 2005**).

These three databases are complementary in nature, reflecting the experiences of their respective industries. For example, the Australian data provides insight with regard to pillar behaviour at relatively high w/h ratios and furnishes the failed case at the w/h ratio of 8.2. In contrast, the South African industry has a high proportion of mining geometries with lower w/h ratios, which is partly reflected in the maximum w/h ratio of only 3.7 for a South African failed case. Similarly, the highwall mining failed pillar cases cover the lower end of the range of w/h ratios, from 0.6 to 1.4.

There are no failed cases in the combined database with a w/h ratio of greater than 8.2, even at a very low FoS, and there is only one failed case at a w/h ratio of >5. The highest FoS assigned to a bord and pillar collapse is 2.1 and this was associated with a w/h ratio of only 2.2. Although there are failed highwall mining pillars with Factors of Safety of >2, all of them have w/h ratios of <2.

A limit envelope can be defined for the database of failed cases, illustrated by the curve and given by the following equation:

$$w/h \text{ ratio} = 22.419e^{-1.148*(FoS)}$$

Beyond this envelope, there is no precedent for failure within the three databases. It is worth noting that the exclusion of the highwall mining pillar data would not materially change the shape of this limit envelope.

In the case of long life (>5 years) pillars, if it is reasonable to assume that the pillars are, or will at some point in the future, be subjected to full tributary area loading, then it is generally considered prudent to design the pillars to be outside (i.e. above) the envelope defined by this equation, even though there are many examples of stable pillars that fall within it.

Furthermore, in the case of critical, long-life pillars, it is considered prudent to allow an additional margin beyond this curve. GA generally suggests a 20% margin, which is defined by the second (i.e. outer) curve in **Figure 6** and the following equation:

$$w/h \text{ ratio} = 26.903e^{-0.957*(FoS)}$$

2.5 Summarised Composite Design Criteria based on FoS and w/h Ratio

As previously indicated, pillar design criteria should reflect the specific requirements and nature of the workings (e.g. short-term production panel, as opposed to long-life coal pillars with surface protection constraints). The approach adopted by GA in Australia can be summarised as follows (**Hill, 2005**):

- A. Short-term production workings, with considerable local knowledge: design may be within the failed pillar database limit envelope, under controlled circumstances.
- B. Short-term production workings (general): design on the basis of being beyond the failed pillar database limit envelope.
- C. Key underground workings (e.g. main headings), with medium to long-term serviceability / stability requirements: design on the basis of the limit envelope plus 20% (i.e. the outer database curve).
- D. Underground workings beneath critical, highly sensitive surface structures and / or features (e.g. key infrastructure, such as railways / waterways): design on the basis of a minimum w/h ratio of five (i.e. squat pillars) with a minimum nominal FoS of 2.11 according to the **Salamon et al 1996** formulae (i.e. a nominal probability of failure of ≤ 1 in a million).

These criteria are summarised in **Figure 7**. They are considered guidelines and it is important that specific attention be given to the geotechnical / mining environment, including historical experience of ground behaviour in the seam under consideration.

A subsequent review of long-term pillar stability issues and the associated design considerations concluded that these design criteria remain appropriate for Australian conditions (**Hill, 2010**). That review also noted that the NSW regulatory approach to pillar design (circa 2006) was rational, see **Figure 8**.

In **Strata Engineering Report 09-001-AIR-4 (SEA, 2010)**, the partial extraction situation at Airly Mine was considered analogous to “key underground workings” (i.e. Category C above); long-term stability is required for surface protection, although in this case the surface features were not in general considered in the highest category of “critical infrastructure”.

Subsequently, in the **GA SIA Report**, a minimum FoS of 2.11 was adopted for pillars in the “Cliff Line Zones” defined by GA, noting the following:

- As previously indicated, a FoS of 2.11 equates to a nominal probability of panel failure of one in a million.
- A geotechnical assessment of the Airly deposit for the purpose of assessing partial extraction options did not identify roof or floor materials that would be considered unusually weak and that might otherwise necessitate the adoption of alternative / more conservative pillar design criteria (**SEA, 2012**).
- Experience of mining the Lithgow Seam does not indicate that floor stability is likely to be an issue for pillar stability at the depths of cover involved at Airly.
- The impact of the varying topography in the context of practical bord and pillar design is the application of average panel Factors of Safety that significantly exceed the design minima.

3.0 PILLAR STABILITY ANALYSIS

3.1 First Workings

Depth is typically in the range of 100m to 200m. For pillar centre distances of <18m, a 6m roadway width has been assumed.

The results are summarised in **Table 1** (re-produced from **GA Report No. 127621105-235-R-Rev0**).

Table 1: First Workings Pillar Design Outcomes

Depth (m)	Pillar Width (solid, m)	Pillar w/h Ratio	Pillar Safety Factor	Probability of Stability (%)	Comments
80	9.7	3.5	2.20	99.99997443	Theoretical minimum square pillar; B = 6m
160	16.4	5.9	2.13	99.99992679	Theoretical minimum square pillar
250	22.4	8.0	2.12	99.99991497	Theoretical minimum square pillar
80	29.5	10.5	10.73	100.00000000	Planned Geometry A: 35m Square Centres
160	29.5	10.5	5.37	100.00000000	Planned Geometry A: 35m Square Centres
250	29.5	10.5	3.44	100.00000000	Planned Geometry A: 35m Square Centres
80	24.5	8.75	9.18	100.00000000	Planned Geometry B: 30m by 45m Centres
160	24.5	8.75	4.59	100.00000000	Planned Geometry B: 30m by 45m Centres
250	24.5	8.75	2.94	100.00000000	Planned Geometry B: 30m by 45m Centres

Note: Probability of Stability has been calculated to eight decimal places

The following comments are made regarding the results for the Cliff Line Zone:

- i) Current development practice relates to “Planned Geometry A” (35m square centres) and is associated with a Probability of Stability of effectively 100%.
- ii) The SIA report suggested an alternative geometry, based on 30m by 45m centres, referred to herein as “Planned Geometry B”. This is associated with a probability of stability of effectively 100%.

- iii) Significant reductions in pillar width are possible. Some of the reduced pillar widths are $<1/10$ depth or $<10\text{m}$ and would require exemption from the regulator. At the minimum zone depth of 80m , it would be feasible to adopt a minimum pillar width to height ratio of 3.5 (associated FoS of 2.20). The reduced pillar widths have Factors of Safety of ≥ 2.13 and acceptable associated probabilities of long-term stability of $\geq 99.9999\%$. Given that a reduction in pillar size would typically be isolated (i.e. a pillar or a few pillars of locally reduced size for operational reasons), this level of stability is considered adequate.
- iv) All of these geometries meet the GA design criteria for long-term stability.

3.2 Additional Pillar Loading due to Adjacent Future Partial Extraction

Reference to the current (March 2017) Life of Mine Plan indicates a great variety of Cliff Line Zone panel layouts across ML1331. For the purpose of this assessment, the analyses have addressed scenarios that cover:

- The depth range of the partial extraction (i.e. panel and pillar) layouts,
- a theoretical range of Offset Distances from the partial extraction operation (i.e. from the goaf edge to closest edge of the first Cliff Line Zone pillar, noting that a distance of 40m is currently being applied in the mine design),
- sliding scale and 21° abutment angle models,
- side abutment loading, given that this will be greater than end loading (i.e. worst case) and
- various pillar geometries, consistent with the design criteria outlined previously (in particular, a minimum final FoS of 2.11).

Consideration has also been given to the potential effects of future splitting and quartering in the adjacent shallow mining zone (**Section 5.2.4**).

3.2.1 Planned Cliff Line Zone Geometry 'A'

The results for Geometry 'A' (i.e. 35m square centres) are summarised in **Table 2** and illustrated in **Figure 9**. Note that a depth of 200m represents the worst case situation in the current mine plan. The stress increments due to adjacent extraction are very small and the GA design criteria for long-term pillar stability are consistently met. The pillar design is conservative.

Table 2: Geometry 'A' Stability Outcomes, assuming a 21° Abutment Angle

Depth (m)	Stress Increment due to Adjacent Extraction (MPa)			Final Pillar Stress (MPa)			Pillar Factor of Safety		
	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55
100	0.1	0.0	0.0	3.6	3.5	3.5	8.4	8.6	8.6
150	0.3	0.1	0.0	5.6	5.4	5.3	5.4	5.6	5.7
200	0.6	0.2	0.1	7.7	7.3	7.1	3.9	4.2	4.3
250	1.1	0.5	0.2	9.9	9.3	9.0	3.0	3.3	3.4

Note: 'OD' is the Offset Distance, in metres

3.2.2 Planned Cliff Line Zone Geometry 'B'

The results for Geometry 'B' (i.e. 30m by 45m centres) are summarised in **Table 3** and illustrated in **Figure 10**. Again, a depth of 200m represents the worst case situation in the current mine plan. The stress increments due to adjacent extraction are very small and the GA design criteria for long-term pillar stability are met. The pillar design is conservative.

Table 3: Geometry 'B' Stability Outcomes, assuming a 21° Abutment Angle

Depth (m)	Stress Increment due to Adjacent Extraction (MPa)			Final Pillar Stress (MPa)			Pillar Factor of Safety		
	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55
100	0.1	0.0	0.0	3.6	3.5	3.5	7.2	7.3	7.3
150	0.3	0.1	0.0	5.6	5.3	5.2	4.6	4.8	4.9
200	0.7	0.3	0.1	7.7	7.3	7.0	3.3	3.5	3.6
250	1.3	0.6	0.2	10.0	9.3	8.9	2.6	2.7	2.9

Note: 'OD' is the Offset Distance, in metres

3.2.3 Localised Small Pillars

The results for localised small pillars (none of which are currently planned) are summarised in **Table 4** and illustrated in **Figure 11**. Again, a depth of 200m represents the worst case situation in the current mine plan. **Table 4** provides the minimum pillar sizes required to meet the GA design criteria for long-term pillar stability. Significant localised reductions in pillar size are possible.

Table 4: Localised Small Pillar Stability Outcomes, assuming a 21° Abutment Angle

Depth (m)	Stress Increment due to Adjacent Extraction (MPa)			Final Pillar Stress (MPa)			Pillar Width (solid, m)		
	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55	OD=35	OD=45	OD=55
80	0.2	0.0	0.0	5.4	5.2	5.1	9.7	9.7	9.7
100	0.4	0.0	0.0	6.1	5.9	5.9	11.8	11.3	11.3
150	0.8	0.3	0.0	7.4	7.1	6.9	17.0	16.0	15.5
200	1.2	0.6	0.2	9.1	8.7	8.4	21.3	20.3	19.6
250	1.6	1.0	0.5	10.9	10.5	10.1	24.6	23.8	23.1

Note: 'OD' is the Offset Distance, in metres

4.0 BEARING CAPACITY

Although the methodology and criteria for assessing pillar stability are applicable across a wide range of roof and floor types, it is still appropriate to consider roof and floor bearing capacity. To determine foundation failure potential, a methodology for estimating bearing capacity for shallow foundations with strip footings has been applied (**Das 2006**). Experience indicates that this method provides a useful estimate of foundation bearing capacity in rock. For calculation purposes, it has also been assumed that the rock shear strength is half the unconfined compressive strength (UCS) (**Budavari 1983**).

The possibility of long-term failure of the strata surrounding the pillars is analysed using Terzhagi's bearing capacity equation as follows:

$$q_u = 5.7c_u + q$$

where:

q_u = Ultimate Bearing Capacity (MPa)

q = Surcharge Loading (MPa, not applicable in this case)

c_u = Cohesion (MPa, shear strength of material substituted for cohesion)

Previous studies indicate that the UCS of both the roof and floor are typically 30 to 40MPa, see **Figure 12**. Using the above equation and taking a UCS of 30MPa, the bearing capacity is 85MPa. Furthermore, **Pells et al (1998)** suggests that the bearing capacity of sedimentary rock is 3 to 5 times the UCS, indicating a capacity of at least that determined using the Terzhagi equation.

Given that the stress on the Cliff Line Zone pillars is $\leq 10\text{MPa}$ for Geometries 'A' and 'B', the FoS against bearing failure is ≥ 8.5 . Even potential localised smaller pillars would involve final stresses of $< 11\text{MPa}$, such that the FoS would be ≥ 7.8 .

For all situations, the FoS exceeds the value of 3 typically suggested for long-term stability by a significant margin.

5.0 SUBSIDENCE ESTIMATES

As the pillars are designed to remain long-term stable, it is considered reasonable to estimate subsidence on the basis of elastic convergence. The methodology used to estimate the expected surface subsidence is based on the geomechanical properties of the strata and estimates of the average stress change using elastic theory. The predicted subsidence consists of 3 components, namely pillar, roof and floor compression. The equations used to determine these components are shown below.

$$\begin{aligned}\Delta_{\text{pillar}} &= \sigma_{\text{net}} h / E_{\text{pillar}} \\ \Delta_{\text{roof}} &= \sigma_{\text{net}} w / E_{\text{roof}} \\ \Delta_{\text{floor}} &= \sigma_{\text{net}} w / E_{\text{floor}} \\ \Delta_{\text{total}} &= \Delta_{\text{pillar}} + \Delta_{\text{roof}} + \Delta_{\text{floor}}\end{aligned}$$

Where:

- Δ_{pillar} = pillar compression (mm)
- Δ_{roof} = roof compression above pillar (mm)
- Δ_{floor} = floor compression below pillar (mm)
- σ_{net} = net pillar stress increase (MPa)
- h = pillar height (2.8m)
- w = pillar width (m)
- E_{pillar} = Young's Modulus for coal (estimated at 2GPa)
- E_{roof} = Young's Modulus for immediate roof material (estimated at 7GPa)
- E_{floor} = Young's Modulus for immediate floor material (estimated at 5GPa)

5.1 Planned Geometry 'A' (35m Square Centres)

Given that the stress change is a function of Offset Distance, this also impacts subsidence.

5.1.1 Geometry 'A', Offset Distance = 35m

Using the methodology described previously, the estimated subsidence values are summarised in **Table 5**.

Table 5: Planned Geometry 'A' Subsidence Estimates (OD = 35m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.6	1.1	12
150	3.8	5.6	1.8	21
200	5.0	7.7	2.7	31
250	6.3	9.9	3.6	42

Hydrogeological studies have predicted that part of the Cliff Line Zone will become partially or fully flooded in the long-term following future secondary extraction activities (subject further extraction plans). The impact of flooding on subsidence has been accounted for using this analytical technique by reducing the modulus of the roof and floor strata by half. The results are summarised in **Table 6**.

**Table 6: Planned Geometry 'A' Subsidence Estimates (Long-Term Worst Case)
(OD=35m)**

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.6	1.1	24
150	3.8	5.6	1.8	39
200	5.0	7.7	2.7	58
250	6.3	9.9	3.6	79

5.1.2 Geometry 'A', Offset Distance = 45m

Using the methodology described previously, the estimated subsidence values are summarised in **Tables 7 and 8** (worst-case).

Table 7: Planned Geometry 'A' Subsidence Estimates (OD = 45m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	12
150	3.8	5.4	1.6	18
200	5.0	7.3	2.3	26
250	6.3	9.3	3.1	35

**Table 8: Planned Geometry 'A' Subsidence Estimates (Long-Term Worst Case)
(OD=45m)**

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	22
150	3.8	5.4	1.6	35
200	5.0	7.3	2.3	49
250	6.3	9.3	3.1	66

5.1.3 Geometry 'A', Offset Distance = 55m

Using the methodology described previously, the estimated subsidence values are summarised in **Tables 9 and 10** (worst-case).

Table 9: Planned Geometry 'A' Subsidence Estimates (OD = 55m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	12
150	3.8	5.3	1.5	18
200	5.0	7.1	2.1	24
250	6.3	9.0	2.7	32

**Table 10: Planned Geometry 'A' Subsidence Estimates (Long-Term Worst Case)
(OD=55m)**

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	22
150	3.8	5.3	1.5	33
200	5.0	7.1	2.1	45
250	6.3	9.0	2.7	59

It is worth noting that the subsidence estimates for an Offset Distance of 55m (**Tables 9 and 10**) approximate to those that would be expected in the first workings situation (i.e. there is negligible load or subsidence contribution related to the adjacent panel and pillar partial extraction operation).

5.2 Planned Geometry 'B' (30m by 45m Centres)

5.2.1 Geometry 'B', Offset Distance = 35m

Using the methodology described previously, the estimated subsidence values are summarised in **Tables 11 and 12** (worst-case).

Table 11: Planned Geometry 'B' Subsidence Estimates (OD = 35m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.6	1.1	10
150	3.8	5.6	1.8	18
200	5.0	7.7	2.7	27
250	6.3	10.0	3.7	37

Table 12: Planned Geometry 'B' Subsidence Estimates (Long-Term Worst Case) (OD=35m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.6	1.1	19
150	3.8	5.6	1.8	33
200	5.0	7.7	2.7	49
250	6.3	10.0	3.7	68

5.2.2 Geometry 'B', Offset Distance = 45m

Using the methodology described previously, the estimated subsidence values are summarised in **Table 13 and 14** (worst-case).

Table 13: Planned Geometry 'B' Subsidence Estimates (OD = 45m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	10
150	3.8	5.3	1.6	15
200	5.0	7.3	2.3	22
250	6.3	9.3	3.0	30

Table 14: Planned Geometry 'B' Subsidence Estimates (Long-Term Worst Case) (OD=45m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	18
150	3.8	5.3	1.6	28
200	5.0	7.3	2.3	41
250	6.3	9.3	3.0	56

5.2.3 Geometry 'B', Offset Distance = 55m

Using the methodology described previously, the estimated subsidence values are summarised in **Tables 15 and 16** (worst-case).

Table 15: Planned Geometry 'B' Subsidence Estimates (OD = 55m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	10
150	3.8	5.2	1.5	15
200	5.0	7.0	2.0	20
250	6.3	8.9	2.7	26

Table 16: Planned Geometry 'B' Subsidence Estimates (Long-Term Worst Case) (OD=55m)

Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Stress Change (MPa)	Subsidence (mm)
100	2.5	3.5	1.0	18
150	3.8	5.2	1.5	27
200	5.0	7.0	2.0	37
250	6.3	8.9	2.7	49

It is worth noting that the subsidence estimates for an offset distance of 55m (**Tables 15 and 16**) approximate to those that would be expected in a first workings situation (i.e. there is negligible load or subsidence contribution related to the adjacent panel and pillar partial extraction operation).

5.2.4 Additional Subsidence related to Future Splitting and Quartering in the Adjacent Shallow Mining Zone

The preceding analyses relate to the effects of future adjacent panel and pillar extraction beyond the Cliff Line Zone. The potential effects of splitting and quartering in the Shallow Zone, downslope of the Cliff Line Zone, also require consideration.

Previous studies have shown that the split and quartered pillars remain long-term stable, with FoS values of ≥ 2.17 (**GA Report No. 127621105-235-R-Rev0**). The SIA report (**GA Report No. 12762-1105-003-R-Rev2**) estimated that expected subsidence related to the split and quartered pillars was <15mm and long-term, worst-case subsidence was <30mm. Subsidence monitoring above the 200 Panel indicates negligible subsidence, in line with expectations (i.e. a maximum of 7mm of subsidence at 80m depth, **GA Report No. 127621105-236-R-Rev0**). Also, the numerical modelling conducted for the SIA report and the monitoring for 200 Panel indicate negligible stress transfer or associated subsidence above the adjacent intact pillars due to the split and quartered pillars.

It is concluded that the Cliff Line Zone pillars are practically unaffected by splitting and quartering in the Shallow Zone.

5.3 Concluding Remarks regarding Subsidence

The following comments are made regarding the subsidence results:

- i) The pillar systems proposed for the Cliff Line Zone are considered long-term stable under all scenarios (i.e. prior to, and following, the proposed future adjacent partial extraction, both in the Panel and Pillar Mining Zone and in the Shallow Mining Zone).
- ii) The representative maximum depth of cover for the Cliff Line Zone pillars in the current mine plan is 200m.
- iii) The minimum planned Offset Distance from the extraction area in the Panel and Pillar Mining Zone to the Cliff Line Zone is 40m. Typical Offset Distances are >55m.

- iv) The SIA study (**GA, 2013**) estimated a long-term subsidence range of 10 to 65mm for the Cliff Line Zone pillars, across a depth range of 50 to 300m. These subsidence estimates related to the first workings situation (i.e. no adjacent partial extraction).
- v) The preparation of a mine plan with defined Offset Distances has aided the estimation of *post* adjacent partial extraction subsidence estimates herein.
- vi) The updated long-term subsidence range for the Cliff Line Zone pillars in the first workings situation (i.e. with no adjacent partial extraction) is 18 to 45mm. The reductions in both the range and maximum value (i.e. 45 versus 65mm previously) are directly due to the reduced depth range that applies in practice to the Cliff Line Zone pillars in the ML1331 area of interest (i.e. 100 to 200m, as opposed to 50 to 300m).
- vii) At the proposed Offset Distances of $\geq 40\text{m}$, the contribution of future adjacent Panel and Pillar mining operations to pillar loading and subsidence within the Cliff Line Zone is negligible (i.e. $< 5\text{mm}$). Essentially, the pillars within the Cliff Line Zone would not “see” the Panel and Pillar operation to any appreciable extent.
- viii) As a result, long-term subsidence estimates for the Cliff Line Zone, even allowing for a future adjacent Panel and Pillar partial extraction operation remain below those originally put forward in the SIA study (i.e. now $\leq 53\text{mm}$, versus $\leq 65\text{mm}$ in the SIA study).
- ix) The subsidence estimates relate to the closest pillars to the proposed Panel and Pillar partial extraction area. Due to load sharing, the actual subsidence across the panel would almost certainly be considerably less again.
- x) The subsidence estimates associated with the two planned geometries are virtually the same.
- xi) No subsidence estimates have been derived for potential localised small pillars, as (a) none are currently planned and (b) individual pillars of reduced size would have negligible effect on the overall outcome.
- xii) Additional subsidence in the Cliff Line Zone due to future proposed splitting and quartering operations in the Shallow Mining Zone would again be negligible.
- xiii) Short to medium-term subsidence is predicted to be $< 30\text{mm}$ and typically $< 20\text{mm}$. This would be very difficult to measure accurately on surface.
- xiv) Long-term, worst-case subsidence would be $\leq 53\text{mm}$ and typically $< 40\text{mm}$. This negligible level of subsidence would still be difficult to measure accurately.
- xv) The stress increment magnitudes associated with adjacent partial extraction are negligible and would also be practically impossible to measure underground.
- xvi) At the predicted subsidence levels, strains would be $< 0.5\text{mm/m}$ and tilts would be $< 1.0\text{mm/m}$.
- xvii) 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.
- xviii) A review of the updated geotechnical database is currently being undertaken. One component of that review relates to strata properties. Preliminary results indicate that an outcome will be an upgrade of the rock moduli values applied to-date, such that future subsidence estimates are again likely to be slightly reduced.
- xix) Additionally, further detailed assessment of the stability of cliff, pagodas and steep slopes will be undertaken as part of future Extraction Plans, when secondary extraction is proposed.

6.0 CONCLUDING REMARKS

The preceding stability analyses and associated subsidence estimates are consistent with previous findings. If anything, the current mine plan is associated with slightly lower subsidence magnitudes than originally envisaged. No surface impacts would be expected at these levels of subsidence.

Please contact me if you require anything further in this matter.

