Centennial Coal

SUBSIDENCE MANAGEMENT PLAN APPLCIATION

VOLUME 1 – SMP WRITTEN REPORT

Partial Extraction of Areas 700 West and 800

Clarence Colliery

November 2011

Centennial Coal
Environment Matters

EXECUTIVE SUMMARY

Clarence Colliery is an underground partial-pillar extraction coal mine located approximately 15 km east of Lithgow in the Western Coalfields of NSW. Operations at the mine commenced in 1979 and are now undertaken by Clarence Colliery Pty Ltd under a joint venture between Centennial Coal Ltd (85%) and SK Networks Resources Australia Pty Ltd (15%).

This report has been prepared as part of the application for Subsidence Management Plan (**SMP**) approval by Clarence Colliery Pty Limited (Clarence Colliery) to undertake partial extraction mining activities within the 700 West area (within Mining Lease (**ML**) 1583) and the 800 area (within ML 1583 and Consolidated Coal Lease (**CLL**) 705) (hereafter referred to as 700 West / 800 Areas).

The mining system for the proposed SMP Area is the partial-pillar extraction system which has been in place for the last twelve years carried out within ML 1583, CCL 705 and ML 1353. This system has been designed such that remnant pillars that remain within and between panels are long-term stable. Subsidence analysis results have proven this method of extraction results in extremely low levels of subsidence. Unlike full extraction mining, partial extraction minimises subsidence through leaving a proportion of the resource in situ. This provides support to the overlying strata, minimising the breakage and falling of the overburden and maintaining the integrity of the aquifers above. Within the proposed SMP Application Area, maximum vertical long-term subsidence is predicted to not exceed 100 mm (but may typically range from 20 - 30 mm), and is considered to be negligible. Modelling based on these results provides great confidence that further mining in the SMP Application Area using the partial pillar extraction method will have negligible impacts.

The mining of the 700 West / 800 Areas is enabled through an existing Development Consent (DA 504.00) previously approved in 2005. Clarence Colliery is seeking SMP approval from the Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (**DRE**) under the NSW Mining Act (1992), for partial extraction mining activities in 700 West / 800 Areas.

The entire surface of the 800 Area is within Crown Land, being the Forests NSW-managed Newnes State Forest. The 700 West Area also includes land managed by Lithgow City Council (**LCC**) and land owned by Boral Quarries as well as a small proportion of the three privately owned lots. The predominant land uses of the surrounding area include native hardwood and pine plantation harvesting and recreational activities such as bush walking, motorcycling and four wheel drive pursuits.

The 700 West Area includes part of the catchment area draining to the Lithgow No. 2 Dam which is a water supply dam for Lithgow. Built infrastructure above the 700 West Area includes the Lithgow No.2 Dam, transfer ponds, a powerline, telecommunications and other minor infrastructure. The entire 800 Area is managed by Forests NSW and the only infrastructure in the area is Forests NSW vehicle tracks and Clarence Colliery monitoring bores.

The potential impacts in the SMP Application Area have been determined through a process of risk assessment, subsidence prediction and specialist investigations. Whilst the SMP Risk Assessment found that the majority of the existing controls in place will adequately address the potential subsidence risks to significant natural and manmade features and infrastructure, Clarence Colliery engaged specialist consultants to undertake a review of the information relating to the SMP Application Area and assess potential impacts for the following key issues:

- Flora;
- Fauna;
- Archaeology;
- Cliff line and pagodas; and
- Groundwater resources.

Assessment was also undertaken to identify and assess any features within the SMP Application Area listed as '*Environmentally Sensitive Areas'* in Appendix B of the SMP Guidelines, 2003 (s6.6.3). Identified surface features include potential archaeological sites, Cliffs and Pagodas, Newnes Plateau Hanging Swamp (**NPHS**) and Newnes Plateau Shrub Swamp (**NPSS**). NPSS is listed as an Endangered Ecological Community (**EEC**) under NSW legislation. NPHS and NPSS together form a component of the federally listed Temperate Highland Peat Swamps on Sandstone (**THPSS**). Given the low levels of subsidence from previous mining at Clarence Colliery and the predicted maximum level of subsidence for the SMP Application Area, the risk of damage to natural and man-made surface features is considered to be negligible.

A Trigger Action Response Plan (**TARP**) has been developed for the SMP. The TARP establishes trigger levels which are used to monitor against predictions made within the SMP. The TARP also provides strategic management responses to monitoring results with a focus on response to results that exceed predictions or cause actual or potential impacts and consequences. The predicted subsidence was assessed as not posing a risk to public safety, and therefore in accordance with Section 7.3 of the SMP guidelines a separate Safety Management Plan was not required, however adequate provisions for public safety are included within the TARP. Recommendations from SMP investigations have been considered and included within the SMP TARP, which is included in Volume 2 of this SMP.

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1 INTRODUCTION

1.1 PURPOSE

This report has been prepared as part of the application for Subsidence Management Plan (SMP) approval by Clarence Colliery Pty Limited (Clarence Colliery) to undertake partial extraction mining activities within the 700 West area (within Mining Lease (**ML**) 1583) and the 800 area (within ML 1583 and Consolidated Coal Lease (**CLL**) 705) (hereafter referred to as 700 West / 800 Areas). **Figure 1** shows the regional setting of Clarence Colliery and extent of 700 West / 800 Areas.

Development consent (DA 504.00) approving mining was granted over the 700 West / 800 Areas in 2005 (**Appendix A**). In accordance with Condition 2, of Schedule 3, of DA 504.00, Clarence Colliery is required to have an approved SMP in place prior to extraction. The proposed mining within the 700 West / 800 Areas is not the subject of an existing SMP; therefore Clarence Colliery is seeking SMP approval from the Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (**DRE**) to undertake partial extraction mining activities in the 700 West / 800 Areas.

1.2 STRUCTURE OF SMP APPLICATION

This report is Volume 1 of the SMP Application, and is referred to as the SMP Written Report.

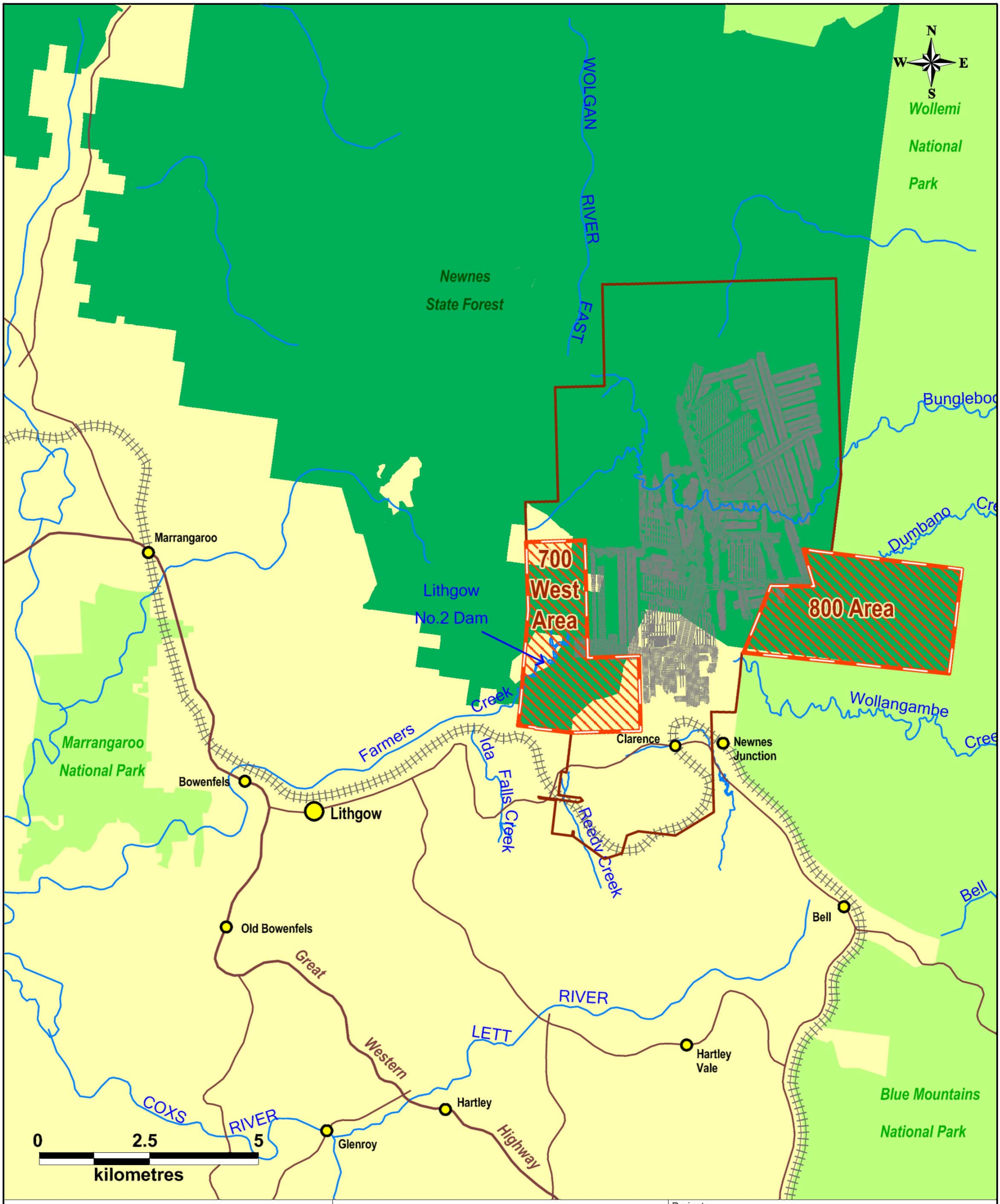
The SMP Application consists of:

- Letter of Application;
- SMP Written Report (SMP Application Volume 1);
- SMP (SMP Application Volume 2); and
- SMP Approved Plan, SMP Plans (1, 2, 3, 5, 6) and Aerial Photo.

1.3 PROJECT OVERVIEW

Clarence Colliery is an underground partial pillar extraction mine that commenced operations in 1979. Clarence Colliery has existing development approvals in place enabling production of three million tonnes per annum (**Mtpa**), but currently produces approximately two Mtpa. Coal is extracted from the Katoomba Coal Seam and there are reserves for approximately 30 years of operations at existing extraction rates. The mine is located approximately 15 kilometres (**km**) east of Lithgow (**Figure 1**) in the Western Coalfields of NSW. The mine entry and primary surface facilities are accessed from the Bells Line of Road. The mine employs approximately 180 people and is predominantly an export mine railing product coal to Port Kembla for shipping.

The mine entry and primary surface facilities within the existing Mining Leases (approx. 7735 hectares) are located in the Wollangambe River, Bungleboori Creek and Farmers Creek catchments, with a small area in the north west of the lease (approximately 20 hectares) draining to the Wolgan River.



LEGEND

- Colliery Holding Boundary
- Existing Workings Area
- SMP Application Area

FIGURE 1

Regional Location Plan

Version:	Date:	Author:	Checked:	Approved:
1	30/11/10	AR	SS	SS
2	24/03/11	AR	SW	BS
3	15/04/11	AR	SW	BS

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Environmental, Land and Project Management Consultants

Project: Clarence SMP - Partial Extraction of 700 West and 800 Areas

Client: Clarence Colliery

File: Fg1_CCC06-011_Location_110415

Projection: MGA 94 (Zone 56)

Clarence Colliery has existing SMP's approved by DRE (formally known as Industry and Investment NSW), which are described in **Section 1.6** and shown on **Figure 2**. SMP Approval is sought for two new areas, 700 West and 800 Areas, outside of the current SMP areas.

Clarence Colliery currently operates under a number of Mining Leases and Development Consents, which are listed in **Table 1** and **Table 2**, and shown on **Figure 3**. The existing consents relevant to this SMP Application are the original development consent DAM.08.76, as modified in 1993, development consent for the extension of mining in the north (DA 174/93) and the development consent DA 504.00 (refer to **Section 1.4**). The leases relevant to this SMP Application are the CCL705 and ML1583. Clarence Colliery also operates under the Environmental Protection License No.726 under the *Protection of the Environment Operations Act 1997*.

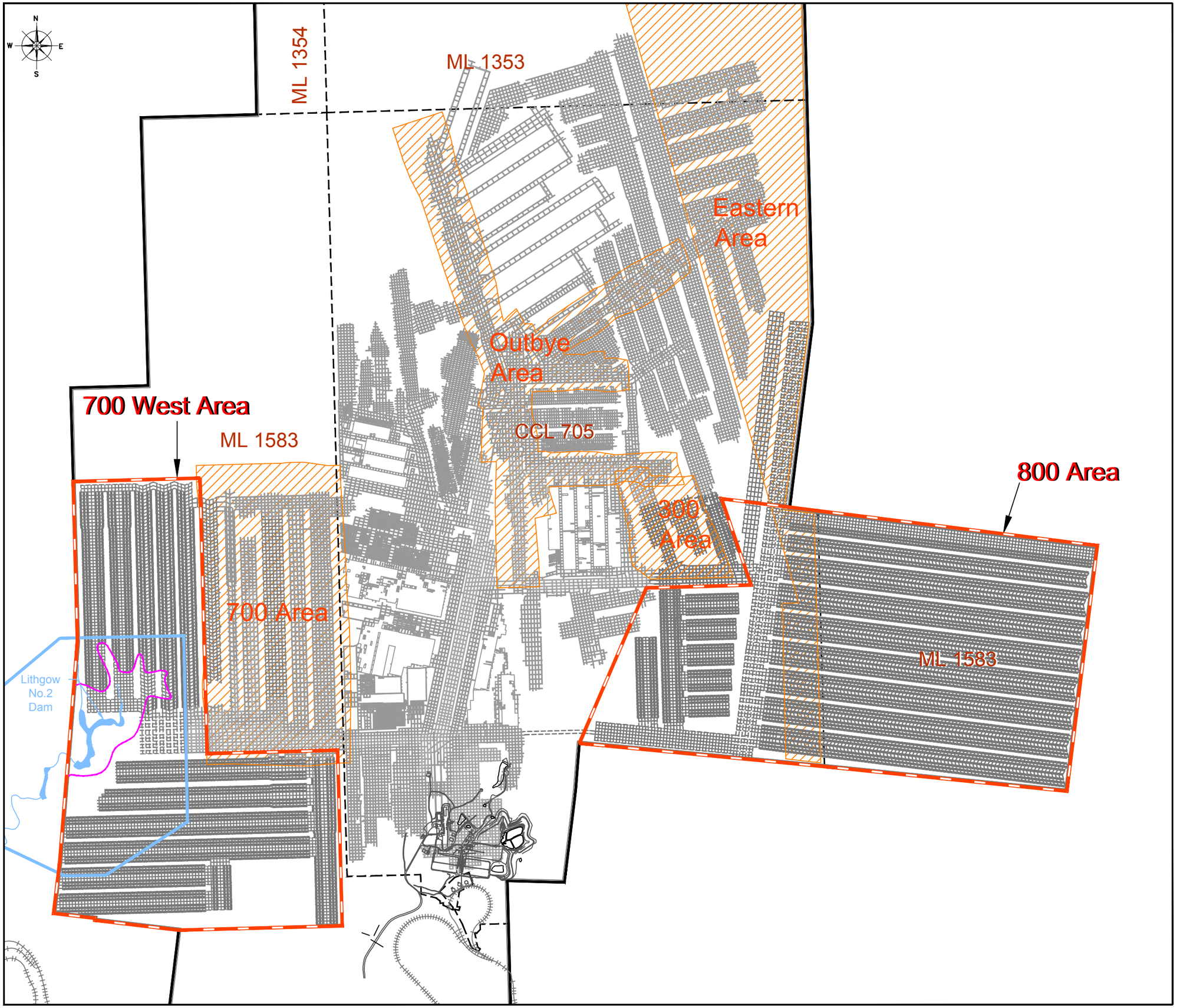
Clarence Colliery initially operated as a bord and pillar mine. In 1992, longwall mining was introduced; however this proved unsuccessful due to the unfavourable geological and geotechnical conditions of the strata overlying the Katoomba Seam within the Lease area. Centennial Coal Company Ltd purchased the mine in 1998 and introduced partial extraction mining techniques to minimise adverse goaf edge conditions (common with full extraction at Clarence Colliery), surface subsidence and aquifer impacts, whilst maximising resource recovery and mine productivity.

The mining partial pillar system has traditionally consisted of a seven heading panel layout with 24.5 or 27.5 metre (**m**) (depending on depth of cover) solid spine pillars, remnant pillars with a minimum 40 m barrier of solid coal retained on either side of the extraction panel to support the roof. Mining height is set at a maximum of 3 m. To date this mining system has not resulted in subsidence greater than 100 millimetres (**mm**). Actual measured subsidence values in panels complying with the design parameters have typically been around 30 mm or less with associated average tilts and strains both in the order of 0.2 mm/m. In normal panel layouts, readings as high as 40 mm have been measured around gully features possibly due to the notching effect of the gully changing the overburden beam characteristics. During a review of historical subsidence carried out for this SMP application, it was found that subsequent flooding of workings has increased subsidence; however the extent of this increase has not exceeded the 100 mm performance criteria. There have been no identified impacts on any surface features from partial extraction to date (SEA, 2011a).

Partial extraction minimises subsidence through leaving a proportion of the resource in situ. This provides support to the overlying strata, minimising the breakage and falling of the overburden and maintaining the integrity of the aquifers above. Clarence Colliery is proposing to leave approximately 50 % of the coal resource in situ.

Substantial underground and surface monitoring of the performance of the seven heading mining layout over a period of eleven years have given Clarence Colliery great confidence in predicting subsidence impacts. Accordingly, Clarence Colliery has collected much data regarding the performance of its mining activities through the careful design and subsequent collection of data from its underground, subsidence and environmental monitoring programs. This has shown that subsidence has never exceeded 100 mm of vertical subsidence and tilts are strains have never exceeded 2 mm/m.

Whilst the traditional partial pillar mining technique has been based on a seven heading layout, Clarence Colliery also proposes to employ a relatively new technique using a flexible conveyor train (**FCT**). The use of the FCT in a five heading layout has already been approved as per the 700 Area SMP approval. However, Clarence Colliery proposes the use of a combination of the FCT in both a five heading layout and seven heading layout, along with traditional seven heading layouts for panels in the 700 West and 800 Area.



LEGEND

- Colliery Holding Boundary
- Mining Lease Boundary
- Lithgow No.2 Dam Notification Area
- SMP Application Area
- First Workings Zone (for Lithgow No.2 Dam)
- Existing Workings Area
- Proposed Workings Area (incl. Secondary Extraction)
- Previously Approved SMP Boundaries

0 1.0 2.0km

Scale 1:35 000 (A3)

FIGURE 2

Regulatory Plan for 700 West and 800 Areas - ML/CCL and SMP Boundaries

Project:
Clarence SMP - Partial Extraction of 700 West and 800 Areas

Client:
Clarence Colliery

File:
Fg2_CCC06-011_700-800Areas_ML-SMP_110729

Projection:
MGA 94 Zone 56

Version:	Date:	Author:	Checked:	Approved:
1	03/02/11	AR	SS	SS
2	24/03/11	AR	SW	BS
3	15/04/11	AR	SW	BS
4	24/04/11	AR	SW	BS
5	29/07/11	LH	SW	BS

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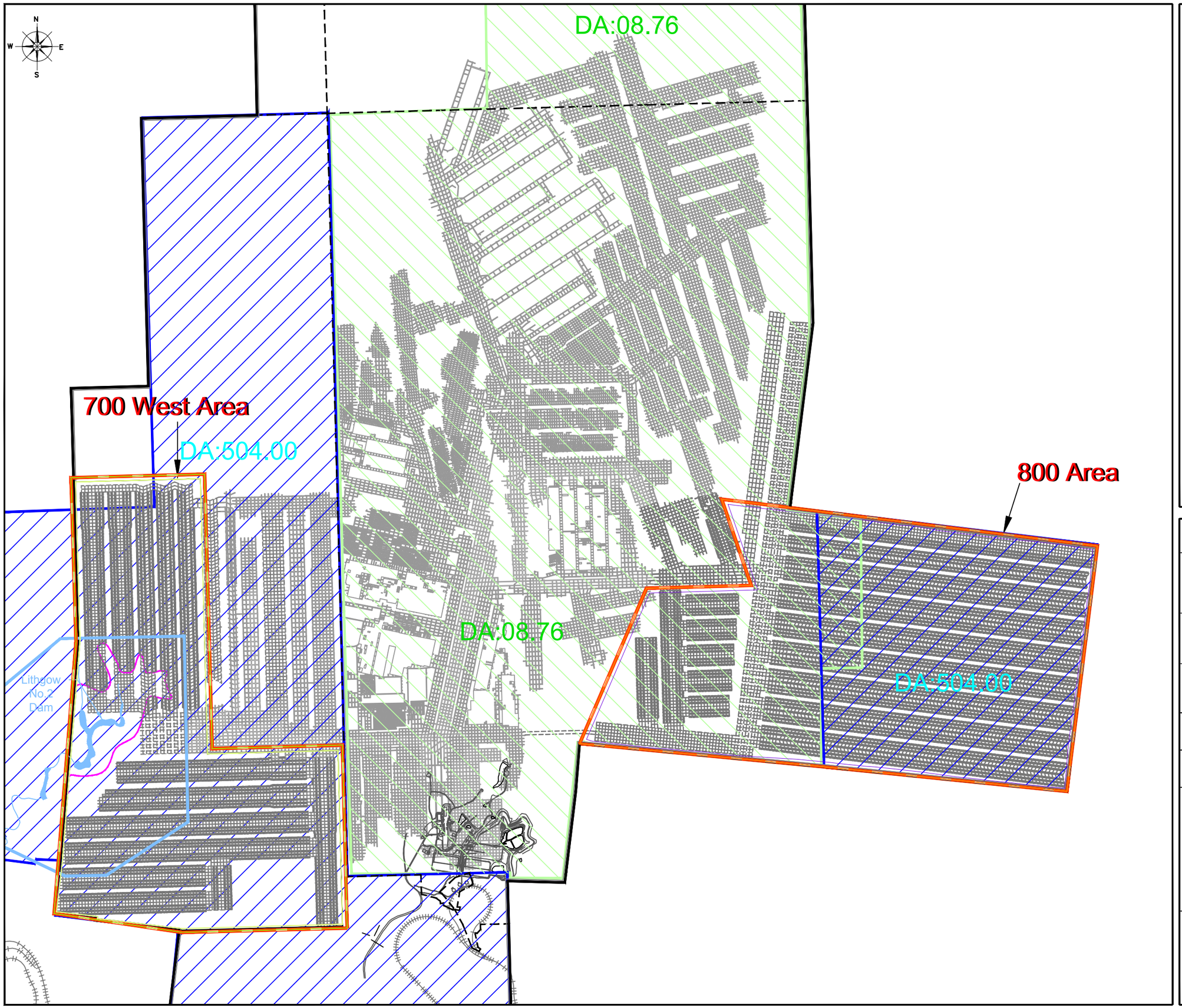

LEGEND

- Colliery Holding Boundary
- Mining Lease Boundary
- Lithgow No.2 Dam Notification Area
- SMP Application Area
- First Workings Zone (for Lithgow No.2 Dam)
- Existing Workings Area
- Proposed Workings Area (incl. Secondary Extraction)
- DA 08.76 Boundary
- DA 504.00 Boundary
- 700 West Angle of Draw
- 800 Area Angle of Draw

0 1.0 2.0km

Scale 1:35 000 (A3)

FIGURE 3

Regulatory Plan for 700 West and 800 Areas - DA Boundaries

Project:
Clarence SMP - Partial Extraction of 700 West and 800 Areas

Client:
Clarence Colliery

File:
Fg3_CCC06-011_700-800Areas_DA_111025

Projection:
MGA 94 Zone 56

Version:	Date:	Author:	Checked:	Approved:
1	03/02/11	AR	SS	SS
2	24/03/11	AR	SW	BS
3	15/04/11	AR	SW	BS
4	24/04/11	AR	SW	BS
5	29/07/11	LH	SW	BS
6	19/09/11	LH	RW	RW
7	25/10/11	Z□	RW	RW

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1.4 DEVELOPMENT CONSENT

A summary of Development Consents applicable to Clarence Colliery is presented in **Table 1**.