Kind Regards,

GOLDER ASSOCIATES PTY LTD

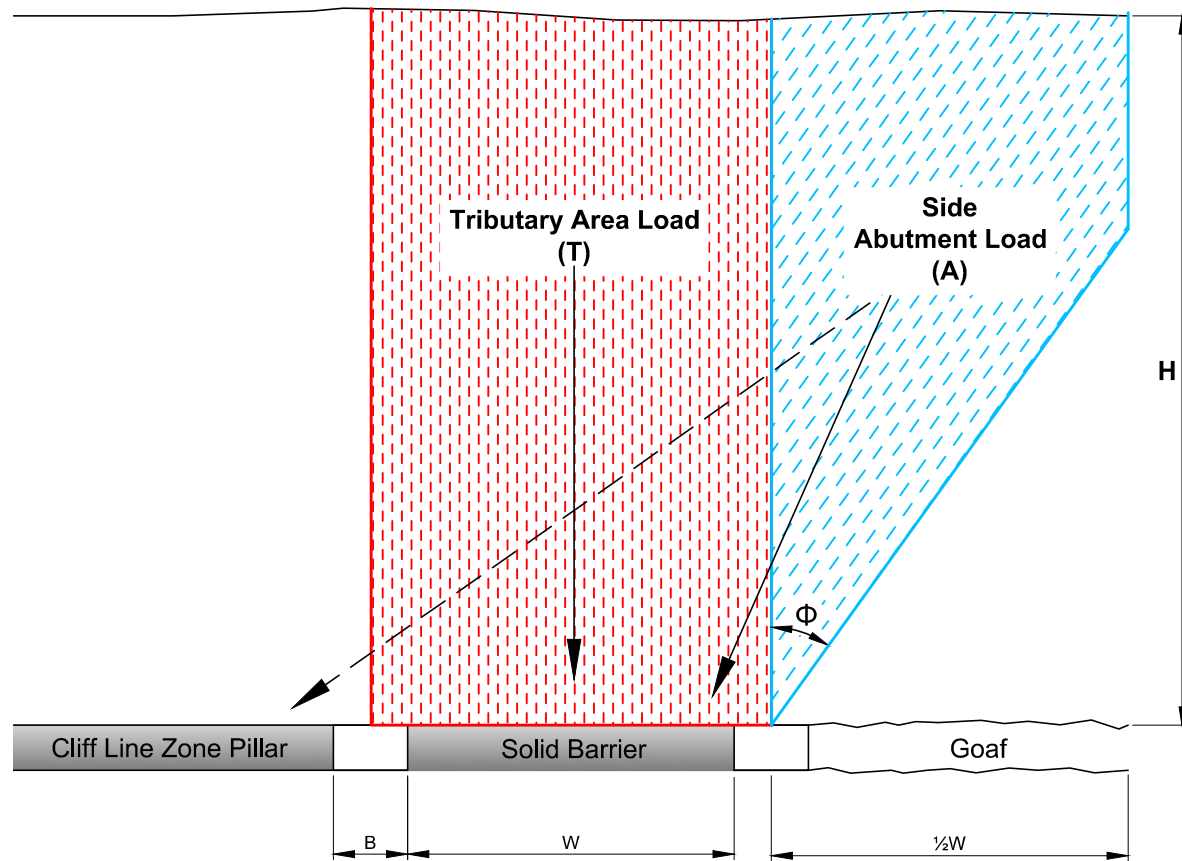


David Hill
Technical Director

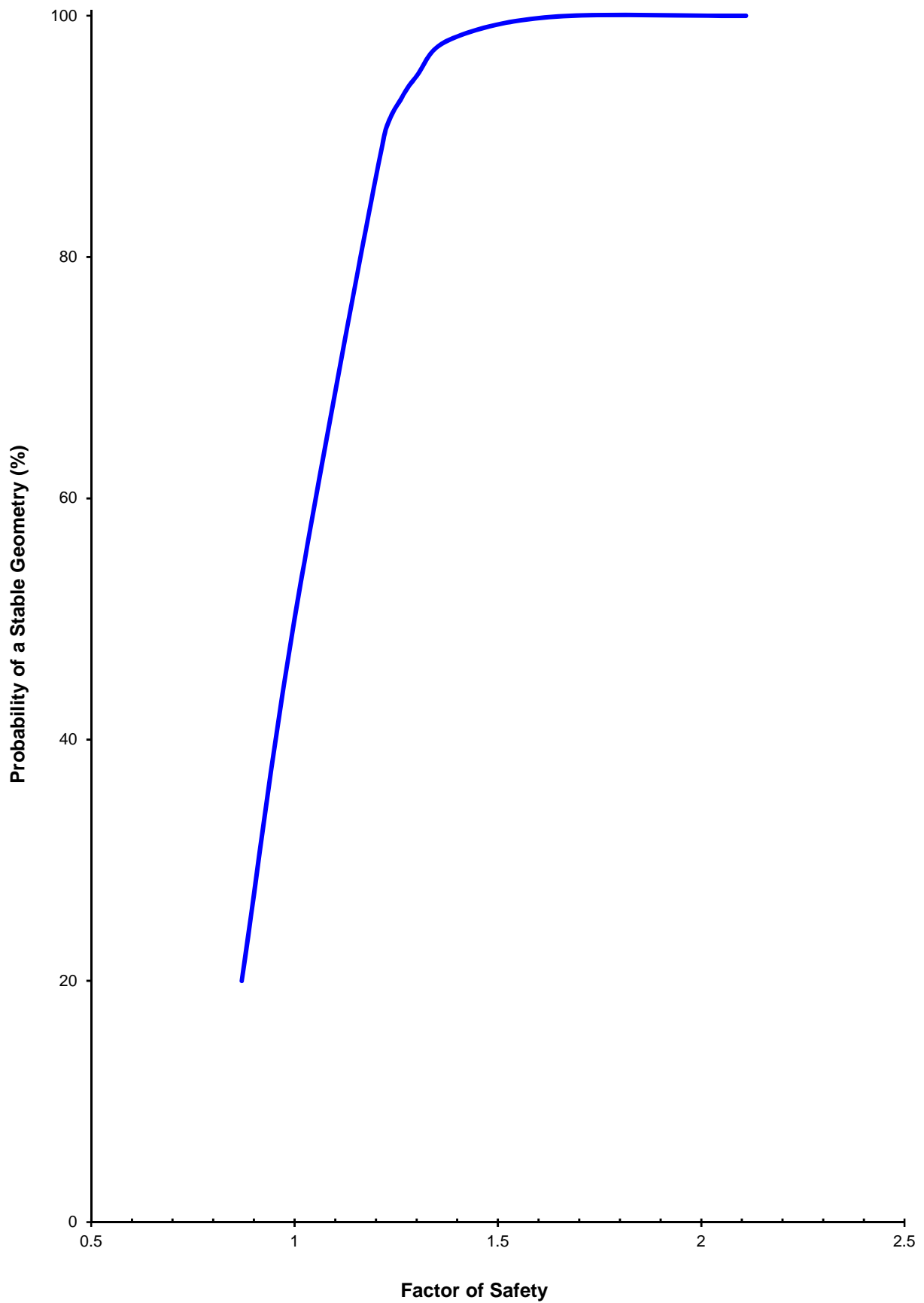
DH/RS/dh

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Engineer:	D. Hill	Client:	Airly Mine	
Drawn:	I. Saliamon	Title:	Loading Model for Sub-critical Panels ($H \tan \phi \geq 0.5W$)	
Date:	11.04.17			
GOLDER ASSOCIATES		Ref:	127621105-313-R	Revision No:
PTY. LTD.		Scale:	NTS	Figure No:
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	Engineer: D. Hill		Client: Airly Mine			
	Drawn: D. Hill		Title: Illustration of Nominal Pillar Design Reliability Based on the Probabilistic Relationship to Factor of Safety (Salamon <i>et al</i> , 1996)			
	Date: 13.04.2017					
	GOLDER ASSOCIATES PTY. LTD. www.golder.com		Ref: 127621105-313-R		Revision No:	1
			Scale: N/A		Figure No:	2

Figure 3a: UCS Test Results on Sandstone Samples (**Madden, 1987**)

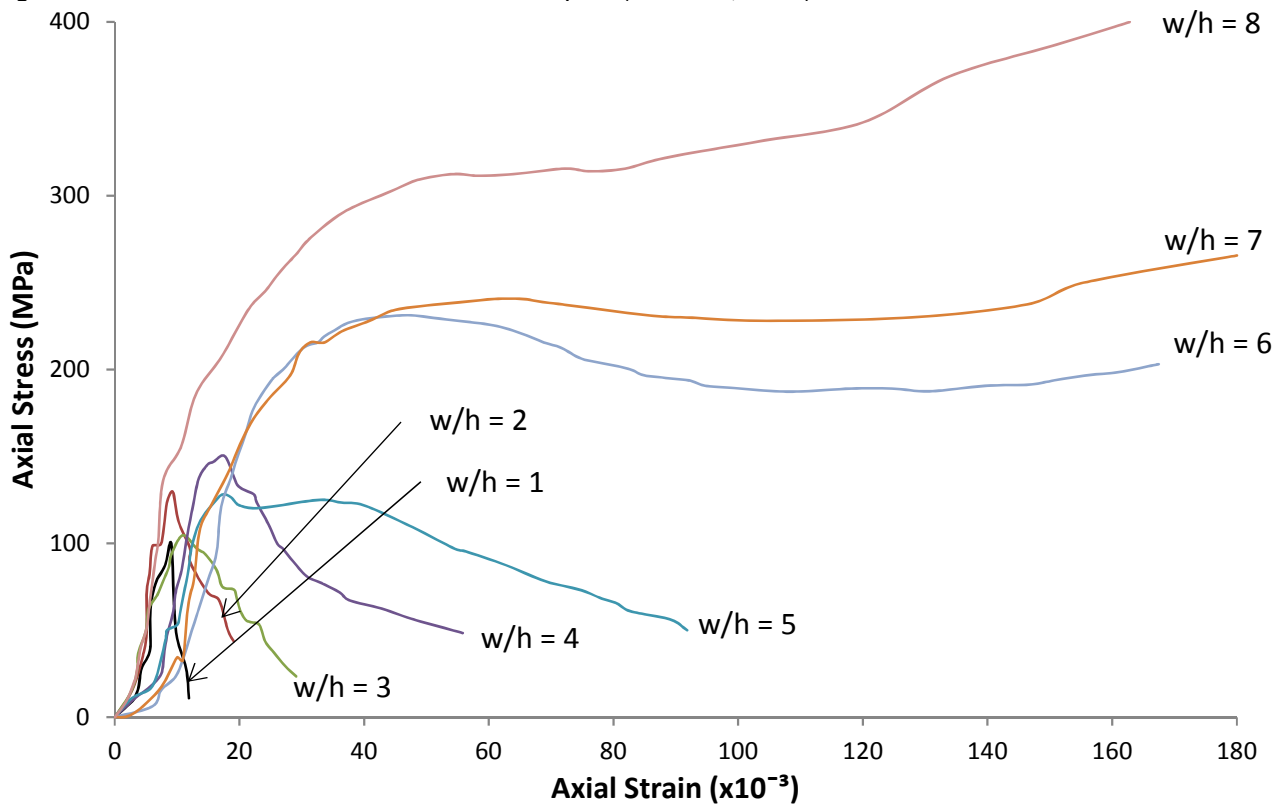
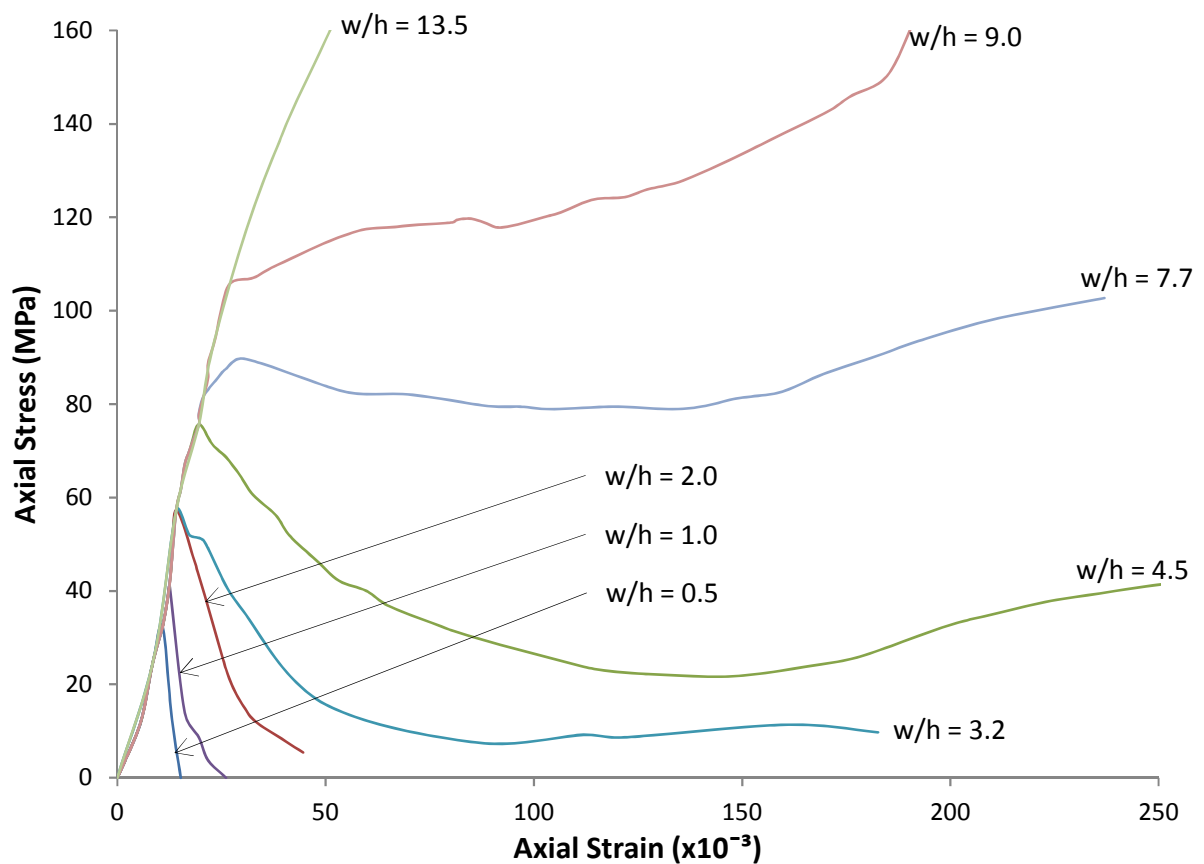
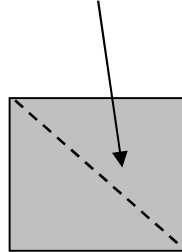


Figure 3b: UCS Test Results on Coal Samples (**Das, 1986**)



	Engineer:	D. Hill	Client:	Airly Mine			
	Drawn:	D. Hill	Title:	Laboratory Test Results on Sandstone and Coal Samples for a Range of Width to Height Ratios			
	Date:	13.04.2017	Ref:	127621105-313-R	Revision:	1	
	GOLDER ASSOCIATES PTY. LTD. www.golder.com			Scale:	N/A	Figure No:	
						3a/b	

45° joint impacts significantly
on structural competency of pillar



Width to Height Ratio = 1

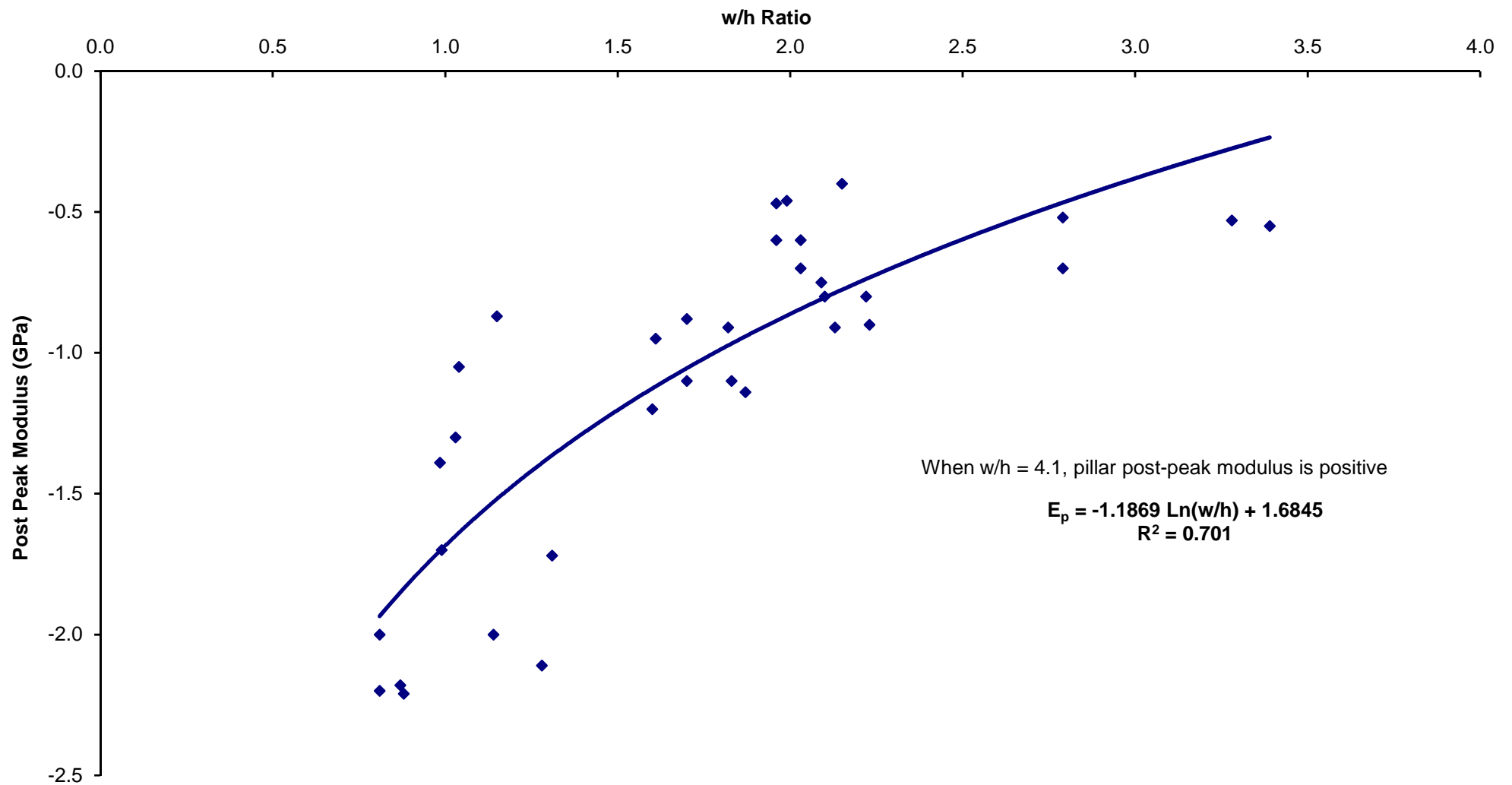
45° joint has minimal impact
on structural competency of pillar



Width to Height Ratio = 5



Engineer:	D. Hill	Client:	Airly Mine
Drawn:	D. Hill	Title:	Increasing Pillar Width to Height Ratio Reduces the Impact of Unfavourably Orientated Structure
Date:	13.04.2017		
GOLDER ASSOCIATES		Ref:	127621105-313-R
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Drawn: D. Hill

Date: 13.04.2017

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Client: Airly Mine

Title: Variation of Pillar Post-Failure Modulus with Increasing Width to Height Ratio

Ref: 127621105-313-R

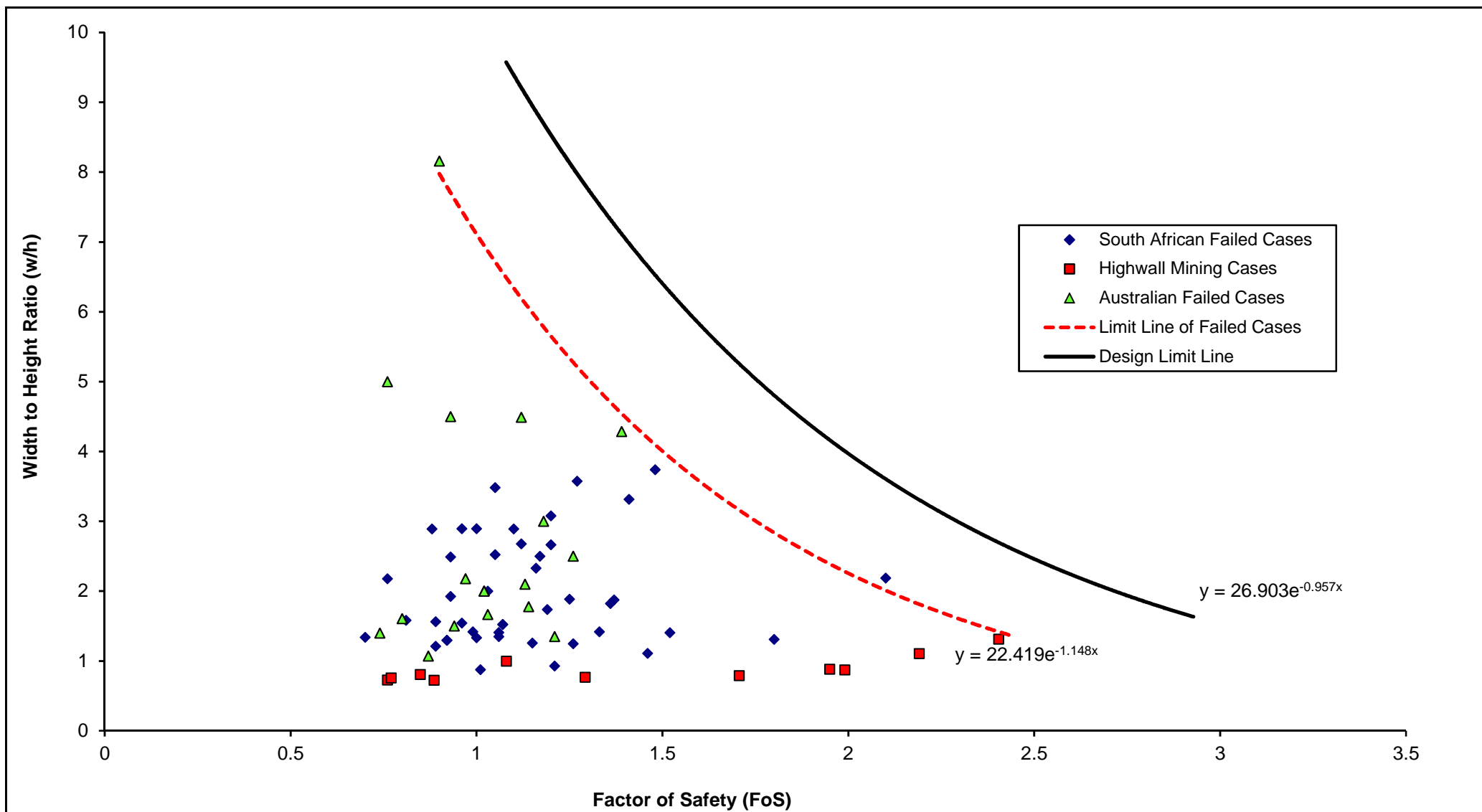
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Engineer: D. Hill

Drawn: D. Hill

Date: 13.04.2017

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Client: Airly Mine

Title: Database of South African and Australian Failed Pillar Cases, Limit and Design Envelopes

Ref: 127621105-313-R

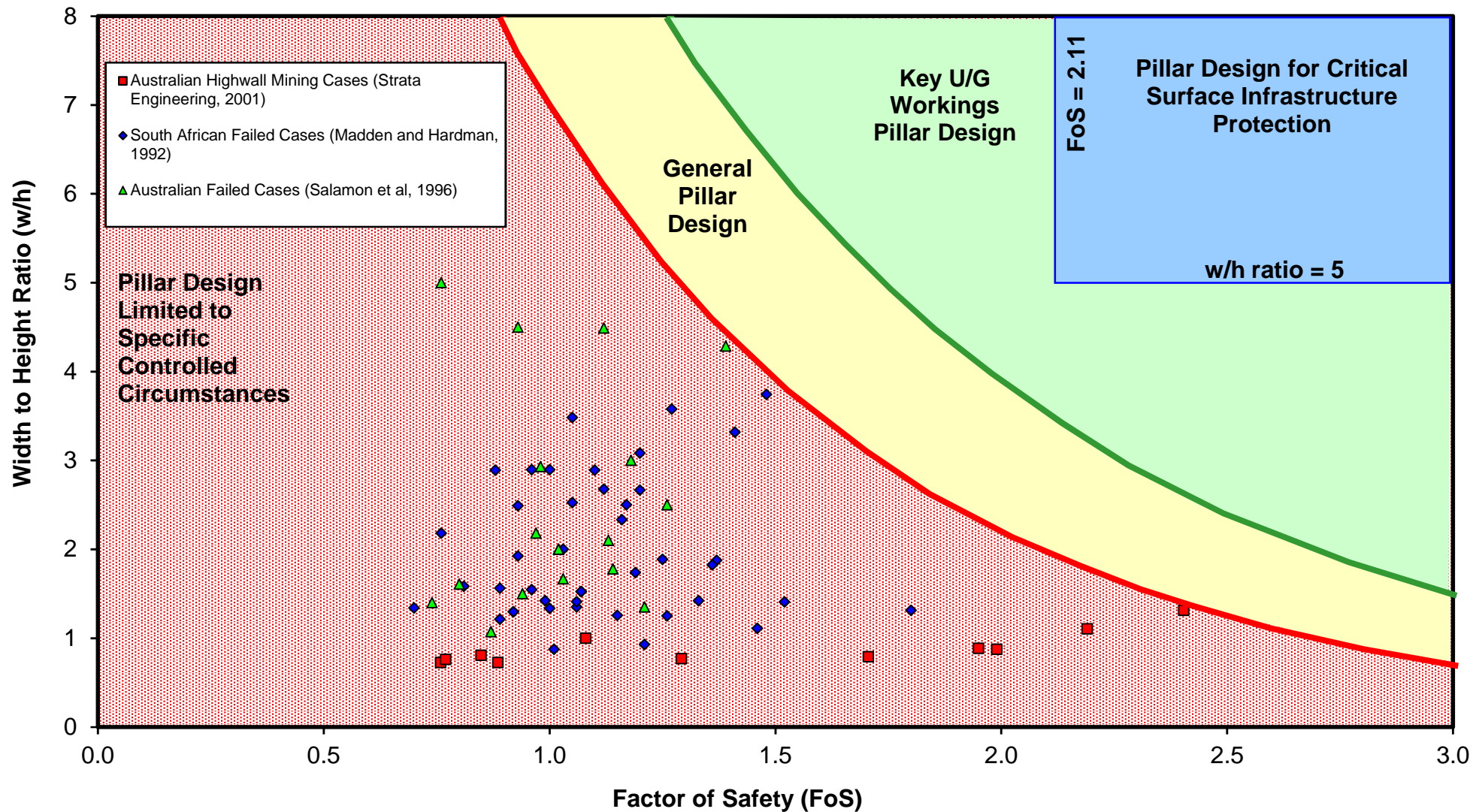
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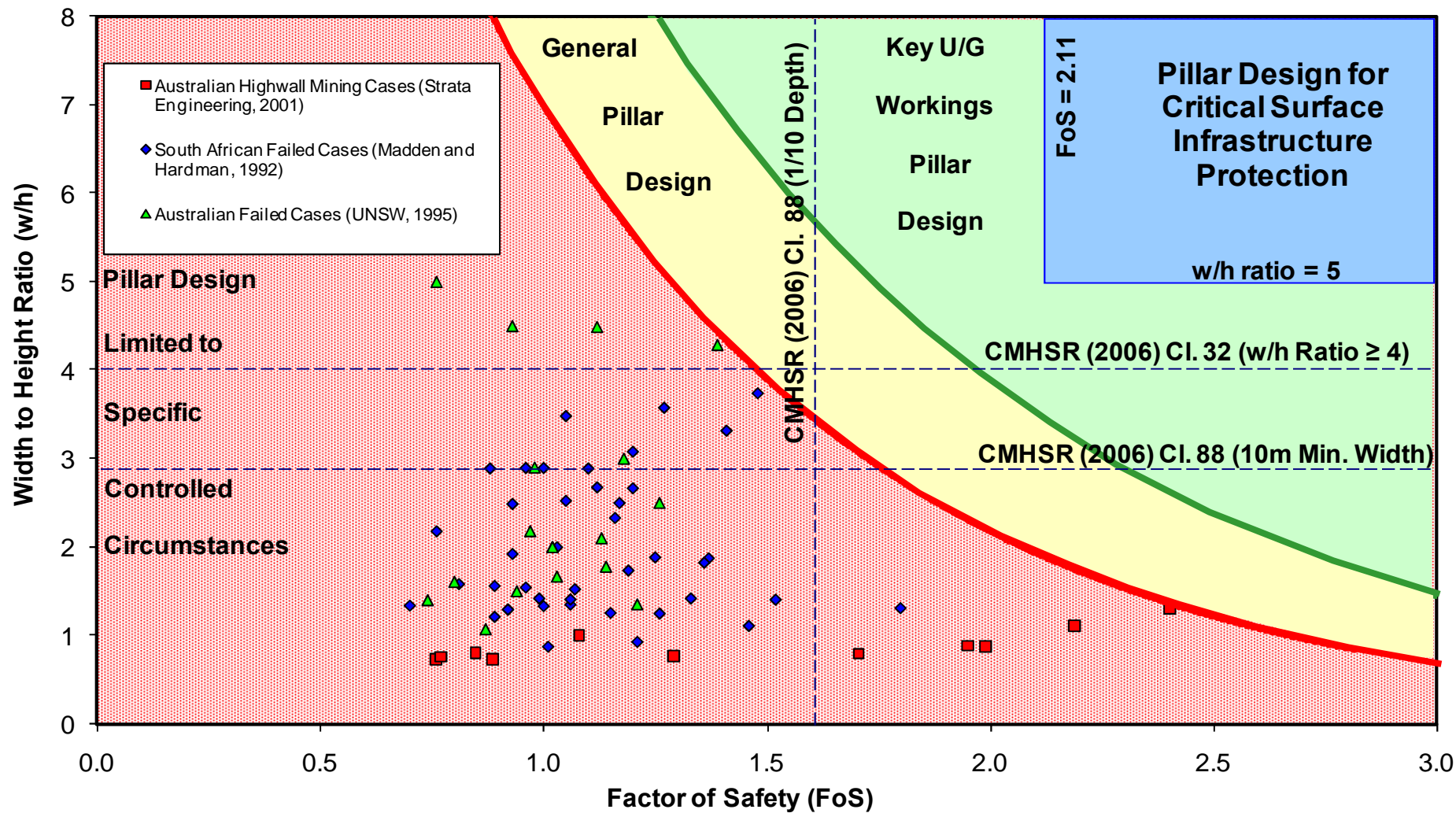
Engineer: D. Hill
Drawn: D. Hill
Date: 13.04.2017

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Title: Database of South African and Australian Failed Pillar Cases and Design Regimes

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Figure No: 7



Note: Clause 32 was subsequently rescinded in the updated legislation (WHS Regulation 2014)



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Date: 13.04.2017

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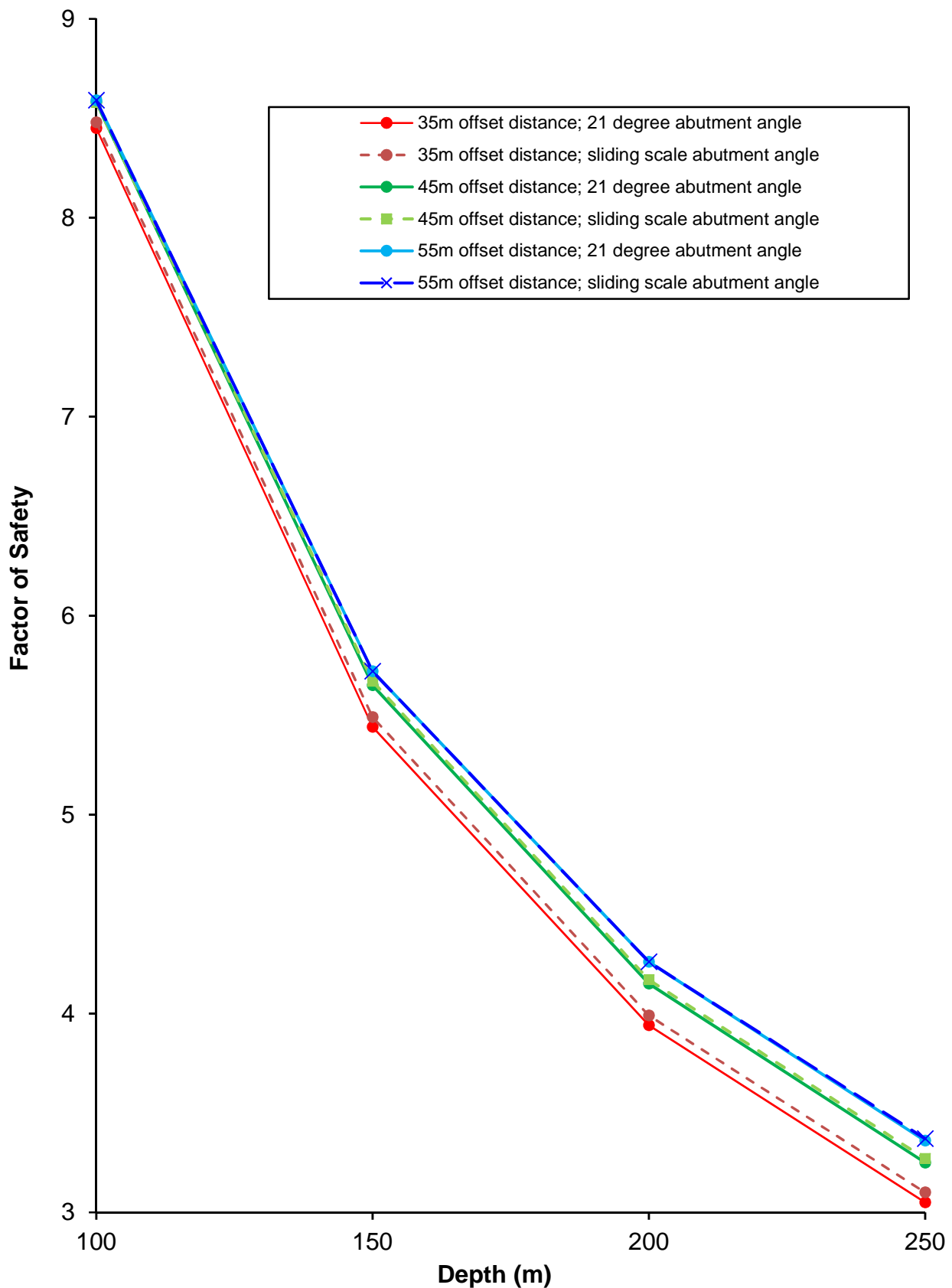
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Ref: 127621105-313-R

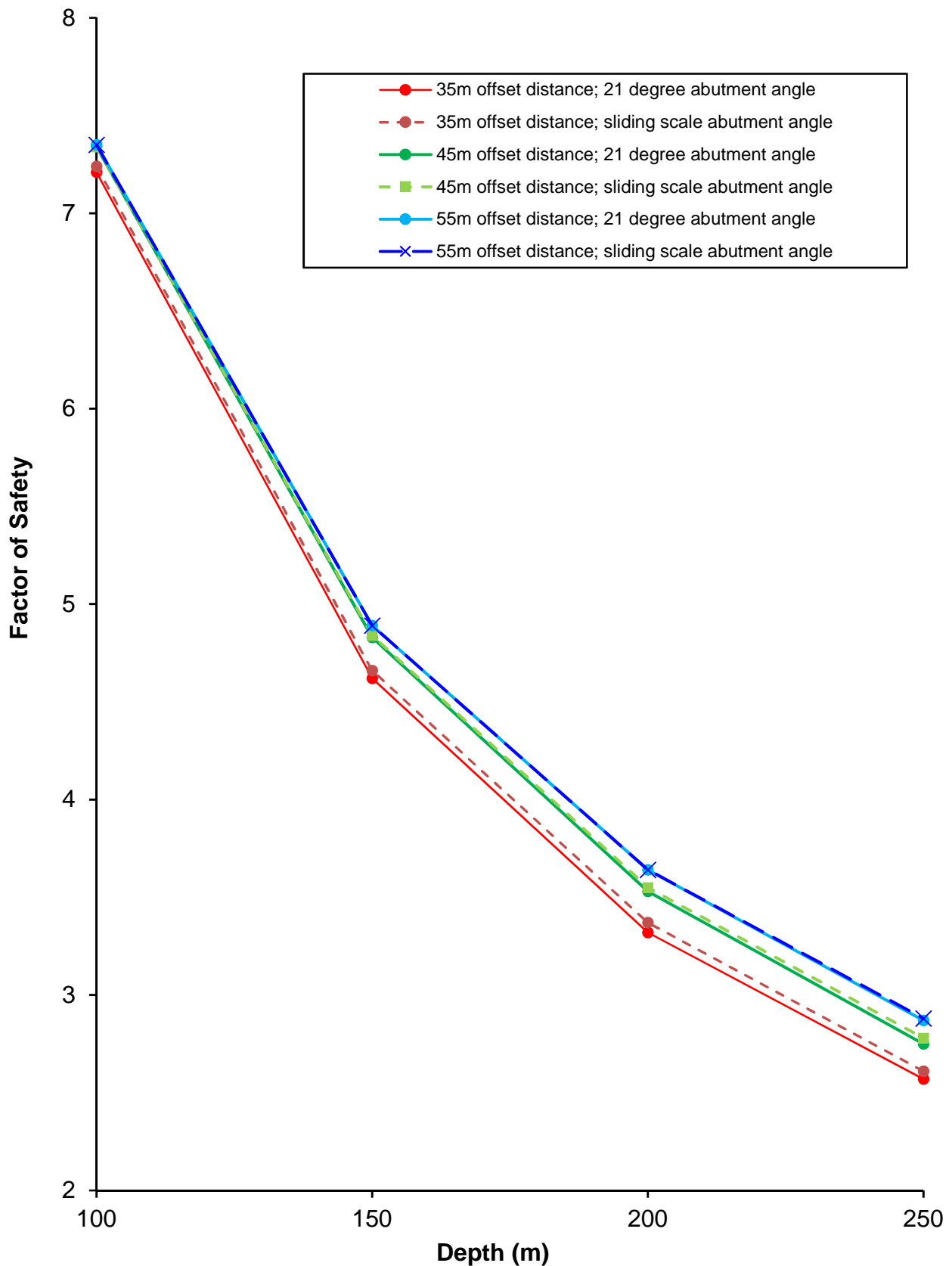
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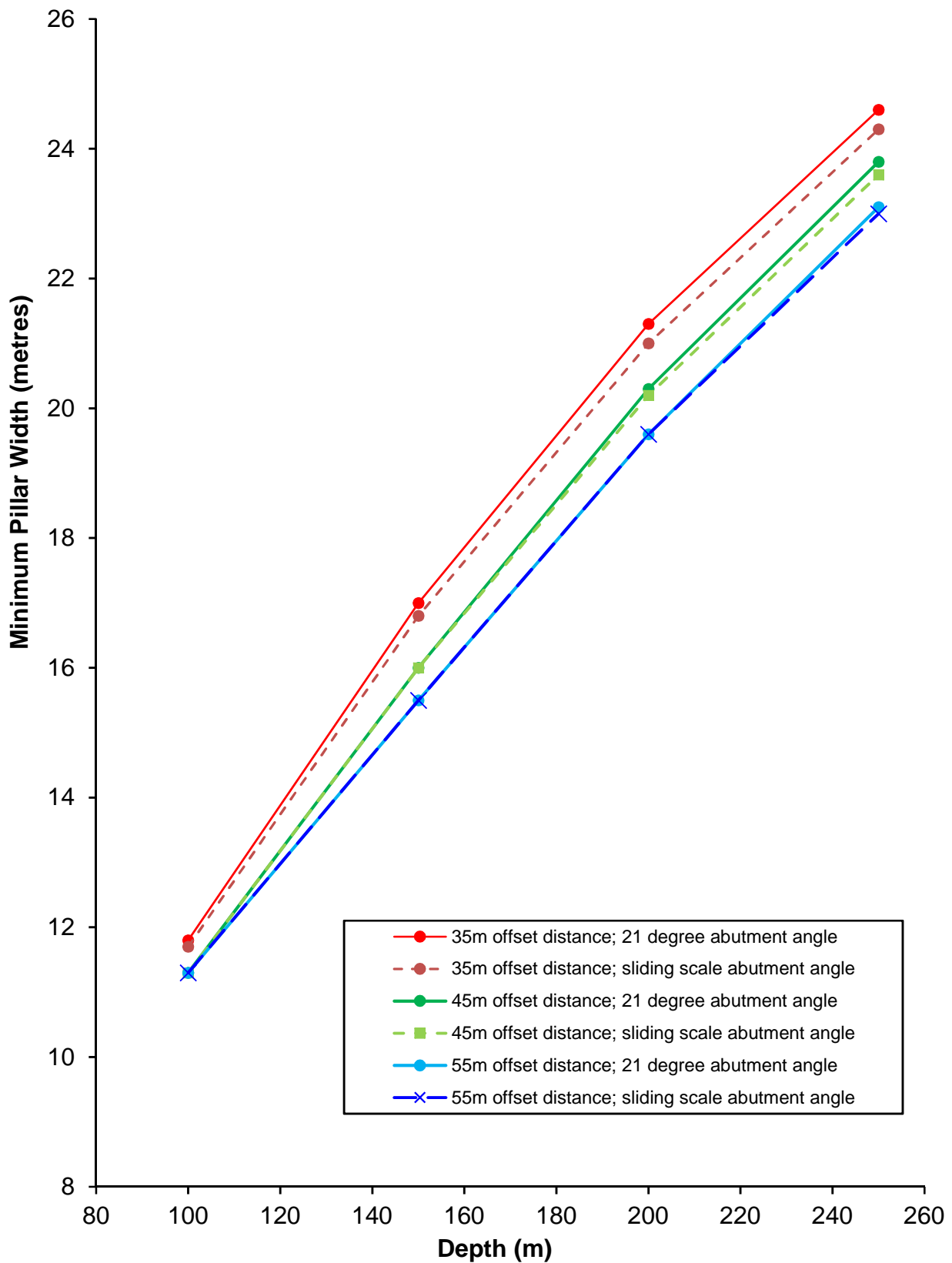
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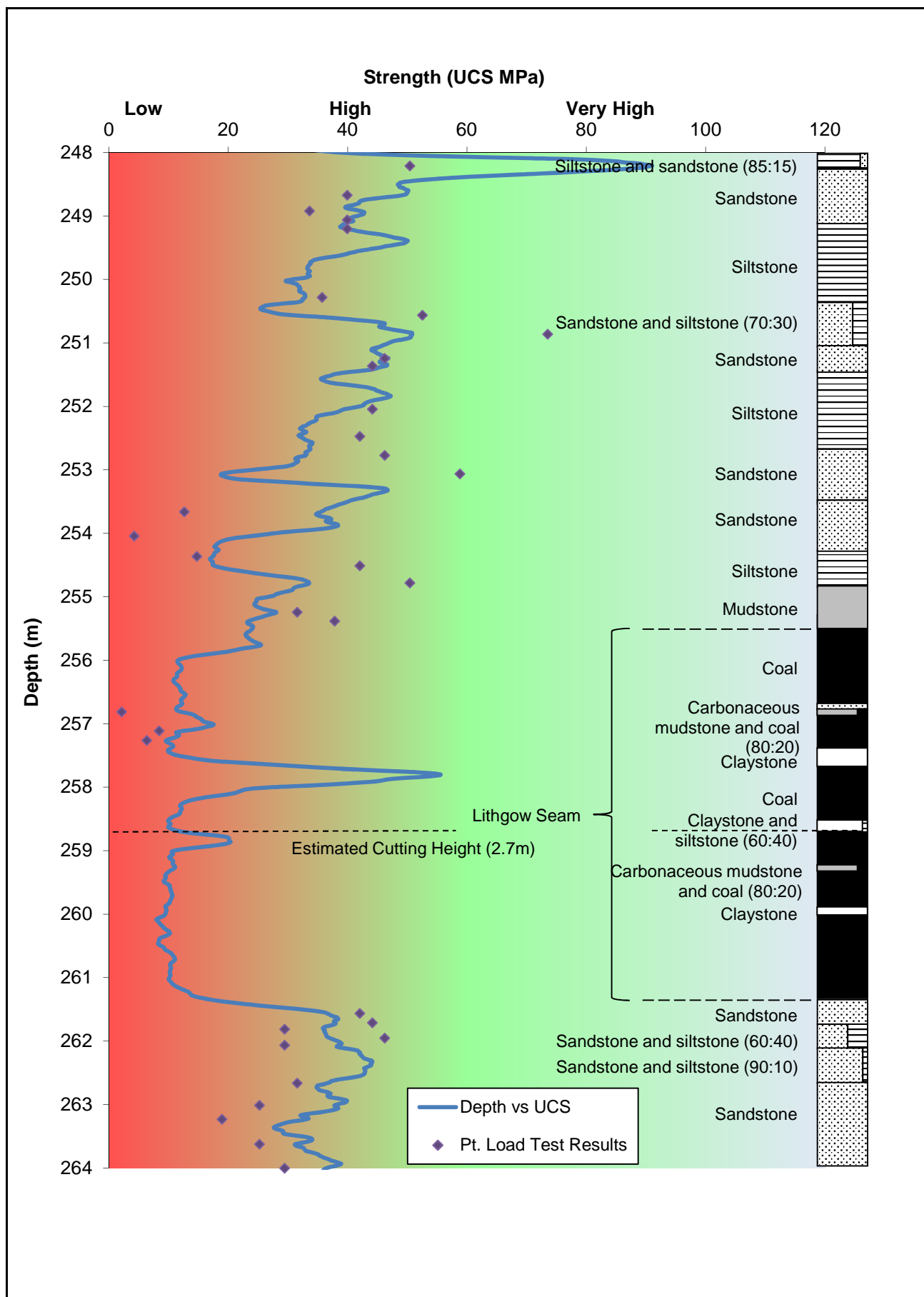
	Engineer:	D. Hill	Client: Airly Mine		
	Drawn:	D. Hill	Title: Cliff Line Zone Pillar Geometry 'A' (35m Square Centres): Factor of Safety versus Depth of Cover Relationship		
	Date:	13.04.2017			
	GOLDER ASSOCIATES PTY. LTD.		Ref:	127621105-313-R	Revision No: 1
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	Engineer:	D. Hill	Client:	Airly Mine		
	Drawn:	D. Hill	Title:	Cliff Line Zone Pillar Geometry 'B' (30m by 45m Centres): Factor of Safety versus Depth of Cover Relationship		
	Date:	13.04.2017	Ref:	127621105-313-R	Revision No:	1
	GOLDER ASSOCIATES PTY. LTD. www.golder.com		Scale:	N/A	Figure No:	10



	Engineer:	D. Hill	Client: Airly Mine		
	Drawn:	D. Hill	Title: Cliff Line Zone Potential Smaller Pillars: Minimum Pillar Width versus Depth of Cover Relationship		
	Date:	13.04.2017			
	GOLDER ASSOCIATES PTY. LTD.		Ref:	127621105-313-R	Revision No: 1
	www.golder.com		Scale:	N/A	Figure No: 11



	Engineer:	D. Hill	Client:	Airly Mine		
	Drawn:	D. Hill	Title:	Sonic-Derived UCS Profile for the Lithgow Seam		
	Date:	13.04.2017		Horizon (Borehole ARP 01)		
	GOLDER ASSOCIATES					
	PTY. LTD.		Ref:	127621105-313-R	Revision No:	1
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Appendix 7:

Development Consent (SSD_5581) and Mining Lease ML1331

Development Consent

Section 89E of the *Environmental Planning & Assessment Act 1979*

As delegate of the Minister for Planning, the Planning Assessment Commission of NSW approves the development application referred to in Schedule 1, subject to the conditions in Schedules 2 to 6.

These conditions are required to:

- prevent, minimise, and/or offset adverse environmental impacts;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the development.