Table 1 Clarence Colliery Development Consents

Approval	Granted	Summary of Consent
Original Development Consent (DAM.08.76) (Blaxland Shire Council)	15/06/1976	Approval of building plans, landscaping, operations in accordance with the EIS, Collection Dam as well as compliance with other State Government Department Conditions.
Amended Development Consent (5161/20000000/0) (Lithgow City Council)	1/07/1993	Amended consent. Underground Coal Mine, Reject Emplacement Areas and Associated Pit Top Facilities.
Development Consent (DA174/93) (Lithgow City Council)	15/02/1994	Development application. Extension of underground coal mining within ML 1353 and 1354.
Development Consent (DA 504-00) (Department of Planning)	19/12/2005	Partial Extraction in Lease Extension Area ML1583.

The existing consents relevant to this SMP Application are the original development consent (DAM.08.76) (Blaxland Shire Council), as modified in 1993, and the development consent (DA 504.00) (Department of Planning). A copy of the relevant development consents is attached as **Appendix A**. Relevant conditions from these approvals relating to this SMP Application are included in **Section 10**.

It is noted that there is a small area in the north-western corner of the 700 West area that lies outside of the DA:504.00 approval area but forms a part of the ML 1583. This is a misalignment of boundaries between ML 1583 and DA 504.00. This should not affect the SMP application process, however, Clarence Colliery will be required to extend the development approval boundary so that it aligns with the Mining Lease Boundary prior to the commencement of mining in that area. Legal advice will be sought regarding the approval pathway to enable this to occur, however it is likely to be a modification to the existing DA 504.00.

1.5 MINING LEASES

The Clarence Colliery underground mine is accessed through CCL705 into ML1353, ML1354 and ML1583. Partial extraction is currently undertaken in CCL705 and ML1583. A summary of Mining Leases for Clarence Colliery is presented in **Table 2**.

Table 2 Clarence Colliery Mining Leases

Primary Facility (underground)	Grant Date	Expiry Date	Area (ha)	Lease Holder
Consolidated Coal Lease 705	20/12/2005	20/12/2026	~3174	Coalex Pty Ltd & Clarence Coal Investments Pty Ltd
Mining Lease 1353	21/07/1994	21/07/2015	1075	Coalex Pty Ltd & Clarence Coal Investments Pty Ltd
Mining Lease 1354	21/07/1994	21/07/2015	155.3	Coalex Pty Ltd & Clarence Coal Investments Pty Ltd
Mining Lease 1583	09/07/2006	09/07/2027	~3331	Coalex Pty Ltd

The leases relevant to this SMP Application are CCL705 and ML1583. A copy of CCL705 and ML1583 are attached as **Appendix A.** Relevant conditions relating to this SMP Application are included in **Section 10**.

1.6 OTHER SMP's AND EXTRACTION APPROVALS

Clarence Colliery has four SMP's approved by the DRE which do not encompass mining within 700 West / 800 Areas. Details of the SMP's are shown in **Table 3**.

Table 3 Current SMPs and Extraction Approvals

Approval	Date Approved	Expiry	Panels
06/0997 (Eastern Area SMP)	27 July 2006	1 June 2013	611 (A - I), 612 (A, B), 613 – 616, 618, 620, 341, 342 and 346
Outbye Area	30 January 2009	1 January 2010	602 only
06/0997 (Outbye Area)	8 May 2009	1 May 2014	302, 305, 306, 307, 400, 403 and 406
06/0997 (700 Area)	8 May 2009	1 May 2014	700, 702, 704, 706, 708, 710 and 712
Panel 314/316	19 February 2010	1 February 2015	314, 316

The area covered by the Eastern Area SMP overlaps with the proposed 800 Area. A variation of the Eastern Area SMP will be obtained to remove the overlap of SMP areas.

1.7 SMP GUIDELINES

Clarence Colliery has prepared this SMP Application in accordance with the *Guideline for Applications for Subsidence Management Approvals* (SMP Guidelines) published by the Department of Primary Industries - Mineral Resources (2003) (now DRE). In preparing this SMP Application, Clarence Colliery has been guided by the SMP Guidelines with respect to keeping the SMP Application relevant and "*appropriate to the nature and scale of potential subsidence impacts*".

To better facilitate reference to the SMP Guideline, the report and corresponding guideline references are correlated below in **Table 4**.

Table 4 SMP Guideline Requirements

Item	Guideline Reference	Report Reference
Mining system, recovery, statutory requirements, expected subsidence, potential subsidence impacts	Section 6.1	Section 3
Application area description	Section 6.2	Section 2
Mining method, system, seam details, recovery, other seams	Section 6.3	Section 3 & 4
Site conditions, cover, stratigraphy, lithology, geology	Section 6.4	Section 4
Stability of workings, working height, detail of lithology, geotechnical, geology	Section 6.5	Section 4 & 5
Surface structures, natural features, monitoring, identification	Section 6.6	Section 7
Subsidence predictions, individual features subsidence	Section 6.7	Section 6
Community consultation	Section 6.8	Section 9
Legislation, approvals, licences	Section 6.9	Section 10
Subsidence impacts, impacts of increased subsidence	Section 6.10	Section 7 & 8
Risk assessment and summary	Section 6.10	Section11
Proposed SMP	Section 6.7	Volume 2 (SMP)
Plans	Section 9	Accompanying
Approved Plan	Section 10	Accompanying

1.8 THE APPLICANT

Clarence Colliery Pty Ltd (**Clarence Colliery**) is a joint venture company owned 85% by Centennial Coal Company Limited and 15% by SK Networks Resources Australia Pty Ltd. The Centennial Coal Company Limited share is comprised of a number of wholly owned subsidiaries including Coalex Pty Ltd (a 51% share), Clarence Coal Investments Pty Ltd (a 29% share) and Japan Energy Australia Pty Ltd (a 5% share). Clarence Colliery operates the existing underground Clarence coal mine (Clarence), near the village of Clarence in NSW, for and on behalf of the joint venture company who own it.

Clarence Colliery ("the Applicant") manages the mine.

1.9 COMMUNITY CONSULTATION

Clarence Colliery has applied the *Guidelines for Best Practice Community Consultation in the New South Wales Mining and Extractive Industries* developed by the NSW Minerals Council (2006), throughout the SMP Application process.

Clarence Colliery has undertaken consultation with the land owner, local community, Aboriginal groups, the local and state government authorities and other relevant stakeholders in preparation of the SMP. A detailed stakeholder consultation log was kept during the preparation of the SMP as a record of the consultation undertaken by Clarence Colliery. A summary of the consultation undertaken is included in **Section 9**.

The consultation to be undertaken during the mining of 700 West / 800 Areas is described in the SMP (Volume 2).

1.10 SUBSIDENCE IMPACTS

The potential impacts in the SMP Application Area have been determined through a formal risk assessment, subsidence predictions and other specialist assessments.

The risk assessment concluded that the majority of the existing controls in place will adequately address the potential subsidence risks to significant natural and manmade features and infrastructure. Existing controls include mine design, management plans and monitoring programs developed over the years in accordance with the existing approvals. The most important subsidence control at Clarence Colliery is the mining technique that inherently controls subsidence by virtue of its design. Despite this, Clarence Colliery engaged specialist consultants to undertake a review of the information relating to the SMP Application Area and assess impacts from partial extraction for the following key issues:

- Flora and fauna;
- Archaeology;
- Cliff line and pagoda; and
- Groundwater resources.

In addition, Clarence Colliery carried out a detailed review of subsidence monitoring (and therefore mining performance) over the last 12 years. This has provided Clarence with a high level of confidence in not only subsidence modelling and predictions but also mining performance and development of subsidence. Subsidence predictions and impacts for these features are addressed in **Section 6**.

2 THE APPLICATION AREA

2.1 SMP APPLICATION AREA

The SMP Application Area for 700 West / 800 Area (SMP Application Area) has been defined using the surface area within the CCL705 and ML 1583 boundaries and includes a 10 degree angle of draw from the limit of proposed mining. A specific assessment has been carried out by Strata Engineering Australia Pty Ltd (**SEA**) regarding a site specific angle of draw at Clarence (**Appendix B**). Over 12 years of subsidence data was used in the evaluation. The analysis showed that it is well below the guidelines of 26.5 degree angle of draw. The maximum angle of draw reliably recorded to date is 5.9 degrees for the V Line beyond the northern boundary of 611E Panel (SEA, 2011a). The analysis showed that previous monitoring of subsidence to date has shown that most commonly, there is no external angle of draw, and that subsidence tends to reduce to <20 mm within the panel boundary. To add a level of conservatism, a site specific angle of draw of 10 degrees has been used for this SMP application.

The SMP Application Area is shown in **Figure 2** and **Figure 3**.

2.2 MINE AREA, PROPERTY DESCRIPTION AND MINING TITLES

The 700 West / 800 Areas are contained within CCL705 and ML 1583. The location of these areas with respect to the leases is presented in **Figure 2**.

The SMP Application Area is located within the Newnes State Forest, Parishes of Clywdd, County of Cook and the Lithgow City local government area.

2.3 LAND USES AND LAND OWNERSHIP

The entire surface of the 800 Area is within Crown Land, being the Forests NSW managed Newnes State Forest. The 700 West Area also includes Crown land and land managed by Lithgow City Council and land owned by Boral Quarries. The SMP application area also includes a small proportion of three privately owned lots of land which lie on the boundary of the southern border of the 700 West Area. Two of these lots will not be directly undermined. The third lot of land owned by Zig Zag Rail Co-op Ltd is proposed to be undermined by Panel 701a currently scheduled to be extracted more than 10 years away. Further and ongoing consultation will be undertaken with the relevant persons at Zig Zag Railway prior to any mining activities taking place. Land Ownership is shown in **Plan 5**.

The predominant land uses of the surrounding area include native hardwood harvesting, pine plantations and recreational activities such as bush walking, motorcycling and four wheel drive pursuits. The surrounding area is also a declared hunting area

The 700 West Area includes part of the catchment area draining to the Lithgow No. 2 Dam which is a water supply dam for Lithgow. Built infrastructure above the 700 West Area includes the Lithgow No.2 Dam, transfer ponds, a powerline, telecommunications, an access track associated with the Zig Zag Railway and other minor infrastructure.

The 800 Area is managed by Forests NSW and the only infrastructure in the area is Forests NSW vehicle tracks and Clarence Colliery monitoring bores.

The Clarence Colliery Lease borders the Blue Mountains National Park (**BMNP**), Wollemi Wilderness Area (**WWA**) and the Greater Blue Mountains World Heritage Area (**GBMWHA**), to the east. The BMNP, WWA and GBMWHA overlap where they border the mining leases. The SMP Application Area is located outside of the boundaries of the BMNP, WWA, and GBMWHA.

3 MINING SYSTEM AND RESOURCE RECOVERY

3.1 PROPOSED MINING METHOD

At Clarence Colliery the immediate roof to the working horizon is strong sandstone within the Caley Formation. Previous experience has shown that total extraction methods (such as longwall mining) can be problematic due to the strong roof, which does not cave predictably. Partial extraction methods however have been successful at Clarence Colliery, and are proposed for the 700 West / 800 Areas. The partial extraction mining system traditionally involves the use of continuous miners, and the partial extraction panels are traditionally formed by the development of several heading and associated cross drives (cut throughs) forming “pillars”. Partial extraction involves the “part removal” of these pillars from the panel. Pillars adjacent to the conveyor belt road are left intact for stability.

The design of the proposed partial extraction mining systems has been prepared by Strata Engineering (Australia) Pty Ltd (**SEA**). The conceptual mine plan involves the use of a combination of flexible conveyor train (**FCT**) in a five and seven heading layout and traditional seven heading layouts. **Appendix B** contains a number of documents from SEA that detail the mining method, predicted subsidence and pillar stability for proposed panels in the 700 West / 800 Area.

The proposed mining of the 700 West / 800 Area will use partial extraction mining methods already established and in use at Clarence Colliery, incorporating a similar design philosophy for subsidence control as used in the 700 Area, the Outbye Area, and Eastern Area SMP layouts. Subsidence related impacts are prevented through the proposed partial extraction mining systems for 700 West / 800 Areas, which are designed to maintain subsidence levels to less than 100 mm. Coal retained in situ is designed to have sufficient strength (or Factor of Safety) to enable spanning of the overlying strata.

Long term panel stability will be further enhanced by a reduction in mining height in some areas of the 700 West area due to seam thinning. The normal seam extraction height at Clarence Colliery is 3 m, however in some panels the extraction will be reduced to 2.8 m with a seam height extraction minimum of around 1.8 m (due to coal seam height) in the southern portion of the 700 West Area.

The rationale underpinning the panel layout and the associated partial extraction system may be summarised as follows:

i. The 40 m (minimum, solid width) barrier pillars have a width to height (**w/h**) ratio of ≥13 and would be commonly regarded as indestructible.

ii. The central spine pillars have w/h ratios of ≥8 and are also very strong and stiff, also regarded as indestructible.

iii. The remnant pillars are not insignificant in size (a minimum w/h ratio of 5) and provide considerable support, at least to the immediate overburden.

iv. The sandstones dominating the overburden at Clarence have considerable spanning and associated load transfer potential. Therefore, during extraction some of the load carried by the stripped pillars is transferred to the stiffer barrier pillars and spine pillars.

v. This spanning ability of the overburden is enhanced by the maintenance of subcritical span to depth ratios. Sub-panel width to depth ratios are typically much less than 50%, such that subsidence principles indicate natural arching of the overburden, significant load transfer and greatly restricted potential for any surface deformation (i.e. subsidence).

vi. As depth reduces, although the spanning capability of the overburden diminishes and width to depth ratio increases, the stability of the in-pillars and in particular the remnants steadily improves and the reliance on load transfer diminishes. The system is therefore effectively self-regulating.

The system provides the following major advantages to the mine:

i. The elimination of any appreciable caving, with post-extraction roof collapses limited to the nether roof in the immediate extraction areas (which are only 16.5 m wide). Heights of localized falls are typically <1 m and fall heights of >6 m are unknown (falls tending to be more common in areas of geological structure).

ii. The elimination of caving greatly reduces water ingress from overlying aquifers.

iii. No adverse surface impacts, which has become a major issue for all stakeholders in recent years. In particular, there is no evidence of surface cracking or mining related rock-falls.

iv. A simple, productive system of work with restricted extraction spans and a controlled loading environment lends itself to enhanced safety, particularly with respect to the maintenance of consistent roof conditions at the goaf edge. This contrasts with the periodic weighting difficulties and goafing events associated with previous total extraction operations at the mine.

This system has now been in use for twelve years, having commenced in 605 Panel, without any evidence of large-scale underground instability. This in itself is an important statistic, as the median time to failure for pillar collapses is five years from mining.

3.2 MINE LAYOUT

The 700 West area is the westward and southward extension of the existing 700 area, at depths ranging from a maximum of 290 m in the east to 100 m in the far south-west and in the vicinity of Lithgow No.2 Dam. There is no mining planned within 400 m of the dam wall, and only limited development (i.e. first workings only) along the northern margin of the water body. The 700 West area will primarily consist of conventional seven heading panels, with the exception of panels 714 to 718 which will be five heading FCT layouts.

The 800 area is the eastward extension of the current 300/600 series area. Depth ranges from a minimum of around 170 m along parts of the northern boundary to 290 m in the central plateau area, and then reduces again to approximately 150 m in the south-west and south-east limits. The most notable feature in the 800 area is Gooches Crater; only first workings are planned beneath this feature.

The 800 area will consist of mainly seven heading FCT panels, similar to the conventional 33 m centres layout and produces acceptable panel stability and subsidence outcomes to the maximum depth of 290 m. The optimised seven heading FCT panel layout involves slightly increasing the pillar length to 35 m with no change to the barrier width of 40 m.

One five heading FCT panel is planned in the 800 area; this layout is similar to those employed in 700 area and produces acceptable panel stability and subsidence outcomes. The optimised five heading FCT panel layout for the 800 area primarily involves an increased pillar length of 34 m with no change to the barrier width of 40 m.

There is also a limited number of conventional seven heading panels planned, primarily in the 313 Panel area; and these panels will be standardised on 33 m centres. Finally, there is one conventional seven heading panel on 30 m centres planned to run along the northern boundary of the 800 area; with only limited partial extraction of this panel planned (i.e. along the three headings on the right hand side of the belt road only). It is noted that pillars designed to 30 m centres only occurs where the depth of cover is less than 265 m.

The general layouts for the different heading layouts proposed are shown in **Figures 4 – 8.**

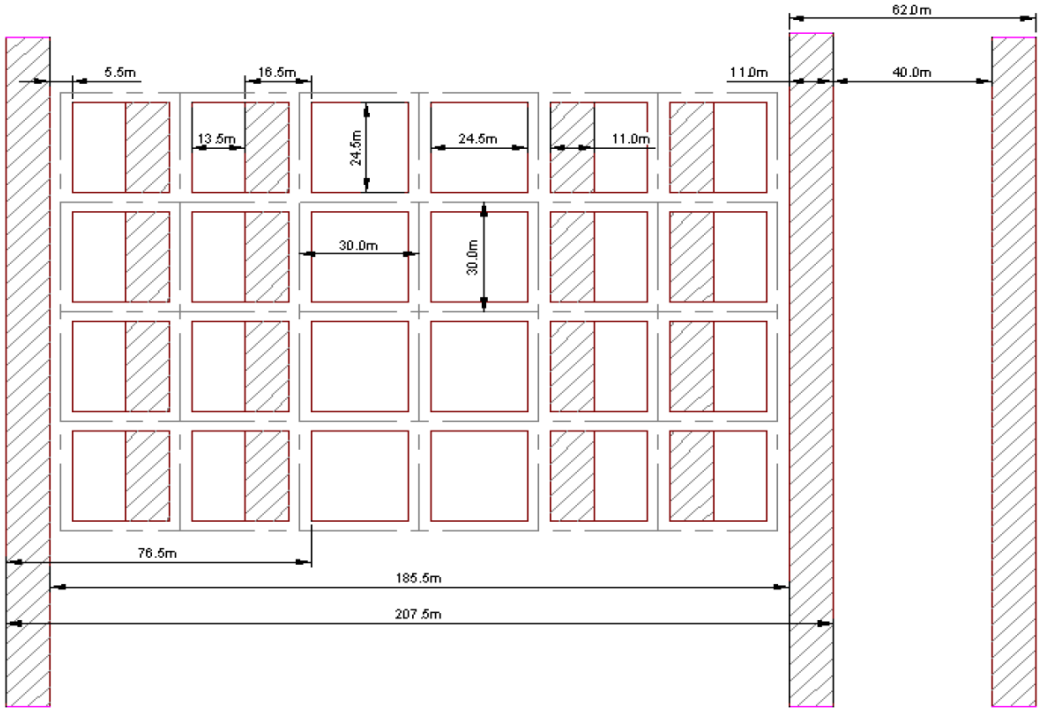


Figure 4 Typical Layout for Seven Heading Panel (30 m centre) (SEA 2011d)

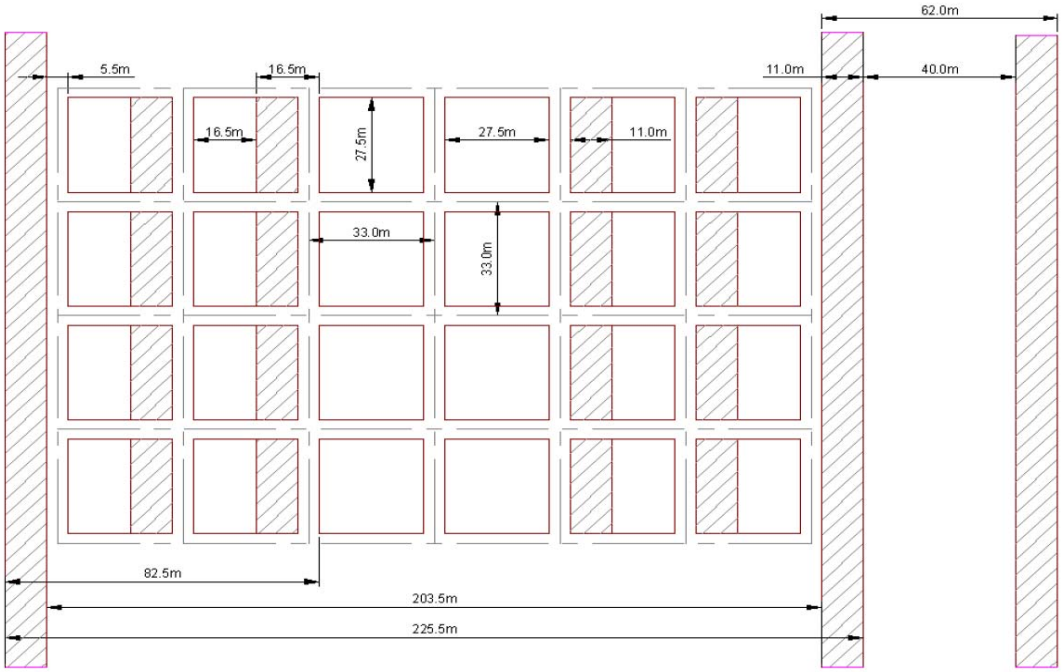


Figure 5 Typical Layout for Seven Heading Panel (33 m centre – Panel 701) (SEA 2011e)