Ms Robyn Kruk AM
Member of the Commission



Dr Maurice Evans
Member of the Commission



Mr David Johnson
Member of the Commission

Sydney

15 December 2016

SCHEDULE 1

Application Number:	SSD_5581
Applicant:	Centennial Airly Pty Limited
Consent Authority:	Minister for Planning
Land:	See Appendix 1
Development:	Airly Mine Extension Project

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DEFINITIONS

Adaptive management	Adaptive management includes monitoring subsidence effects and impacts and, based on the results, modifying the mining plan as mining proceeds to ensure that the effects, impacts and/or associated environmental consequences remain within predicted and/or designated ranges and in compliance with the conditions of this consent
Annual review	The review required by condition 13 of Schedule 6
Applicant	Centennial Airly Pty Limited, or any other person/s who rely on this consent to carry out the development
ANZECC guidelines	Australian and New Zealand guidelines for fresh and marine water quality (2000), or their latest version
BCA	Building Code of Australia
Built features	Includes any building or work erected or constructed on land, and includes dwellings and infrastructure such as any formed road, street, path, walk or driveway; pipeline; water, sewer, telephone, gas or other service main
CCC	Community Consultative Committee
Cliff	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°)
Cliff Line Zone and Zone of First Workings	The area of proposed mining shown in Figure 2 in Appendix 3, as may be modified by an approved Extraction Plan
CHPP	Coal Handling and Preparation Plant
Conditions of this consent	Conditions contained in Schedules 2 to 6 inclusive
Construction	The demolition of buildings or works, carrying out of works and erection of buildings covered by this consent
Council	Lithgow City Council
Date of commencement	The date notified to the Department by the Applicant under condition 9 of Schedule 2
Day	The period from 7am to 6pm on Monday to Saturday, and 8am to 6pm on Sundays and Public Holidays
Department	Department of Planning and Environment
Deputy Secretary, Resources and Energy	Deputy Secretary, Resources and Energy within the Department of Trade & Investment, Regional Infrastructure & Services, or the equivalent role
Development	The development described in the EIS
DoE	The Australian Government department administering the EPBC Act
DPI	Department of Primary Industries
DPI Water	Department of Primary Industries Water
DRE	Division of Resources and Energy, within the Department of Trade & Investment, Regional Infrastructure & Services
DSC	Dams Safety Committee
EEC	Endangered ecological community, as defined under the <i>Threatened Species Conservation Act 1995</i>
EIS	The environmental impact statement titled <i>Airly Mine Extension Project</i> , dated September 2014 and associated response to submissions titled <i>Airly Mine Extension Project</i> , dated February 2015, including the supplementary information comprising water licensing requirements letter dated 6 March 2015, noise assessment letter dated 10 March 2015, MSEC peer review report dated 18 March 2015, revised economic impact assessment dated March 2015, ecotoxicology assessment dated March 2015, supplementary letters and attachments dated 15 April 2015, 8 May 2015 and 18 June 2015, and Centennial's responses to the IPRP's Report in letters dated 8 July and 19 July 2016
Environmental consequences	The environmental consequences of subsidence impacts, including damage to built features; loss of surface water flows to the subsurface; loss of standing pools in watercourses; adverse water quality impacts; cliff falls; rock falls; damage to Aboriginal heritage sites; impacts on terrestrial or aquatic ecology; and ponding
EPA	Environment Protection Authority, or its successor
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPL	Environment Protection Licence issued under the POEO Act
Evening	The period from 6pm to 10pm
Exploration activities	Prospecting Operations, as defined under the <i>Mining Act 1992</i>
Feasible	Feasible relates to engineering considerations and what is practical to build or implement

First workings	The extraction of coal by bord and pillar mining methods and from main headings and the like (but not including pillar splitting or quartering)
GDE	Groundwater Dependent Ecosystems
Heritage item	An item as defined under the <i>Heritage Act 1977</i> and/or an Aboriginal Object or Aboriginal Place as defined under the <i>National Parks and Wildlife Act 1974</i>
Incident	A set of circumstances that: <ul style="list-style-type: none"> • causes or threatens to cause material harm to the environment; and/or • breaches or exceeds the limits or performance measures/criteria in this consent
IEP	Independent Expert Panel to be established and operated by the Department, which must be comprised of suitably qualified, experienced and independent experts with expertise in the assessment, monitoring and management of subsidence-related impacts on cliff lines, pagodas and steep slopes, to the satisfaction of the Secretary
IPRP's Report	<i>Report of the Independent Review Panel established to review and report on accuracy and reliability of mine subsidence impacts on sensitive features across the Airlie mine extension project application area, dated 1 July 2016</i>
Land	As defined in the EP&A Act, except for where the term is used in the noise and air quality conditions in Schedule 4 of this consent where it is defined to mean the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at the Land Titles Office at the date of this consent
Material harm to the environment	Actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial
Mining operations	Includes the extraction, processing, handling, storage and transportation of coal carried out on the site
Minister	Minister for Planning, or delegate
Minor cliff	A continuous rock face, including overhangs, which has a: <ul style="list-style-type: none"> • minimum length of 20 metres and a height between 5 metres and 10 metres; and • minimum slope of 2 to 1 (> 63.4°)
Mitigation	Activities associated with reducing the impacts of the development
MSB	Mine Subsidence Board
Negligible	Small and unimportant, such as to be not worth considering
New Hartley interaction zone	The area of proposed mining which may interact with the former workings of the New Hartley mine complex identified as the New Hartley Shale mine potential interaction zone in Figure 2 in Appendix 3, as may be modified by an approved Extraction Plan
Night	The period from 10pm to 7am on Monday to Saturday, and 10pm to 8am on Sundays and Public Holidays
NPWS	National Parks and Wildlife Service
OEHL	Office of Environment and Heritage
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
Pagodas	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
Panel and Pillar Mining Zone	The area of proposed mining shown in Figure 2 in Appendix 3, as may be modified by an approved Extraction Plan
Partial Pillar Extraction Zone	The area of proposed mining shown in Figure 2 in Appendix 3, as may be modified by an approved Extraction Plan
Privately-owned land	Land that is not owned by a public agency or a mining or petroleum company (or its subsidiary)
Public infrastructure	Linear and other infrastructure that provides services to the general public, such as roads, railways, water supply, drainage, sewerage, gas supply, electricity, telephone, telecommunications, etc
Reasonable	Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, costs of mitigation versus benefits provided, community views and the nature and extent of potential improvements
Reasonable costs	The costs agreed between the Department and the Applicant for obtaining independent experts to review the adequacy of any aspects of the extraction plan, or where such costs cannot be agreed, the costs determined by a dispute resolution process
Rehabilitation	The restoration of land disturbed by the development to a good condition, to ensure it is safe, stable and non-polluting
Remediation	Activities associated with partially or fully repairing or rehabilitating the impacts of the development or controlling the environmental consequences of this impact
RMS	Roads and Maritime Service
ROM	Run-of-mine

Safe, serviceable & repairable	Safe means no danger to users who are present, serviceable means available for its intended use, and repairable means damaged components can be repaired economically
Second workings	The extraction of coal by pillar extraction methods (including panel and pillar mining, single and double-sided lifting, and pillar splitting and quartering) except where remnant pillars are designed to be long-term stable and non-subsiding (ie leading to < 20 mm subsidence at the surface)
Secretary	Secretary of the Department, or any person authorised to act on their behalf
Site	All land to which the development application applies as listed in Appendix 1 and shown in Appendix 2
Steep slope	An area of land having a gradient between 1 in 3 (33% or 18.3°) and 2 in 1 (200% or 63.4°)
Subsidence	The totality of subsidence effects, subsidence impacts and environmental consequences of subsidence impacts
Subsidence effects	Deformation of the ground mass due to mining, including all mining induced ground movements, such as vertical and horizontal displacement, tilt, strain and curvature
Subsidence impacts	Physical changes to the ground and its surface caused by subsidence effects, including tensile and shear cracking of the rock mass, localised buckling of strata caused by valley closure and upsidence and surface depression or troughs.
TSC Act	<i>Threatened Species Conservation Act 1995</i>

SCHEDULE 2 ADMINISTRATIVE CONDITIONS

OBLIGATION TO MINIMISE HARM TO THE ENVIRONMENT

1. 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.

TERMS OF CONSENT

2. 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.

Note: The layout of the development is shown in Appendices 2, 3 and 10.
3. If there is any inconsistency between the documents in condition 2(a) above, the most recent document shall prevail to the extent of the inconsistency. However, the conditions of this consent shall prevail to the extent of any inconsistency.
4. The Applicant must comply with any reasonable requirement/s of the Secretary arising from the Department's assessment of:
 - (a) any strategies, plans, programs, reviews, audits, reports or correspondence that are submitted in accordance with this consent (including any stages of these documents);
 - (b) any reviews, reports or audits undertaken or commissioned by the Department regarding compliance with this consent; and
 - (c) the implementation of any actions or measures contained in these documents.

LIMITS ON CONSENT

Mining Operations

5. The Applicant may carry out mining operations on the site for a period of 20 years from the date of commencement.

Note: Under this consent, the Applicant is required to rehabilitate the site and perform additional undertakings to the satisfaction of both the Secretary and DRE. Consequently, this consent will continue to apply in all other respects other than the right to conduct mining operations until the rehabilitation of the site and these additional undertakings have been carried out satisfactorily.

Coal Extraction

6. The Applicant must not extract more than 1.8 million tonnes of ROM coal from the site in any calendar year.

Hours of Operation

7. The Applicant may undertake mining operations 24 hours a day, 7 days a week.

Coal Transport

8. The Applicant must ensure that:
 - (a) all product coal is transported from the site by rail;
 - (b) no more than an average of 2 laden trains leave the site each day over any calendar year; and
 - (c) no more than 5 laden trains leave the site on any day.

NOTIFICATION OF COMMENCEMENT

9. Prior to commencing any development under this consent, the Applicant must notify the Department in writing of the date on which it will commence the development permitted under this consent.

SURRENDER OF EXISTING DEVELOPMENT CONSENTS

10. Within 12 months of the date of commencement, unless the Secretary agrees otherwise, the Applicant must surrender the existing development consent DA162/91 (as modified) in accordance with clause 97(1) of the EP&A Regulation, to the satisfaction of the Secretary.

Following the commencement of development under this consent, the conditions of this consent must prevail to the extent of any inconsistency with the conditions of those consents and approvals.

Note: This requirement does not extend to the surrender of construction and occupation certificates for existing and proposed building works under Part 4A of the EP&A Act. Surrender of a consent should not be understood as implying that works legally constructed under a valid consent can no longer be legally maintained or used.

STRUCTURAL ADEQUACY

11. The Applicant must ensure that all new buildings and structures, and any alterations or additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the BCA.

Note: Under Part 4A of the EP&A Act, the Applicant is required to obtain construction and occupation certificates (where applicable) for the proposed building works. Part 8 of the EP&A Regulation sets out the requirements for the certification of the development.

DEMOLITION

12. The Applicant must ensure that all demolition work is carried out in accordance with *Australian Standard AS 2601-2001: The Demolition of Structures*, or its latest version.

PROTECTION OF PUBLIC INFRASTRUCTURE

13. Unless the Applicant and the applicable authority agree otherwise, the Applicant must:
 - (a) repair, or pay the full costs associated with repairing, any public infrastructure that is damaged by the development; and
 - (b) relocate, or pay the full costs associated with relocating, any public infrastructure that needs to be relocated as a result of the development.

Note: This condition does not apply to damage to roads caused as a result of general road usage.

OPERATION OF PLANT AND EQUIPMENT

14. The Applicant must ensure that all plant and equipment used on site, or to monitor the performance of the development is:
 - (a) maintained in a proper and efficient condition; and
 - (b) operated in a proper and efficient manner.

COMMUNITY ENHANCEMENT

15. From the date of commencement, the Applicant must pay a community contribution to LCC of \$0.03 per saleable tonne of coal produced at Airly mine capped at a maximum payment of \$200,000 in total from the Springvale, Angus Place and Airly mines (ie for all 3 mines collectively). The community contribution is to be paid on an annual basis to LCC and no later than 31 March each year (for the preceding calendar year). The contribution must be used for long-term community activities and projects to be agreed by both the Applicant and LCC and must be reported publicly.
-

SCHEDULE 3 SPECIFIC ENVIRONMENTAL CONDITIONS – UNDERGROUND MINING

SUBSIDENCE

Restrictions on Mining

1. The Applicant must not:
 - (a) carry out any second workings in the Panel and Pillar Zone or the Partial Pillar Extraction Zone that are within an angle of draw 26.5 degrees of the Cliff Line Zone and Zone of First Workings before it has completed mining in at least four adjacent extraction panels in the Panel and Pillar Zone beneath Mt Airly; or
 - (b) carry out any second workings within an angle of draw 26.5 degrees plus 50 metres from the New Hartley Shale Mine Potential Interaction Zone.

Note: For more detail on the zones referred to in this condition, see the Figure 2 in Appendix 3.

Performance Measures – Natural and Heritage Features, etc

2. The Applicant must ensure that the development does not cause any exceedances of the performance measures in Table 1 to the satisfaction of the Secretary.

Table 1: Subsidence Impact Performance Measures – Natural and Heritage Features, etc

Water Resources	Performance Measure
Gap and Genowlan Creeks	<ul style="list-style-type: none"> Wherever depth of cover is < 40 m, no first or second workings within 20 m of the edge of the creek bed, measured horizontally in the seam 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)
All other watercourses	No greater subsidence impacts or environmental consequences than predicted in the EIS
Land	
The Grotto	Negligible subsidence impacts or environmental consequences
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>ie 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
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)	No greater subsidence impacts or environmental consequences than predicted in the EIS (<i>ie 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 pagodas
Pagodas within a 26.5 degree angle of draw of the New Hartley interaction zone	No greater subsidence impacts or environmental consequences than predicted in the EIS
Minor cliffs	No greater subsidence impacts or environmental consequences than predicted in the EIS
Steep slopes	No greater subsidence impacts or environmental consequences than predicted in the EIS
All other land not covered by a performance measure above	No greater subsidence impacts or environmental consequences than predicted in the EIS
Biodiversity	
Threatened species, threatened populations, EECs and groundwater dependent ecosystems (with the exception of those listed below)	Negligible environmental consequences
<i>Pultenaea</i> sp. Genowlan Point population and Genowlan Point <i>Allocasurina nana</i> Heathland community	No environmental consequences
Heritage sites	
Aboriginal heritage sites identified in Appendix 5	Negligible environmental consequences
Non-Aboriginal heritage sites identified in Appendix 6	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
Mine workings	
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
Second workings	To be carried out only in accordance with an approved Extraction Plan

Notes:

- These performance measures apply to all mining taking place after the date of this consent.
- The Applicant will be required to define more detailed performance indicators (including impact assessment criteria) for each of these performance measures in the various management plans that are required under this consent (see condition 5 below).
- Measurement and/or monitoring of compliance with performance measures and performance indicators is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.

Performance Measures – Built Features

- The Applicant must ensure that the development does not cause any exceedances of the performance measures in Table 2 to the satisfaction of the Secretary.

Table 2: Subsidence Impact Performance Measures – Built Features

Built Features	Performance Measures
Emergency services communication tower and associated sheds and infrastructure	<ul style="list-style-type: none"> • Always safe and serviceable • Damage must be fully repairable, and must be fully repaired
State survey mark at Genowlan Trig Station, Telstra copper cable and Nissen Hut and outbuilding	<ul style="list-style-type: none"> • Always safe and serviceable, unless otherwise agreed with the owner • Damage must be fully repairable, and must be fully repaired
“Stone Cottage”	<ul style="list-style-type: none"> • No second workings to occur within a setback distance defined by half the depth of cover from the building, measured horizontally in the seam, unless otherwise agreed with the owner • Always safe and serviceable, unless otherwise agreed with the owner • Damage must be fully repairable, and must be fully repaired, unless otherwise agreed with the owner
Other built features and improvements including Airlay Camp Ground, walking and 4WD tracks, fences and gates	<ul style="list-style-type: none"> • Use should be maintained wherever practicable in consultation with OEH • Damage must be fully repairable and must be fully repaired
Public Safety	
Public safety	Negligible additional risk, in consultation with DRE and OEH

Notes:

- These performance measures apply to all mining taking place after the date of this consent.
- The Applicant will be required to define more detailed performance indicators for each of these performance measures in the Built Features Management Plans or Public Safety Management Plan (see condition 5 below).
- Measurement and/or monitoring of compliance with performance measures and performance indicators is to be undertaken using generally accepted methods that are appropriate to the environment and circumstances in which the feature or characteristic is located. These methods are to be fully described in the relevant management plans. In the event of a dispute over the appropriateness of proposed methods, the Secretary will be the final arbiter.
- Requirements regarding safety or serviceability do not prevent preventative or mitigatory actions being taken prior to or during mining in order to achieve or maintain these outcomes.

- Any dispute between the Applicant and the owner of any built features over the interpretation, application or implementation of the performance measures in Table 2 is to be settled by the Secretary, following consultation with DRE. Any decision by the Secretary shall be final and not subject to further dispute resolution under this consent.

Independent Review and Monitoring Panel

5. The Applicant must pay all costs incurred by the Department to establish and operate an IEP for the development.

First Workings

6. With the exception of first workings in the Cliff Line Zone and Zone of First Workings, the Applicant may carry out first workings within the underground mining area, other than in accordance with an approved Extraction Plan, provided that DRE is satisfied that the first workings are designed to remain stable and non-subsiding in the long-term, except insofar as they may be impacted by approved second workings.

Note: The intent of this condition is not to require an additional approval for first workings, but to ensure that first workings are built to geotechnical and engineering standards sufficient to ensure long term stability, with negligible resulting direct subsidence impacts.

Extraction Plan

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:
 - (a) be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the Secretary;
 - (b) provide a detailed justification for any proposed divergence from the advice of the IEP or DRE;
 - (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;
 - (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;
 - (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;
 - (f) provide an assessment of the likely stability of cliff lines, pagodas and steep slopes, in consultation with the IEP;
 - (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;
 - (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, and manage or remediate any impacts and/or environmental consequences to meet the rehabilitation objectives in condition 31 of Schedule 4, following consultation with the IEP;
 - (i) include a:
 - (i) *Subsidence Monitoring Program* which has been prepared in consultation with the IEP, DRE and OEH, 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;
 - (ii) *Built Features Management Plan* which has been prepared in consultation with DRE, to manage the potential subsidence impacts of the proposed underground workings on built features, and which:
 - has been prepared in consultation with the owner/s of potentially affected feature/s;
 - 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;
 - (iii) *Water Management Plan* which has been prepared in consultation with OEH and DPI Water, which provides for the management of potential 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;
 - surface water flows in Airly village spring and the Grotto;
 - groundwater levels, yield and quality in the region;
 - surface and groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse impacts on water resources or water 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 mining operations;
 - the height of groundwater depressurization;
 - background changes in groundwater yield/quality against mine-induced changes, in particular, on groundwater bore users;
 - permeability, hydraulic gradient, flow direction and connectivity of the deep and shallow groundwater aquifers;
 - a description of any adaptive management practices 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 monitoring results with modelled predictions; and
 - a plan to respond to any exceedances of the surface water and groundwater assessment criteria.
- (iv) *Biodiversity Management Plan* which has been prepared in consultation with DoE and OEH, 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);
- (v) *Land Management Plan* which has been prepared in consultation with the IEP, DRE, OEH 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;
- (vi) *Heritage Management Plan* which has been prepared in consultation with OEH 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 23 of Schedule 4;
- (vii) *Public Safety Management Plan* which has been prepared in consultation with the IEP, DRE and OEH to ensure public safety and manage access on the site;
- (viii) include Trigger Action Response Plans, or equivalent, to prevent greater than predicted subsidence impacts and environmental consequences that may result from mining subsidence;
- (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 any such exceedance appears likely;
- (x) proposes appropriate revisions to the Rehabilitation Management Plan required under condition 33 in Schedule 4; and
- (xi) include a program to collect sufficient baseline data for future Extraction Plans.

The Applicant must implement the approved Extraction Plan for the development.

Notes:

- *This condition does not apply to first or second workings which are covered by an Extraction Plan or Subsidence Management Plan approved, or under assessment as at the date of this development consent.*
- *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 management plans that are relevant to the specific underground workings that are being carried out.*
- *Due to the sensitive and rugged terrain of the Mugii Murum-ban State Conservation Area, the Applicant may propose remote subsidence monitoring techniques.*

PAYMENT OF REASONABLE COSTS

8. The Applicant must pay all reasonable costs incurred by the Department to engage suitably qualified, experienced and independent experts to review the adequacy of any aspect of an Extraction Plan.

SCHEDULE 4 ENVIRONMENTAL PERFORMANCE CONDITIONS – GENERAL

NOISE

Hours of Operation

- The Applicant must comply with the restrictions to operating hours in Table 3.

Table 3: Operating hours

Activity	Operating Hours
<ul style="list-style-type: none"> Construction Exploration and monitoring borehole drilling 	7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturdays.

Noise Criteria

- The Applicant must ensure that the noise generated by the development does not exceed the criteria in Table 4.

Table 4: Noise criteria dB(A)

Land	Day <i>L_{Aeq}(15 min)</i>	Evening <i>L_{Aeq}(15 min)</i>	Night <i>L_{Aeq}(15 min)</i>	Night <i>L_A (max)</i>
Any residence on privately-owned land	35	35	35	52
	<i>L_{Aeq} (period)</i>			
R17 (camp ground)	50 (when in use)			N/A
R18 (Nissen Hut)	50 (when in use)			N/A

Note: To interpret the locations referred to in Table 4 see the applicable figure(s) in Appendix 7.

Noise generated by the development is to be measured in accordance with the relevant requirements of the *NSW Industrial Noise Policy*. Appendix 8 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

However, these criteria do not apply if the Applicant has a negotiated agreement with the owner/s of the relevant residence or land to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

Operating Conditions

- The Applicant must:
 - minimise the construction, road and rail noise of the development;
 - minimise the noise impacts of the development during meteorological conditions under which the noise limits in this consent do not apply (see Appendix 8);
 - carry out monitoring to determine whether the development is complying with the relevant conditions of this consent,
to the satisfaction of the Secretary

Noise Management Plan

- Prior to carrying out any development under this consent, unless the Secretary agrees otherwise, the Applicant must prepare a Noise Management Plan for the development to the satisfaction of the Secretary. This plan must:
 - be prepared in consultation with the EPA;
 - describe the measures that would be implemented to ensure compliance with the noise criteria and operating conditions of this consent;
 - include a monitoring program that evaluates and reports on:
 - compliance against the noise criteria in this consent; and
 - compliance with the noise operating conditions in condition 3 above.

The Applicant must implement the approved Noise Management Plan for the development.

AIR QUALITY

Air Quality Criteria

5. The Applicant must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the development do not cause exceedances of the criteria in Table 5 at any residence on privately-owned land.

Table 5: Air quality criteria

Pollutant	Averaging Period	Criterion	
Particulate matter < 10 µm (PM ₁₀)	Annual	a,d 30 µg/m ³	
Particulate matter < 10 µm (PM ₁₀)	24 hour	a 50 µg/m ³	
Total suspended particulates (TSP)	Annual	a,d 90 µg/m ³	
^c Deposited dust	Annual	^b 2 g/m ² /month	a,d 4 g/m ² /month

Notes to Table 5:

a Cumulative impact (ie increase in concentrations due to the development plus background concentrations due to all other sources).

b Incremental impact (ie increase in concentrations due to the development alone, with zero allowable exceedances of the criteria over the life of the development).

c Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.

d Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Secretary.

e "Reasonable and feasible avoidance measures" includes, but is not limited to, the operational requirements in conditions 6 and 7 to develop and implement an air quality management system that ensures operational responses to the risks of exceedance of the criteria.

Operating Conditions

6. The Applicant must:
- implement all reasonable and feasible measures to minimise the:
 - odour, fume and dust emissions of the development; and
 - release of greenhouse gas emissions from the development;
 - minimise any visible air pollution generated by the development;
 - minimise the surface disturbance of the site generated by the development; and
 - minimise the air quality impacts of the development during adverse meteorological conditions and extraordinary events (see note d to Table 5 above), to the satisfaction of the Secretary.

Air Quality Management Plan

7. Prior to carrying out any development under this consent, unless the Secretary agrees otherwise, the Applicant must prepare an Air Quality Management Plan for the development to the satisfaction of the Secretary. This plan must:
- be prepared in consultation with the EPA;
 - describe all reasonable and feasible measures which would be implemented to ensure compliance with the air quality criteria and operating conditions of this consent;
 - describe the air quality management system in detail;
 - include an air quality monitoring program that:
 - uses monitors to evaluate the performance of the development against the air quality criteria in this consent;
 - adequately supports the air quality management system;
 - evaluates and reports on:
 - the effectiveness of the air quality management system; and
 - compliance with the air quality criteria and operating conditions in condition 6 above;
 - defines what constitutes an air quality incident, and includes a protocol for identifying and notifying the Department and relevant stakeholders of any air quality incidents.

The Applicant must implement the approved Air Quality Management Plan for the development.

METEOROLOGICAL MONITORING

10. Prior to commencement of development under this consent and for the life of the development, the Applicant must ensure that there is a meteorological station in the vicinity of the site that:
- (a) complies with the requirements in the *Approved Methods for Sampling of Air Pollutants in New South Wales* guideline and the *NSW Industrial Noise Policy*; and
 - (b) is capable of continuous real-time measurement of atmospheric stability category determined by the sigma theta method in accordance with the *NSW Industrial Noise Policy*.

WATER

Water Supply

11. The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations on site to match its available water supply.

Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain the necessary water licences for the development.

Water Pollution

12. Unless an EPL authorises otherwise, the Applicant must comply with Section 120 of the POEO Act.

Compensatory Water Supply

13. The Applicant must provide a compensatory water supply to the owner of any privately-owned land whose water supply is adversely and directly impacted (other than a negligible impact) as a result of the development, in consultation with DPI Water, and to the satisfaction of the Secretary.

The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent, in quality and volume, to the loss attributed to the development. Equivalent water supply should be provided (at least on an interim basis) within 24 hours of the loss being identified.

If the Applicant and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution.

If the Applicant is unable to provide an alternative long-term supply of water, then the Applicant must provide alternative compensation to the satisfaction of the Secretary.

Water Management Performance Measures

14. The Applicant must comply with the performance measures in Table 6 to the satisfaction of the Secretary.

Table 6: Water Management Performance Measures

Feature	Performance Measure
Water Management – General	<ul style="list-style-type: none">Minimise the use of clean water on siteMinimise the use of the supplementary water supply from the production bore
Construction and operation of linear infrastructure	<ul style="list-style-type: none">Design, install and maintain erosion and sediment controls generally in accordance with the series <i>Managing Urban Stormwater: Soils and Construction including Volume 1, Volume 2A – Installation of Services and Volume 2C – Unsealed Roads</i>Design, install and maintain infrastructure within 40 m of watercourses generally in accordance with the <i>Guidelines for Controlled Activities on Waterfront Land (July 2012)</i>, or its latest versionDesign, install and maintain creek crossings generally in accordance with <i>Policy and Guidelines for Fish Friendly Waterway Crossings (NSW Fisheries 2003)</i> and <i>Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries 2003)</i>, or their latest versions
Sediment dams	<ul style="list-style-type: none">Design, install and maintain the dams generally in accordance with the series <i>Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E – Mines and Quarries</i>
Mine water storages	<ul style="list-style-type: none">Design, install and maintain mine water storage infrastructure to ensure no unlicensed or uncontrolled discharge of mine water off-site

Feature	Performance Measure
	<ul style="list-style-type: none"> Minimise discharges to surface waters as far as reasonable and practicable New on-site storages (including mine infrastructure dams, groundwater storage and treatment dams) are suitably treated to comply with a permeability standard of $< 1 \times 10^{-9}$ m/s Achieve an improvement in the quality of water held in the 35 ML dam generally in accordance with Figure 6-7 in Appendix F of the EIS (surface water impact assessment) over the life of the mine.
Water discharge to Airly Creek	<ul style="list-style-type: none"> No greater impacts than predicted in the EIS for water flow and quality in Airly Creek between LDP 001 and Point 4 (refer Appendix 9) Negligible environmental consequences for water quality (ie. protection to 99% of all species in accordance with ANZECC guidelines) and flow in Airly Creek where it enters the Gardens of Stone National Park and Greater Blue Mountains World Heritage Area
Gap and Genowlan Creeks	<ul style="list-style-type: none"> No greater impact than predicted in the EIS for water flow and quality
Emplacement of CHPP rejects	<ul style="list-style-type: none"> Emplacement, and/or encapsulation and/or capping to prevent or minimise the migration of pollutants due to seepage from the REA
Chemical and petroleum storage	<ul style="list-style-type: none"> Chemical and hydrocarbon products to be stored in bunded areas in accordance with relevant Australian Standards
Aquatic and riparian ecosystems	<ul style="list-style-type: none"> Maintain or improve baseline channel stability Develop site-specific water quality objectives in accordance with ANZECC Guidelines and <i>Using the ANZECC Guidelines and Water Quality Objectives in NSW</i> procedures (DECC 2006) or its latest version

Water Management Plan

15. Prior to carrying out any development under this consent, unless the Secretary agrees otherwise, the Applicant must prepare a Water Management Plan for the development to the satisfaction of the Secretary. This plan must:
- be prepared in consultation with the DoE, EPA and DPI Water, by suitably qualified and experienced person/s whose appointment has been approved by the Secretary;
 - include detailed performance criteria and describe measures to ensure that the Applicant complies with the Water Management Performance Measures (see Table 6);
 - in addition to the standard requirements for management plans (see condition 3 of Schedule 6), this plan must include a:
 - Site Water Balance, that:
 - includes details of:
 - sources and security of water supply, including contingency supply for future reporting periods;
 - water use and management on site;
 - any off-site water discharges; and
 - reporting procedures, including the preparation of a site water balance for each calendar year; and
 - investigates and implements all reasonable and feasible measures to minimise water use on site;
 - Surface Water Management Plan, that includes:
 - detailed baseline data on water flows and quality in the watercourses that could potentially be affected by the development, including, but not limited to Gap, Genowlan and Airly Creeks;
 - continuous flow monitoring at Airly village spring and the Grotto;
 - provisions for the recalculation of site-specific trigger values in relation to water discharges to Airly Creek once a minimum of two years data is obtained from the Airly Creek 'U/S' monitoring location (refer Appendix 9) in accordance with ANZECC guidelines;
 - the provision and implementation of adaptive management measures to ensure that subsequent water discharges to Airly Creek comply with the recalculated site-specific trigger values derived from the Airly Creek 'U/S' monitoring location;
 - a detailed description of the water management system, including the:
 - clean water diversion systems;
 - erosion and sediment controls (mine water system); and
 - mine water management systems;
 - detailed objectives and performance criteria, including trigger levels for investigating any potentially adverse impacts associated with the development for:
 - downstream surface water quality;

- downstream water users, including with respect to any subsidence-related flow reductions in Gap and Genowlan Creeks;
 - stream and riparian vegetation health in Gap, Genowlan and Airly Creeks within and immediately outside of the site;
 - design and management for the emplacement of coal reject materials;
 - reinstatement of drainage lines on the rehabilitated areas of the site; and
 - control of any potential water pollution from the rehabilitated areas of the site;
 - a program to monitor and report on:
 - effectiveness of the mine water management system;
 - surface water flows, quality and geomorphology of the watercourses potentially affected by the development within and immediately outside of the site;
 - the performance measures listed in Table 6 including, but not limited to event-based monitoring of the hydrology, quality, ecotoxicology and chemical composition of water in Airly Creek under discharge conditions at points 5 and 6 (refer Appendix 9), or as otherwise determined in consultation with the EPA, to ensure that protection is provided to 99% of all species in the Gardens of Stone National Park and Greater Blue Mountains World Heritage Area in accordance with ANZECC Guidelines;
 - reporting procedures for the results of the monitoring program; and
 - a plan to respond to any exceedances of the performance measures, and repair, mitigate and/or offset any adverse surface water impacts of the development, including measures to provide compensatory water supply to any affected downstream water user under condition 13 of this Schedule;
- (iii) Groundwater Management Plan, which is consistent with DPI Water's guideline entitled *Groundwater Monitoring and Modelling Plans – Introduction for prospective mining and petroleum activities*, and includes:
- detailed baseline data of groundwater levels, yield and quality in the region that could be affected by the development, including licensed privately-owned groundwater bores and a detailed survey/schedule of groundwater dependent ecosystems (including springs and their discharge quantity and quality);
 - consultation with DPI Water on the installation of all new monitoring bores, the scheduled sampling and quality determination of parameters for monitoring bores;
 - groundwater assessment criteria including trigger levels for investigating any potentially adverse groundwater impacts;
 - a program to monitor and report on:
 - springs and their discharge quantity and quality;
 - groundwater inflows transferred to the surface water management system;
 - the seepage/leachate from water storages and emplacements;
 - impacts of the development on:
 - o regional and local (including alluvial) aquifers;
 - o groundwater supply of potentially affected landowners; and
 - o groundwater dependent ecosystems (including rules for the management of groundwater level impacts to protect GDEs), and riparian vegetation;
 - a program to monitor and report on stygofauna and hyporheic fauna;
 - a program to review and validate the groundwater model for the development, including independent expert review; and
 - a plan to respond to any exceedances of the performance measures.

The Applicant must implement the approved Water Management Plan for the development.

Independent Expert Review

16. As part of any Independent Environmental Audit of the development (see condition 12 of schedule 6), the Applicant must commission an independent expert whose appointment has been endorsed by the Secretary, to carry out a review of the Groundwater Management Plan for the development, including the groundwater model. This review must include a:
- (a) review of all available monitoring data;
 - (b) comparison of predicted and actual groundwater impacts; and
 - (c) review of the effectiveness of the Groundwater Management Plan for the development, including the groundwater model.

BIODIVERSITY

Biodiversity Management Plan

17. Prior to carrying out any development under this consent that would cause surface disturbance, the Applicant must prepare a Biodiversity Management Plan for the development to the satisfaction of the Secretary. This plan must:
- (a) be prepared in consultation with OEH and DoE;
 - (b) establish baseline data for the existing remnant vegetation and habitat on site, including mapping of the location of the *Pultenaea* sp. Genowlan Point;
 - (c) describe the short, medium, and long-term measures that would be implemented to manage the remnant vegetation and habitat on the site, including but not limited to;
 - *Prostanthera stricta* (Mt Vincent Mint-bush);
 - *Eucalyptus cannonii* (Capertee Stringybark);
 - *Pultenaea* sp. Genowlan Point; and
 - Genowlan Point *Allocasurina nana* Heathland;
 - (d) include a detailed description of the measures that would be implemented to:
 - minimise the impacts to fauna on site, including undertaking pre-clearance surveys;
 - avoid and mitigate the spread of *Phytophthora cinnamomi* (*P. cinnamomi*);
 - control weeds and feral pests including, but not limited to goats, rabbits, European Red Fox, cats and pigs;
 - manage salinity;
 - control erosion;
 - control access; and
 - manage bushfire risk;
 - (e) include a program to monitor and report on the effectiveness of these measures, and progress against the detailed performance and completion criteria; and
 - (f) include details of who would be responsible for monitoring, reviewing, and implementing the plan.

The Applicant must implement the approved Biodiversity Management Plan for the development.

Note: The Biodiversity Management Plan and Rehabilitation Management Plan need to be substantially integrated for achieving biodiversity objectives for the rehabilitated mine-site.

TRANSPORT

Monitoring of Coal Transport

18. The Applicant must monitor and report on:
- (a) the amount of coal transported from the site; and
 - (b) the date and time of each train movement to and from the site;
- to the satisfaction of the Secretary.

Traffic Management Plan

19. Prior to the commencement of construction activities approved under this consent or within three months of the commencement of development under this consent (whichever is sooner), the Applicant must prepare a Traffic Management Plan for the development to the satisfaction of the Secretary. This plan must:
- (a) be prepared in consultation with RMS and Council;
 - (b) include measures to minimise the traffic impacts to Glen Davis Road and in the village of Capertee that may occur during the construction of new and/or upgraded surface infrastructure at the pit top; and
 - (c) a program to monitor and report on the effectiveness of these measures.

The Applicant must implement the approved Traffic Management Plan for the development.

HERITAGE

Protection of Aboriginal Sites

20. Unless otherwise authorised under the National Parks and Wildlife Act 1974, the Applicant must ensure that the development does not cause any direct or indirect impact on identified Aboriginal sites.

Note: Aboriginal heritage sites are identified in Appendix 6.

Heritage Management Plan

21. Prior to carrying out any development under this consent that would cause surface disturbance, the Applicant must prepare a Heritage Management Plan for the development to the satisfaction of the Secretary. This plan must:
- (a) be prepared by suitably qualified and experienced person/s whose appointment has been endorsed by the Secretary;
 - (b) be prepared in consultation with OEH, Council, any relevant local historical organisations (in relation to non-Aboriginal heritage) and local Aboriginal stakeholders (in relation to Aboriginal heritage);
 - (c) include a description of the measures that would be implemented for:
 - managing the discovery of human remains or previously unidentified heritage items on site; and
 - ensuring any workers on site receive suitable heritage inductions and that suitable records are kept of these inductions;
 - (d) include the following for the management of Aboriginal heritage:
 - a description of the measures that would be implemented for:
 - protecting, monitoring and/or managing (including any proposed archaeological investigations and/or salvage measures) the heritage items identified in Appendix 5;
 - managing the discovery of previously unidentified Aboriginal items on site;
 - conserving the sites outside the surface disturbance area (see Appendix 5);
 - maintaining and managing reasonable access for Aboriginal stakeholders to heritage items on site;
 - ongoing consultation with the Aboriginal stakeholders in the conservation and management of Aboriginal cultural heritage on site; and
 - (e) include the following for the management of non-Aboriginal heritage items:
 - a description of the measures that would be implemented for:
 - protecting, monitoring and managing the heritage items identified in Appendix 6; and
 - managing the discovery of previously unidentified cultural heritage items on site.

Note: This plan can be incorporated in a regional Aboriginal Cultural Heritage Management Plan for Centennial's other mines and mine infrastructure in the Lithgow Local Government Area.

The Applicant must implement the approved Heritage Management Plan for the development.

VISUAL

Visual Screening of Reject Emplacement Area

22. The Applicant must:
- (a) plant trees at the basal area of the proposed reject emplacement area (REA) to minimise views of the REA to travellers along Glen Davis Road;
 - (b) carry out tree planting in the road reserve of the Castlereagh Highway in locations where the REA is visible, in consultation with the relevant road authority;
 - (c) complete this tree planting at least three months prior to constructing the proposed REA; and
 - (d) maintain this tree screening over the life of the mine to the satisfaction of the Secretary.

Operating Conditions

23. The Applicant must:
- (a) implement all reasonable and feasible measures to minimise the visual and off-site lighting impacts of the development;
 - (b) ensure that all external lighting associated with the development complies with *Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting* or its latest version;
 - (c) ensure that the visual appearance of all buildings, structures, facilities or works (including paint colours and specifications) is aimed at blending as far as possible with the surrounding landscape, to the satisfaction of the Secretary.

BUSHFIRE MANAGEMENT

24. The Applicant must:
- (a) ensure that the development is suitably equipped to respond to any fires on site; and
 - (b) assist the Rural Fire Service, emergency services and NPWS as much as possible if there is a fire in the surrounding area.

WASTE

25. The Applicant must:
- (a) implement all reasonable and feasible measures to minimise the waste (including coal reject) generated by the development;
 - (b) ensure that the waste generated by the development is appropriately stored, handled and disposed of; and

- (c) monitor and report on the effectiveness of waste minimisation and management measures in the Annual Review,
to the satisfaction of the Secretary.

EXPLORATION ACTIVITIES & SURFACE INFRASTRUCTURE

Exploration Activities and Minor Surface Infrastructure Management Plan

26. Prior to carrying out exploration activities on site under this consent that would cause surface disturbance or the construction and/or upgrade of minor surface infrastructure, the Applicant must prepare an Exploration Activities and Minor Surface Infrastructure Management Plan for the development to the satisfaction of the Secretary. This Plan must:
- be prepared by suitably qualified and experienced person/s whose appointment has been endorsed by the Secretary;
 - be prepared in consultation with DRE and OEH;
 - include a description of the measures that would be implemented for:
 - managing exploration activities on site;
 - managing construction and operation of minor surface infrastructure (including groundwater monitoring bores) and associated access tracks;
 - consulting with and addressing concerns of affected landowners;
 - avoiding threatened species, populations or their habitats and EECs;
 - minimising clearance and disturbance of native vegetation;
 - minimising erosion and sedimentation;
 - achieving applicable standards and goals; and
 - rehabilitating disturbed areas.

The Applicant must implement the approved Exploration Activities and Minor Surface Infrastructure Management Plan for the development.

Note: This condition does not apply to the construction of approved surface infrastructure in the Airly Pit Top area.

REHABILITATION

Rehabilitation Objectives

27. The Applicant must rehabilitate the site to the satisfaction of the DRE. This rehabilitation must be generally consistent with the proposed Rehabilitation Strategy described in the EIS (and depicted conceptually in Appendix 10) and comply with the objectives in Table 7.

Table 7: Rehabilitation objectives

Feature	Objective
Site (as a whole)	<ul style="list-style-type: none"> Safe, stable and non-polluting
Surface Infrastructure	<ul style="list-style-type: none"> To be decommissioned and removed, unless DRE agrees otherwise The Reject Emplacement Area and all surface infrastructure is to be made safe and hydraulically and geotechnically stable All surface infrastructure sites are to be revegetated with suitable local native plant species to a landform consistent with the surrounding environment
Rehabilitation materials	<ul style="list-style-type: none"> Materials from areas disturbed under this consent (including topsoils, substrates and seeds) are to be recovered, managed and used as rehabilitation resources
REA	<ul style="list-style-type: none"> The REA is to be revegetated with suitable local native plant species, and to a landform consistent with the surrounding environment Capping materials (including depth of application) are to be approved by DRE prior to capping
Revegetated final landforms	<ul style="list-style-type: none"> Stable and sustain the intended land use Consistent with surrounding topography to minimise visual impacts Incorporate relief patterns and design principles consistent with natural drainage
Native flora and fauna	<ul style="list-style-type: none"> Flora species used in rehabilitation selected to re-establish and complement local and regional biodiversity Rehabilitated areas contribute to achieving self-

Feature	Objective
	sustaining biodiversity habitats
Cliffs and steep slopes	<ul style="list-style-type: none"> No additional risk to public safety compared to pre-mining conditions
All watercourses subject to mine-water discharges and/or subsidence impacts	<ul style="list-style-type: none"> Hydraulically and geomorphologically stable, with aquatic ecology and riparian vegetation that is the same, or better than prior to grant of this consent
Water quality	<ul style="list-style-type: none"> Water retained on site is fit for the intended post mining land use(s) Water management is consistent with the regional catchment management strategy
Community	<ul style="list-style-type: none"> Ensure public safety Minimise the adverse socio-economic effects of mine closure

Note: These rehabilitation objectives apply to all subsidence impacts and environmental consequences caused by mining taking place after the date of this consent, and to all surface infrastructure part of the project, whether constructed prior to or following the date of this consent.

Progressive Rehabilitation

28. The Applicant must rehabilitate the site progressively, that is, as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time.

Rehabilitation Management Plan

29. Prior to carrying out any development under this consent, unless the Secretary agrees otherwise, the Applicant must prepare a Rehabilitation Management Plan for the development to the satisfaction of the DRE. This plan must:
- be prepared in consultation with the Department, DPI Water, OEH, Council and the CCC;
 - be prepared in accordance with any relevant DRE guideline;
 - include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and triggering remedial action (if necessary);
 - describe the measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including mine closure, final landform and final land use;
 - include the design and implementation of a Closure Groundwater Monitoring and Management Plan, which:
 - assists in restoring natural groundwater flow to pre-mining conditions to the maximum extent possible;
 - includes the implementation of appropriate mitigation strategies to reduce adverse groundwater impacts to seeps, springs and flows in terms of acidity, salinity or location;
 - involves the removal of all non-natural material from within the mine not required for groundwater or subsidence management and describe measures that would be implemented to prevent polluting materials from entering the mine so as to not affect groundwater quality;
 - include interim rehabilitation where necessary to minimise the area exposed for dust generation;
 - include a program to monitor, independently audit and report on the effectiveness of the rehabilitation measures and progress against the detailed performance and completion criteria; and
 - build to the maximum extent practicable on the other management plans required under this consent.

The Applicant must implement the approved Rehabilitation Management Plan for the development.

Note: The Biodiversity Management Plan and Rehabilitation Management Plan require substantial integration to achieve biodiversity objectives for the rehabilitated mine site.

SCHEDULE 5 ADDITIONAL PROCEDURES

NOTIFICATION OF LANDOWNERS/TENANTS

1. As soon as practicable after obtaining monitoring results showing:
 - (a) an exceedance of any relevant criteria in Schedule 4, the Applicant must notify the affected landowners in writing of the exceedance, and provide regular monitoring results to these landowners until the project is again complying with the relevant criteria; and
 - (b) an exceedance of the relevant air quality criteria in Schedule 4, the Applicant must send a copy of the NSW Health fact sheet entitled "Mine Dust and You" (as may be updated from time to time), to the affected landowners and/or existing tenants of the land (including the tenants of any mine-owned land).

INDEPENDENT REVIEW

2. If an owner of privately-owned land considers the project to be exceeding the relevant criteria in Schedule 4, then he/she may ask the Secretary in writing for an independent review of the impacts of the project on his/her land.

If the Secretary is satisfied that an independent review is warranted, then within 2 months of the Secretary's decision the Applicant must:

- (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Secretary, to:
 - consult with the landowner to determine his/her concerns;
 - conduct monitoring to determine whether the project is complying with the relevant criteria in Schedule 4; and
 - if the project is not complying with these criteria, then identify the measures that could be implemented to ensure compliance with the relevant criteria; and
 - (b) give the Secretary and landowner a copy of the independent review.
-

SCHEDULE 6

ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING

ENVIRONMENTAL MANAGEMENT

Environmental Management Strategy

1. Prior to carrying out any development under this consent, the Applicant must prepare an Environmental Management Strategy for the development to the satisfaction of the Secretary. This strategy must:
 - (a) be submitted to the Secretary for approval, unless otherwise agreed;
 - (b) provide the strategic framework for environmental management of the development;
 - (c) identify the statutory approvals that apply to the development;
 - (d) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the development;
 - (e) describe the procedures that would be implemented to:
 - keep the local community and relevant agencies informed about the operation and environmental performance of the mine;
 - receive, handle, respond to, and record complaints;
 - resolve any disputes that may arise during the course of the development;
 - respond to any non-compliance;
 - respond to emergencies; and
 - (f) include:
 - copies of any strategies, plans and programs approved under the conditions of this consent; and
 - a clear plan depicting all the monitoring to be carried out in relation to the development.

The Applicant must implement the approved Environmental Management Strategy for the development.

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:
 - (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 and environmental performance of the development;
 - effectiveness of any management measures (see c above);
 - (e) a contingency plan to manage any unpredicted impacts and their 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.

Revision of Strategies, Plans and Programs

3. Within 3 months of:
 - (a) the submission of an incident report under condition 10 below;
 - (b) the submission of an annual review under condition 12 below;
 - (c) the submission of an audit report under condition 13 below; or
 - (d) any modification to the conditions of this consent, (unless the conditions require otherwise),the Applicant must review the strategies, plans, and programs required under this consent, to the satisfaction of the Secretary. Where this review leads to revisions in any such document, then within 4 weeks of the review the revised document must be submitted for the approval of the Secretary.

Note: This is to ensure that strategies, plans and programs are regularly updated to incorporate any measures recommended to improve the environmental performance of the development.

Updating & Staging of Strategies, Plans or Programs

4. To ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development, the Applicant may submit revised strategies, plans or programs required under this consent at any time. With the agreement of the Secretary, the Applicant may also submit any strategy, plan or program required by this consent on a staged basis.

The Secretary may approve a revised strategy, plan or program required under this consent, or the staged submission of any of these documents, at any time. With the agreement of the Secretary, the Applicant may prepare the revised or staged strategy, plan or program without undertaking consultation with all parties nominated under the applicable condition in this consent.

Notes:

- While any strategy, plan or program may be submitted on a staged basis, the Applicant must ensure that the existing operations on site are covered by suitable strategies, plans or programs at all times.
- 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 this stage to any future stages, and the trigger for updating the strategy, plan or program.

Relationships between Management Plans

5. The Water, Biodiversity and Heritage Management Plans required by conditions 15, 16 and 20 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 5 of Schedule 3. In particular, those management plans should address all areas subject to existing or proposed surface disturbance associated with the development.

Consolidation of Strategies, Plans or Programs

6. With the approval of the Secretary, the Applicant may incorporate any strategies, plans or programs required by this consent (except those required under condition 5 of Schedule 3) with the strategies, plans and programs required for Centennial Coal's mining operations in the Lithgow Local Government Area.

Adaptive Management

7. 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. Any exceedance of these performance measures and/or criteria constitutes a breach of this consent and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.

Where any exceedance of these criteria and/or performance measures has occurred, the Applicant must, 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.

COMMUNITY CONSULTATIVE COMMITTEE

8. The Applicant must operate a Community Consultative Committee (CCC) for the development to the satisfaction of the Secretary. This CCC must be operated in accordance with the *Guidelines for Establishing and Operating Community Consultative Committees for Mining Projects* (Department of Planning, 2007) or its latest version.

Notes: The CCC is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Applicant complies with this consent.

REPORTING

Incident Reporting

9. 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.

Regular Reporting

10. 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.

Annual Review

11. By the end of March each year following the commencement of development under this consent, or other timing as may be agreed by the Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development to the satisfaction of the Secretary. This review must:
 - (a) describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year;
 - (b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, which includes a comparison of these results against the:
 - the relevant statutory requirements, limits or performance measures/criteria;
 - the monitoring results of previous years; and
 - the relevant predictions in the documents listed under condition 2(a) and the IPRP's Report;
 - (c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
 - (d) identify any trends in the monitoring data over the life of the development;
 - (e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and
 - (f) describe what measures will be implemented over the next year to improve the environmental performance of the development.

INDEPENDENT ENVIRONMENTAL AUDIT

Independent Environmental Audit

12. Within one year of the date of commencement and every 3 years thereafter, unless the Secretary directs otherwise, the Applicant must commission and pay the full cost of an Independent Environmental Audit of the development. This audit must:
 - (a) be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary;
 - (b) include consultation with the relevant agencies;
 - (c) assess the environmental performance of the development and assess whether it is complying with the requirements in this consent, and any other relevant approvals, relevant EPL/s and/or Mining Lease/s (including any assessment, plan or program required under these approvals);
 - (d) review the adequacy of any strategies, plans or programs required under the abovementioned approvals; and
 - (e) recommend appropriate measures or actions to improve the environmental performance of the development, and/or any strategy, plan or program required under these approvals; and
 - (f) be conducted and reported to the satisfaction of the Secretary.

Note: This audit team must be led by a suitably qualified auditor, and include experts in any fields specified by the Secretary.