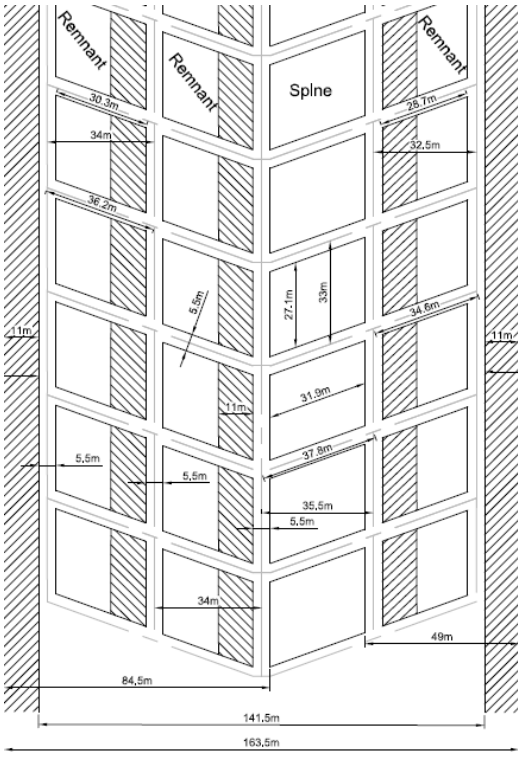


Figure 6 Typical Layout for Five Heading FCT Panel (700 West) (SEA 2011f)

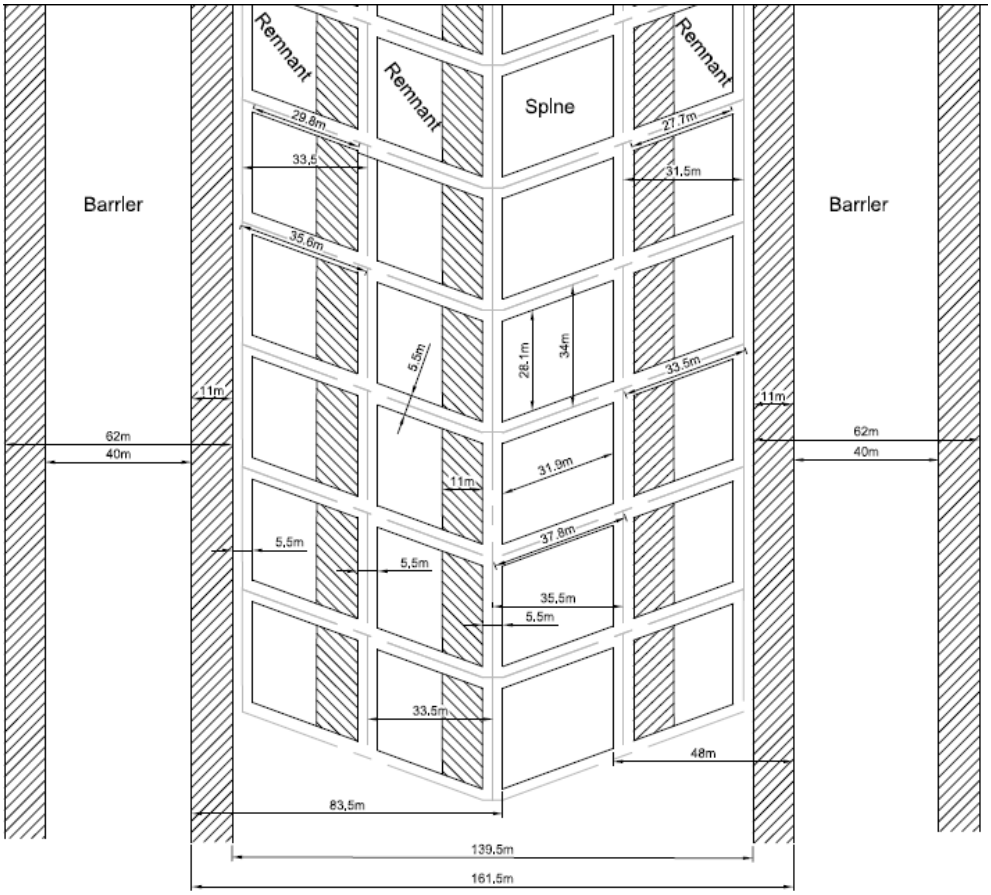


Figure 7 Typical Layout for Five Heading FCT Panel (Panel 804) (SEA 2011d)

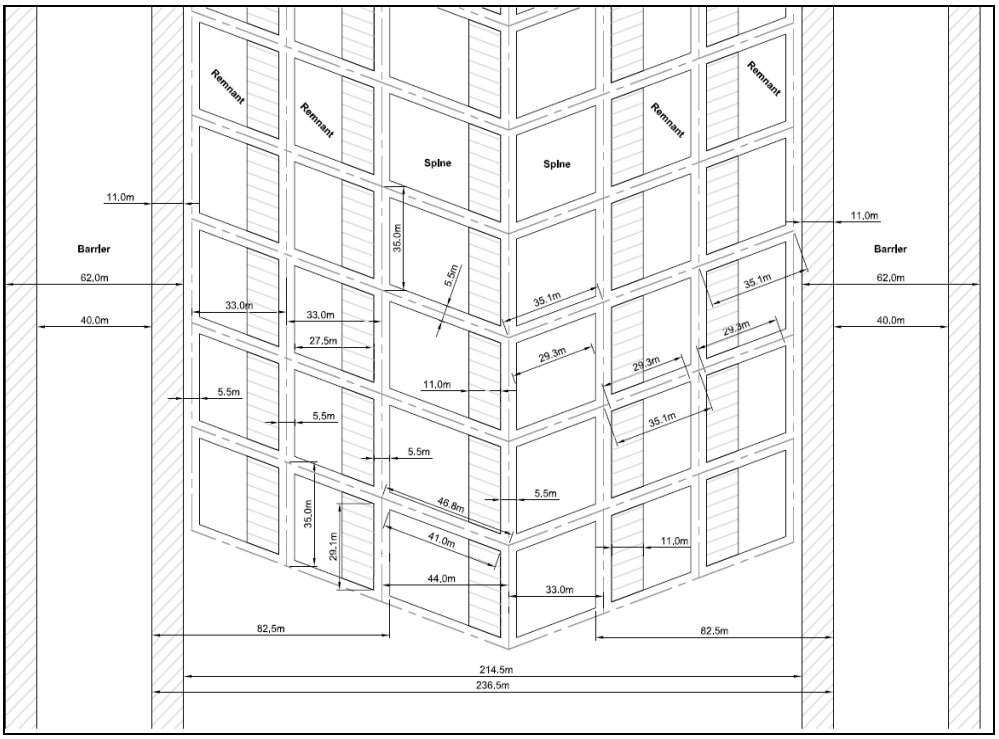


Figure 8 Typical Layout for Seven Heading FCT Panel (800 Area) (SEA 2011b)

The strategy for protection of surface features and surface groundwater systems is threefold.

- Firstly the partial extraction mining system minimises subsidence to less than 100 mm and does not create great stress in the rock nor substantially mobilise the overburden.

- Secondly, the integrity of the strata and therefore ground water systems is preserved broadly across the area by avoiding caving (through use of the partial extraction system). The groundwater data demonstrates this in areas above partially extracted areas and in areas outside of partially extracted areas. To this end, the integrity groundwater aquifers (above the coal seam) should remain in tact both above the mined area and outside of the mined area (i.e. the National Park). This is further discussed in **Section 8** and **Appendix C**)

- Thirdly, the mine design minimises fault plane intercepts by leaving additional coal in faulted pillars where necessary.

It is important to note that the mine plan is based on the geological data available at the time this SMP application was submitted. Whilst considered a reliable indicator of conditions to be expected within the SMP Application Area, it is likely that fault projections will have to be revised to some extent as further characteristics of the geology are confirmed during development through ongoing underground mapping. The mine layout (not geometry) and approval process will need to be able to readily adapt to such changes. The SMP process allows for changes in mine layout without the need for an SMP Variation where these changes are not major and impacts are unchanged (SMP Guidelines). Clarence Colliery intends to revisit the risk assessment should changes in mine layout be required and consult with the DRE on whether a variation is appropriate.

3.3 SEAM AND EXTRACTION DETAILS

Partial extraction within 700 West / 800 Areas will occur within the Katoomba Seam. Thickness of the Katoomba seam varies between 1.5 and 4.5 m within the colliery holding area. Clarence Colliery has typically mined the upper section of coal to a maximum height of 3 m both in development and on partial extraction, to provide a balance between coal quality, resource recovery and pillar stability.

Seam height for the 700 West / 800 Areas is typically 3 m, and mining height will typically be 2.8 m (either due to seam height or depth of cover) with a minimum of around 1.8 m in the southern portion of the 700 West Area. Roadway widths also have a nominal width of 5.5 m. Each panel is proposed to be situated at varying depths of cover and this impacts upon the design of the pillars (i.e. 30m centre pillars can only be designed for depths of cover less than 265m).

The method of extraction for each of the layouts proposed has been described in **Section 3.2**. Some general points relating to the details of the extraction listed below:

1. Lift depths in all cases shall not exceed 11 m and regardless of roadway size, the total void width opened up in any pillar is not planned to exceed 16.5 m. This is the current practice and has been very successful to date;

2. Local roof support in the extraction workings is to be provided by the primary roof support installed during development. Additional support as required by the pre-extraction review will be installed prior to extraction in a pillar and timber support will also be installed (where required) in the form of props; and

3. Stooks will be left at the inbye and outbye end of a pillar being partially extracted to provide localised support to the adjacent intersection and anywhere else in the extraction cycle deemed necessary by management from time to time.

3.4 SCHEDULE OF PROPOSED MINING

It is assumed that the mine will continue to operate seven days per week. The production shifts are mainly, but not exclusively, planned on three 8.5 hour shifts during the week.

It is anticipated that first workings in the 700 West area will commence in January 2012, with pillar extraction commencing in May 2012. It is anticipated that first workings in the 800 Area will commence in March 2011, with pillar extraction commencing in October 2013.

3.5 IMPACT ON RESOURCE RECOVERY OF REMAINING MINING LEASES

The adjoining leases are held by Clarence Colliery and partial pillar extraction in the 700 West / 800 Areas does not impact on resource recovery in these areas.

3.6 ESTIMATED RECOVERY

Resource recovery within the 700 West / 800 SMP Application Area is impacted by the number and extent of unmined areas left as support pillars to minimise subsidence and minimise the impact of faulting within the seam through avoidance where necessary. Both the final layout and recoverable tonnages will be dependent on further definition of the geological model after detailed geological mapping and survey work is carried out. Total theoretical recovery including barriers and both development and partial extraction is approximately 50%.

An estimated 9, 816, 734 tonnes of coal is available for recovery in the proposed 700 West area, with 16, 453, 381 tonnes available in the 800 area. A summary of the estimated tonnages from each panel is shown in **Table 5**.

Table 5 Estimated Tonnage Recovery

Panel	Heading Layout	Estimated Tonnage (t)	
		Development	Extraction
700 West Area			
714	5 FCT	433353	405574
716	5 FCT	417603	360502
718	5 FCT	404076	309244
700	Mains Development	504047	N/A
701	7 Traditional	441182	337324
707	7 Traditional	457869	346847
709	7 Traditional	453228	347204
711	7 Traditional	483452	327598
713	7 Traditional	473991	321489
715	7 Traditional	86231	59394
717	7 Traditional	270646	184439
719	7 Traditional	257016	174909
907	7 Traditional	612931	388714
909	7 Traditional	574384	383478
Panel numbering is shown on 700 West SMP – Plan 1 (CL810)			
800 Area			
800	Mains Development	451315	N/A
852	Mains Development	709548	N/A
802	7 Traditional	786776	432778
804	5 FCT	554156	484741
806	7 FCT	797595	698388
808	7 FCT	795127	749087
810	7 FCT	787425	742002
812	7 FCT	776626	731751
814	7 FCT	771222	726550
816	7 FCT	766072	721393
818	7 FCT	757247	711538
801	7 Traditional	145610	118958
803	7 Traditional	137997	111366
805	7 Traditional	120260	88353
807	7 Traditional	112548	82581
809	7 Traditional	105387	77156
811	Mains Development	333600	N/A
813	7 Traditional	206472	126911
854	5 Traditional	92837	90911
856	Development only	28084	N/A
313	7 Traditional	206472	150231
Panel numbering is shown on 800 Area SMP - Plan 1 (CL827)			

3.7 POSSIBLE EFFECT ON OTHER SEAMS

As the Katoomba Seam is the upper-most seam in the application area, no other seams below will be sterilised by partial extraction within the Katoomba Seam. The only other economically mineable seam in the general vicinity is the Lithgow Seam, which was accessed through the former Blue Mountains Colliery. Blue Mountains Colliery ceased production in December 1999 with all surface infrastructure since removed and rehabilitation works completed in 2000 and 2001. It is anticipated that the Lithgow Seam under the application area is approximately 1 m (or less) thick and not economically recoverable at this time. All other coal seams in the application area are either too thin and/ or too high in ash to be recoverable at this time.

3.8 FURTHER PLANS FOR MINING IN OTHER SEAMS

As discussed above, the only other seam of potential interest in the general vicinity is the Lithgow Seam. This seam is located approximately 140 m below the Katoomba Seam, but is currently understood to be split, of poor quality, and of no economic interest below the SMP Application Area. There are currently no future plans for mining other seams in the application area.

4 SITE CONDITIONS OF THE APPLICATION AREA

4.1 GENERAL SURFACE TOPOGRAPHY

The Newnes Plateau is formed on the Banks Wall Sandstone and is the largest plateau in the Blue Mountains and one of the highest in the Sydney Basin. The surface of the land within (and immediately adjacent to) the SMP Application Area consists of rugged cliff lines (up to 50 m in height), pagodas, gentle plateaus, watercourses and swamps. The area is predominately covered with native vegetation, including communities defined in the *Vegetation of the Western Blue Mountains including the Capertee, Coxs, Jenolan and Gumang Areas* (DEC, 2006) as Blue Mountains Sandstone Plateau Forest, Montane Gully Forest, Newnes Plateau Woodland, Newnes Plateau Shrub Swamp, Newnes Plateau Hanging Swamp, Montane Heath and Pagoda Rock Complex.

4.2 GENERAL OVERBURDEN STRATIGRAPHY

The SMP Application Area lies in the Western Coalfield within the Sydney Basin. The overburden stratigraphy is of the late Permian and Triassic periods and largely consists of massive Triassic sandstones (**Table 6**). The strata associated with the coal seams were laid down during the Permian period and comprise the Illawarra Coal Measures.

Table 6 Generalised Stratigraphy of the Western Coalfield

Period	Stratigraphy			Lithology	Height of base above seam roof (m)	Hydro-geology
	Group	Subgroup	Formation			
Tertiary				Basalt		
Triassic	Wiannamatta Group		Ashfield Shale	Shale, Mudstone		
			Hawkesbury Sandstone	Sandstone		
	Narrabeen Group	Burralow Subgroup		Sandstone Shale	300 m	
		Grose Subgroup	Banks Wall Sandstone	Medium-coarse sandstone	100 m	Unconfirmed and semi-confined aquifers, including Clarence Aquifer
			Mount York Claystone	Claystone, mudstone	96 m	Major aquiclude
			Burro-Moko Head Sandstone	Sandstone	30 m	Possible minor aquifer
			Caley Formation	Siltstone. Sandstone, mudstone	0 m	
Permian Late	Illawarra Coal Measures	Wallerawang Subgroup	Katoomba Seam	Coal		Minor confined aquifers
			Farmers Creek Formation	Coal, sandstone, claystone, siliceous claystone		

Aurecon (2011)

In the 700 West / 800 areas, Narrabeen Group rocks near the surface belong to the Grose Sub-group, and include the Banks Wall Sandstone, the uppermost part of which may be deeply weathered and very friable. The sandstone is underlain by the Mt York Claystone, a thin, fine-grained unit that limits vertical infiltration of groundwater from the overlying strata.

4.3 LOCATION OF THE PROPOSED MINE WORKINGS

There are no existing overlying or underlying underground workings within the SMP Application Area that may interact with the proposed partial pillar extraction workings, as defined by Section 6.5 of the SMP guidelines (DPI 2003).

4.4 GENERAL LITHOLOGICAL AND GEOTECHNICAL CHARACTERISTICS OF THE OVERBURDEN

The overburden lithology at Clarence Colliery is characterised by competent interbedded sandstones, shales and fine to medium grained massive sandstones tending to basal conglomerates. The interbedded sandstones are of typical Unconfined Compression Strength (UCS) of 60-70 Mpa (14-15 Gpa Young's Modulus) while the massive units are generally stiffer (17-18 Gpa) though of lower UCS (around 50 Mpa).

Strength testing was undertaken at selected horizons in borehole SPR 26, located within the neighbouring Springvale Mine lease. This is considered to be representative of the regional stratigraphy which includes the Clarence Colliery mining area (see **Table 7**).

Table 7 Regional Geotechnical Properties as shown in SPR 26

Formation	Depth of Sample from Surface (m)	UCS (Mpa)	Young's Modulus (Gpa)	Brazil Tensile Strength (Mpa)
Banks Wall Sandstone	68.00 – 68.55	16.3	8.5	2.06
Banks Wall Sandstone	100.81 – 101.23	24	9.5*	1.47
Banks Wall Sandstone	132.41 – 132.97	30	11.9*	1.50
Mount York Claystone	152.40 – 152.77	38	8.2*	3.56
Burro-Moko Head Sandstone	166.88 – 167.59	39.4	5	2.66
Burro-Moko Head Sandstone	192.47 – 192.90	48.5	14.9	4.29
Caley Formation	234.05 – 234.37	46*	8.4*	5.31
Caley Formation**	251.16 – 252.71	51.6	8.4	4.77***

* Values calculated from triaxial strength tests
** This formation directly overlies the Katoomba seam
*** Average of finer grained part of sample, coarser part was 22.06 Mpa and 10.85 Mpa. Golder Associates (August 2002)

4.5 GENERAL LITHOLOGICAL AND GEOTECHNICAL CHARACTERISTICS OF THE ROOF AND FLOOR

The Katoomba Seam roof and floor material is highly competent and provides excellent support to the pillars at Clarence Colliery (**Table 8**). This summary is representative of the characteristics within the SMP Application Area.

Table 8 Typical Roof and Floor Characteristics, Katoomba Seam, Clarence Colliery

Unit	Lithology	UCS (Mpa)	Young's Modulus (Gpa)	Bearing Capacity (Mpa)
Katoomba Seam Roof	Bedded sandstone and siltstone	Range 16 - 85 typical and modelled at 64	Range 7.4 - 28.2 typical and modelled at 17.8	182
Katoomba Seam Floor	Laminated, fine grained sandstone and shale	Range 53 - 142 typical and modelled at 53	Range 9.3 – 26.7 typical and modelled at 14.9	151

SEA (2005)

4.6 SPECIFIC GEOLOGICAL CONDITIONS

This assessment is based on Clarence Colliery's geological model which contains mapping data from 700 West / 800 Areas. Historical data from geological reports and boreholes was also utilised.

4.6.1 LITHOLOGY

The lithology from the surface consists of the Banks Wall Sandstone of a quartzose Sandstone with minor shales, the distinctive Mount York Claystone of red to brown claystone, the Burro-Moko Head Sandstone of a quartzose Sandstone with minor shales and the variable Caley Formation of interbedded sandstones, and claystones and mudstones. Below the floor of the Katoomba Seam are the claystone, mudstone and minor sandstone of the Burragorang Claystone.

4.6.2 SEAM THICKNESS

Seam height for the 700 West / 800 Areas is typically 2.8 – 2.6 m. For the 800 Area, seam thickness varies from 3 m in the north west corner to around 2.4 m in the east and south east. For the 700 West area, seam thickness varies from 3 – 3.2 m in the west to around 1.8 m in the far south of the 700 West area.

4.6.3 SEAM QUALITY

Current mining at Clarence Colliery is producing a 15-16% ROM ash product. Generally the full seam raw ash in 800 Area will remain consistent at approximately 15-16%. It is possible there will be some minor variation in ash, particularly around the bottom section of the seam.

The full seam raw ash in the 700 West Area varies from approximately 16% in the east of the area, grading to approximately 25% towards the West of the Lease boundary.

4.6.4 DEPTH OF COVER

The depth of cover in the 700 West area ranges from 100 m (in the far south western corner) to 290 m, with the lowest values along the valley of Farmers Creek. The depth of cover over the 800 area extraction panels ranges from 160 m to 320 m, with the majority of the area have a cover depth of 200 m or more.

4.6.5 FAULTING

There are two dominant joint directions present at Clarence Colliery, orientated North-northwest and East-northeast.

In the western coalfields surface lineament zones (valleys, steep sided cliffs) can be identified on aerial photos. These surface lineaments show a strong correlation to seam level faults. The lineaments associated with zones of poor roof conditions are generally recognisable because their orientation differs significantly from the regional joint trends.

In the western coalfields surface lineament zones (valleys, steep sided cliffs) can be identified on aerial photos. These surface lineaments, in many cases, show a strong correlation to seam level faults and basement structures. The lineaments associated with zones of poor roof conditions are generally recognisable because their orientation differs significantly from the regional joint trends.

5 STABILITY OF UNDERGROUND WORKINGS

Partial extraction mining at Clarence Colliery removes less than 50 % of the coal seam within partially extracted areas. The remaining coal provides support to the overlying strata, aquifers and surface features. It is worth noting that there are very few cases of collapse where extraction percentage is less than 50 %.

SEA carried out assessments on the stability of partial extraction workings planned for the 700 West /800 Areas (**Appendix B**). The scope of the assessment included:

- Evaluation of the pillar stability of the panels under consideration;
- Evaluation of the potential loading influence of adjacent panels on these panels; and
- Estimation of the expected long term surface effects.

The information contained within this section has been summarised from the information provided by SEA which can be found in **Appendix B**.

5.1 PILLAR STABILITY METHODOLOGY

Factor of Safety and Width to Height Ratio

The assessment of pillar stability requires the determination of pillar load, strength and an appropriate Factor of Safety (**FoS**). The FoS concept is commonly applied when the potential for pillar collapse or failure is being analysed, as it can generally be related to the probability of failure occurring. A probability of stability of 99.9% is attained at a FoS of 1.63, and further increases in FoS have minimal effect, as the probability of stability curve approaches 100% asymptotically. From a risk management perspective, increasing the FoS beyond 1.63 can only reduce the failure probability by less than 0.1%. It is emphasised that the FoS relates to the overall panel situation, rather than that of individual pillars (SEA 2008b).

The role of increasing width to height ratio (w/h Ratio) in enhancing pillar stability has long been known. Pillar width to height ratio, applied in conjunction with other design criteria, such as FoS, is a useful indicator of design reliability, utilising existing databases of experience.

Design Criteria Based on FoS and w/h Ratio

Coal pillar design criteria should reflect the specific requirements and nature of the workings (e.g. short-term production panel, as opposed to long-life pillars with surface protection constraints). The general approach adopted by SEA (2008b) can be summarised as follows:

1. Short-term production workings, with considerable local knowledge: design may be within the failed pillar database limit envelope, under controlled circumstances.
2. Short-term production workings (general): design on the basis of being beyond the failed pillar database limit envelope.
3. Key underground workings, for example main heading, with medium to long-term serviceability / stability requirements: design on the basis of the limit envelope plus 20% (i.e. the outer database curve).

4. 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 (i.e. a probability of failure of $\leq$ 1 in a million).

The partial extraction situation at Clarence Colliery is analogous to "key underground workings" (i.e. Category 3 above); long-term stability is required for surface protection, although in this case the surface features are not in the highest category of "critical infrastructure".

The above criteria are only guidelines and it remains important that specific attention be given to the geotechnical / mining environment, including historical experience of ground behaviour in the seam under consideration.

Pillar Design Issues for Subsidence Control

To control subsidence above coal pillar workings, SEA (2008b) suggests that long-term pillar design should take into account the following possible issues and subsidence mechanisms:

- Pillar instability (e.g. pillar strength and load);
- Elastic pillar compression;
- Immediate pillar floor and roof compression and the potential for bearing failure;
- Overburden strata spanning capability; and
- Panel dimensions (e.g. panel span, depth, etc.).

The final mining layout is designed to be long-term stable and to control surface subsidence to <100±25 mm. The stability of the overall layout during first workings was assessed using tributary area load.

Once an estimation of the load is obtained, other issues such as the design assumption that the roof, pillar and floor will act as an effectively elastic structural system, can be tested by considering the long-term stability and bearing capacity of both the immediate roof and floor.

Methodology Used for Assessment of Stability and Subsidence

1. Determine appropriate factor of safety for the workings proposed;
2. Determine maximum load case – in this case tributary area loading was considered to be the maximum load case;
3. Determine appropriate barrier and pillar sizes for stability at maximum loading;
4. Analytical and/ or numerical modelling of the systems with varying degrees of pillar softening to determine the effects on barriers and in panel pillars;
5. Analytical and/ or numerical modelling of the systems to determine likely levels of subsidence. A comparison is also done of the existing system to provide a calibration of the modelling; and
6. Compare the results with actual levels of subsidence measured from current partial extraction methods.

5.2 RESULTS OF PILLAR STABILITY ANAYLSIS

Based on the methodologies described in **Section 5.1**, **Table 9** summarises the results of the analysis of pillar stability (relating to Panel layout and depth of cover) of the overall system undertaken by SEA. The loading described is for the maximum case, which was assessed to be tributary area loading. The resistance offered by the pillar system has been calculated from the strength of the individual pillar components. It is noted that **Table 9** refers to Factors of Safety (**FoS**) after the pillar has been partially extracted.

Table 9 Overall System Stability (Post Extraction) of each Heading Layout

Heading	Depth (m)	Total Pillar Load Carrying Capacity (MN per 33m)	Total Overburden Load (MN per 33m)	System (Panel) Factor of Safety (FoS)
Traditional 7 (30 m)	140	140,881	25,494	5.5
	180		32,778	4.3
	220		40,062	3.5
	260		47,346	3.0
Traditional 7 (33 m)	260	164,388	49,765	3.3
	270		51,679	3.2
	280		53,594	3.1
	280		55,508	3.0
5 FTC (700 West)	150	119,680	24,705	4.8
	200		32,940,	3.6
	250		41,174	2.9
	260		42,821	2.8
5 FCT (800)	150	124,483	25,203	4.9
	200		33,604	3.7
	240		42,005	3.0
	285		47,886	2.6
7 FCT	100	152,568	23,734	6.4
	150		35,601	4.3
	200		47,468	3.2
	250		59,335	2.6
	290		68,829	2.2

For all layout types, the pillar system FoS ranges from 2.2 to 6.4 following lifting (partial pillar extraction). These results indicate that the likelihood of failure following extraction is considered practically impossible. The design is considered long-term stable. Furthermore, the design is regarded as highly conservative, given the range of cover depths involved in this case.

With regards to first workings, SEA (2010b) notes that pillar FoS exceed 3, at width to height ratios of 10. The nominal probability of failure of such pillars is much less than one in a million, and there is no known precedent for the failure of a bord and pillar panel with such geometry, by any mechanism.

The results mentioned above are of overall system stability from the analytical assessments completed for pillar stability. Results of the various elements in the system are not discussed in detail here, however the stability of all the various pillars in the system is considered adequate for the maintenance of long-term stability. For further details on the system elements refer to the various reports by SEA in **Appendix B**.

6 SUBSIDENCE PREDICTION

The partial extraction mining method adopted by Clarence Colliery results in a maximum predicted subsidence of 100 mm with low tilts and strains, virtually immeasurable valley closure, minimal (if any) upsidence and no surface cracking. The primary objective pertaining to surface subsidence is to ensure that subsidence is limited to a value well within that considered to be characteristic of 'elastic' overburden behaviour (i.e. no caving to surface), which is defined as 100±25 mm (SEA, 2005). This subsidence impact threshold has been accepted within previous SMPs for Clarence, and is conditioned within Development Consent DA 504.00 Schedule 3, which states that:

> *'The Applicant shall ensure that surface subsidence generated by the development does not exceed the criteria listed in Table 1 (First Workings – 20mm subsidence, 1.0mm/m tilt, 1.0mm/m horizontal strain. Partial Extraction – 100mm subsidence, 3.0mm/m tilt, 2.0mm/m horizontal strain.'*

SEA carried out an assessment on the stability of partial extraction workings for 700 West / 800 Areas, and the information contained within the section below has been summarised from the information provided in the SEA documents contained in **Appendix B**.

6.1 SUBSIDENCE PREDICTION METHODOLOGY

In relation to surface subsidence, the primary objective is to ensure that subsidence is limited to a value well within that considered to be characteristic of 'elastic' overburden behaviour (i.e. no caving to surface) defined as 100±25 mm (SEA, 2005). As indicated in **Section 5**, the layouts are expected to remain long-term stable. Accordingly, it is considered acceptable to assume that only elastic convergence will take place as a result of partial pillar extraction within the SMP area.

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 the elastic theory. The predicted subsidence consists of three components, i.e. pillar, roof and floor compression. The equations used and strength and elastic moduli used are contained in the SEA assessments.

6.2 RESULTS OF SUBSIDENCE PREDICTIONS

A summary of the results of the estimated expected and worse case subsidence above the panels after lifting for the various panel layouts at differing depths of cover is presented in **Table 10** and **Table 11**. Expected subsidence is that predicted using the calibrated subsidence model. Following a detailed analysis of the subsidence data collected over the last twelve years (including data over areas that have been flooded), it is now possible to predict "worst case" subsidence in consideration of the effects of flooding. To this end, predicted subsidence is presented in **Table 10** and worst case subsidence is presented in **Table 11**.

Whilst **Tables 10** and **11** present the outcomes of the numerical modelling, the overall subsidence performance criteria for all partial extraction mining undertaken at Clarence is 100mm (vertical subsidence), 3 mm/m tilt and 2 mm/m strain. The TARP is based on these performance criteria.

Table 10 Subsidence Estimates for Proposed Heading Layouts

Heading	Maximum Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Average Stress Change (MPa)	Compression (mm)			
					Roof	Floor	Pillar	Total
Traditional 7 (30 m)	140	3.5	7.0	3.5	4.8	5.7	2.0	**12.5**
	180	4.5	9.0	4.5	6.2	7.4	2.6	**16.1**
	220	5.5	11.0	5.5	7.2	9.0	3.1	**19.7**
	260	6.5	13.0	6.5	8.9	10.6	3.7	**23.3**
Traditional 7 (33 m)	140	3.5	6.6	3.1	4.8	5.7	2.0	**12.5**
	180	4.5	8.5	4.0	6.2	7.4	2.5	**16.1**
	220	5.5	10.4	4.9	7.5	9.0	3.1	**19.6**
	260	6.5	12.3	5.8	8.9	10.6	3.7	**23.2**
	300	7.5	14.1	6.6	10.3	12.3	4.2	**26.8**
5 FTC (700 West)	150	3.8	7.2	3.4	5.8	6.9	2.2	**14.8**
	200	5.0	9.6	4.6	7.7	9.2	2.9	**19.7**
	250	6.2	11.9	5.7	9.6	11.5	3.6	**24.7**
	280	7.0	13.4	6.4	10.7	12.8	4.1	**27.6**
5 FCT (800)	150	3.8	7.2	3.4	5.8	6.9	2.2	**14.9**
	200	5.0	9.6	4.6	7.7	9.2	2.9	**19.8**
	250	6.3	12.0	5.7	9.6	11.5	3.6	**24.8**
	280	7.1	13.6	6.5	11.0	13.1	4.2	**28.2**
7 FCT	100	2.5	4.9	2.4	3.7	4.5	1.5	**9.7**
	150	3.8	7.4	3.6	5.6	6.7	2.3	**14.6**
	200	5.0	9.8	4.8	7.5	8.9	3.1	**19.5**
	250	6.3	12.3	6.0	9.3	11.1	3.9	**24.3**
	290	7.3	14.3	7.0	10.3	12.9	4.5	**28.2**

Table 11 Worst Case Subsidence Estimates for Proposed Heading Layouts

Heading	Maximum Depth (m)	Vertical Virgin Stress (MPa)	Average Pillar Stress (MPa)	Average Stress Change (MPa)	Compression (mm)			
					Roof	Floor	Pillar	Total
Traditional 7 (30 m)	140	3.5	7.0	3.5	11.5	9.2	2.0	**22.7**
	180	4.5	9.0	4.5	14.8	11.8	2.6	**29.2**
	220	5.5	11.0	5.5	18.1	14.4	3.1	**35.7**
	260	6.5	13.0	6.5	21.4	17.1	3.7	**42.2**
Traditional 7 (33 m)	140	3.5	6.6	3.1	11.5	9.2	2.0	**22.7**
	180	4.5	8.5	4.0	14.8	11.8	2.5	**29.1**
	220	5.5	10.4	4.9	18.1	14.4	3.1	**35.6**
	260	6.5	12.3	5.8	21.4	17.0	3.7	**42.1**
	300	7.5	14.1	6.6	24.7	19.6	4.2	**48.6**
5 FTC (700 West)	150	3.8	7.2	3.4	13.8	11.0	2.2	**27.0**
	200	5.0	9.6	4.6	18.5	14.7	2.9	**36.1**
	250	6.2	11.9	5.7	23.1	18.4	3.6	**45.1**
	280	7.0	13.4	6.4	25.8	20.6	4.1	**50.5**
5 FCT (800)	150	3.8	7.2	3.4	13.9	11.1	2.2	**27.1**
	200	5.0	9.6	4.6	18.5	14.7	2.9	**36.2**
	250	6.3	12.0	5.7	23.2	18.4	3.6	**45.2**
	280	7.1	13.6	6.5	26.4	21.0	4.2	**51.6**
7 FCT	100	2.5	4.9	2.4	9.0	7.1	1.5	**17.7**
	150	3.7	7.4	3.6	13.5	10.7	2.3	**26.5**
	200	5.0	9.8	4.8	18.0	14.3	3.1	**35.3**
	250	6.3	12.3	6.0	22.4	17.9	3.9	**44.2**
	290	7.3	14.3	7.0	26.0	20.7	4.5	**51.2**

Clarence Colliery's maximum subsidence should not exceed 100 mm (as stipulated within other SMP applications and subsequent approvals). The results indicate that the expected predicted long-term subsidence from extracting the proposed mine plan ranges from 9.7 to 28.2 mm for these panels. As the defined limit of measurable subsidence is 20 mm (DPI, 2003), the expected subsidence due to the partial extraction in these panels using the proposed mining layouts is likely to be almost negligible. The subsidence estimates related to the maximum depth (i.e. worst case scenario) range from 17.7 to 51.6 mm, which is still regarded as minor, and significantly below the 100 mm subsidence limit.

Subsidence associated with first workings will be generally less than that of secondary extraction, as the pillars are larger, and panel span narrower on development. SEA (2010b) states that although not specifically modelled, theoretical subsidence due to first workings would be less than 20 mm, which is historically considered to be the limit of reliably detectable movement.

No appreciable surface impacts are expected to result from 100mm of subsidence.

6.3 ESTIMATION OF THE RELIABILITY OF SUBSIDENCE PREDICTIONS

The subsidence data from previously mined areas, in combination with the other underground and surface monitoring data sets, constitutes a highly consistent body of information that confirms the favourable and generally highly predictable performance of the partial extraction system, increasing confidence with regard to future stability and related subsidence outcomes.

Strata Engineering Australia undertook a *Review of Subsidence Information from Recent Partial Extraction Areas* (SEA 2011a), which is attached in **Appendix B**. The predicted and measured subsidence for the existing partial extraction panels is summarised in **Table 12**. The review of subsidence was carried out to obtain a thorough understanding of previous mining performance, compare results against the 100 mm performance criteria and thorough calibration of the subsidence model. The review also critically reviewed predicted subsidence and measured subsidence from previous assessments and subsequent mining of the approved areas. Of most interest, the review has looked at the impact of underground flooding on subsidence development.

Table 12 Subsidence Results from Partial Extraction Panels at Clarence Colliery

Panel	No. of Headings	Pillar Width (centres, m)	Representative Depth (m)	Maximum Subsidence at Panel Mid-Span (mm)		
				Analytical and/or Numerical Estimate	Measured	
					Pre-Flooding	Post-Flooding
332	7	30	200	15-20	22	N/A
609D	7	33	300	25	28	N/A
609C	7	33	305	25-30	22	N/A
609B	7	33	305	25-30	19	29
609A	7	33	260	20-25	24	N/A
609	7	33	305	25-30	32	57
612	7	30	240	20-25	78	97
614	6-7	30	170	15-20	37	38
602 (Inbye)	7	30	220	20-40	14	21
602 (Outbye)	7	30	240	20-40	14	18
605	7	30	235	N/A	3	6
611A	7	30	260	20-25	15	24
611B	7	30	270	20-25	17	21
611C	7	30	220	15-20	40	45
611D	7	30	210	15-20	48	50
611E	7	33	270	20-25	26	37
611 (Inbye)	7	33	290	25	20	57
611 (Outbye)	7	33	260	20-25	11	12
702 Inbye	7	30	220	20-25	35	N/A
702 Outbye	7	33	290	25-30	23	N/A

Panel	No. of Headings	Pillar Width (centres, m)	Representative Depth (m)	Maximum Subsidence at Panel Mid-Span (mm)		
				Analytical and/or Numerical Estimate	Measured	
					Pre-Flooding	Post-Flooding
704 Inbye	5	35.5/30	235	20-25	34	N/A
704 Outbye	5	35.5/30	290	25-30	24	N/A
708 (Inbye)	5	35.5	230	20-25	23	N/A
710 (Inbye)	3	36/25	220	20	15	N/A
				Average	**26**	**37**
				Standard deviation	**15**	**24**

SEA (2011a)

As a result of this review, the following comments are made by SEA (2011a) regarding these results:

1. Average subsidence prior to flooding is 26 mm, very marginally higher than the typical predicted range of 20 to 25 mm, noting that 20 mm has historically been regarded as the measurable limit of subsidence. The standard deviation of 15 mm suggests that an upper bound result of the order of 50 to 60 mm could be expected.

2. The post-flooding average of 37 mm is 42% higher than the equivalent pre-flooding figure, which reflects the weakening effect on the strata of saturation. The measured impact is less than predicted and suggests that the analytical approach adopted of applying the measured lower bound strata moduli to arrive at long-term, worst-case compression (subsidence) estimates is appropriately conservative. The post-flooding standard deviation of 24 mm suggests that worst-case subsidence results of the order of 80 to 90 mm could be possible in the long-term (but is still less than the 100 mm performance criteria).

3. The quoted averages are adversely influenced by one anomalously poor result from 612 Panel, which was impacted by bottom coaling (since discontinued) in the earlier adjacent 610 Panel, the application of the 7 heading, 30 m centres layout at close to maximum design depth, irregular surface topography, locally poor operational practice and finally flooding. Given this experience, including the layout design changes in recent years, it is considered extremely unlikely that a similarly poor result would be obtained again in future.

4. Some of the most favourable results (e.g. from 605 and 710 Panels), are also readily explainable, particularly in terms of limited panel span.

Overall, SEA (2011a) confirms that the subsidence results provide significant confidence with regard to current design approaches and likely future subsidence outcomes. Periodic surface inspections, including photographic surveys, confirm the absence of any discernible subsidence-related damage above partially extracted areas.

6.4 SUMMARY OF SUBSIDENCE PREDICTIONS

The primary objective pertaining to surface subsidence is to ensure that subsidence is limited to a value well within that considered to be characteristic of ‘elastic’ overburden behaviour (i.e. no caving to surface), which is defined as 100±25 mm (SEA, 2005).

Based on measured experiences to-date and analytical / numerical modelling of subsidence, SEA (2011a) concludes that the layouts in current use and planned for future areas are expected to result in subsidence within the 100 mm performance criteria:

The limited magnitude of the subsidence associated with partial extraction at Clarence Colliery has not resulted in any discernable surface damage to date, and consequently no significant surface impacts are predicted to occur as a result of the partial extraction proposed in the 700 West / 800 Areas.

7 IDENTIFICATION OF SURFACE AND SUB-SURFACE FEATURES

7.1 MINE SUBSIDENCE DISTRICTS

The SMP Application Area does not lie within a Mines Subsidence District. The nearest district embraces the township of Lithgow approximately 15 km west of the 700 West area.

7.2 PROPOSED DEVELOPMENT

The only proposed development within or adjacent to the SMP Application Area is the future installation of temporary subsidence monitoring equipment. There is also potential for a pipeline to be constructed to transport water from Clarence Colliery to Lithgow No.2 Dam across the 700 West area. On 25 August 2011, LCC released a draft Review of Environmental Factors (**REF**) assessing the potential impacts from the development. Key features of the proposal outlined in the draft REF (GHD, 2011) includes:

- Pump replacement and minor pipework modifications at Clarence Colliery's main dam pump station.
- Pump replacement and minor pipework modification at the Council pump station located south of Clarence Colliery, including plant station alarms and signals.
- Decommissioning the existing settling ponds and associated gravity pipeline from the settling ponds to the existing release point.
- Installation of a new maintenance hole.
- Extension of the existing rising main from the existing settling ponds to the new maintenance hole.
- Installation of a gravity pipeline from the new maintenance hole to Farmers Creek dam including energy dissipation and air release points (pipeline proposed to be 2.78 km in length)

The REF states that the pipeline would be constructed using poly ethylene pipe materials to allow for high pipe velocities and anticipated mine subsidence (GHD, 2011). The REF is available (at the time of writing this document) for viewing at www.council.lithgow.com/gen_exhibitions

The report notes that the Mine Subsidence Board will be consulted at a later stage in the project to determine if mine subsidence will be an issue for this project.

7.3 GENERAL DESCRIPTION

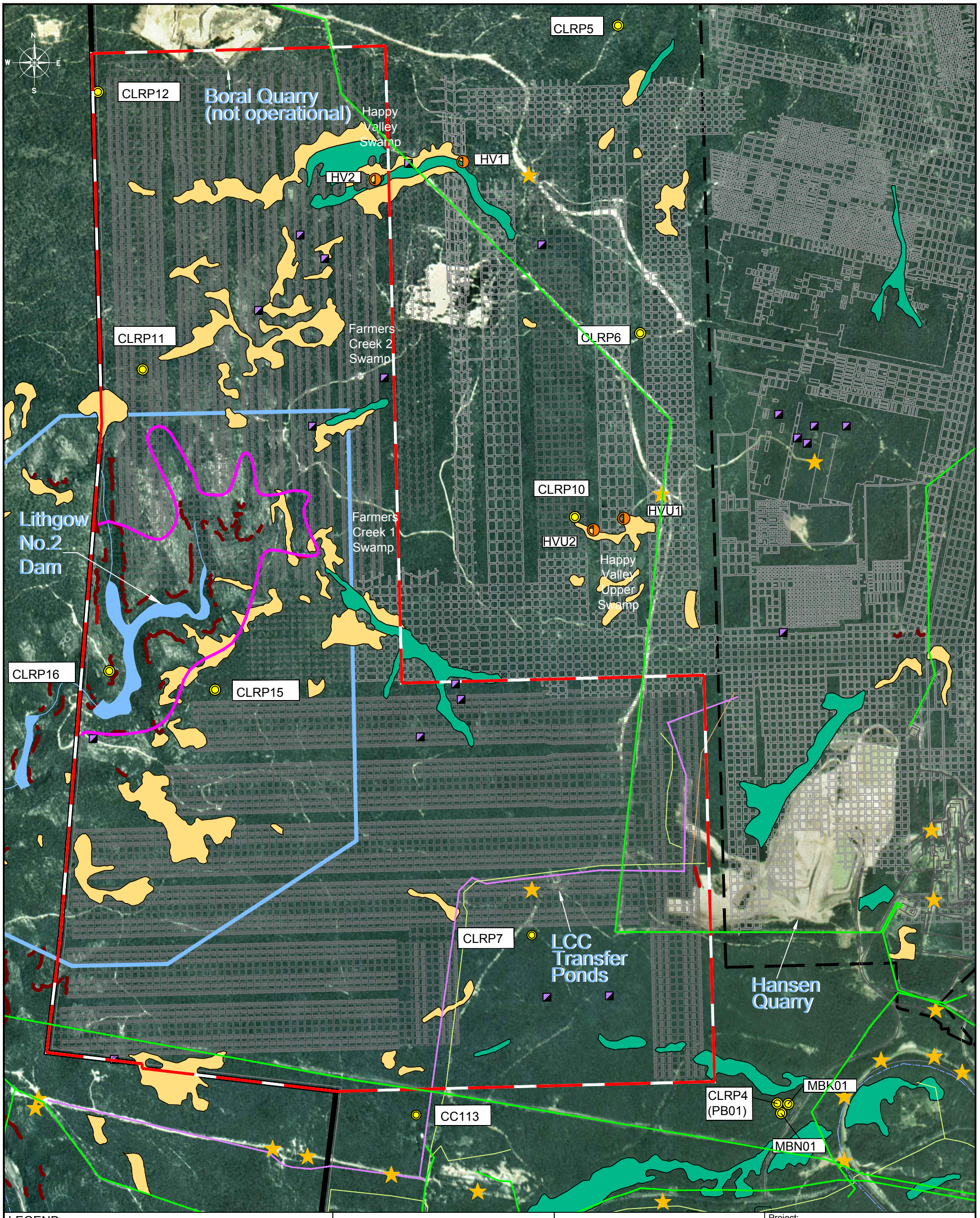
The entire surface of the 800 Area is contained within the Newnes State Forest which is predominantly covered with native vegetation, with minimal surface improvements. The 700 West Area includes part of the catchment area draining to the Lithgow No. 2 Dam which is a water supply dam for Lithgow. Built infrastructure above the 700 West Area includes the Lithgow No.2 Dam, transfer ponds, a powerline, telecommunications, a small proportion of the Zig-Zag railway (unlikely to be undermined within the next 10 years) and other minor infrastructure. The following sections identify and describe all the significant natural features and surface improvements that lie within the SMP Application Area.