13. Within 12 weeks of commissioning this audit, or as otherwise agreed by the Secretary, the Applicant must submit a copy of the audit report to the Secretary, together with its response to any recommendations contained in the audit report and a timetable for the implementation of these recommendations as required. The Applicant must implement these recommendations, to the satisfaction of the Secretary.

ACCESS TO INFORMATION

14. The Applicant must:
 - (a) make the following information publicly available on its website:
 - the documents listed under condition 2(a);
 - the IPRP's report;
 - all current statutory approvals for the development;
 - 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;
 - minutes of CCC meetings;
 - the last five annual reviews;
 - any independent environmental audit, and the Applicant's response to the recommendations in any audit;

- any report and/or advice issued by the IEP to the Applicant in respect of a draft or approved Extraction Plan;
 - any other matter required by the Secretary; and
- (b) keep this information up to date,
to the satisfaction of the Secretary.
-

**APPENDIX 1
SCHEDULE OF LAND**

Property ID	Lot/Section No./ Deposited Plan
1	11/1152312
2	4/1152312
3	2/1152312
4	3/1152312
5	5/1152312
6	3/1/758011
7	14/1755757
8	11/1758011
9	4/1758011
10	154/1722292
11	7020/1029319
12	13/1755786
13	66/1722329
14	68/1722329
15	81/1755757
16	117/1755757
17	112/1755757
18	124/1755757
19	102/1755757
20	94/1755757
21	104/1755757
22	105/1755757
23	95/1755757
24	33/1755757
25	98/1755757
26	91/1755757
27	11/1/758011
28	7/3/758011
29	12/1118801
30	7026/1050399
31	7304/1130566

Property ID	Lot/Section No./ Deposited Plan
32	21/1118800
33	20/1118800
34	23/1118800
35	7/1118784
36	10/1118784
37	13/1118784
38	8/1118784
39	16/1118801
40	100/1755757
41	7018/1051447
42	7014/1057712
43	83/1755757
44	113/1755757
45	121/1755757
46	7022/1050402
47	67/1722329
48	7016/1114802
49	7300/1130496
50	16/2/758011
51	6/2/758011
52	5/2/758011
53	8/1/758011
54	9/1/758011
55	5/3/758011
56	4/3/758011
57	8/3/758011
58	5/1755766
59	7023/1050402
60	56/1755786
61	3/2/758011
62	1/1577478

Property ID	Lot/Section No./ Deposited Plan
63	4/1755766
64	1/1007126
65	4/2/758011
66	1/1755766
67	12/1755786
68	3/1755766
69	19/1755766
70	5/1/758011
71	51/1755786
72	2/1/758011
73	7021/1050431
74	7001/1057060
75	97/1755757
76	119/1755757
77	22/1755786
78	116/1755757
79	79/1755757
80	109/1755757
81	107/1755757
82	90/1755757
83	126/1755757
84	120/1755757
85	110/1755757
86	108/1755757
87	99/1755757
88	115/1755757
89	6/3/758011
90	1/2/758011
91	1/3/758011
92	2/3/758011
93	3/3/758011

Property ID	Lot/Section No./ Deposited Plan
94	9/3/758011
95	123/1755757
96	34/1755757
97	10/1118781
98	7303/1130566
99	18/1118800
100	19/1118800
101	22/1118800
102	11/1118784
103	14/1118784
104	13/1118801
105	14/1118801
106	15/1118801
107	24/1118800
108	9/1118784
109	12/1118784
110	101/1755757
111	96/1755757
112	106/1755757
113	78/1755757
114	89/1755757
115	118/1755757
116	82/1755757
117	7001/1028024
118	7024/1050402
119	39/1755786
120	125/1755757
121	80/1755757
122	42/1755757
123	103/1755757
124	7025/1050399

Property ID	Lot/Section No./ Deposited Plan
125	7031//1116097
126	7032//1116097
127	7034//1116073
128	7300//1130282
129	114//755757
130	28//755786
131	10/1//758011
132	17/2//758011
133	2/2//758011
134	15/2//758011
135	60//755757
136	6/1//758011
137	7/1//758011
138	701//1058328
139	4//577478
140	7018//1030008
141	71//755758
142	100//849168
143	7037//1065193
144	72//755758
145	7021//1030009
146	65//755786
147	3//577478
148	7017//1029387
149	701//1030007
150	703//1030007
151	701//1058325
152	70//755758
153	7036//1065193
154	63//755758
155	7027//1066212

Property ID	Lot/Section No./ Deposited Plan
156	89//755758
157	7016//1029387
158	7025//1066211
159	7014//1029387
160	9//655050
161	702//1058325
162	702//1058328
163	7024//1066211
164	7026//1066212
165	704//1030007
166	11//755757
167	702//1030007
168	2//577478
169	7015//1029387
170	54//755786
171	7300//1126380
172	7301//1126380
173	7023//1116918
174	7005//1116573
175	7006//1116573
176	7024//1116919
177	7303//1130728
178	7302//1130590
179	1//864999
180	7004//1029383
181	2//864999
182	10//755758
183	22//650039
184	7035//1117631
185	7033//1116073
186	7013//1057515

Property ID	Lot/Section No./ Deposited Plan
187	94//755758
188	93//755758
189	7020//1030008
190	7022//1029388
191	102//1079781
192	103//1079781
193	7013//1029386
194	111//755758
195	7001//1029380
196	13//755758
197	5//986083
198	17//244899
199	39//746912
200	10//132551
201	17//755758
202	2//131546
203	44//755758
204	28//755758
205	37//746912
206	25//755758
207	7002//1029380
208	A//349704
209	9//755758
210	1//346651
211	107//755758
212	36//755758
213	16//755758
214	41//755758
215	23//755758
216	6//131546
217	46//755758

Property ID	Lot/Section No./ Deposited Plan
218	38//746912
219	5//131546
220	18//244899
221	24//755758
222	8//755758
223	C//349704
224	1//119590
225	3//131546
226	45//755758
227	B//349704
228	1//1072590
229	32//755758
230	19//244899
231	14//244899
232	110//755758
233	20//244899
234	4//131546
235	78//755758
236	15//755758
237	15//244899
238	41//746912
239	55//755758
240	40//746912
241	1//131546
242	22//755758
243	16//244899
244	2//927952
245	1//927952
246	18//1106972
247	7010//1021311
248	1//1115443

Property ID	Lot/Section No./ Deposited Plan
249	1//122407
250	42//755758
251	112//755758
252	31//755758
253	26//755758
254	27//755758
255	29//755758
256	30//755758
257	7019//1030008
258	82//755758
259	1//197770
260	126//722134
261	7029//1065275
262	81//755758
263	153//257075
264	142//755757
265	7009//1029698
266	4//755757
267	67//755758
268	17//755757
269	92//755757
270	156//722330
271	102//610704
272	94//755778
273	13//244899
274	86//755757
275	51//755757
276	133//755757
277	85//755757
278	603//615881
279	101//610704

Property ID	Lot/Section No./ Deposited Plan
280	185//755778
281	164//48336
282	2//132549
283	2//379339
284	87//755757
285	35//755758
286	231//1012729
287	159//722293
288	77//755757
289	1//194534
290	2//813231
291	25//665681
292	601//615881
293	2//547497
294	128//755757
295	1//1070723
296	54//755757
297	163//48336
298	47//755758
299	77//755758
300	7015//1057714
301	3//792135
302	58//755757
303	1//132549
304	134//755757
305	1//564345
306	10//755757
307	49//755757
308	135//755757
309	75//755757
310	2//792135

Property ID	Lot/Section No./ Deposited Plan
311	3//709009
312	233//1012729
313	7008//1029698
314	111//755757
315	31//755757
316	55//755757
317	4//709009
318	48//755758
319	6//665679
320	79//755758
321	25//665682
322	141//755757
323	56//755757
324	40//755757
325	3//565109
326	7003//1056614
327	232//1012729
328	132//755757
329	59//755757
330	129//755757
331	4//792135
332	1//831104
333	1//195875
334	157//722330
335	7012//1056868
336	15//755757
337	7028//1029701
338	7029//1075846
339	83//755758
340	70//755757
341	43//755757

Property ID	Lot/Section No./ Deposited Plan
342	7038//1117632
343	158//722293
344	139//755757
345	93//755757
346	7037//1117633
347	7036//1117631
348	137//755757
349	13//755757
350	136//755757
351	20//755757
352	18//755757
353	27//755757
354	41//755757
355	26//755757
356	47//755757
357	24//755757
358	50//755757
359	7002//1058210
360	7302//1130728
361	7304//1130728
362	7028//1065275
363	21//755758
364	35//755786

APPENDIX 2 DEVELOPMENT SITE

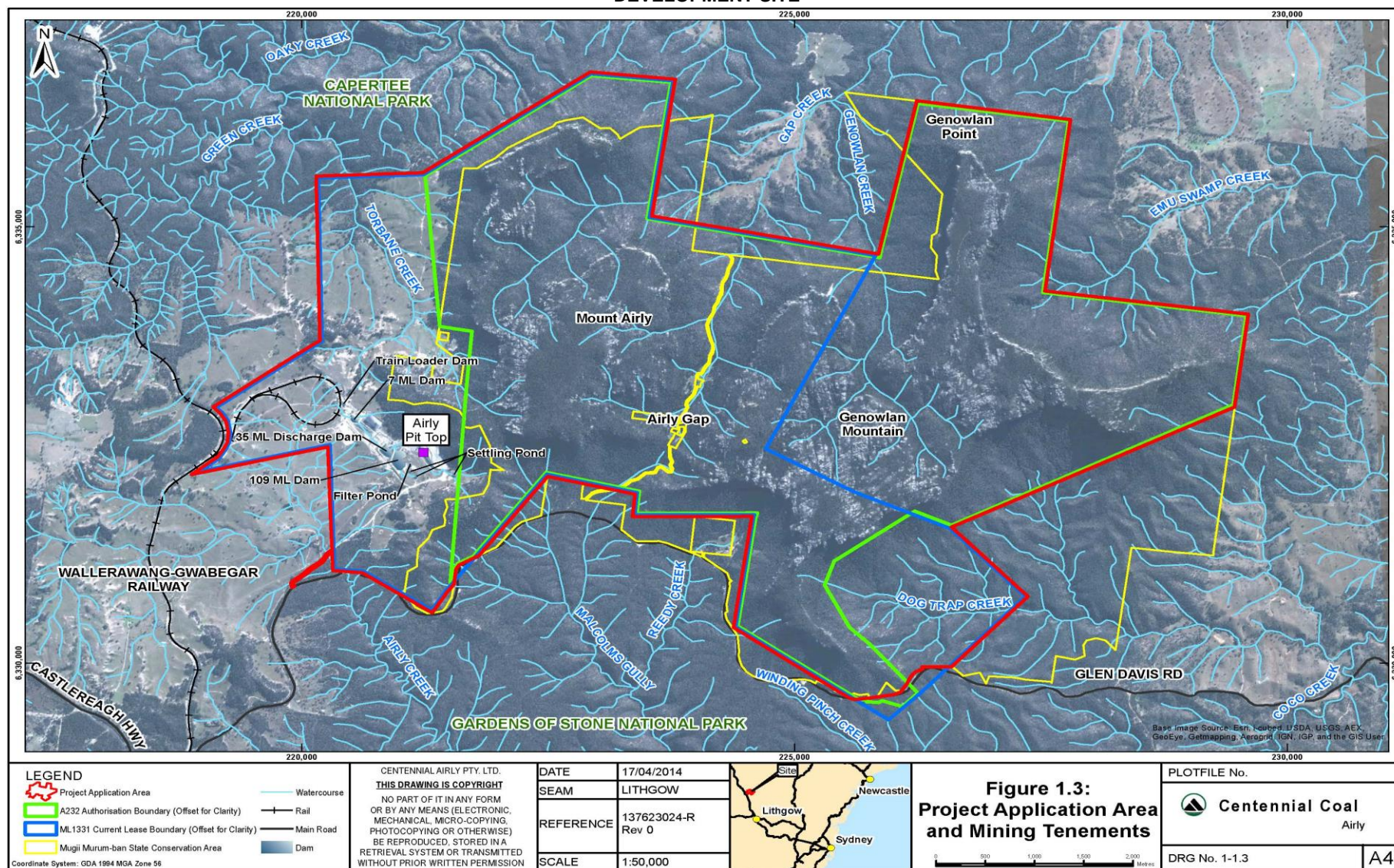
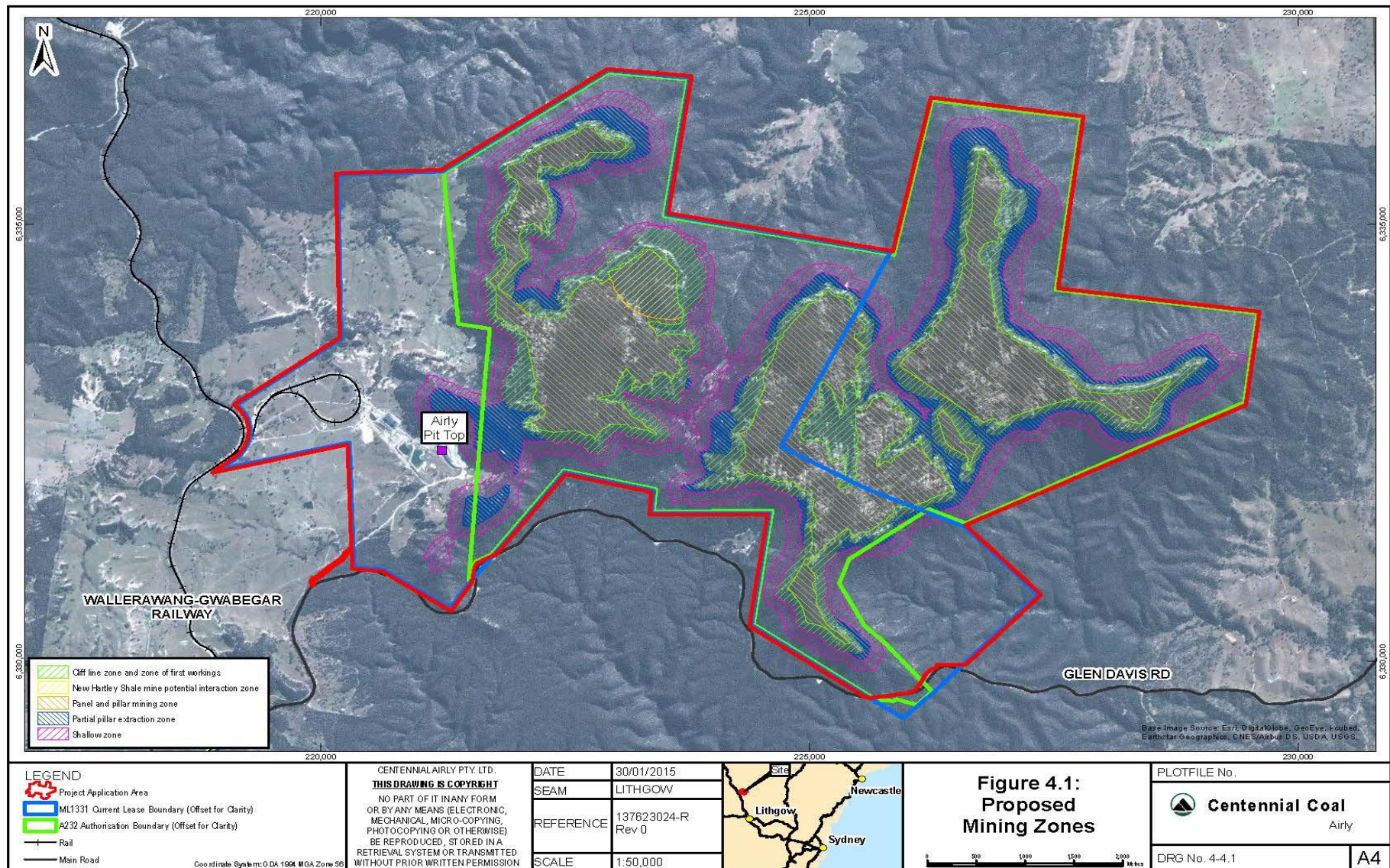