Reference to the SMP Guideline (DPI 2003) was made to assist in identifying the features that may be affected by mining. Sources used to confirm the features within the SMP Application Area included:

- Aerial photos;
- Digital cadastral information also showing surface features;
- On site surveys by mine surveyors;
- Field surveys by Clarence Colliery's Environmental Co-ordinator;
- Community consultation;
- Local knowledge of the area by mine personnel, various consultants and Forests NSW officers;
- Information provided by public utilities; and
- Information provided by government departments.

7.4 IDENTIFICATION OF FEATURES

During the preparation of the SMP, an assessment has been undertaken to identify any features in the SMP Application Area from the list in Appendix B of the SMP Guidelines. The results of this assessment are shown in **Table 13** below. The location of the features identified is shown in **Figure 9** and **Figure 10**.



LEGEND

- Colliery Holding Boundary
- Mining Lease Boundary
- Lithgow No.2 Dam Notification Area
- SMP Application Area
- First Workings Zone (for Lithgow No.2 Dam)
- Existing Workings Area
- Proposed Workings Area (incl. Secondary Extraction)
- Newnes Plateau Hanging Swamp (Dec 2005)
- Newnes Plateau Shrub Swamp (Dec 2005)
- Known Archaeological Site
- Monitoring Bore Location
- Shallow Piezometer Location
- State Survey Marker
- Telstra Underground Cable
- Telstra Optic Fibre Cable
- Telstra Aboveground Cable
- Integral Powerline
- Cliffs and Pagodas

0 400 800m

Scale 1:15 000(A3)

Version	Date:	Author:	Checked:	Approved:
1	18/03/11	AR	BS	BS
2	24/03/11	AR	SW	BS
3	15/04/11	AR	SW	BS
4	29/07/11	LH	SW	BS
5	18/08/11	LH	SW	SW
6	14/09/11	LH	RW	RW
7	25/10/11	ZJ	RW	RW
8	09/11/11	KC	RW	RW

FIGURE 9

Surface Feature Plan - 700 West Area

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

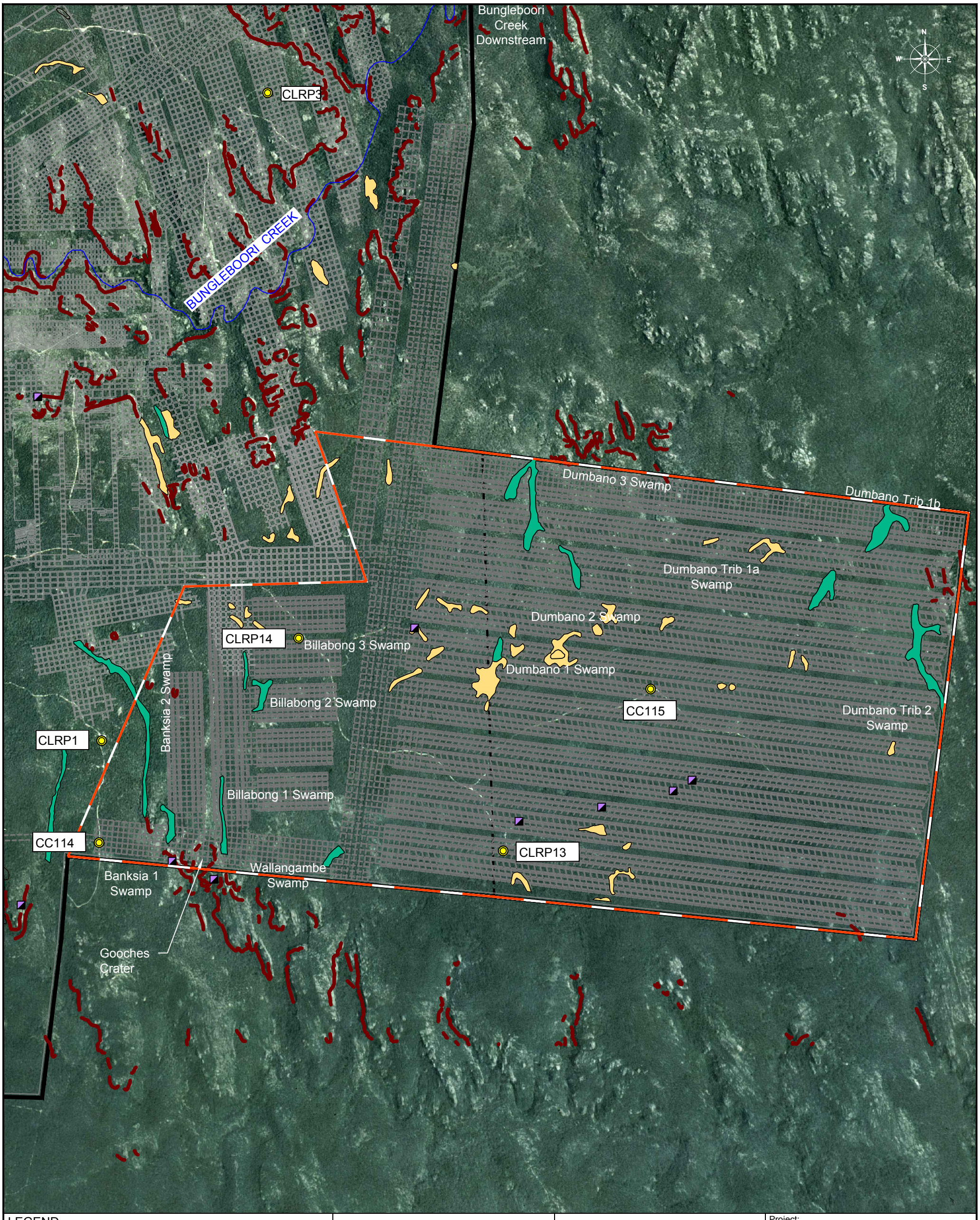
Project: Clarence SMP - Partial Extraction of 700 West and 800 Areas

Client: Clarence Colliery

File: Fg9_CCC06-011_SurfPlan700_111109

Projection: MGA 94 Zone 56

V:\CCC06-011\Figures\Final\CAD\Fg9_CCC06-011_SurfPlan700_111109.dwg



LEGEND

- Colliery Holding Boundary
- Mining Lease Boundary
- SMP Application Area
- Existing Workings Area
- Proposed Workings Area (incl. Secondary Extraction)
- Newnes Plateau Hanging Swamp (Dec 2005)
- Newnes Plateau Shrub Swamp (Dec 2005)
- Known Archaeological Site
- Monitoring Bore Location
- Cliffs and Pagodas
- River

0 500 1.0km

Scale 1:20 000(A3)

Base Plan Data Source:

Version	Date:	Author:	Checked:	Approved:
1	24/03/11	AR	BS	BS
2	29/07/11	LH	SW	BS
3	18/08/11	LH	SW	SW

FIGURE 10

Surface Feature Plan - 800 West Area

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Clarence SMP - Partial Extraction of 700 West and 800 Areas

Client: Clarence Colliery

File: Fg10_CCC06-011_SurfPlan800_110818

Projection: MGA 94 Zone 56

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Table 13 Surface and Subsurface Features

Feature (SMP Guidelines DPI 2003)	Applicable	Detail	Section Ref
Item 1 - Natural Features			
Catchment areas and declared special areas	N	-	-
Rivers and Creeks	Y	Farmers Creek and tributaries in the 700 West Area Tributaries of the Dumbano and Wollangambe River in the 800 Area	8.1.1
Aquifers, known groundwater resources	Y	Clarence aquifer, which forms part of the Blue Mountains sandstone aquifer. (Provides a potable water supply for the village of Clarence)	8.1.2
Springs	Y	Potentially associated with baseflow with Newnes Plateau Hanging Swamp and Newnes Plateau Shrub Swamp.	8.1.5
Sea/Lake	N	-	-
Shorelines	N	-	-
Natural Dams	N	-	-
Cliff/pagodas	Y	There are a number of cliffs and pagodas within the 700 West / 800 Areas.	8.1.3
Steep Slopes	Y	There are areas of steep slopes adjoining the clifflines in both the 700 West and 800 Areas	8.1.4
Escarpments	Y	There are a number of cliffs / escarpments within the 700 West / 800 Areas.	8.1.3
Land prone to flooding or inundation	N	-	-
Swamps, wetlands, water related ecosystems	Y	The flora and fauna assessment has identified areas Newnes Plateau Hanging Swamp and Newnes Plateau Shrub Swamp within the SMP Application Area	8.1.5
Threatened and protected species	Y	There is the potential for 32 threatened fauna species and 7 threatened flora species and 1 EEC within the SMP Application Area (under NSW Threatened Species Conservation Act 1995)	0
National Parks	N	The Blue Mountains National Park lies adjacent to the 800 Area	-
State Recreation Areas	N	-	-
State Forests particularly areas zoned FMZ 1, 2 and 3	Y	The SMP Application Area is within the Newnes State Forest, FMZ 2 and FMZ 4	8.1.8
Natural Vegetation	Y	The SMP Area is predominantly covered with native vegetation of various communities	0

Feature (SMP Guidelines DPI 2003)	Applicable	Detail	Section Ref
Areas of significant geological interest	Y	Mount York Claystone, which acts as an aquiclude between the mine workings and the Clarence aquifer	8.1.2
Any other feature considered significant	N	-	-
Item 2 – Public Utilities			
Railway	N	-	-
Roads (all types)	Y	Various NSW Forests roads and trails are present over both the 700 West and 800 areas	8.2.1
Bridges	N	-	-
Tunnels	N	-	-
Culverts	N	-	-
Water / gas / sewerage pipelines	N	-	-
Liquid fuel pipelines	N	-	-
Electricity transmission lines (overhead / underground) and associated plants	Y	Integral Energy powerline crosses panel 714 and part of panel 716	8.2.3
Telecommunication lines (overhead / underground) and associated plants	Y	Telstra optic fibre cable, underground cable and aboveground cable in south eastern corner of 700 West Area.	8.2.4
Water tanks, water and sewerage treatment works	N	-	-
Dams, reservoirs and associated works	Y	Lithgow No.2 Dam and Notification Area and associated transfer ponds are above the proposed 700 West mining area	8.2.1
Air strips	N	-	-
Any other infrastructure items	N	-	-
Item 3 – Public Amenities	N	-	-
Item 4 – Farm Land and Facilities	N	-	-
Item 5 – Industrial, Commercial and Business Premises			
Factories	N	-	-
Workshops	N	-	-
Business or commercial premises	N	-	-
Gas and / or fuel storage and associated plants	N	-	-
Waste storages and associated plants	N	-	-
Buildings, equipment and operations that are sensitive to surface movements	N	-	-

Feature (SMP Guidelines DPI 2003)	Applicable	Detail	Section Ref
Surface mining (open cut) voids and rehabilitated areas	Y	Two sand quarries marginally encroach into the 700 West area; the Hanson Sand Quarry in the south east of the area, and the inactive Boral Sand Quarry in the north	8.2.5
Mine infrastructure including tailings dams and emplacement areas	N	-	-
Any other feature considered significant	N	-	-
Item 6 - Areas of archaeological and / or heritage significance (including aboriginal)	Y	The Cultural Heritage Assessment predicts a high number of Aboriginal cultural heritage sites. Non-indigenous sites are not expected	8.1.7
Item 7 - Items of Architectural significance	N	-	-
Item 8 - Permanent survey control marks	Y	One permanent survey control mark is located in south eastern corner of 700 West area	8.2.6
Item 9 – Residential Establishments	N	-	-

Section 6.6.3 of the SMP Guidelines (DPI 2003) sets out a list of potentially environmentally sensitive areas to be assessed as part of the application. Each item has been assessed with respect to the SMP Application Area, and the results presented in **Table 14**.

Table 14 Areas of Environmental Sensitivity

Feature (SMP Guidelines DPI 2003)	Applicable	Detail	Section Ref
Land reserved as State conservation area under *National Parks and Wildlife Act 1974* (NPW Act)	N	-	-
Land reserved as an Aboriginal Place under NPW Act	N	-	-
Land identified as wilderness by the Director NPWS under the *Wilderness Act 1987*	N	-	-
Land subject to a conservation agreement under NPW Act	N	-	-
Land acquired by Minister for the Environment under Part 11 NPW Act	N	-	-
Land within State Forests mapped as Forestry Management Zones 1, 2 or 3	Y	The SMP Application Area is within the Newnes State Forest, FMZ 2 and FMZ 4.	8.1.8

Feature (SMP Guidelines DPI 2003)	Applicable	Detail	Section Ref
Wetlands mapped under SEPP14 – Coastal Wetlands	N	-	-
Wetlands listed under the Ramsar Wetlands Convention	N	-	-
Lands mapped under SEPP 26 – Coastal Rainforests	N	-	-
Areas listed on the Register of National Estate	N	-	-
Areas listed under the *Heritage Act 1977* for which a plan of management has been prepared	N	-	-
Land declared as critical habitat under the Threatened Species Conservation Act 1995	N	-	-
Land within a restricted area prescribed by a controlling water authority	N	-	-
Land reserved or dedicated under the Crowns Land Act 1989 for the preservation of flora, fauna, geological formations or other environmental protection purposes	N	-	-
Significant surface watercourses and groundwater resources identified through consultation with relevant government agencies	Y	Farmers Creek in 700 West Area. Clarence aquifer, which forms part of the Blue Mountains sandstone aquifer. (Provides a potable water supply for the village of Clarence and potential baseflows to swamps and creeks)	8.1.1 & 8.1.2
Lake foreshores and flood prone areas	N	-	-
Cliffs, escarpments and other significant natural features	Y	There are cliffs and pagodas within the escarpments areas spanning 700 West / 800 Areas.	8.1.3
Areas containing significant ecological values	Y	Newnes Plateau Shrub Swamp and Newnes Plateau Hanging Swamp are both listed as endangered ecological communities.	8.1.5
Major surface infrastructure	Y	Lithgow No 2 Dam	8.2.1
Surface features of community significance (including cultural, heritage or archaeological significance)	Y	The Cultural Heritage Assessment predicts a high number of Aboriginal cultural heritage sites. Non-indigenous sites are not expected	8.1.7
Any other land identified by the Department to the titleholder	N	-	-

8 FEATURE CHARACTERISATION AND SUBSIDENCE IMPACT ASSESSMENT

8.1 NATURAL FEATURES

8.1.1 RIVERS AND CREEKS

Characterisation

The 700 West proposed mining passes beneath Farmers Creek and tributaries of Farmers Creek which report to Lithgow No.2 Dam. Farmers Creek is a fourth order stream under the Strahler system of stream ordering. The tributaries of Farmers Creek include first, second and third order streams.

The 800 area passes beneath tributaries of the Dumbano and Wollangambe River. The tributaries of these rivers include first, second, third and fourth order streams.

Statutory Requirements / Guidelines

The legislation that regulates potential subsidence impacts on creeks and rivers is the *Mining Act 1992* under the SMP Guidelines. This SMP Application has been prepared to gain approval for mining using partial extraction under the creeks and swamps within the application area.

Surface water is regulated under the *Water Management Act 2000*. The Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources and the Greater Metropolitan Region Groundwater Sharing Plan both commencing on 1 July 2011 and includes rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading in the area.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9**.

During the Stakeholder Presentation for this SMP Application, no issues were raised regarding the partial extraction of pillars underneath the drainage lines.

Baseline Monitoring

Access to the tributaries within the SMP Application Area is very difficult and measurement of surface water (flow and quality) is not warranted given the negligible impact of mining on the tributaries (demonstrated over the previous 12 years).

Potential impacts on surface water (flow and quality) as a result of mining will be identified through groundwater (piezometric head) monitoring of the near-surface aquifers. Piezometric head monitoring is considered the best indicator of impact as it would occur almost immediately with mining and prior to any surface impacts. Groundwater baseline monitoring is discussed in **Section 8.1.2**.

Impact Assessment

The partial extraction mining method adopted by Clarence Colliery results in maximum predicted subsidence of 100 mm with low tilts and strains (<2 mm/m), no measured valley closure, no upsidence and no surface cracking. With this low level of movement it is considered that there will be no adverse impacts on the flow, flow characteristics (i.e. ponding, bank stabilisation) or quality of rivers and creeks from mining at Clarence Colliery.

The key issue in relation to the effects of the mining proposal on creeks relate to the loss of water from the upper (near-surface) aquifers that provide baseflow to the creeks. Studies confirming the predictions in relation to the effects of the proposed partial extraction system on aquifers are outlined in **Section 8.1.2**.

Monitoring, Mitigation and Management

Monitoring of rivers and creeks will continue as per the Clarence Colliery Water Management Plan approved by the Department of Planning and the environmental monitoring programs developed under the Outbye Area (Clarence Colliery, 2009a), Eastern Area (Clarence Colliery, 2005) and 700 Area (Clarence Colliery, 2009b) approvals. The monitoring points are presented in **Figure 11**.

The potential impact of the mining proposal draining the aquifers feeding baseflow to rivers and creeks will be addressed through the groundwater monitoring program.

The SMP Application Volume 2 contains further details on the monitoring, mitigation and management of potential impacts.

8.1.2 AQUIFERS - KNOWN GROUNDWATER SOURCES

Characterisation

The nearby Springvale Colliery in conjunction with the CSIRO completed a groundwater assessment titled “Interpretation of Hydrogeological Data at Springvale Colliery” during 2004 (CSIRO, 2004). In addition, Bish (1999) carried out a “Hydrological Assessment for Coxs River Catchment”. Both of these studies looked at defining the extent, reliability and character of groundwater resources within the regional Newnes Plateau area (focusing on the mining areas of Springvale, Angus Place and Clarence Colliery). ERM (2003) carried out a “Groundwater Investigation underneath Clarence” to understand the relationship between shallow aquifers near the Clarence Village and water make within the Clarence Colliery underground operations, and Connell Wagner PPI (2006) completed a “Report on Potential Impacts of Mining on the Local Hydrogeology” at Clarence Colliery.

In addition to the previous studies, an assessment of the likely impacts on the local groundwater regime was undertaken by Aurecon (2011) specifically for the SMP Application, and is attached as **Appendix C**. The following section includes a summary of the findings of this report.

The aim of the 2011 report was to determine the impact of partial extraction mining in the proposed 700 West and 800 areas on the identified aquifers. As part of the SMP process, the Colliery needs to examine the impact of the proposed mining on the local groundwater regime. In particular, it is necessary to determine the likely impact on local aquifers, and groundwater dependant ecosystems, as well as any potential for regional hydrogeological impacts. The 2011 study concentrated on the ‘Clarence’ aquifer, is situated within the Banks Walls Sandstone.

The Groundwater Impact Assessment completed by Aurecon (2011) conducted a review of the data obtained from the Clarence Colliery groundwater monitoring program. This included the surface to seam piezometer results in six boreholes, groundwater level data from the groundwater observation bores established in the Banks Wall Sandstone, an investigation into the extent of the Clarence Aquifer zone and an interpretation of the current condition of the Clarence Aquifer. This report also reviewed the groundwater level and groundwater behaviour in Newnes Plateau Shrub Swamps and Newnes Plateau Hanging Swamps overlying extracted areas. Importantly, the assessment considered impacts on groundwater to date from partial extraction mining activities. It is important to understand the impact of partial extraction mining not only on the aquifers overlying the mining area, but also the impact of partial extraction on the aquifers in the vicinity (but not undermined) of the partial extraction mining activities.

The study strongly suggests that the Clarence aquifer is the source of groundwater for many of the swamps on the plateau south of Bungleboori Creek. Many of the swamps appear to be controlled by the distribution of aquifers, and occur at the discharge zones of the aquifers, where the aquifers crop out. Aurecon (2011) divided the swamps into two basic types, based on whether they were dependent predominantly on rainfall infiltration (periodically waterlogged swamps), or dependant predominantly on an aquifer water source as well as rainfall contribution (permanently waterlogged swamps). The Clarence aquifer provides a potable water supply for numerous residents within the village of Clarence, which is approximately 6 km to the south of the SMP Application Area. It was evident that the best yields from the Clarence aquifer lie 60 m above the Mount York Claystone and therefore can be considered the main aquifer zone. The Clarence aquifer is approximately 4 km wide in the east-west direction, and 7 km long in the north-south direction. From existing groundwater data, it is interpolated that the Clarence aquifer outcrops (or discharges) across the SMP Application Area. This is further explained in **Appendix C**.

In addition to the Clarence Aquifer, there are other water-bearing zones in the Banks Wall Sandstone, which is up to 200 m thick in this area. The upper part of the Banks Wall Sandstone is an unconfined aquifer. The Mount York Claystone is a low permeability unit in the Triassic section, and forms an aquiclude in the overburden about 100 m above the Katoomba seam. It is generally about four m thick in this area, and forms an effective barrier to the downward percolation of near-surface groundwater. The claystone separates the two local hydrologic regimes — the near-surface unconfined/leaky aquifer system in the Banks Wall Sandstone, including the Clarence Aquifer, and the confined aquifers in the underlying coal measures. In general, the aquifer zones below the Mount York Claystone are of minimal importance due to their lower permeability and poor yields. The most important aquifer zone in the region is the Clarence Aquifer.

The Groundwater Impact Assessment (**Appendix C**) includes a more detailed description (including Figures) of the Clarence aquifer including:

- Extent of aquifer;
- Inferred outcropping of aquifer zone;
- Base of aquifer zone; and
- Groundwater level contours.

The assessment highlighted several important aspects of the local groundwater regime, which are:

- The data shows that there is a natural groundwater mound around the Clarence village. This is important as it indicates that the major source of recharge to the aquifer in this vicinity is via direct infiltration and percolation of rainwater in the vicinity of the village itself. There appears to be very little potential for recharge of the aquifer from the north, due to the dip of the strata and the presence of Browns Swamp. This demonstrates the importance of groundwater management in the village itself, as the aquifer in this area is effectively isolated;

- The aquifer at Clarence drains generally in a north-east direction into Browns Swamp, which would rely on the groundwater from the aquifer as one of its prime water sources. The aquifer in the village also drains west and south into Reedy Creek, and south east into Dargans Creek;

- North of Clarence, the aquifer generally drains in a northerly direction, although there is some drainage into the Wollangambe River to the east, and into Farmers Creek to the west;

- The data suggest that it is highly unlikely that any mining activity in the Clarence Colliery could have an impact on the water resource in the Clarence village area. This is due to several factors, including the distance of the village from the mine, the groundwater flow directions, the hydraulic gradient in the aquifer at discharge points, the location of the recharge area, the dip of the strata and the presence of Browns Swamp, which forms a natural drain in the aquifer between the village and the mine;

- At its northern end, the aquifer drains into Bungleboori Creek, which forms its northern boundary. There is a limited connection to the remainder of the Blue Mountains sandstone aquifer on the north-western side of the Clarence aquifer; and

- It is noteworthy that, even though there has been mining for many years beneath the northern end of the Clarence aquifer, there does not appear to be any significant depletion of the aquifer in this area, as the groundwater high is still located beneath the ridge, and there is a significant head of water above the base of the aquifer zone.

Statutory Requirements / Guidelines

The legislation that regulates potential subsidence impacts on aquifers is the *Mining Act 1992* under which the SMP Guidelines (DPI 2003) apply. This SMP Application has been prepared to gain approval for mining under the creek tributaries and swamps within the application area.

Groundwater is regulated under the *Water Management Act 2000*. The Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources commenced on 1 July 2011 and includes rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading in the area.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

Clarence Colliery is aware that any impacts to the Clarence aquifer and associated impacts on swamps and the National Park would be of concern to the community of Clarence, and subsequently, the impact assessment below addresses this issue.

Baseline Monitoring

Monitoring of existing groundwater conditions has been the focus of numerous studies and monitoring programs. Clarence Colliery has an extensive Groundwater Monitoring Program and Response Program (**GW Program**) which is described within the existing Water Management Plan (Clarence Colliery, 2007). The Water Management Plan and GW Program cover the entire Clarence Colliery lease area and were developed following issue of Development Consent DA504-00. The Water Management Plan provides details of numerous studies and background programs in place prior to the development of the GW Program. Baseline groundwater data at that time primarily included data from 13 existing boreholes located within and immediately adjacent to the 700 West and 800 areas, as detailed in **Table 15**. There are an additional five groundwater boreholes that existing over other areas of the Clarence Colliery holdings (including one within the village of Clarence).

Table 15 Baseline Groundwater Monitoring in the 700 West /800 Areas

700 West area	Monitoring Commenced	Depth (m)	800 area	Monitoring Commenced	Depth
CLRP11 (P4)	2010	61	C114 (P4)	2009	45
CLRP11 (P3)		74.5	C114 (P3)		75
CLRP11 (P2)		134.5	C114 (P2)		135
CLRP11 (P1)		165	C114 (P1)		165
CLRP4 (MBN01)	2008	71	CC115 (P4)	2010	120
CLRP4 (PB01)		175-181	CC115 (P3)		170
CLRP4 (MBK01)		180	CC115 (P2)		200
CC113	2008	37	CC115 (P1)		270
CLRP7	2008	41	CLRP1 (P4)	2004	60
CLRP10	2010	60	CLRP1 (P3)		100
CLRP12 (P4)	2010	100	CLRP1 (P2)		150
CLRP12 (P3)		120	CLRP1 (P1)		175
CLRP12 (P2)		180	CLRP13 (P5)	2010	80
CLRP12 (P1)		230	CLRP13 (P4)		110
CLRP15 (P4)	2010	60	CLRP13 (P3)		140
CLRP15 (P3)		90	CLRP13 (P2)		210
CLRP15 (P2)		130	CLRP13 (P1)		240
CLRP15 (P1)		160	CLRP14 (P4)	2010	100
CLRP16 (P2)	2010	134.5	CLRP14 (P3)		130
CLRP16 (P1)		165	CLRP14 (P2)		185
			CLRP14 (P1)		220

The baseline groundwater assessment focuses on the results from boreholes CLRP4, 5, 7, 8, 10 and CCL113 to assess Clarence Aquifer and CCL114, 115 and CLRP1, 2, 3 and 6 for general groundwater monitoring across the site. Results indicate that there has been no impact from previous mining on the groundwater levels in the upper strata, including the Clarence Aquifer because the monitoring has shown no change in groundwater behaviour monitored pre-mining and post mining. The base line data provided is invaluable for assessing future mining impacts on groundwater behaviour

The location of all the groundwater monitoring bores is shown in **Figure 11**.

Measured Effects of Mining

The available piezometer data has been evaluated and interpreted to determine the likely impact of the mining on the groundwater regime. The Groundwater Impact Assessment (**Appendix C**) contains analysis of data from the above mentioned sites.

- The evidence from CLRP 4 shows a relative unchanged groundwater level profile across the full recording history (since 2008) except for the fluctuations resulting from storm events. This data suggests that the strata above the Mount York Claystone is unaffected by mining in the Katoomba Seam, and the groundwater regime will be likewise unaffected as there has been no mining near this bore.

- The evidence from CLRP 5 shows a rising trend from May 2008 to February 2011, with the groundwater level rising approximately 8 m, most likely the result of a diminishing rainfall deficit and groundwater level stabilising. The record does not show response to individual storms, which may suggests low permeability of the strata and possibly semi-confined conditions. There has been no mining near this bore and as a result the groundwater regime will likely be unaffected**.**

- The evidence from CLRP 7 shows a rising trend from June 2008 to May 2010, with the groundwater level rising approximately 2.7 m, most likely the result of a diminishing rainfall deficit and groundwater level stabilising. This was followed by a period of steady groundwater level to March 2011. There has been no mining near this bore and as a result the groundwater regime will likely be unaffected**.**

- CLRP 8 is the most direct measurement of domestic water supply available as the bore is located in the Clarence Village. CLRP8 is now more than 2 m higher than when the monitoring commenced two years ago most likely a result of increased rainfall. There has been no mining near this bore**.** Mining of the Outbye, 314, and 316 areas occurred through 2009 and 2010, which was more than 5 km from the village. The groundwater record shows no discernible impact from mining on groundwater levels in Clarence Village

- CLRP 10 is the only Clarence Aquifer monitoring site to have been undermined. The groundwater level shows no changes before, during, and after mining. Mining has had no discernible impact on groundwater level in this bore

- The evidence from CCL113 is similar to that of CLRP 5 and shows a rising trend over the period, with the groundwater level rising approximately 8 m, most likely the result of a diminishing rainfall deficit and groundwater level stabilising. The record does not show response to individual storms, which may suggests low permeability of the strata and possibly semi-confined conditions. There has been no mining near this bore and as a result the groundwater regime will likely be unaffected**.**

- CC114 is located 1.7 km east-northeast of Clarence pit top, in an area that has not been mined. Following a variable period of stabilisation after construction, the instruments all show flat pore pressure trends.

- CC115 is located 4.9 km east northeast of Clarence pit top, in an area that has not been mined. One of the Instruments shows an irregular rise in pore pressure, then a slow decline. The reason for the initial rises in pore pressure is not clear, although instrumental effects and ground/grout stabilisation may be the cause. All three instruments currently appear to be producing acceptable results.

- CLRP1 contains four piezometers at different levels and was subjected to nearby mining during December 2004. The lower two piezometers were located <30m from the mining horizon and below the Mount York Claystone and hence below the Clarence Aquifer. However these two instruments show the characteristic rapid decline in pore pressure expected when mining has an effect on the roof strata. These instruments also appear to stabilise and recover post mining. The upper two piezometers do not show the same characteristic indicating a different response to mining at different levels and that the upper strata appears to have no discernible affect as a result of the mining.

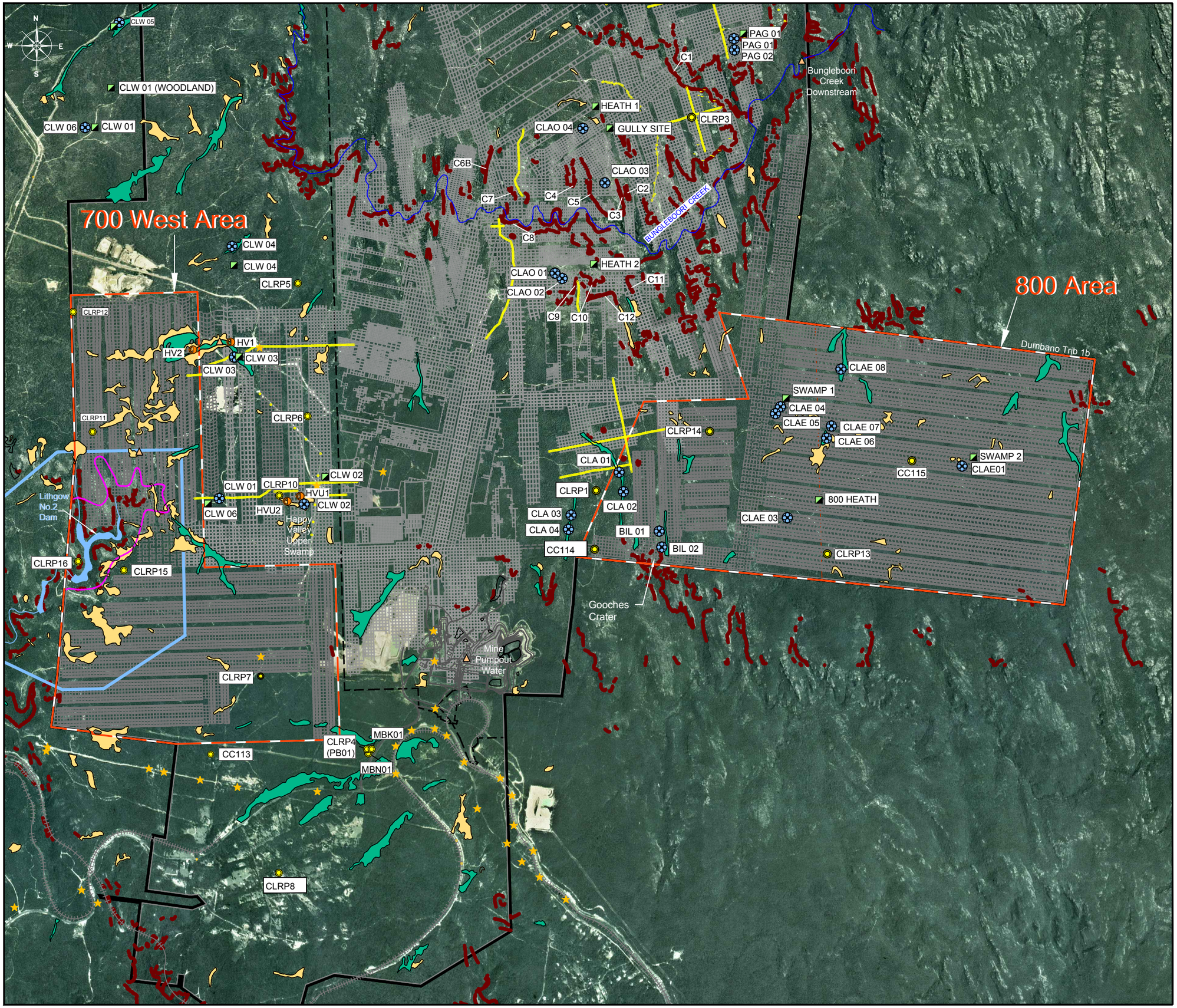
- CLRP2 is located above Panel 611E, about 5 km north of the proposed 800 area. This bore, which was undermined during 2007, and does not indicate any adverse impact on the near-surface aquifers. If there was any serious, adverse impact, then the plot of the piezometric pressures would show a rapid decline. There has been an increase in pressure that suggests there has not been any cracking which could serve to drain the strata downwards into the mine. The magnitude of the pressure increases measured in the upper aquifers is not sufficient to cause hydraulic fracturing in the strata, especially given the in-situ confining pressure.

- Although mining impacts would be difficult to see in the data due to the low natural heads, the results at CLRP3 appear to show that there has been no significant impact on any of the piezometers from the mining in Panel 612.

Monitoring of the Clarence Aquifer is carried out using open boreholes with single piezometers installed. Monitoring of the Clarence Aquifer shows that the groundwater levels have not varied markedly over the period since June 2008. Groundwater levels before, during, and after mining are not markedly changed. There is no evidence in these data that mining has had an impact on groundwater in the Clarence Aquifer.

The behaviour of groundwater in deeper strata has been monitored by boreholes with multi-level Piezometers. All the boreholes in mining areas show consistent flat trends in their upper piezometers, similar to those in the unmined area. This indicates that mining did not have any discernible impact on groundwater levels in the upper strata in these boreholes. Piezometers at the mining horizon show groundwater draining as mining occurs. Intermediate strata may show some temporary impacts as mining passes, followed by recovery of pore pressures. These observations are consistent with expectations, given the very low levels of mine subsidence caused by the mining method used, and the observed behaviour of strata above the mining horizon.

Available groundwater data indicate that mining has no impact on groundwater pore pressures and water table levels in the upper strata, including the Clarence Aquifer either above or adjacent to mine workings.



LEGEND

- Colliery Holding Boundary
- Mining Lease Boundary
- SMP Application Area
- First Workings Zone (for Lithgow No.2 dam)
- Existing Workings Area
- Proposed Workings Area (incl. Secondary Extraction)
- Flora Monitoring Sites
- Fauna Monitoring Sites
- Surface Water Monitoring Sites
- Shallow Peizometer Location
- Monitoring Bore Location
- State Survey Marker
- Cliffs and Pagodas
- River
- Subsidence Lines
- Newnes Plateau Hanging Swamp (Dec 2005)
- Newnes Plateau Shrub Swamp (Dec 2005)

0 1.0 2.0km

Scale 1:35 000 (A3)

FIGURE 11

Baseline Monitoring

Project:
Clarence SMP - Partial Extraction of 700 West and 800 Areas

Client:
Clarence Colliery

File:
Fg11_CCC06-011_Monitoring_110729

Projection:
MGA 94 Zone 56

Version:	Date:	Author:	Checked:	Approved:
1	17/02/11	AR	SS	SS
2	24/03/11	AR	SW	BS
3	15/04/11	AR	SW	BS
4	29/07/11	LH	SW	BS

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

V:\CCC06-011\Figures\Drafts\AutoCAD\Fg11_CCC06-011_Monitoring_110729.dwg

Impact Assessment

The proposed extraction area is unlikely to have any significant impact on the groundwater system. Nevertheless, it is instructive to examine more closely the potential for impacts on the groundwater systems in the area. The potential for adverse impacts in each area are discussed below.

Local Impact

The groundwater and piezometer monitoring has indicated that the mining to date has apparently had no impact on the near surface aquifers including the Clarence Aquifer (which sits above the Mount York Claystone). Since a similar extraction methodology is proposed for the 700 West / 800 Areas, it is likely that there will be no additional impact from this mining.

This 700 West area is located below the western edge of the Clarence Aquifer and about 1.5 km to the north of Clarence village. The groundwater levels indicate that the groundwater gradient is towards Bungleboori Creek to the northeast of Clarence village. This gradient suggests that there is sufficient recharge to the aquifer to remain a viable groundwater resource for the Clarence community. The conclusion is therefore drawn that the impact of the proposed mining on the Clarence Aquifer will be negligible; even if a crack were to form the effects would only be local. There would be no measureable effects at the Clarence village.

The proposed 800 area of extraction is located on the eastern side of the mining lease. The Clarence Aquifer is located at depth in this area and the nature of the aquifer in this area is not as well understood as in the west. However since the geology of the area and the proposed mining technique are similar to that used in the western areas, it is suggested that there would be no effect on the aquifer and groundwater resource, especially due to this area being even further from the Clarence village.

Regional Impact

The previous sections examined the likely impact of the proposed mining on the aquifer systems in the SMP Application Area. It is also important to examine if there will be any adverse unintended regional impacts. It has been demonstrated in the previous sections that the upper sandstone aquifers are unlikely to suffer any significant permanent impacts due to the mining. As a result, the regional impact on these aquifers is also judged to be negligible.

Any regional impacts are likely to be limited to the aquifer associated with the Katoomba Seam. Previous studies suggest that the piezometric head in the seam has already been depleted by the many years of mining in the local area. The coal seam does not outcrop down dip of the colliery, so that there are no creeks or vegetation communities that rely on the groundwater in the seam. It is unlikely that there will be any significant quantities of groundwater in the seam in this area. The conclusion can therefore be drawn that the proposed extraction will not have any incremental effect on the regional hydrogeology.

Conclusion

Groundwater monitoring over and adjacent to existing mine workings shows no impact on the groundwater regime above the mine, apart from in the immediate mining horizon. Aurecon (2011) has concluded that the proposed mining will have no significant impact on the groundwater regime on both a local and regional scale provided subsidence is maintained at the current low levels. Consequently it is highly unlikely that there will be an impact to the shallow groundwater regime in areas adjacent to the proposed mining areas.

Mining within the SMP Application Area will therefore have no adverse impact on the availability of future groundwater supply resources in the area or on aquifers feeding base flow to rivers, creeks or swamps.

Monitoring, Mitigation and Management

Monitoring of groundwater will continue as per the GW Program in the Clarence Colliery Water Management Plan (2007) approved by the former Department of Planning, as well as the approved EMP's developed for the Outbye Area (Clarence Colliery, 2009a), 700 Area (Clarence Colliery 2009b) and the Eastern Area (Clarence Colliery, 2005). It is noted that the Clarence Colliery Water Management Plan is undergoing review and this has been carried out in consultation with DP&I, SCA, OEH and NOW.

Given the likely negligible impact on the groundwater regime from the proposed mining and limited interaction with near-surface aquifers (including the Clarence aquifer), the existing groundwater monitoring program will be sufficient to detect any potential mining related impacts. Some of the existing piezometers are located away from current mining areas (and away from the proposed 700 West / 800 Areas) and will continue to provide valuable background data on local (and regional) hydrological conditions including the response of aquifers to rainfall.

The SMP (SMP Application Volume 2) contains further details on the monitoring, mitigation and management of potential impacts.

8.1.3 CLIFFS / PAGODAS

Strata Engineering Australia (SEA) (2011g) carried out an assessment on the cliff lines above the proposed 700 West / 800 Areas (**Appendix B**). The outcomes of this assessment are summarised below.

Characterisation

The SMP Application Area contains numerous cliffs and pagodas. The areas in which clifflines are found are relatively remote, and are only accessible by foot. Although bushwalkers do periodically enter the area, the area is not frequently accessed, except by mine employees.

The cliff lines forming the subject of the assessment were identified from aerial photographs and a 'Lidar' survey of the Clarence area. The relevant sections of the cliff lines in the study area were also inspected, mapped and photographed. The mapping was completed using aerial photographs, surface geology plans, GPS and compass techniques. The cliff locations are shown in **Figure 9** and **Figure 10**.

The cliff lines in the 700 West areas consist mainly of 20 to 50 m high sheer cliffs with small (5 to 10 m high) pagodas noted along some of the crests. The pagodas are present for approximately 30% to 50% of total cliff lines. The cliffs inspected in the 700 West area comprise of the cliff lines surrounding Lithgow No. 2 Dam and the gully area in the south-west corner.

The cliff lines inspected in the 800 Area consist mainly of 20 to 30 m high sheer cliffs with small (5 to 10 m) high pagodas along approximately 20 to 30 % of the crests. These cliffs are located in the south-west corner of the 800 Area, adjacent to the natural feature known as Gooches Crater.

Statutory Requirements / Guidelines

The impact of mining operations on clifflines and pagodas within the SMP Application Area is not regulated by any specific statutory requirements. The legislation that regulates potential subsidence impacts on surface features (including cliffs) is the *Mining Act 1992* under which the SMP Guidelines apply. This SMP Application has been prepared to gain approval for mining under the cliffs and pagodas within the application area.

ACARP Project No. C9067 (2002) '*Subsidence Impacts on River Valleys, Cliffs, Gorges and River Systems'* provides a methodology for assessing subsidence impacts in cliffs. This has been evaluated within the impact assessment.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

During the stakeholder consultation for this SMP Application, no concerns relating to impacts on cliffs and pagodas were raised.

Baseline Monitoring

The relevant sections of the cliff lines in the SMP Application Area were inspected, mapped and photographed by SEA between the 1 February and 3 February 2011. The mapping was completed using aerial photographs, surface geology plans, GPS and compass techniques. Scratch testing on accessible rock exposures was also conducted to determine approximate Uniaxial Compressive Strength (**UCS**) values. Point load and laboratory UCS testing was also conducted on representative samples from previous exploration boreholes to define rock strength.

It should be noted that there was no reasonable access to two isolated areas in the north-east and south-east corners of the 800 area, and limited exposure of the cliff lines (due to vegetation) in two gullies north of Lithgow No. 2 Dam in the 700 West area.

The subsidence monitoring data from previous partial pillar extraction workings indicate that no appreciable mine subsidence damage to cliff lines and pagodas (including slot canyons) has occurred to date in the Clarence Colliery lease above panels extracted using the partial extraction method.

Impact Assessment

The expected impact on the cliffs in the SMP Application Area has been evaluated based on reference to the empirically based impact classification or rating system presented in ACARP (2002).

The ACARP method focuses on overall stability of the cliff lines and the upper bound limit of the proportion of cliff lines that could be impacted by rock falls. The method does not allow a quantitative assessment of the potential for cracking damage. However, a reasonable qualitative assessment is possible by comparing the ratings for previously damaged and undamaged cliff lines. The method essentially allows an overall assessment of the impact of mining on cliff face stability and aesthetic appeal. The contribution of the natural instability of the cliff lines due to on-going weathering processes is also factored into the assessment.

The method requires the following input data:

- The geotechnical/physical characteristics of the cliffs (i.e. height, lithology, geological structure, aesthetic appeal, public accessibility);
- The predicted subsidence deformations and direction of mining in relation to the cliff lines; and
- The active natural weathering processes that cause cliff instability and talus formation (i.e. preferential weathering leading to overhang development, water and wind erosion, groundwater seepage).

Acceptable Impact Rating For 700 West / 800 Areas SMP

Previous cliff line impact assessments for partial extraction panels at the mine concluded that a low impact rating or less for both Category 1 (mine subsidence impacts) and the overall Category 1 to 3 impact rating was ideally required to achieve a low level of impact risk (i.e. no mine induced cracking or obvious increase in rock fall activity). From this study it is concluded that the assessment for the 700 West / 800 SMP Application Area should also fall within these categories.

The maximum subsidence parameters in the proposed mining areas should therefore be limited to the values shown in **Table 16**.

Table 16 Recommended Mine Subsidence Deformation Limits for Cliffs in 700 West /800 Areas

Mining Induced Cliff Impact Parameter	Acceptable Values
Mine subsidence	<50mm
Differential horizontal movement at crest	<50mm
Mining induced tilt at cliff	<2.5 mm/m
Mining induced strain at cliff	<2 mm/m

Impact Assessment

A summary of the results of the impact ratings for the cliff lines is provided in **Table 17** and **Table 18**. The combined rating for all three impact categories returns a moderate to very low overall impact rating.

The cliff lines presented in **Table 17** and **Table 18** are shown on Figures 1a and 1b in the SEA (2011g) cliffline assessment report attached in **Appendix B**.