Figure 1: Airly Mine Extension Project – Development Site

APPENDIX 3 DEVELOPMENT LAYOUT



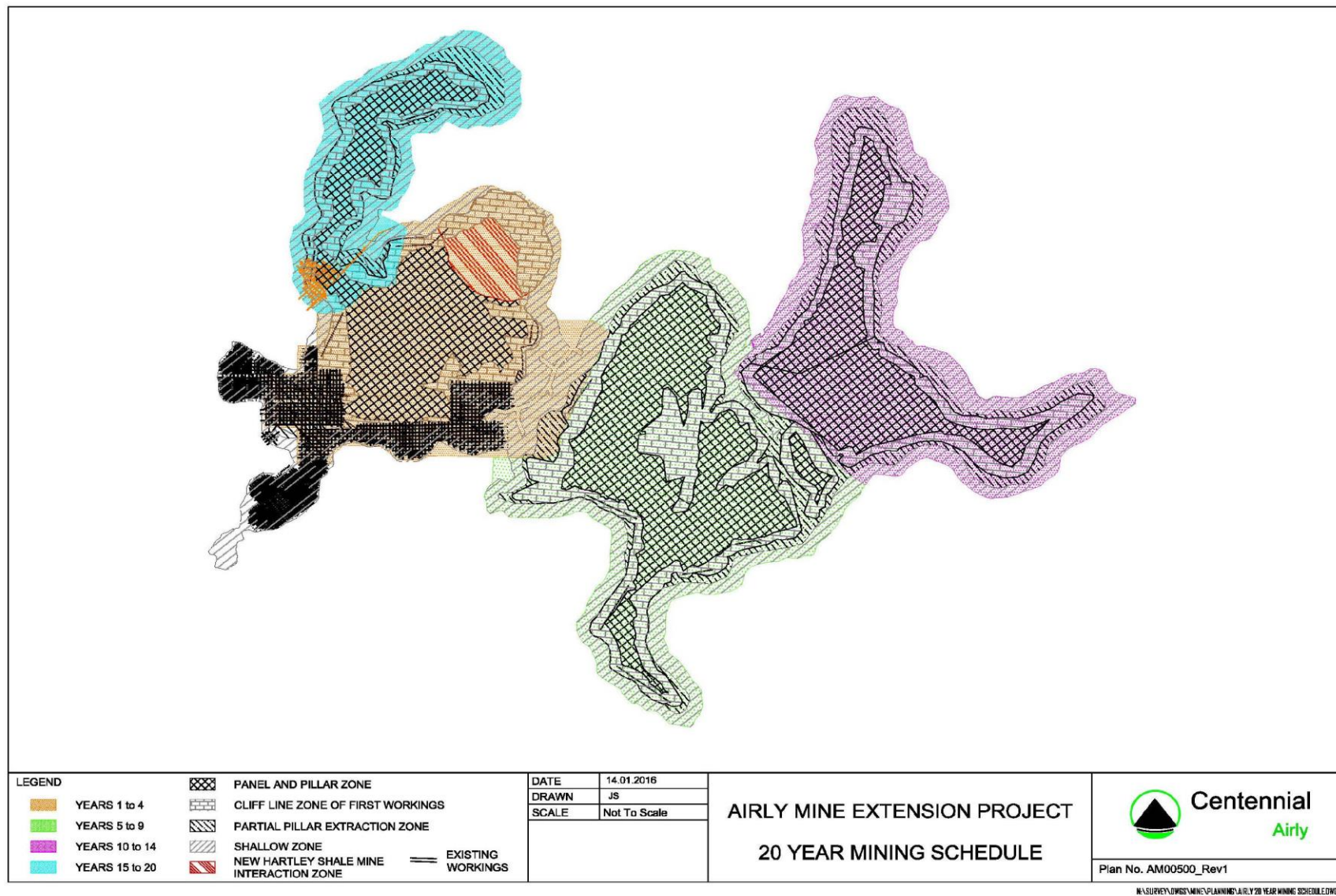


Figure 3: Mining schedule

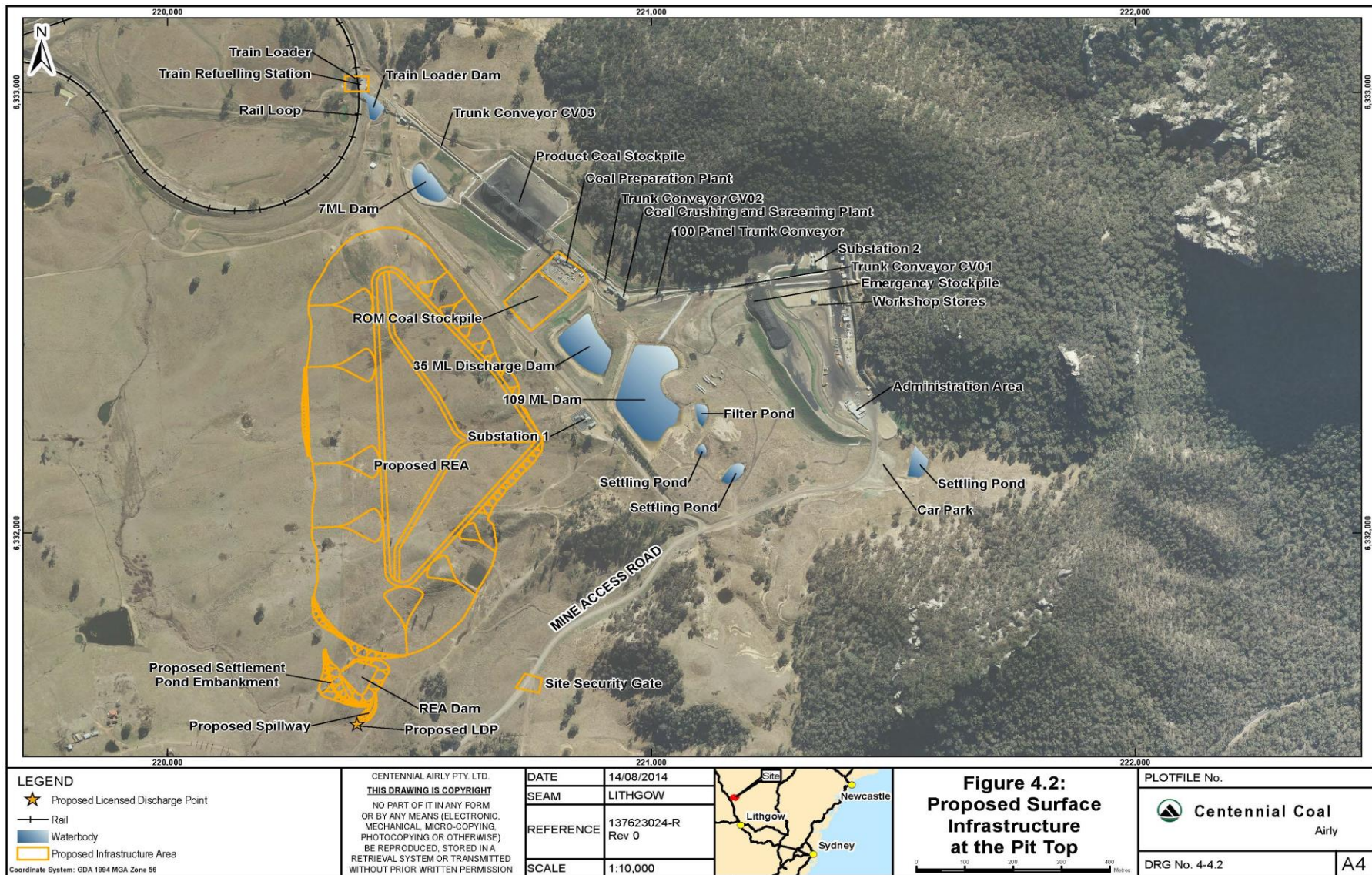


Figure 4: General layout of existing and proposed infrastructure areas

APPENDIX 4 LAND OWNERSHIP

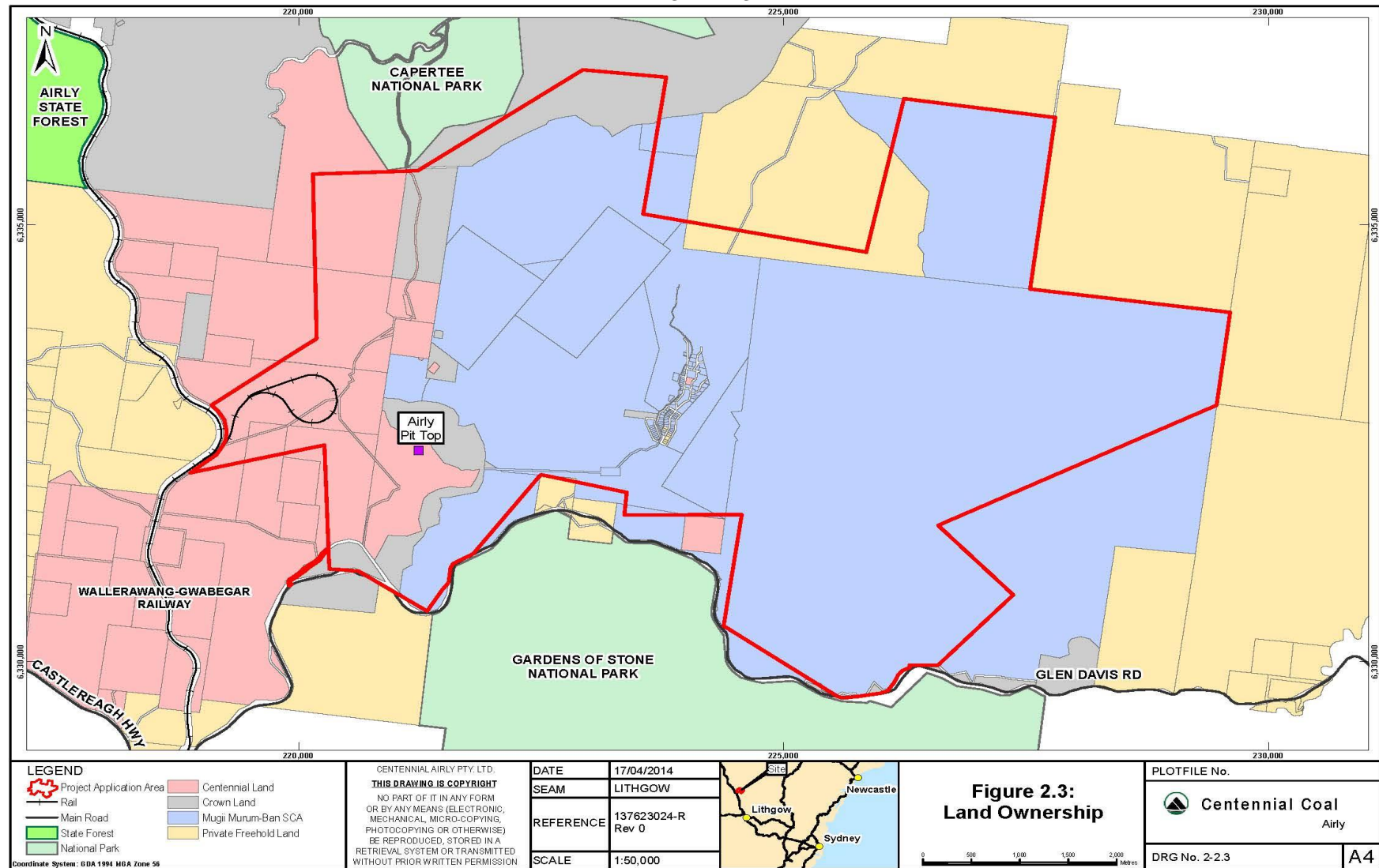


Figure 4: Land ownership plan

APPENDIX 5 ABORIGINAL HERITAGE SITES

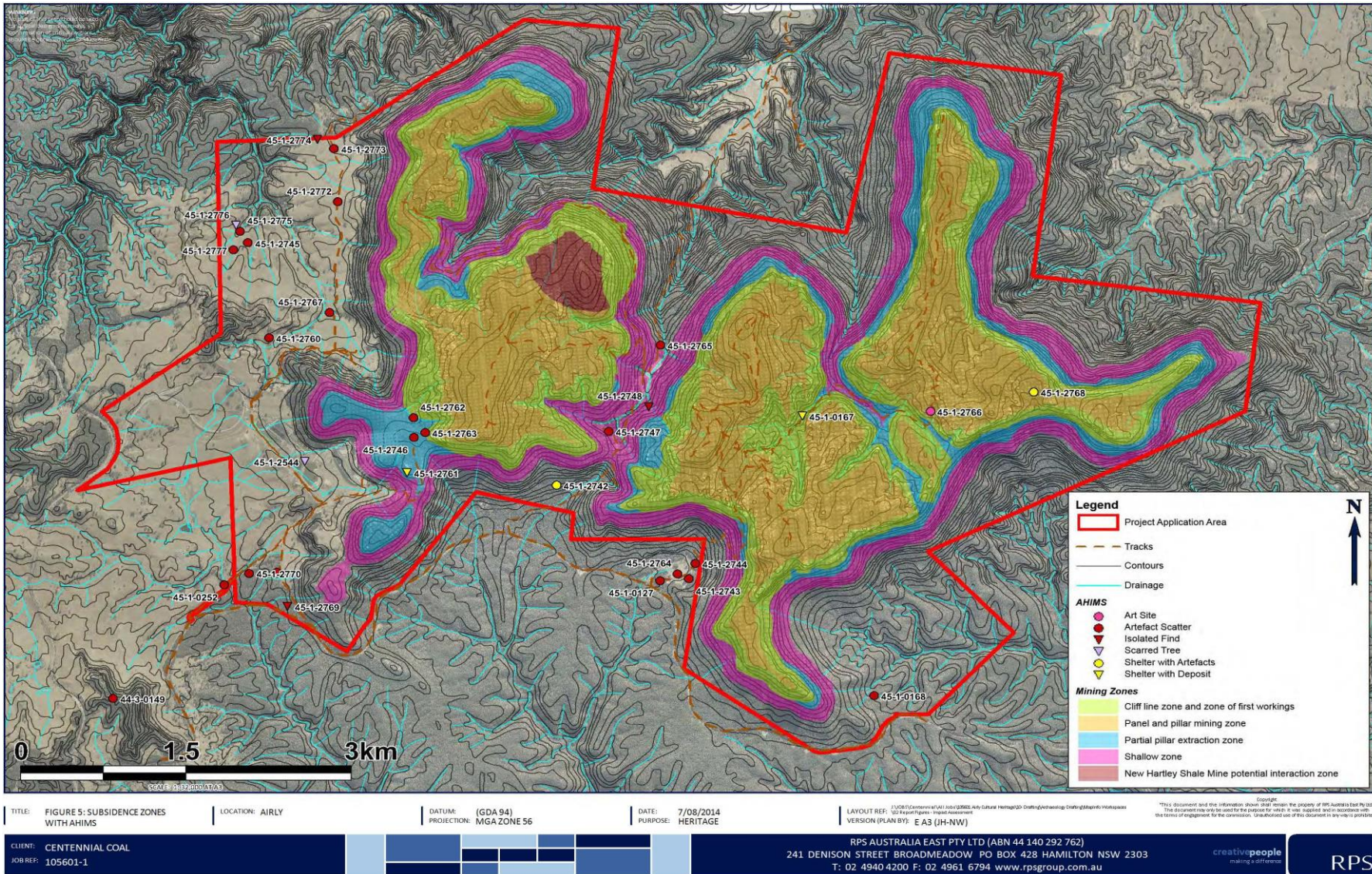


Figure 5: Aboriginal heritage sites within or near to the PAA and proposed mining zones

APPENDIX 6 NON-ABORIGINAL HERITAGE SITES

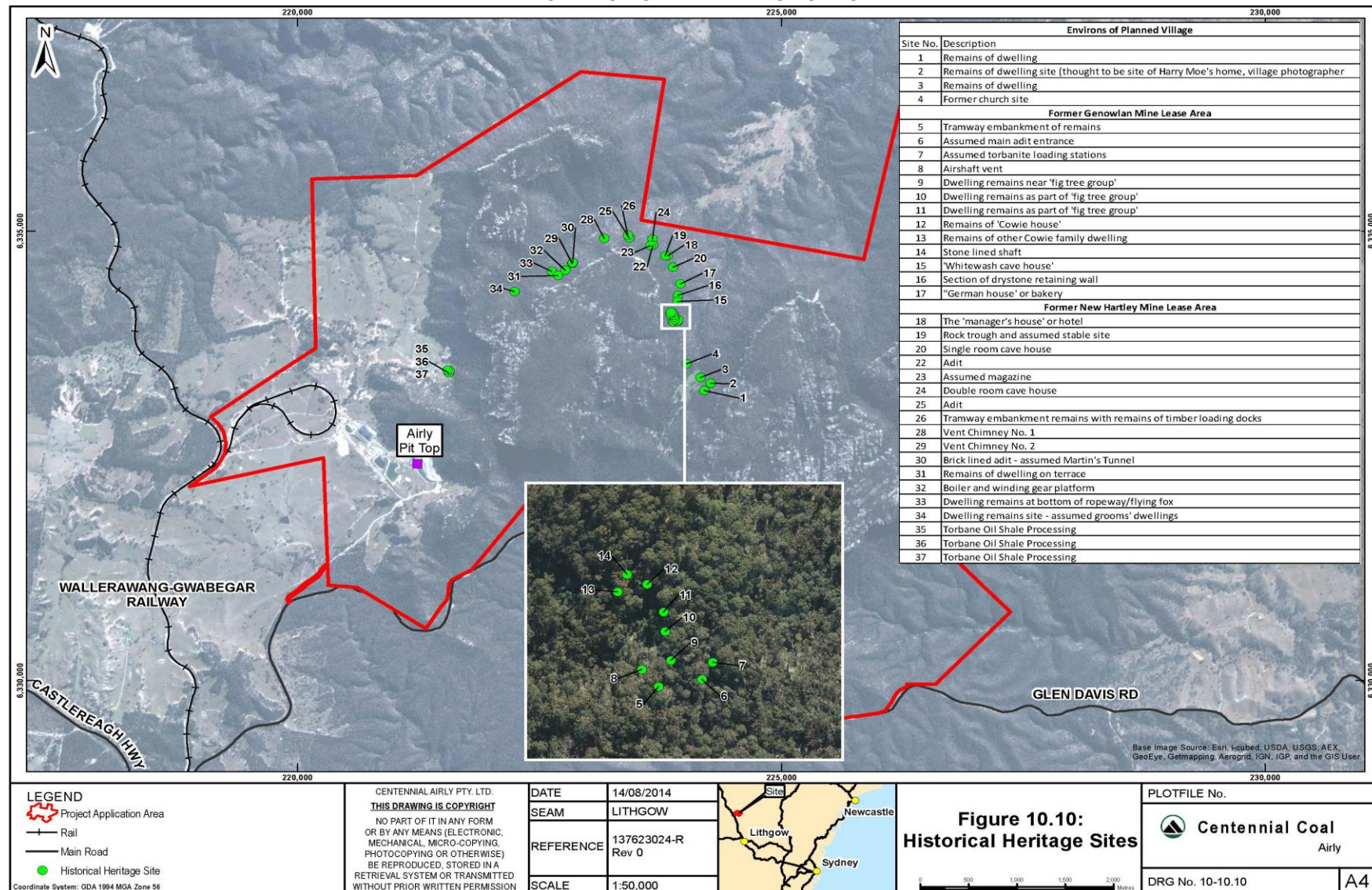


Figure 6: Cultural heritage sites in the PAA

APPENDIX 7 NOISE RECEIVER LOCATIONS

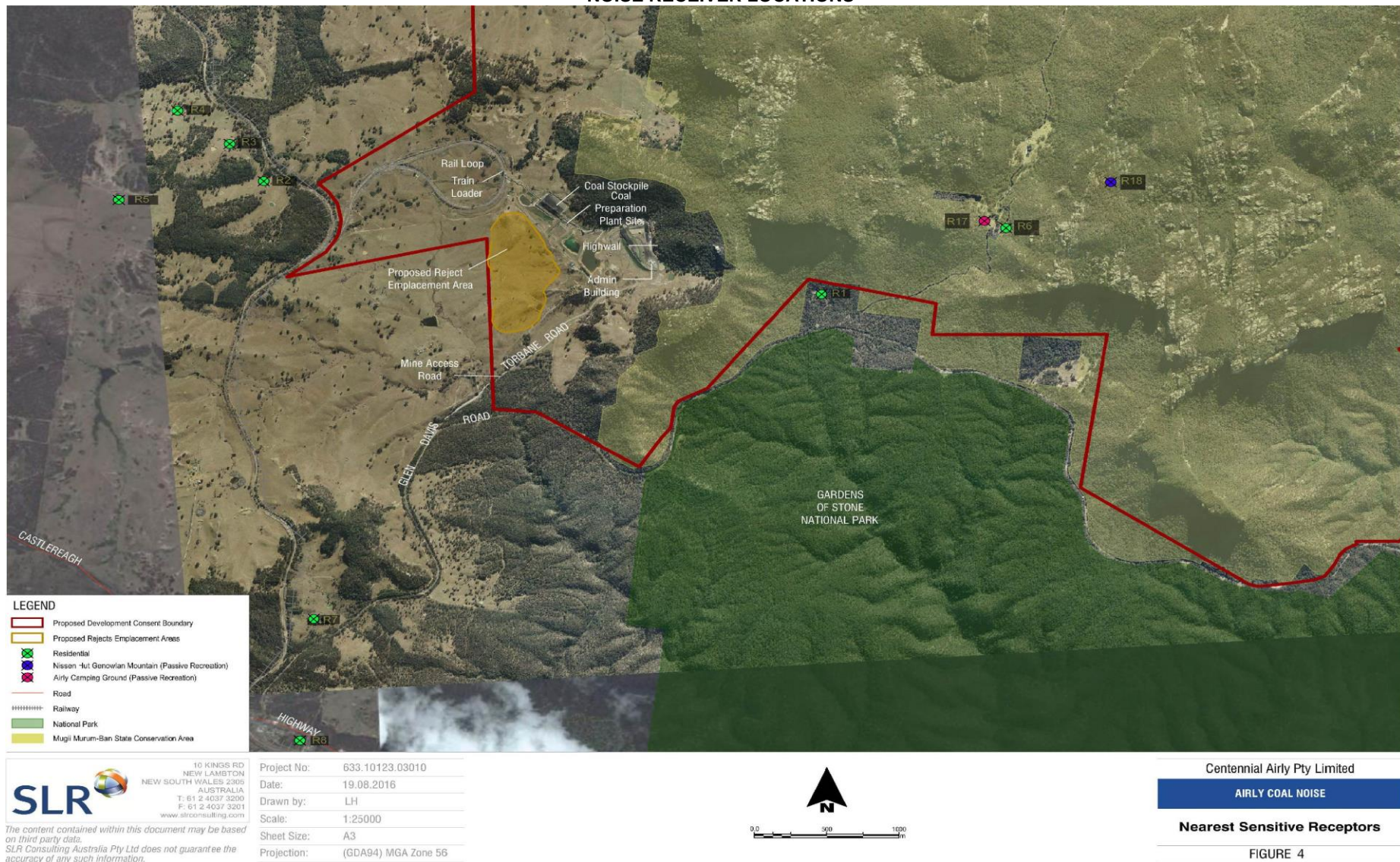


Figure 7: Noise receiver locations

APPENDIX 8 NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

1. The noise criteria in Table 4 in Schedule 4 are to apply to a receiver under all meteorological conditions except under:
 - (a) wind speeds greater than 3 m/s at 10 m above ground level; or
 - (b) stability category F temperature inversions and wind speed greater than 2 m/s at 10 m above ground level; or
 - (c) stability category G temperature inversion conditions.

Determination of Meteorological Conditions

2. Except for wind speed at microphone height, the data to be used for determining meteorological conditions must be that recorded by the meteorological station required under condition 8 of Schedule 4.

Compliance Monitoring

3. Attended monitoring is to be used to evaluate compliance with the relevant conditions of this consent.
4. Unless the Secretary agrees otherwise, this monitoring is to be carried out in accordance with the relevant requirements for reviewing performance set out in the *NSW Industrial Noise Policy* (as amended from time to time), in particular the requirements relating to:
 - (a) monitoring locations for the collection of representative noise data;
 - (b) meteorological conditions during which collection of noise data is not appropriate;
 - (c) equipment used to collect noise data, and conformity with Australian Standards relevant to such equipment; and
 - (d) modifications to noise data collected, including for the exclusion of extraneous noise and/or penalties for modifying factors apart from adjustments for duration.

APPENDIX 9 AIRLY CREEK MONITORING LOCATIONS

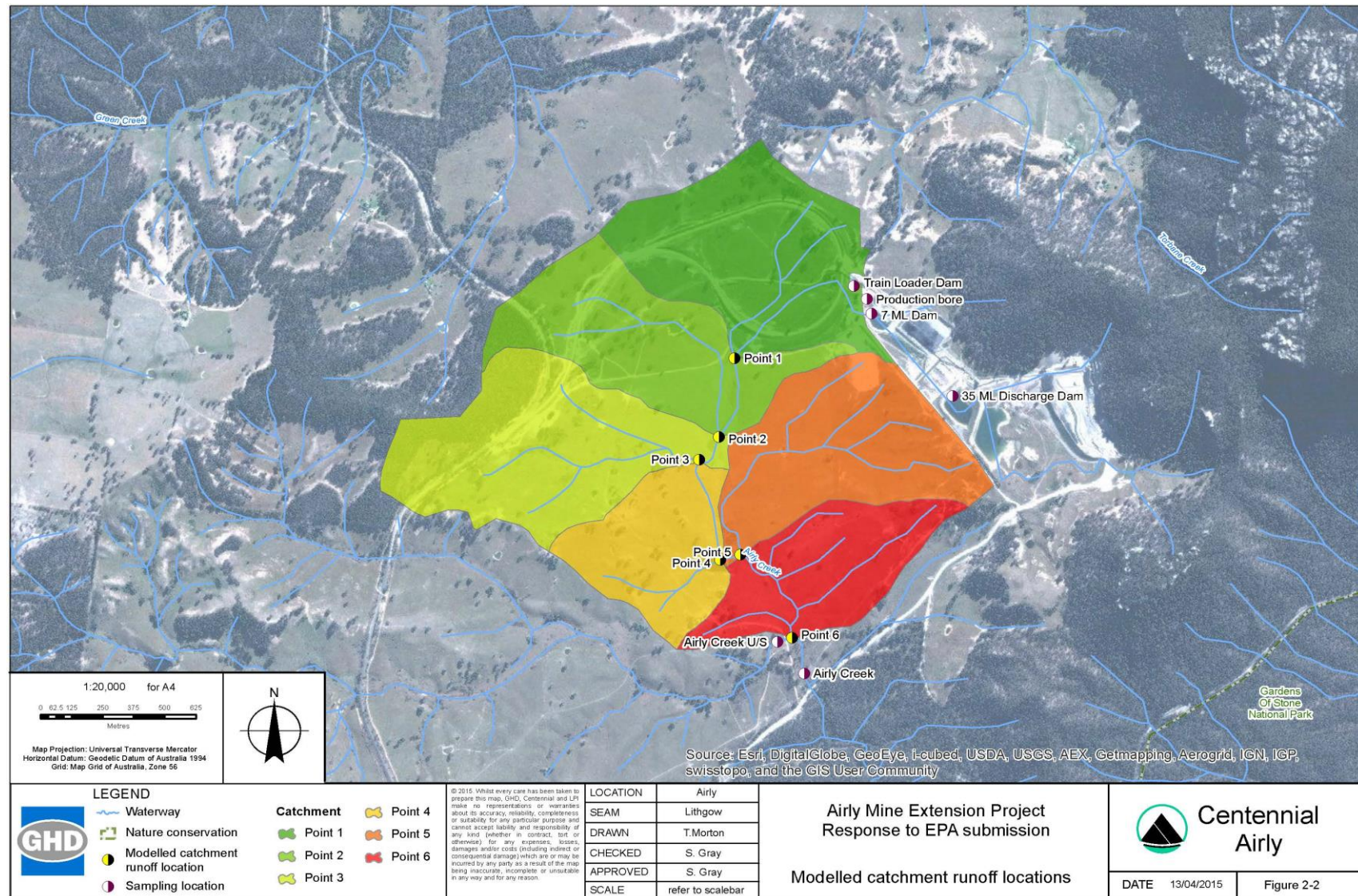


Figure 8: Airly Creek Monitoring Locations

APPENDIX 10 REHABILITATION PLANS

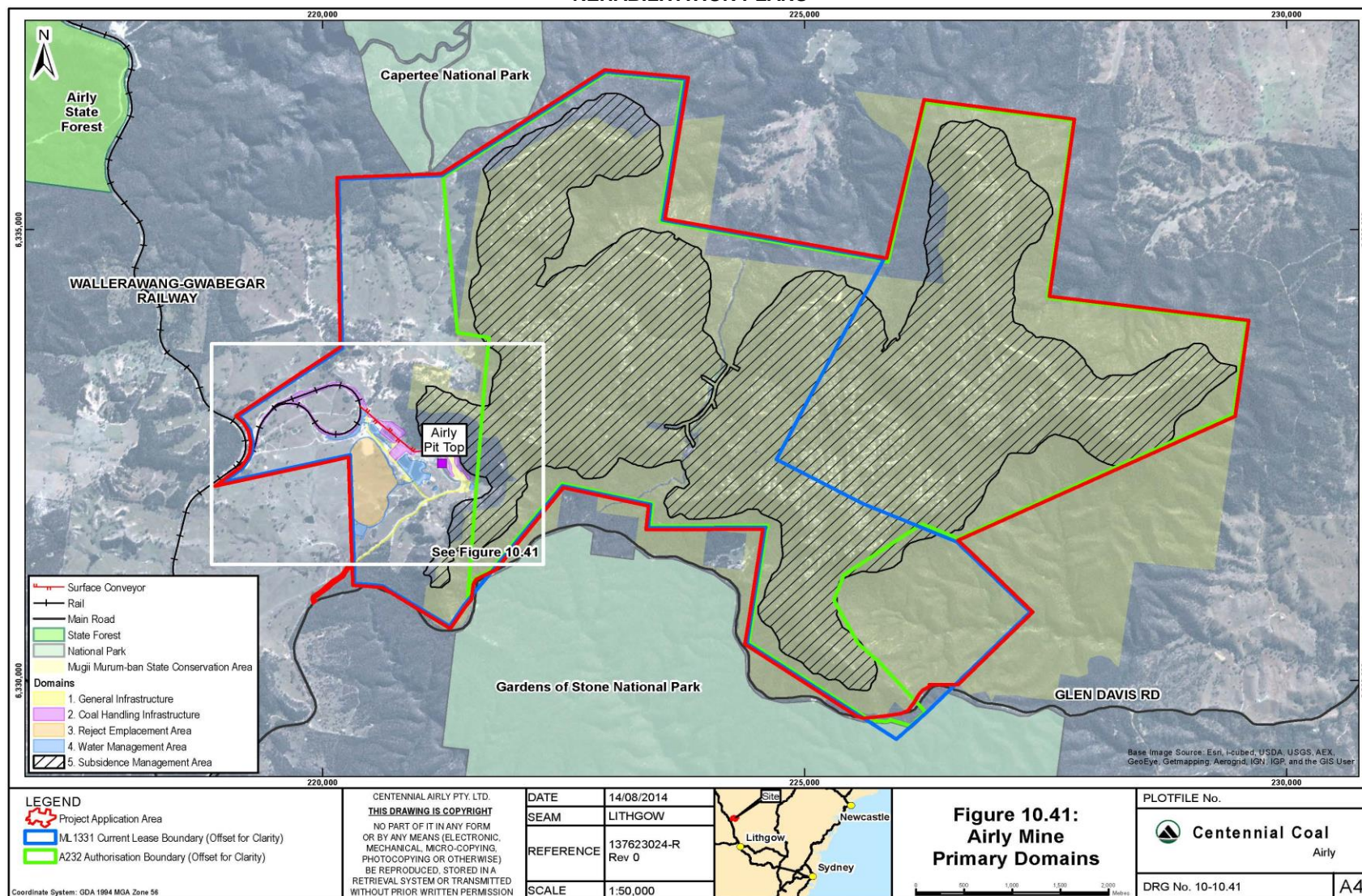


Figure 9: Primary domain rehabilitation plans

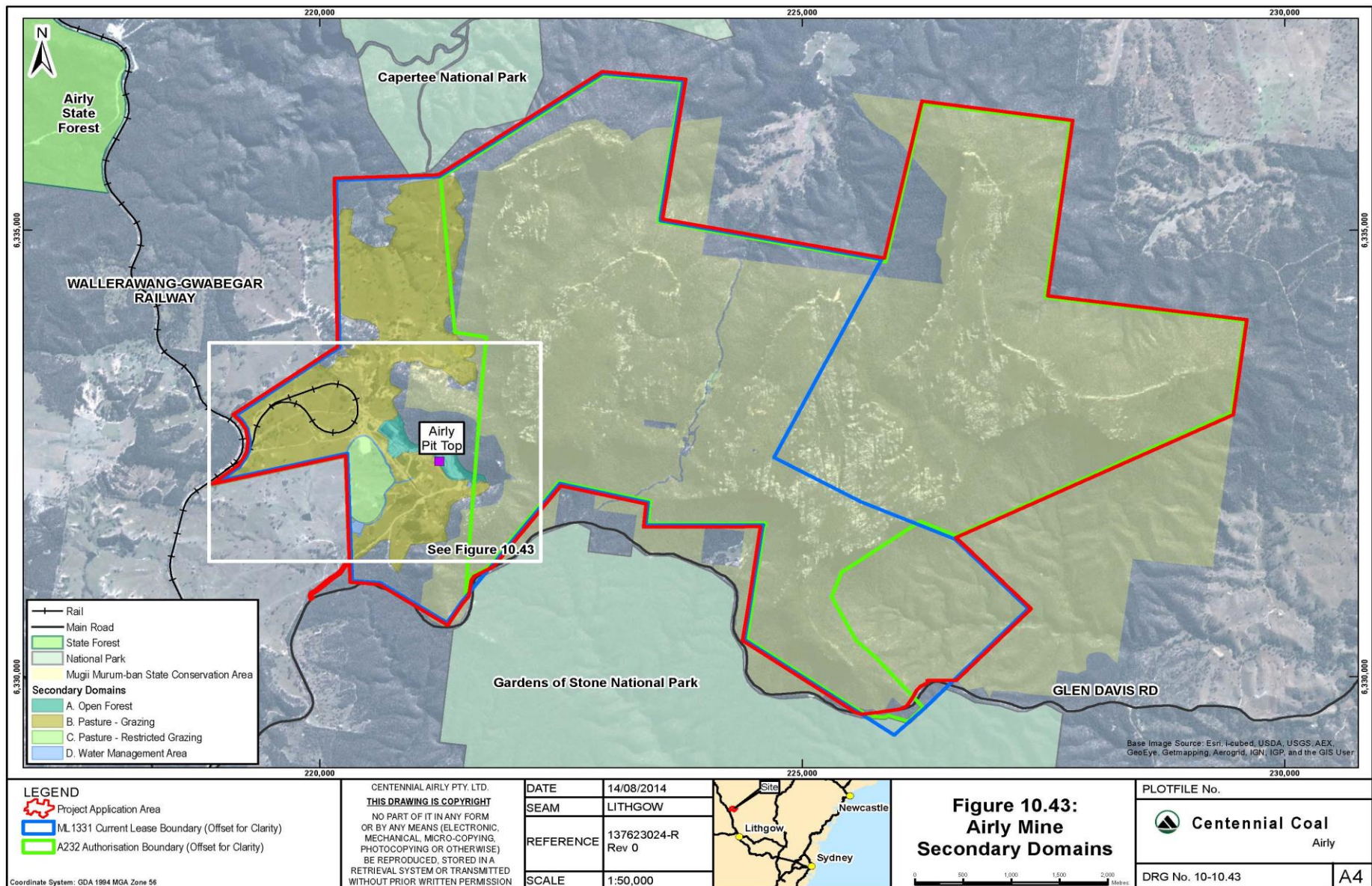


Figure 10: Final land use rehabilitation plan

INSTRUMENT OF RENEWAL

LEASE:	MINING LEASE NO 1331 (ACT 1992)
---------------	--

HOLDER:	CENTENNIAL AIRLY PTY LIMITED (ACN 078 693 722)
----------------	---

DATE OF LEASE:	12 OCTOBER 1993
-----------------------	------------------------

EXPIRY DATE OF LEASE:	12 OCTOBER 2014
------------------------------	------------------------

PERIOD OF RENEWAL UNTIL:	12 OCTOBER 2035
---------------------------------	------------------------

AREA:	2745 HECTARES
--------------	----------------------

AS SHOWN BY PLAN NO:	D7174
-----------------------------	--------------

SURFACE EXCEPTION:	PART 20 METRES
---------------------------	-----------------------

DEPTH RESTRICTION:	PART 20 METRES REMAINDER 900 METRES BELOW AHD
---------------------------	--

MINERALS:	COAL
------------------	-------------

ROYALTY PAYABLE:	At the rate which, from time to time, may be prescribed.
-------------------------	---

AMENDMENTS TO THE CONDITIONS OF THE LEASE:

- (a) All the Conditions contained in the lease prior to the renewal have been deleted.
- (b) The lease is now subject to the attached Mining Lease Conditions 2013 (Coal) numbered:
1 – 11 (inclusive)

Conditions 2 to 6 are identified as conditions relating to environmental management for the purposes of Section 378D of the *Mining Act 1992*.

Note: Conditions 2 to 6 of this mining lease are imposed pursuant to sections 238 and 239 of the Mining Act 1992. Clause 7 of Schedule 12 of the Mining Regulation 2010 saves higher penalties for a breach of condition imposed by or under sections 238 or 239 of the Act.

We, Centennial Airly Pty Limited (ACN 078 693 722), hereby accept the renewal of this Lease and agree to be bound by the conditions specified.



Tony Macko
Company Secretary

.....
CENTENNIAL AIRLY PTY LIMITED
(ACN 078 693 722)

Renewed this

8th

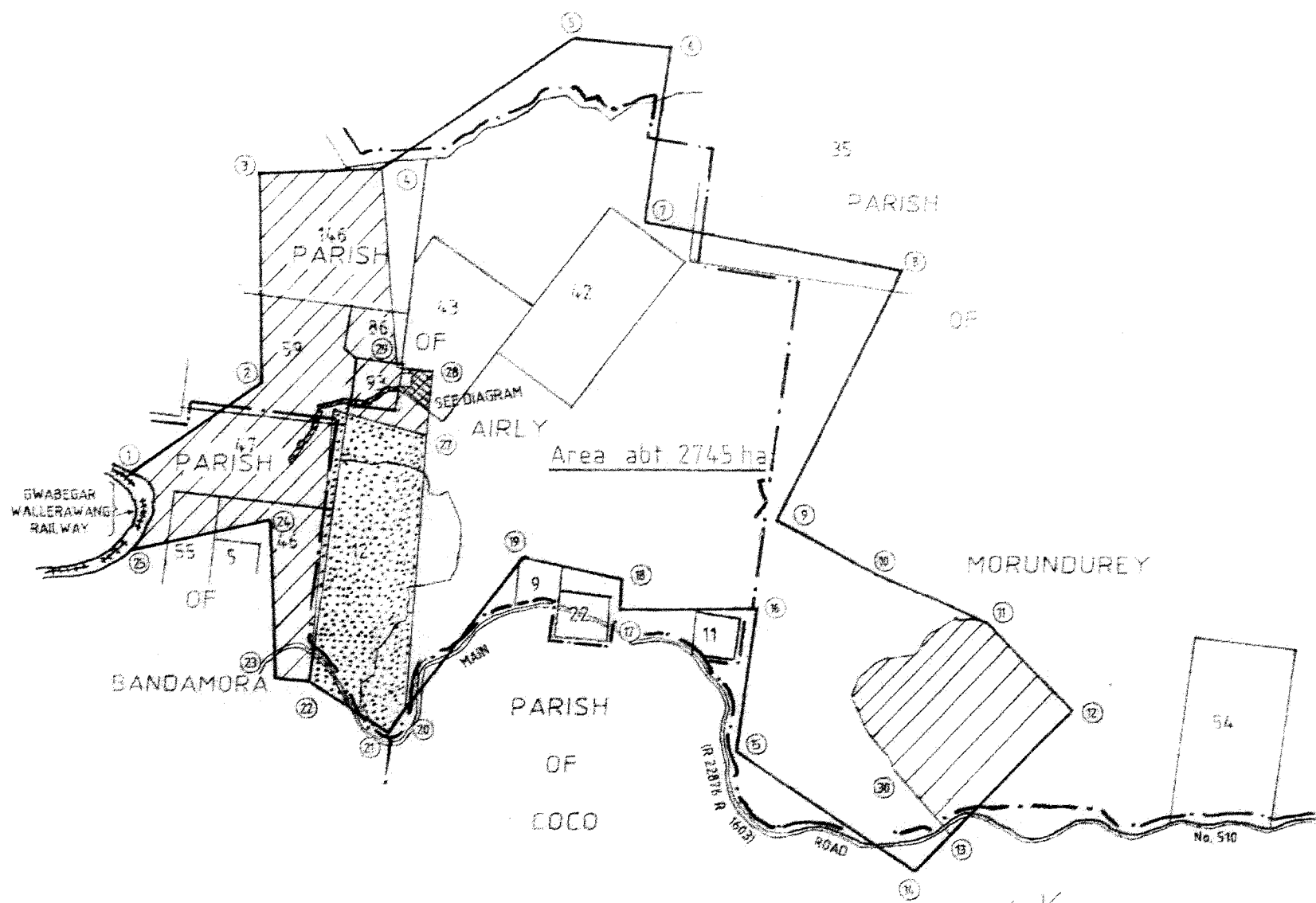
day of

May

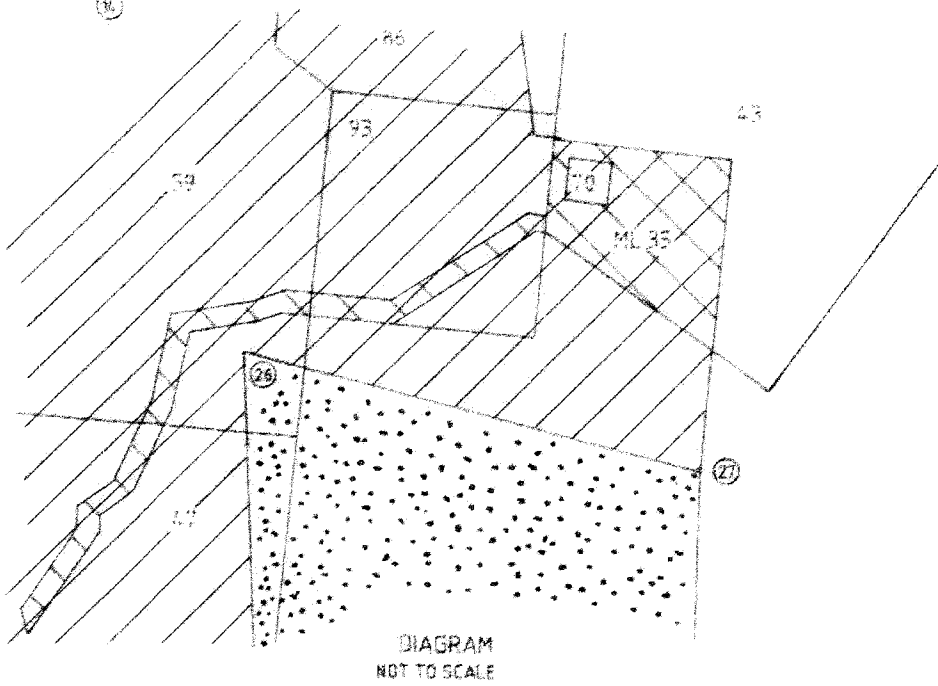
20 14



.....
MINISTER FOR RESOURCES AND ENERGY



I. S. G. COORDINATES ZONE 56/1					
COR.	EASTING	NORTHING	COR.	EASTING	NORTHING
1	205540	1335020	16	211060	1333720
2	206720	1335820	17	209850	1333740
3	206720	1337700	18	209880	1334000
4	207800	1337720	19	209000	1334220
5	209520	1338840	20	207960	1332920
6	210380	1338740	21	207800	1332680
7	210110	1337180	22	207100	1333150
8	212400	1336700	23	206800	1333180
9	211240	1334500	24	206780	1334600
10	212110	1334000	25	205550	1334340
11	213080	1333560	26	207360	1335560
12	213840	1332750	27	208180	1335320
13	212740	1331650	28	208240	1335880
14	212400	1331340	29	207920	1335940
15	210850	1332450	30	212240	1332250



DIAGRAM

Papers C 90 - 0581
 C.L. Application 242 at H.O.
 by NOVACOAL AUSTRALIA
 PTY LIMITED
 appn. 7-9-93
 Mineral: COAL
 Purpose Method: UNDERGROUND
 MINING LEASE No 1331 (Act 1992)

PARISH } AIRLY, COCO,
 COUNTY } BANDAMORA AND
 MORUNDUREY
 ROXBURGH

REF. MAP 2831-1-N,
 8931-4-N & 8931-4-S

- Surface Exception:
 Depth Restriction:
- * [Symbol] Excludes the surface and the land below thereof to a depth of 20 metres.
 - [Symbol] Includes the surface and the land below thereof to a depth of 20 metres
 - * [Symbol] Includes the surface and the land below thereof to unlimited depth.

Scale: 1:50000 Lengths in metres

[Symbol] Embraces the strata between the depths of 3 metres and 20 metres below the surface.

Notes
 * Title restricted to a maximum depth of 900 metres below Australian Height Datum.



Prepared *[Signature]* 26.08.93
 Examined *[Signature]* 26.8.93
 Approved *[Signature]* 30.8.93
 Authorised Officer

CATALOGUE No: D 7174

MINING LEASE CONDITIONS 2013

Definitions

- 1. Notice to Landholders**
- 2. Rehabilitation**
- 3. Mining Operations Plan and Annual Rehabilitation Report**
- 4. Compliance Report**
- 5. Environmental Incident Report**
- 6. Subsidence Management**
- 7. Resource Recovery**
- 8. Security**
- 9. Cooperation Agreement**
- 10. Environmental Protection Zones**
- 11. Second Workings**

Note: Exploration Reports (Geological and Geophysical)

Definitions:

Words used in this mining lease have the same meaning as defined in the *Mining Act 1992* except where otherwise defined below:

Act means the *Mining Act 1992*.

Department means the Division of Resources & Energy within the Department of Trade and Investment, Regional Infrastructure and Services.

Environment has the same meaning as in the *Protection of the Environment Operations Act 1997*.

Harm to the environment has the same meaning as in the *Protection of the Environment Operations Act 1997*.

Landholder for the purposes of these conditions does not include a secondary landholder and includes, in the case of exempted areas, the controlling body for the exempted area.

Material harm to the environment has the same meaning as in the *Protection of the Environment Operations Act 1997*.

Minister means the Minister administering the Act.

Pollution incident has the same meaning as in the *Protection of the Environment Operations Act 1997*.

MINING LEASE CONDITIONS 2013

1. Notice to Landholders

- (a) Within a period of three months from the date of grant/renewal of this mining lease, the lease holder must serve on each landholder a notice in writing indicating that this mining lease has been granted/renewed and whether the lease includes the surface. A plan identifying each landholder and individual land parcel subject to the lease area, and a description of the lease area must accompany the notice.
- (b) If there are ten or more landholders, the lease holder may serve the notice by publication in a newspaper circulating in the region where the lease area is situated. The notice must indicate that this mining lease has been granted/renewed; state whether the lease includes the surface and must contain a plan and description of the lease area. If a notice is made under condition 1(b), compliance with condition 1(a) is not required.

2. Rehabilitation

Any disturbance resulting from the activities carried out under this mining lease must be rehabilitated to the satisfaction of the Minister.

3. Mining Operations Plan and Annual Rehabilitation Report

- (a) The lease holder must comply with an approved Mining Operations Plan (MOP) in carrying out any significant surface disturbing activities, including mining operations, mining purposes and prospecting. The lease holder must apply to the Minister for approval of a MOP. An approved MOP must be in place prior to commencing any significant surface disturbing activities, including mining operations, mining purposes and prospecting.
- (b) The MOP must identify the post mining land use and set out a detailed rehabilitation strategy which:
 - (i) identifies areas that will be disturbed;
 - (ii) details the staging of specific mining operations, mining purposes and prospecting;
 - (iii) identifies how the mine will be managed and rehabilitated to achieve the post mining land use;
 - (iv) identifies how mining operations, mining purposes and prospecting will be carried out in order to prevent and or minimise harm to the environment; and
 - (v) reflects the conditions of approval under:
 - the *Environmental Planning and Assessment Act 1979*;
 - the *Protection of the Environment Operations Act 1997*; and

- any other approvals relevant to the development including the conditions of this mining lease.
- (c) The MOP must be prepared in accordance with the *ESG3: Mining Operations Plan (MOP) Guidelines September 2013* published on the Department's website at www.resources.nsw.gov.au/environment
- (d) The lease holder may apply to the Minister to amend an approved MOP at any time.
- (e) It is not a breach of this condition if:
 - (i) the operations which, but for this condition 3(e) would be a breach of condition 3(a), were necessary to comply with a lawful order or direction given under the *Environmental Planning and Assessment Act 1979*, the *Protection of the Environment Operations Act 1997*, the *Mine Health and Safety Act 2004 / Coal Mine Health and Safety Act 2002* and *Mine Health and Safety Regulation 2007 / Coal Mine Health and Safety Regulation 2006* or the *Work Health and Safety Act 2011*; and
 - (ii) the Minister had been notified in writing of the terms of the order or direction prior to the operations constituting the breach being carried out.
- (f) The lease holder must prepare a Rehabilitation Report to the satisfaction of the Minister. The report must:
 - (i) provide a detailed review of the progress of rehabilitation against the performance measures and criteria established in the approved MOP;
 - (ii) be submitted annually on the grant anniversary date (or at such other times as agreed by the Minister); and
 - (iii) be prepared in accordance with any relevant annual reporting guidelines published on the Department's website at www.resources.nsw.gov.au/environment.

Note: The Rehabilitation Report replaces the Annual Environmental Management Report.

4. Compliance Report

- (a) The lease holder must submit a Compliance Report to the satisfaction of the Minister. The report must be prepared in accordance with any relevant guidelines or requirements published by the Minister for compliance reporting.
- (b) The Compliance Report must include:
 - (i) the extent to which the conditions of this mining lease or any provisions of the Act or the regulations applicable to activities under this mining lease, have or have not been complied with;
 - (ii) particulars of any non-compliance with any such conditions or provisions,
 - (iii) the reasons for any such non-compliance;

- (iv) any action taken, or to be taken, to prevent any recurrence, or to mitigate the effects, of that non-compliance.
- (c) The Compliance Report must be lodged with the Department annually on the grant anniversary date for the life of this mining lease.
- (d) In addition to annual lodgement under condition 4(c) above, a Compliance Report:
 - (i) must accompany any application to renew this mining lease under the Act;
 - (ii) must accompany any application to transfer this mining lease under the Act; and
 - (iii) must accompany any application to cancel, or to partially cancel, this mining lease under the Act.
- (e) Despite the submission of any Compliance Report under (c) or (d) above, the titleholder must lodge a Compliance Report with the Department at any date or dates otherwise required by the Minister.
- (f) A Compliance Report must be submitted one month prior to the expiry of this mining lease, where the licence holder is not seeking to renew or cancel this mining lease.

5. Environmental Incident Report

- (a) The lease holder must notify the Department of all:
 - (i) breaches of the conditions of this mining lease or breaches of the Act causing or threatening material harm to the environment; and
 - (ii) breaches of environmental protection legislation causing or threatening material harm to the environment (as defined in the *Protection of the Environment Administration Act 1991*),

arising in connection with significant surface disturbing activities, including mining operations, mining purposes and prospecting operations, under this mining lease. The notification must be given immediately after the lease holder becomes aware of the breach.

Note. Refer to www.resources.nsw.gov.au/environment for notification contact details.

- (b) The lease holder must submit an Environmental Incident Report to the Department within seven (7) days of all breaches referred to in condition 5(a)(i) and (ii). The Environmental Incident Report must include:
 - (i) the details of the mining lease;
 - (ii) contact details for the lease holder;
 - (iii) a map identifying the location of the incident and where material harm to the environment has or is likely to occur;

- (iv) a description of the nature of the incident or breach, likely causes and consequences;
- (v) a timetable showing actions taken or planned to address the incident and to prevent future incidents or breaches referred to in 5(a).
- (vi) a summary of all previous incidents or breaches which have occurred in the previous 12 months relating to significant surface disturbing activities, including mining operations, mining purposes and prospecting operations under this mining lease.

Note. The lease holder should have regard to any relevant Director General's guidelines in the preparation of an Environmental Incident Report. Refer to www.resources.nsw.gov.au/environment for further details.

- (c) In addition to the requirements set out in conditions 5(a) and (b), the lease holder must immediately advise the Department of any notification made under section 148 of the *Protection of the Environment Operations Act 1997* arising in connection with significant surface disturbing activities including mining operations, mining purposes and prospecting operations, under this mining lease.

6. Subsidence Management

The lease holder must not commence or undertake underground mining operations that may cause subsidence of the surface other than in accordance with an Eligible Subsidence Management Plan approved by the Director-General.

For the purposes of this condition, an 'Eligible Subsidence Management Plan' means:

- (i) A Subsidence Management Plan prepared in accordance with current government guidelines for the preparation of Subsidence Management Plans; or
- (ii) Those parts of an Extraction Plan or another type of plan:
 - prepared, either in whole or in part, with reference to current government guidelines for the preparation of a Subsidence Management Plan; and
 - approved for the purposes of the *Environmental Planning and Assessment Act 1979* (or any planning legislation which replaces that Act) by the Minister or Director-General of the Department of Planning & Infrastructure, or another officer of that Department authorised to approve such a plan,
 which relate to issues of subsidence.

7. Resource Recovery

The lease holder must optimise recovery of the minerals that are the subject of this mining lease to the extent economically feasible.

8. Security

The lease holder is required to provide and maintain a security deposit to secure funding for the fulfilment of obligations of all or any kind under the mining lease, including obligations of all or any kind under the mining lease that may arise in the future.

The amount of the security deposit to be provided has been assessed by the Minister at **\$3,236,000**.

9. Cooperation Agreement

The lease holder must make every reasonable attempt, and be able to demonstrate its attempts, to enter into a cooperation agreement with the holder(s) of any overlapping title(s). The cooperation agreement should address but not be limited to issues such as:

- access arrangements
- operational interaction procedures
- dispute resolution
- information exchange
- well location
- timing of drilling
- potential resource extraction conflicts; and
- rehabilitation issues.

SPECIAL CONDITIONS

Note: The standard conditions apply to all mining leases. The Division of Resources & Energy (DRE) reserves the right to impose special conditions, based on individual circumstances, where appropriate.

10. Environmental Protection Zones

- (a) Before commencing to win or work any coal under Environmental Protection Zones designated on Plan ACP 1 and referred to in the Development Consent Condition 12(a), the registered holder shall notify the Chief Inspector of Coal Mines of his intention to do so and shall submit a plan of the system whereby such coal is proposed to be won or worked and shall obtain the written approval of the Chief Inspector of Coal Mines to such system.

No such coal shall be won or worked except in accordance with the system approved in writing by the Chief Inspector of Coal Mines as altered added to or omitted from as hereinafter provided. In connection with every such submission the registered holder shall do such acts and furnish such information as the Chief Inspector of Coal Mines may require. The Chief Inspector of Coal Mines may at any time cancel any approval to a system and may from time to time alter omit from or add to any system approved by him.

- (b) Mining is not to be conducted within the area referred to in Condition 10 (a) of this lease (Environmental Protection Zones, shown on ACP 1 map in Development Consent, based on Novacoal 1:8000 map of proposed coal lease, development consent area and protected zones dated December 1992) unless such mining will not adversely impact on the structural and visual significance of high, external cliffs and other major rock formations known as "pagodas" and "beehives", located within the Environmental Protection Zones. Any such mining conducted in the Environmental Protection Zones is to be as approved by the Chief Inspector of Coal Mines.

(High is defined as 20m or more change in elevation in any section with a slope greater than 75 degrees).

12. 11. Second Workings

- (a) Any application for second workings approval shall be accompanied by a detailed land form survey of the topography overlying the area of the application. Such survey will include and detail all cliffs which are 20 metres or higher and all major pagodas and beehives. A copy of such survey shall be provided to the New South Wales Department of Planning, the Council of the City of Greater Lithgow, the National Parks and Wildlife Service, and the special monitoring committee referred to in Development Consent Condition No. 31.
- (b) Initial applications for second workings approvals are to be made for relatively small and less sensitive areas within the lease. This is with a view to collecting site specific data from initial operations for use in subsequent approvals.
- (c) The registered holder shall, as far as is possible, adopt mining techniques and practices (consistent with optimising coal extraction outside of Environmental Protection Zones) which minimise disturbance to high internal cliffs and major “pagodas” and “beehives”.

Exploration Reporting

Note: Exploration Reports (Geological and Geophysical)

The lease holder must lodge reports to the satisfaction of the Minister in accordance with section 163C of the Mining Act 1992 and in accordance with clause 57 of the Mining Regulation 2010.

Reports must be prepared in accordance with Exploration Reporting: A guide for reporting on exploration and prospecting in New South Wales (Department of Trade and Investment; Regional Infrastructure and Services 2010).



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