Table 17 Summary of Impact Assessment Ratings for Cliff Lines in the 700 West Area

Reference Location	Nature of Mining	Category			Overall
		Mining Influence	Aesthetic Quality & Public Exposure	Natural Instability	
2a	None	Low	Low	Low	Low
2b, 2c	None	Low	Low	Moderate	Moderate
2d	None	Low	Low	Low/Moderate	Low
2e	None	Low	Low	Moderate	Moderate
2f	First Workings	Low	Very Low	Low	Very Low
2g	Edge of Extraction	Low	Very Low	Low	Very Low
2h	None	Low	Very Low	Low	Very Low
2i	None	Low	Very Low	Low	Very Low
2j	None	Low	Low	Moderate	Moderate
2k	None	Moderate	Low	Moderate	Moderate
2k-SW	None	Moderate	Very Low	Low/Moderate	Low
3a	First Workings	Low	Very Low	Low	Very Low
3b	None	Low	Low	Moderate	Moderate
3c	First Workings	Low	Low	Low	Low
3d	First Workings	Low	Very Low	Low	Very Low
3e	First Workings	Low	Low	Low/Moderate	Low
3f	First Workings	Low	Low	Low	Low
3g	Edge of Extraction	Low	Very Low	Low	Very Low
3h	Edge of Extraction	Low	Very Low	Low	Very Low
3i	None	Moderate	Very Low	Low	Low

Table 18 Summary of Impact Assessment Ratings for Cliff Lines in the 800 Area

Reference Location	Nature of Mining	Category			Overall
		Mining Influence	Aesthetic Quality & Public Exposure	Natural Instability	
1a	First Workings	Low	Very Low	Very Low	Very Low
1b	First Workings	Low	Very Low	Very Low	Very Low
1c	First Workings	Low	Very Low	Low	Very Low
1d	First Workings	Low	Very Low	Very Low	Very Low
1e	First Workings	Low	Low	Very Low	Very Low
1f	First Workings	Low	Low	Low	Low

Reference Location	Nature of Mining	Category			Overall
		Mining Influence	Aesthetic Quality & Public Exposure	Natural Instability	
1g	Partial Extraction	Low	Very Low	Low	Very Low

All cliff lines to be undermined in the 700 West / 800 areas are categorised as low in terms of mining impact and very low to low in overall. This highly favourable outcome is again indicative of the conservative nature of the mine plan.

The outcome of this rating for the SMP Application Area therefore indicates the following level of impact due to the proposed mining method:

- No acceleration of weathering or increase in rock fall activity;
- No mine induced fracturing or general cliff line instability;
- No changes to natural drainage or erosion patterns.

The predicted outcomes are consistent with actual subsidence experiences associated with the partial extraction system operated at the mine since 1999.

SEA (2011g) concludes that no adverse surface impacts from mining are expected, due to the very limited magnitudes of subsidence associated with the conservative mine plan and the mining method.

Monitoring, Mitigation and Management

Given that the probability of impacts on the clifflines and pagodas within the mining area is low to very low, it is proposed to photograph and inspect individual clifflines and pagodas over each panel in the SMP Application Area prior to and after extraction. Should the impacts to any cliffline or pagoda within the SMP Application Area be greater than the impact predictions various mitigation and public safety procedures will be enacted. These mitigation strategies range from the erection of warning signs in the area notifying of potentially dangerous conditions to the inspection and recommendation of remedial actions and the review of the mine plan and layout by a qualified geotechnical engineer. Clarence Colliery has taken the recommended mine subsidence deformation limits, in respect of clifflines, into account.

The SMP (SMP Application Volume 2) contains further details on the monitoring, mitigation and management of potential impacts.

8.1.4 STEEP SLOPES

Characterisation

There are areas of steep slopes adjoining the clifflines in both the 700 West and 800 area.

Any ground within the SMP Application Area at a grade of 1 in 3 (33.33%) or greater has been considered as a steep slope. Whilst these areas have not been specifically delineated, the steeper areas can be readily identified from the contours on **Plan 2**.

Statutory Requirements / Guidelines

The impact of mining operations on steep slopes within the SMP Application Area is not regulated by any specific statutory requirements. The legislation that regulates potential subsidence impacts on surface features (including steep slopes) is the *Mining Act 1992* under which the SMP Guidelines apply. This SMP Application has been prepared to gain approval for mining under the cliffs and pagodas within the application area.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

During the stakeholder consultation for this SMP Application, concerns relating to impact on steep slopes have not been raised by stakeholders.

Baseline Monitoring

The steep slopes in the vicinity of the cliffs and pagodas were visually inspected during the inspection of cliffs and pagodas as part of the SEA (2011g) cliff assessment.

Impact Assessment

Steep slopes have been previously undermined at Clarence Colliery with the full extraction (full pillar extraction and longwall) and partial extraction mining methods. With no impacts in previously mined partial extraction areas, there is a very low potential for any impact on steep slopes as similar mining techniques will be used within the 700 West / 800 Areas. This is supported by the conclusion of SEA (2011g) that there is a low probability of any impact on the clifflines, which are much steeper and intrinsically less stable than the steep slopes.

Monitoring, Mitigation and Management

Given there is a very low probability of impact on steep slopes from the proposed mining operations, minimal monitoring of steep slopes is required.

The steep slopes in the vicinity of the cliffs and pagodas will be visually inspected during the inspection of cliffs and pagodas. This includes ad-hoc inspections of steep slopes prior to and after mining.

The SMP (SMP Application Volume 2) contains further details on the monitoring, mitigation and management of potential impacts.

8.1.5 SPRINGS, SWAMPS, WETLANDS, WATER RELATED ECOSYSTEMS

Characterisation

RPS Australia Pty Ltd (RPS) conducted a Flora and Fauna Assessment to determine the ecological characteristics of the SMP Application Area, and identify any impacts that the potential subsidence may have. A copy of the assessment can be found in **Appendix D**, which identified the vegetation communities known as the Newnes Plateau Shrub Swamp and Newnes Plateau Hanging Swamp within the SMP Application Area.

In total, 16 vegetation communities were identified using the document titled 'The Vegetation of the Western Blue Mountains' (DEC, 2006). One of the vegetation communities, Map Unit 50 – *Newnes Plateau Shrub Swamp* (**NPSS**), is listed as an Endangered Ecological Community (**EEC**) under the NSW *Threatened Species Conservation Act 1995* (**TSC Act**). In addition, NPSS and Map Unit 51 – *Newnes Plateau Hanging Swamp (***NPHS**) is also identified in the SMP Application Area both correspond to the *Temperate Highland Peat Swamp on Sandstone EEC* under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (**EPBC Act**). The areas of each of these swamps occurring in the SMP Application Area can be found in **Table 19** and are shown on **Figure 9** and **Figure 10**.

Table 19 Water Related Ecosystem Areas in the SMP Application Area

Vegetation Community	Area within 700 West site (ha)	Area within 800 site (ha)	Total area (ha)
Newnes Plateau Shrub Swamp	12	16.72	28.72
Newnes Plateau Hanging Swamp	50	13.98	63.98

Swamps generally occupy gully heads and ridge top sites at points of water seepage where percolating groundwater travelling through the sandstone is forced outwards by impermeable (and most likely) shale layers. Not all swamps are dependant on continuous seepage of groundwater. Some swamps rely solely on rainfall. Accordingly, the swamps must have a peat substrate that retains water during dry times. The peat substrate retains moisture for a longer period of time as compared to well draining soils.

The base flow for the swamps is generally fed by near surface aquifers (unless solely dependant on rainfall).

Shallow groundwater monitoring within NPSS and NPHS has been undertaken within representative swamps. A total of four piezometers have been measuring the groundwater characteristics and behaviour since 2009. This prediction has been made based on the experience within the 700 area whereby three shallow piezometers hand augured into Happy Valley and Happy Valley Upper Swamp were undermined in the 700 Area. The monitoring results showed no change in groundwater behavior when pre-mining and post mining data were compared.

Statutory Requirements / Guidelines

The NPSS within the SMP Application Area is listed as an EEC under the NSW TSC Act. In addition, both the NPSS and the NPHS form a component of the *Temperate Highland Peat Swamps on Sandstone* EEC listed under the EPBC Act.

The Greater Metropolitan Region Groundwater Source Water Sharing Plan states (in Schedule 4) that THPSS are a high priority Groundwater Dependant Ecosystem. Schedule 4 also states that these GDE's will be considered in the assessment of any application for a water supply works approval. This is a separate approval not related to the SMP approval process.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

During the stakeholder consultation for this SMP Application, concerns relating to impact on NPSS or NPHS were raised by stakeholders. Clarence Colliery is aware that any impacts to these swamps would be of concern to the local community and environmental groups, Government Departments and subsequently, the impact assessment below addresses this issue.

Baseline Monitoring

Baseline monitoring of swamps for this SMP Application includes the monitoring of the Clarence aquifer, a swamp within the SMP Application Area and swamps outside the SMP Application Area that are subject to the same mining process as those within the SMP Application Area. Monitoring of other swamps and other vegetation units have been undertaken over the lease area for around 20 years.

Monitoring of the swamps within the Eastern SMP Area commenced in July 2004 for flora and September 2005 for fauna. The objective of these studies was to quantify that the partial extraction mining operation has no impact on either NPSS or NPHS over the Clarence Colliery mining lease area. With extraction completed in these panels, the sites are used to measure any impact from mining.

Inspections of swamps undermined by full pillar extraction and longwall mining have also been undertaken by Gingra Ecological Surveys (2008) prior to preparing previous SMP Applications. These inspections revealed that there appeared to be no mining related damage in the swamps included in the monitoring program.

It is believed that the Clarence Aquifer outcrops in the vicinity of the NPSS. Therefore, impact from partial pillar extraction on the Clarence aquifer will be monitored as a part of the groundwater monitoring program. There is one shallow hand augured piezometer located within Happy Valley Swamp that is located over Panel 714. Ongoing monitoring will detect whethere there is any impact to groundwater behaviour as result of partial extraction mining. It is noted that the outcome of previous assessments have found that the risk of impact from partial pillar extraction is low. It is further noted that there is sufficient background data in respect of the existing groundwater behaviour. Any other impacts will be determined by regular inspections.

The two swamps with hand augured piezometers installed include Happy Valley Swamp (with piezometers HV1 and HV2) and Happy valley Upper Swamp (with HVU1 and HVU2). Happy Valley Swamp is a NPSS and Happy Valley Upper Swamp is a NPHS. Monitoring of HV1, HV2, HVU1 and HVU2 commenced in 2009. HVU1 is located in the upstream section of Happy Valley Upper Swamp and over the life of the monitoring, groundwater levels have fluctuated. These fluctuations have been highly dependant on rainfall and groundwater levels have varied from a low of 1 m below ground level (**bgl**) to a high of just above ground level.

HVU2 has shown similar groundwater behaviour to HVU1 albeit with a more muted fluctuations ranging from 0.4 m bgl to just over 0.2 m above ground level. This is because the piezometer is located at the downstream end of the swamp. Both HVU1 And HVU2 have been extracted beneath and their groundwater behaviour has not changed when data from pre and post mining is compared.

HV1 and HV2 are located in a NPSS and have both shown consistent groundwater levels since monitoring commenced in 2009. The water level recorded by both piezometers has generally remained at 0.1 – 0.2 m above ground level even after HV1 was extracted beneath approximately 18 months to two years ago.

Impact Assessment

The Groundwater Impact Assessment (Aurecon 2011) found that:

- The impact of the proposed mining on the Clarence Aquifer will be negligible; and
- Since the impact on the aquifer will be negligible, then the likely impact on any groundwater dependent ecosystems that rely on the discharge from the aquifer is also likely to be negligible.

This finding agrees with monitoring data form piezometers over previously mined areas.

The impact assessment for groundwater concluded that the proposed mining will have no significant impact on the groundwater regime on both a local and regional scale, and that mining will have no significant impact on aquifers feeding base flow to rivers, creeks or swamps.

There are several Newnes Plateau Shrub Swamps in the 700 West and 800 areas that rely on groundwater and rainfall for their survival, and any depletion in these sources is undesirable. Nevertheless, since the investigations by Aurecon (2011) have indicated that the proposed mining will have no significant impact on the groundwater regime on both a local and regional scale, mining will have no significant impact on aquifers feeding base flow to rivers, creeks or swamps.

Mining could potentially impact these swamps through surface cracking and/or tilting which may divert water from the watercourse. However, due to the very low level of subsidence values (< 100 mm) expected and the very low levels of tilts and strains, the occurrence of surface cracking is highly unlikely, and the likelihood of negative impacts on aquifers or swamps is extremely low.

Further to this, the evidence from historical groundwater monitoring data from the Newnes Plateau Shrub Swamps and Newnes Plateau Hanging Swamps shows no changes in groundwater behaviour when comparing pre-mining data to post mining data.

Monitoring, Mitigation and Management

Mitigation strategies against impacting aquifers by the propped extraction are not required as the mine design provides substantial mitigation by minimising subsidence and caving within the overburden. However, the primary risk to springs and seepage into the swamps is the same as the potential impact on the aquifers above the Mount York Claystone that feed these springs and swamps systems. Subsequently, monitoring of potential impacts on swamps is focused on groundwater monitoring.

Monitoring of groundwater will continue as per the GW Program in the Clarence Colliery Water Management Plan approved by the Department of Planning, as well as the Outbye Area (Clarence Colliery, 2009a), 700 Area (Clarence Colliery, 2009b), and Eastern Area (Clarence Colliery, 2005) EMP's. It is noted that the GW Program is currently under review in consultation with DP&I, SCA, OEH and NOW.

The current assessment has indicated that the proposed mining at Clarence 700 West and 800 areas as proposed, using partial pillar extraction methods can be carried out with negligible risk to the local groundwater regime (including the Clarence Aquifer, NPSS and NPHS).

The following monitoring, management and mitigations (as outlined in Aurecon (2011) :

1. Continue the existing subsidence monitoring programs.

2. Where mine subsidence exceeds previously observed maxima, undertake a review of reasons for observed results and likely future observations, and implications for groundwater security.

3. Continue existing groundwater monitoring programs.

4. Where groundwater behaviour appears anomalous, undertake a review of reasons for observed results and likely future observations, and implications for groundwater security.

5. Continue existing swamp groundwater and vegetation monitoring programs. The lack of evidence of any impact in the existing data indicates that there is no need to extend these programs to other swamps, given the impact on the swamps that installing and conducting monitoring is likely to have, and the difficulty of access.

6. Develop an inspection regime for the remainder of the swamps in place of groundwater and vegetation monitoring.

7. In cases where continuing monitoring indicates that a potential hazard may be developing, review the mine plan.

8. Review all results at the completion of each mining panel to ensure that mining performance does not exceed predictions.

Individual swamps and some portions of those swamps contain varying levels of predicted subsidence due to the depths of mining extraction works. Regardless of the different proposed depths, all levels of predicted subsidence lie within the 100mm acceptance threshold (RPS, 2011).

Monitoring of subsidence and surface inspections of previous extracted sites within the area has allowed for an accurate prediction of the subsidence for this site. No noticeable subsidence damage has occurred to cliff lines (one of the most sensitive surface features) above partial extraction panels and no long-term damage is expected due to predicted mining-related subsidence within the site (RPS, 2011).

The results from historic monitoring effort are used to assess the risk to other NPSS's and NPHS's that are not monitored to such detail, but are subject to the same impacts (less than 100 mm subsidence, 2 mm/m tilts and 1 mm/m strains). To date, the existing monitoring has shown minimal effects (if any) on the NPSS's and NPHS's from partial pillar extraction. The ongoing monitoring program will continue to assess the risk of the current mining technique on these vegetation communities.

Whilst regular inspections of the swamps are recommended, additional monitoring of the swamps within the SMP Application Area is not recommended due to the low level of risk from partial pillar extraction. The monitoring of NPSS's and NPHS's over Clarence Colliery will continue on a risk based approach which will be continually reviewed through regular assessment of the ongoing monitoring program. The NPSS and NPHS will be regularly inspected and photographed as part of the swamp monitoring program.

8.1.6 FLORA AND FAUNA

Characterisation

RPS completed a Flora and Fauna Assessment (**Appendix D**) specific to the SMP Application Area to assess the level of existing ecological information, and determine the likely impacts of the proposed mining activities. The assessment includes the following:

- A desktop assessment of relevant ecological assessments within and adjacent to the SMP Application Area;
- Identification of threatened flora and fauna species, populations and ecological communities known or likely or occur within a 10 km radius of the SMP Application Area;
- Field surveys to ground-truth vegetation mapping and locate threatened flora and fauna species within the SMP Application Area;
- A seven part test under the TSC Act to assess the potential of the project to have a significant impact on any threatened species, populations or ecological communities known or likely to occur in within the SMP Application Area or its immediate vicinity;
- An assessment of likely impacts to Matters of National Environmental Significance listed under the EPBC Act; and
- A State Environmental Planning Policy (SEPP) 44 assessment to determine the likely level of impact on the koala.

The SMP Application Area supports a range of native flora and fauna. This assessment has focused on the threatened and protected species which have been characterised in accordance with the TSC Act and the EPBC Act.

The Flora and Fauna Assessment identified that 11 threatened flora species, 26 threatened fauna species and one EEC listed in the TSC Act are known or predicted to occur within a 10 km radius of the SMP Application Area. Details of the survey methods used can be found in **Appendix D**.

Flora

The Flora and Fauna Assessment (RPS 2011a) identified that there is the potential for 11 threatened flora species to occur in the SMP Application Area, as identified in **Table 20**.

Table 20 Potential or Known Threatened Flora Species in the SMP Application Area

SCIENTIFIC NAME	COMMON NAME	Status TSC Act	Status EPBC Act
Lastreopsis hispida	Bristly Shield Fern	E	
Acacia bynoeana	Bynoe's Wattle	E	
Eucalyptus aggregata	Black Gum	V	
Eucalyptus pulverulenta	Silver-leafed Gum	V	V
Prasophyllum fuscum	Slaty Leek Orchid	E	

SCIENTIFIC NAME	COMMON NAME	Status TSC Act	Status EPBC Act
Isopogen fletcheri	Fletcher's Drumsticks	V	
Persoonia acerosa	Needle Geebung	V	
Persoonia hindii		E	
Asterolasia buxifolia		E	
Boronia deanei	Deane's Boronia	V	V
Derwentia blakelyi		V	

V=Vulnerable, E = Endangered

A total of 81 flora species were identified during field investigations, of which none were exotic. In the 700 West area a stand of *Persoonia hindii* (which is listed as Endangered under the TSC Act) was recorded in the north-west section, and *Derwentia blakelyi* (listed as Vulnerable under the TSC Act) was detected in the south-east section.

In total, 16 vegetation communities were identified within the SMP Application Area, with ground surveys confirming the location of each. The 700 West area is predominately comprised of Newnes Plateau Narrow-leaved Peppermint – Silver-top Ash Layered Open Forest, Newnes Plateau Dwarf Sheoak – Banksia Heath to the north, and Sandstone Plateau and Ridge Scribbly Gum – Silver-top Ash Shrubby Woodland and Sandstone Slopes Sydney Peppermint Shrubby Forest in the south. The 800 area is predominately covered by Exposed Blue Mountains Sydney Peppermint – Silver-top Ash Shrubby Woodland. Both sites have scattered patches of other vegetation types throughout.

The Newnes Plateau Hanging Swamp and Newnes Plateau Shrub Swamp are known to occur in the area and are listed under the TSC Act as EECs. In addition, the federal EPBC Act lists *Temperate Highland Peat Swamps on Sandstone* as an EEC, which include Newnes Plateau Hanging Swamp and Newnes Plateau Shrub Swamp. This is discussed further in **Section 8.1.5**.

Fauna

The Flora and Fauna Assessment (RPS 2011a) identified that there is the potential for 26 threatened fauna species to occur in the SMP Application Area, as identified in **Table 21**.

Table 21 Potential or Known Threatened Fauna Species in the SMP Application Area

Scientific Name	Common Name	Status TSC Act	Status EPBC Act
Amphibia			
Heleioporus australiacus	Giant Burrowing Frog	V	V
Pseudophyne australis	Red-crowned Toadlet	V	
Reptilia			
Eulamprus leuraensis	Blue Mountains Water Skink	E	E
Aves			
Hieraaetus morphnoides	Little Eagle	V	
Oxyura australis	Blue Billed Duck	V	

Scientific Name	Common Name	Status TSC Act	Status EPBC Act
Callocephalon fimbriatum	Gang-gang Cockatoo	V	
Calytorhynchus lathami	Glossy Black Cockatoo	V	
Climacteris picumnus	Brown Treecreeper	V	
Daphoenositta chrysoptera	Varied Sittella	V	
Melanodryas cucullata	Hooded Robin	V	
Petroica boodang	Scarlet Robin	V	
Petroica phoenicea	Flame Robin	V	
Pomatostomus temporalis	Grey-crowned Babbler	V	
Glossopsitta punsilla	Little Lorikeet	V	
Ninox strenua	Powerful Owl	V	
Tyto novaehollandiae	Masked Owl	V	
Mammalia			
Cercartetus nanus	Eastern Pygmy-possum	V	
Dasyurus maculatus	Spotted-tailed Quoll	V	E
Petaurus australis	Yellow-bellied Glider	V	
Petaurus norfolcensis	Squirrel Glider	V	
Phascolarctos cinereus	Koala	V	
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	
Scoteanax rueppellii	Greater Broad-nosed Bat	V	
Insecta			
Paralucia spinfera	Bathurst Copper Butterfly	E	V
Petalura gigantea	Giant Dragonfly	E	

A total of seven species of frog were identified, along with six individual reptile species. However no threatened amphibian or reptile species were recorded.

A total of 35 species of birds were systematically recorded during combined survey periods. One threatened bird species was recorded, being the Varied Sitella. Whilst Glossy Black Cockatoos, listed as vulnerable under the TSC Act, were not observed in the SMP Application Area, *Allocasuarina* tree species, suited to the foraging requirements of this species were present. The SMP Application Area also has potential to represent a portion of the local foraging range of both the Masked Owl and Powerful Owl, due to the presence of terrestrial and arboreal mammals as prey.

Five species of terrestrial and arboreal mammals were identified as occurring within the SMP Application Area; however none of these species are listed under the TSC Act and/or EPBC Act as threatened. A total of six bat species were confidently identified, including the Eastern Bent-wing Bat which is listed as vulnerable under the TSC Act. Additional bat species known to exist in the locality that could not be confidently identified include the vulnerable Eastern False Pipistrelle, East Coast Freetail Bat and the Greater Broad-nosed Bat.

No threatened invertebrate fauna was recorded during the survey, although habitat was found to be present for the Giant Dragonfly. The food plant of the Bathurst Copper Butterfly larvae, although occurring in the wider locality, was not recorded within the SMP Application Area.

Statutory Requirements / Guidelines

The TSC Act and the EPBC Act aim to list and protect threatened species and habitat types. The Acts protect species by allowing a list of threatened species to be constructed and maintained.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

During the stakeholder consultation for this SMP Application, concerns relating to impact on threatened fauna species were raised by stakeholders. Particular concern was raised in relation to species such as the Giant Dragonfly that are reliant on swamps in the area and therefore are seen (by stakeholders) to be particularly sensitive to subsidence impacts on hydrology. This was considered in the SMP risk assessment, which found that the risk to threatened fauna species from the proposed partial extraction in the SMP Application Area was low.

During the stakeholder consultation for this SMP Application, concerns relating to impact on NPSS or NPHS were raised by stakeholders. Clarence Colliery is aware that any impacts to these swamps would be of concern to the local community and environmental groups, Government Departments and subsequently, the impact assessment below addresses this issue.

Baseline Monitoring

Since 2004, there have been on-going flora and fauna monitoring surveys within Clarence Colliery holdings, including the 800 area incorporated in this SMP Application and the 700, Outbye and Eastern areas. The locations of the baseline flora and fauna monitoring sites are shown in **Figure 11**.

Baseline monitoring for flora and fauna has been undertaken in a number of swamps and heath land over the 800 Area. No specific baseline monitoring has been undertaken within the 700 West Area but monitoring of swamps adjacent to this area (i.e. 700 Area) has been undertaken.

Due to the proximity of the current monitoring locations to the SMP Application Area, it should be possible to monitor any potential effects from mining activities using the partial extraction mining technique by continuing surveys at existing sites. It is acknowledged that it would be impractical to monitor every swamp particularly in light of the difficulty and safety hazards regarding access to some of the more remote areas.

The monitoring sites have been selected to monitor flora and fauna within swamp, woodland and cliffline environments. Previous experience from the extensive flora and fauna monitoring in place over areas that have been extracted (using partial pillar extraction techniques), has shown no impact to flora and fauna following mining. This demonstrates that the risk of impacts from mining on flora and fauna over the SMP application area is extremely low. Consequently data from the ongoing surveying from these sites can be used

to monitor the area associated with 700 West /800 Areas, including the swamps. No additional baseline monitoring has been recommended by RPS (2011b)

Impact Assessment

Following an assessment of the likeliness of occurrence, RPS (2011b) conducted a seven part test on the species listed as vulnerable under the TSC Act known or likely to exist within the SMP Application Area. In total seven threatened flora species, 32 threatened fauna species and one EEC were assessed, and RPS concluded that the potential subsidence associated with the project is unlikely to significantly impact on any threatened species, populations or ecological communities. In the unlikely event that minor surface impacts do occur (such as ponding and/or surface cracks), effects on any threatened species, populations or ecological communities are not expected to be significant as the area of impact will be minor relative to the remaining similar habitat areas within and neighbouring the SMP Application Area. Even for those species associated with wet areas, including swamp habitats, it is unlikely that these minor changes would alter habitat conditions such that species would not survive.

Clarence Colliery is located within the Greater Lithgow LGA which is listed on Schedule 1 of SEPP 44 and therefore the Proposal is subject to SEPP 44 assessment. None of the tree species listed on Schedule 2 were recorded on site. Additionally, none of the vegetation communities recorded on site list any Schedule 2 tree species as a dominant or diagnostic species. Therefore, whilst tree species listed on Schedule 2 may occur within the site it is unlikely that they would make up 15% or more of the tree species present. The site is therefore unlikely to represent “potential” koala habitat. Furthermore, given the low level of impact predicted to occur, it is highly unlikely that any koala habitat, if present, would be affected by the proposal.

The site is not a World Heritage area however it is closely bordered by the world heritage declared Greater Blue Mountains Area NSW. The 700 West site is located 2.1 km from the western border of the Greater Blue Mountains Area NSW. The 800 site is bordered by the world heritage area on the north, east and south boundaries of the site.

The site is not a National Heritage Place however it is closely bordered by the National Heritage declared Greater Blue Mountains Area NSW. The 700 West site is located 2.1 km from the western border of the Greater Blue Mountains Area NSW. The 800 site is bordered by the national heritage area on the north, east and south boundaries of the site.

The site is not part of any RAMSAR Wetland area, and is not in proximity to any such area.

A Protected Matters Search was conducted to determine if any nationally listed threatened species and ecological communities under the EPBC Act 1999 were recorded within a 10km radius of the project area. A number of threatened species and one community were recorded within a 10 km radius of the project area. An assessment was undertaken in accordance with the EPBC Act and *EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance* (DEWHA, 2009). The results of this assessment carried out by PRS (2011) are presented below.

Surface impacts are considered unlikely to occur and no changes to natural drainage, groundwater systems or erosion patterns will occur as a result of mining procedures as the mining procedures are considered conservative (Strata Engineering, 2011). Subsidence is not expected to exceed 100 mm. A worst-case scenario, which entails only an increase in subsidence levels, would be in the event of flooding where subsidence could reach a possible 90mm. However, worst case scenarios are considered unlikely to occur and still lie within the limits of the accepted 100 mm subsidence threshold. It is therefore concluded that the thresholds for determining that a significant impact is likely, as listed above, have not

been reached. It is therefore considered unlikely the above listed threatened species, migratory species and ecological community will be affected by the proposal.

The Proposal will not have a significantly adverse effect on any Commonwealth marine area, as there are no such marine areas within the region. Furthermore partial pillar extraction within the 700 West and 800 Areas do not involve nuclear activities.

Based on all of the above and pursuant to the EPBC Act, an assessment of potential impacts arising from the proposal on MNES has concluded that no significant impact is likely to relevant Matters of National Environmental Significance.

Monitoring, Mitigation and Management

Flora and fauna monitoring will continue to be undertaken in accordance with standard practice at Clarence Colliery, at the baseline monitoring locations shown on **Figure 11.** The existing monitoring sites in the 700 area represent the majority of the habitat located within the 700 West area, therefore it is not deemed necessary to establish additional monitoring. Baseline monitoring sites currently exist over the 800 area, and these will continue to be monitored during mining in this area. The monitoring is currently undertaken during three seasons of the year (autumn, spring and summer) to ensure natural variability of fauna populations are taken into consideration.

Flora monitoring will continue within the following Swamps:

- Dumbano 3 Swamp;
- Hanging Swamps within the 800 Area;
- Dumbano 1 Swamp;
- Billabong 1 Swamp;
- Banksia 2 Swamp; and
- Happy Valley Swamp.

Fauna monitoring will continue at the three sites already established within the 800 Area and the 700 Area.

The SMP (SMP Application Volume 2) contains further details on the monitoring, mitigation and management of potential impacts.

8.1.7 AREAS OF ARCHAEOLOGICAL AND/OR HERITAGE SIGNIFICANCE

Characterisation

RPS conducted a Cultural Heritage Assessment of the SMP application area to assess the impact of the proposed extraction on known Aboriginal artefacts. A copy of the report is attached as **Appendix E**. The Assessment (which includes consultation in accordance with the *Aboriginal Cultural Heritage Consultation Requirements (**ACHCRs**) for Proponents* (DECCW 2010)) comprises a detailed background review of previous archaeological assessments for the area, the environmental context, a brief history of Lithgow LGA and results from an Aboriginal Heritage Information Management System (**AHIMS**) database search.

The Assessment included the use of a previously developed Predictive Model for the Clarence area. The original model was produced by RPS-HSO in 2008 for the archaeological assessment for the Outbye Area SMP, and was based upon data sourced from a search of the AHIMS database and from a literature review of available archaeological reports pertinent to the study area. **Figures 9 and 10** show the location of surrounding archaeological sites in relation to the mining area. The predictive model indicated that the region would contain a high number of Aboriginal cultural heritage sites.

An AHIMS search was undertaken for a 10 km radius of the SMP Application Area, which identified a total of 91 archaeological sites as being registered within the search area. The site types in the AHIMS search area included shelters (with art or deposits), artefact scatters, axe grinding grooves, scarred trees and isolated finds.

A field survey of the SMP Application Area was undertaken by RPS archaeologists and Aboriginal stakeholders on Monday 8 November 2010 to Wednesday 10 November 2010. The SMP Application Area was surveyed in eight survey units, with each survey unit assessed for exposure and visibility. Further details of the field survey methodology can be found in **Appendix E**. During the field survey, one new and previously unregistered Aboriginal archaeological site was identified. RPS CL IF1 was recorded as an isolated find comprising a quartz flake, and has been since recorded on the AHIMS database.

Rock shelters were the most common site type present in the SMP Application Area, with two shelters on tributaries of Farmers Creek and a cluster of shelters along tributaries of the Wollangambie River in the area of Gooches Swamp area. Artefact sites (scatters and isolated finds) were found close to water on flat lying areas along creek lines or on lower slopes, as well on crests and simple slopes areas. Only one scar tree site has been previously recorded, but the field survey was unable to relocate them due to bushfire damage in the area. Sites located (and where they sit above the proposed panels) are presented in **Table 22.**

Table 22 Summary of Predicted Subsidence and Typical Subsidence at each Archaeological Site

Site	Site Type	Panel Number	Predicted subsidence (typical subsidence) mm	Overall Significance
700 West Area				
45-1-0085	Artefact Scatter	707	<100 (35.7)	Low
45-1-0192	Artefact Scatter	Outside SMP area	<100	Low
45-1-0193	Artefact Scatter	Barrier pillar	<100	Low
45-1-0194	Artefact Scatter	716	<100 (36.1)	Low
45-1-0195	Rock Shelter	716	<100 (36.1)	Moderate
45-1-0196	Artefact Scatter	716	<100 (36.1)	Low
45-1-2696	Artefact Scatter; PAD	707	<100 (35.7)	Low
45-1-2702	Shelter; PAD	718	<100 (27-36.1)	Low
C-S-2	Shelter with Deposit	719	<100 (22.7)	Low
45-1-2700	Artefact Scatter	Not undermined	n/a	Low
45-1-2701	Artefact Scatter	Not undermined	n/a	Low
45-1-2690	Artefact Scatter	Not undermined	n/a	Low
45-1-2693	Isolate Find	Not undermined	n/a	Low
800 Area				
45-1-0053	Shelter with Art and Deposit	First workings	Immeasurable (<20mm)	High

45-1-0054	Shelter with Art and Deposit	Outside SMP area	Immeasurable (<20mm)	High
45-1-2698	Artefact Scatter	810	<100 (35-51)	Low
45-1-2699	Artefact Scatter	814	<100 (35-51)	Low
45-1-2705	Scar Tree	816	<100 (35-51)	Low
45-1-2703	Isolated Find	814	<100 (35-51)	Low
45-1-2704	Isolated Find	816	<100 (35-51)	Low

No evidence resembling the early Lithgow settlement record and mining industry, or other items of European cultural significance were identified during the field survey investigation.

Statutory Requirements / Guidelines

The National Parks and Wildlife (NPW) Act (1974) (as amended) is the primary state legislation relating to cultural heritage. The legislation is overseen by the OEH.

The NPW Act provides statutory protection for all Aboriginal relics (not being a handicraft made for sale), with penalties levied for breaches of the Act. Part 6 of this Act is the relevant part concerned with Aboriginal objects and places, with the Section 86 and Section 90 being the most pertinent. In 2010, this Act was substantially amended, particularly with respect to Aboriginal cultural heritage requirements.

There are now four major offences:

1. A person must not harm an object that the person knows is an Aboriginal object;

2. A person must not harm an Aboriginal object;

3. For the purposes of s86, "*circumstances of aggravation*" include (a) the offence being committed during the course of a commercial activity; or (b) that the offence was the second or subsequent offence committed by the person; and

4. A person must not harm or desecrate an Aboriginal place.

Penalties for all offences under Part 6 of this Act have also been substantially increased, depending on the nature and severity of the offence.

Historical archaeological relics, buildings, structures, archaeological deposits and features are protected under the Heritage Act 1977 (as amended 1999) and may be identified on the State Heritage Register (**SHR**) or by and active Interim Heritage Order. Certain types of historic Aboriginal sites may be listed on the SHR or subject to an active Interim Heritage Order; in such cases they would be protected under the Heritage Act 1977 and may require approvals or excavation permits from the NSW Heritage Branch.

Stakeholder Consultation

Aboriginal consultation was undertaken in accordance with the *Aboriginal Cultural Heritage Consultation Requirements* (**ACHCR**) *for Proponents* (DECCW 2010). Representatives from Bathurst Local Aboriginal Land Council (**BLALC**), Gundungurra Tribal Council Aboriginal Corporation (**GTCAC**), Dhuuluu-Yala Aboriginal Corporation (**DYAC**), Wiradjuri Traditional Owners Central West Aboriginal Corporation (**WTOCWAC**), Warrabinga Native Title Claimants Aboriginal Corporation (**WNTCAC**) and North East Wiradjuri Company Ltd (**NEWCo**) registered through the ACHCR process. Each of these groups participated in the field survey from Monday 8 November through to Wednesday 10 November 2010, and their comments and views related to the project are included in RPS (2011b) Cultural Heritage

Assessment. Consultation with the Aboriginal Community will continue throughout the duration of the project should any matters relating to Aboriginal heritage arise.

The general consultation process and community consultation undertaken is described in **Section 9**.

During the stakeholder consultation for this SMP Application, concerns relating to impact on archaeological sites have not been raised by stakeholders

Baseline Monitoring

Field surveys have verified the locations of the archaeological sites within the SMP Application Area. No additional baseline monitoring is required prior to mining.

Impact Assessment

As the level of subsidence from the proposed mining is predicted to be no more than 100 mm, it is unlikely that artefact scatters or isolated finds will be impacted by the proposed works. **Table 23** provides a summary of potential impacts, risk to heritage and mitigation options.

Table 23 Summary of potential impacts, risk and mitigation options for heritage

Impact	Risk to Heritage	Mitigation Option 1	Mitigation Option 2	Mitigation Option 3
Mine Subsidence	Disturbance/damage to cultural heritage sites	Ensure SMP is undertaken in consultation with the registered ACS	Regular monitoring including pre and post mining monitoring programme	Move artefacts under an AHIP to location outside the impact area if subsidence is predicted to cause potential harm
Plant/vehicle movement	Disturbance/damage to identified artefact scatters and isolated finds	Avoid; ensure Centennial Clarence Environmental officer is given site location	Cordon off site area or prevent vehicular access to site	Move artefacts under an AHIP to location outside of impact area
	In wet conditions, heavy plant equipment/vehicles may disturb soil profiles at artefact scatters and isolated finds	Restrict heavy plant/vehicle movement to dry weather conditions	Avoid	Move artefacts under an AHIP to location outside impact area
Vandalism	Disturbance/damage to rock shelters, grinding groove areas and rock art	Avoid; ensure Centennial Clarence environmental officer is given site location	Cordon off site area and block access route to prevent vehicular access to site	Site awareness and sensitivity education program

A significance assessment of sites identified within the boundary of the SMP Application Area or within 500 m was undertaken as part of the Cultural Heritage Assessment (RPS 2011b). Only two sites (45-1-0053 and 45-1-0054), both rock shelters with art and deposit, were classed as having a high local and regional significance.

The previously unregistered isolated find RPS CL IF1 (registered as 45-1-2693) was assessed as having low significance for representativeness on a local and regional scale due to the common use of quartz as flaked stone tools in the regional area.

No Aboriginal sites of state significance were identified by RPS (2011a), and as such there are no sites of high significance to NSW that require protection for inter-generational equity purposes.

Clarence Colliery has identified no impacts on the surface of previously mined areas using the partial extraction mining methods, and as such it is expected that mining in the 700 West / 800 Areas will also have no impacts on any Aboriginal cultural heritage sites.

As no items of non-Indigenous cultural heritage were identified in the SMP Application Area, no impacts are predicted.

Monitoring, Mitigation and Management

Conservation of Aboriginal sites and areas of archaeological sensitivity is the preferred heritage outcome. However, other mitigation options have been developed in case this in unfeasible as part of the proposed development. The following recommendations have been suggested by RPS (2011a), taking into consideration the significance of Aboriginal heritage, potential impacts and relevant legislation.

1. Ensure that disturbance associated with the proposed mining operations is limited to the boundaries of the area identified in this report. If additional works are planned outside of the study area, additional cultural heritage investigation may be required.

2. It is recommended that any artefacts remain on site unless impact to the sites is deemed unavoidable. It is further recommended that Clarence Colliery monitors the sites on a regular basis in order to check the ongoing status of the site.

3. If impact to any sites containing artefacts is unavoidable then a surface salvage should be undertaken under a Section 90 Permit. A Control and Care Permit should be obtained in consultation with local Aboriginal Community Stakeholders and the artefacts transferred to a designated keeping place. However it is considered highly unlikely that any of the artefact sites within the 700 West or 800 areas will be impacted upon by the proposed bord and pillar partial extraction works.

4. It is recommended that during the general course of the project a monitoring plan could be implemented for any rock shelter sites to monitor for the effects of cracking or movement. Also ongoing management of the site could include pre and post mining inspections to assess and quantify any impact. Rock shelter sites contained in the 700 West and 800 areas are #45-1-0053 and #45-1-0054 in the Wollangambie catchment and C-S-1, C-S-2 and #45-1-0095 in the Farmers Creek catchment area.

5. It is recommended that during the course of the project work Clarence Colliery limits or avoids any proposed works in this area (out of abundance of caution) that may impact on the Gooches Crater shelter complex comprising AHIMS sites #45-1-0053 and #45-1-0054.

6. It is recommended that during the general course of the project scar tree sites could be monitored for the effects of movement. Also ongoing management of the site could include pre and post mining inspections to assess and quantify any impact. The scar tree site C-ST-1 in the 800 area is unlikely to be affected by predicted subsidence levels.

7. All relevant Clarence Colliery staff should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a part of the normal induction process.

8. The location of any Aboriginal cultural heritage sites in the study area should be included in the Clarence Colliery environmental management framework for the study area, so that all relevant staff members are aware that these areas will require management.

9. If further Aboriginal site/s are identified in the study area, then all works in the area should cease, the area cordoned off and contact made with the OEH Environment Line phone no. 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.

10. In the unlikely event that skeletal remains are identified, work must cease immediately in the vicinity of the remains and the area cordoned off. The proponent will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, the proponent must contact the OEH Environment Line 131 555, a suitably qualified archaeologist and representatives of the local Aboriginal Community Stakeholders to determine an action plan for the management of the skeletal remains, formulate management recommendations and to ascertain when work can recommence.

11. If, during the course of development works, significant European cultural heritage material is uncovered, work should cease in that area immediately. The NSW Heritage Branch should be notified and works only recommence when an appropriate and approved management strategy is instigated.

8.1.8 STATE FOREST – FORESTRY MANAGEMENT ZONES

Characterisation

The 800 Area is located wholly within Forestry Management Zone (FMZ) 2. The 700 West Area is located within FMZ 4, with small areas of FMZ 2 present. FMZ 2 and 4, and the surrounding FMZs are shown in **Figure 12**. The FMZs relevant to Clarence Colliery are broadly defined by NSW Forests as:

- **FMZ 2** – Specific management and protection of natural and cultural conservation values, where it is not possible or practical to include them in Zone 1.

- **FMZ 4** – Management of native forests for timber production utilising the full range of silvicultural options as appropriate and for conservation of broad area habitat and environmental values that are not dependant on the structure of the forests.

It is noted that there are inconsistencies in the cadastral information supplied by the Land and Property Management Authority (**LPMA**) and the mining lease boundary associated with the southern boundary of ML 1583 extended from CCL705. This LPMA cadastral information is distributed in digital and hard copy format, including the 1:25,000 topographical and orthophoto maps which are widely available. It is assumed that the perceived conflict has been raised in previous discussions with various stakeholders.

In 1984, the Chief Surveyor of the Foresty Commission (now known as Forests NSW) was notified that there was an inconsistency within the “metres and bounds” description of the State Forest which affected the eastern boundary of the State Forest.

During the development of Clarence Colliery, the proposed mine design was centred around the location of crucial infrastructure, such as the surface to seam drift and the underground bin as well as surface parameters such as the existing State Forest / National Park boundary. Mine roadways in an easterly direction from the underground bin were designed with these constraints in mind. When the Chief Surveyor of the Forestry Commission made his determination on the State Forest boundary, the final line which formed the southern boundary of the State Forest swung too far north and prevented the extension of proposed mine roadways to the east. Calculations provided by Mr Elliston (Mine Surveyor at Clarence Colliery) show the distance required to enable the continued projection of mine roadways in an easterly direction past the corner of the National Park boundary.

It is understood that subsequent consultation between the Forestry Commission and the then Department of Mineral Resources **(DMR)** resolved the issue and the Forestry Commission swung the southern boundary of the State Forest to the south to facilitate the projection of the mine workings past the corner of the SF / NP boundary.

The plan notations displayed on DRE Diagram M78-2245 in **Figure 13:**

> *"Variation of plan from plans Misc. 129A & 129B catalogued in Forestry Commission of NSW-see letter dated 29-11-84 pps. T70-6973."*

and also displayed on the lease plan for ML1583, DRE Diagram M27062, shown in **Figure 14***:*

> *"Coordinates based on the Determination of the Eastern Boundaries of Newnes State Forest No.748 by Mr FW Hearfield, Chief Surveyor Forestry Commission of NSW in 1984 (ISG). These boundaries are the western boundaries of the Blue Mountains National Park"*

confirm that the information used for the location of the southern boundary of CCL705, A416, ML1583 and EL5072 was provided by the Forestry Commission. At this time, this update is not reflected in the cadastral information provided by the LPMA or Forests NSW.

Correspondence from Forest NSW in 2009 confirms the following:

> "*Further investigation of the forest boundary ….. has revealed that the co-ordinates delineated on Misc F 129B were not transferred to the GIS layers to accurately reflect the forest boundary. …. This boundary now co-incides with the mining lease boundary as determined by their surveyors*"

In summary, Clarence Colliery is using the boundary (as referred to by Forests NSW in 2009) as stipulated in Mining Lease 1583.

N
W
E
S

700 West Area

800 Area

Lithgow
No.2
Dam

LEGEND

- Colliery Holding Boundary
- Mining Lease Boundary
- Lithgow No.2 Dam Notification Area
- SMP Application Area
- First Workings Zone (for Lithgow No.2 dam)
- Existing Workings Area
- Proposed Workings Area (incl. Secondary Extraction)

Forestry Management Zones

- FMZ 2 - □nformal Reserve (Special Management)
- FMZ 3b - Special Prescription
- FMZ 4 - General Management Native Forest
- FMZ 6 - Softwood Planted Forest Estate
- FMZ 7 - Non Forestry □se

Source Data: Forests NSW

□□he FMZ provides management intent for all State Forests. □t is derived from a preliminary revision of the Preferred Management Priority system to more realistically represent State Forests expectations of appropriate □oning for forest management practices. □he Layer is indicative of management intent and is intended for use as context to land use planning.

0 1.0 2.0km

Scale 1:35 000 (A3)

FIGURE 12

Forestry Management Zones

Project:
Clarence SMP - Partial Extraction of 700 West and 800 Areas

Client:
Clarence Colliery

File:
Fg12_CCC06-011_FMZs_111109

Projection:
MGA 94 Zone 56

Version:	Date:	Author:	Checked:	Approved:
1	08/04/11	AR	SS	SS
2	15/04/11	AR	SW	BS
3	29/07/11	LH	SW	BS
4	25/10/11	Z□	SW	BS
5	09/11/11	□C	SW	BS

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

V:\CCC06-011\Figures\Final\CAD\Fg12_CCC06-011_FMZs_111109.dwg

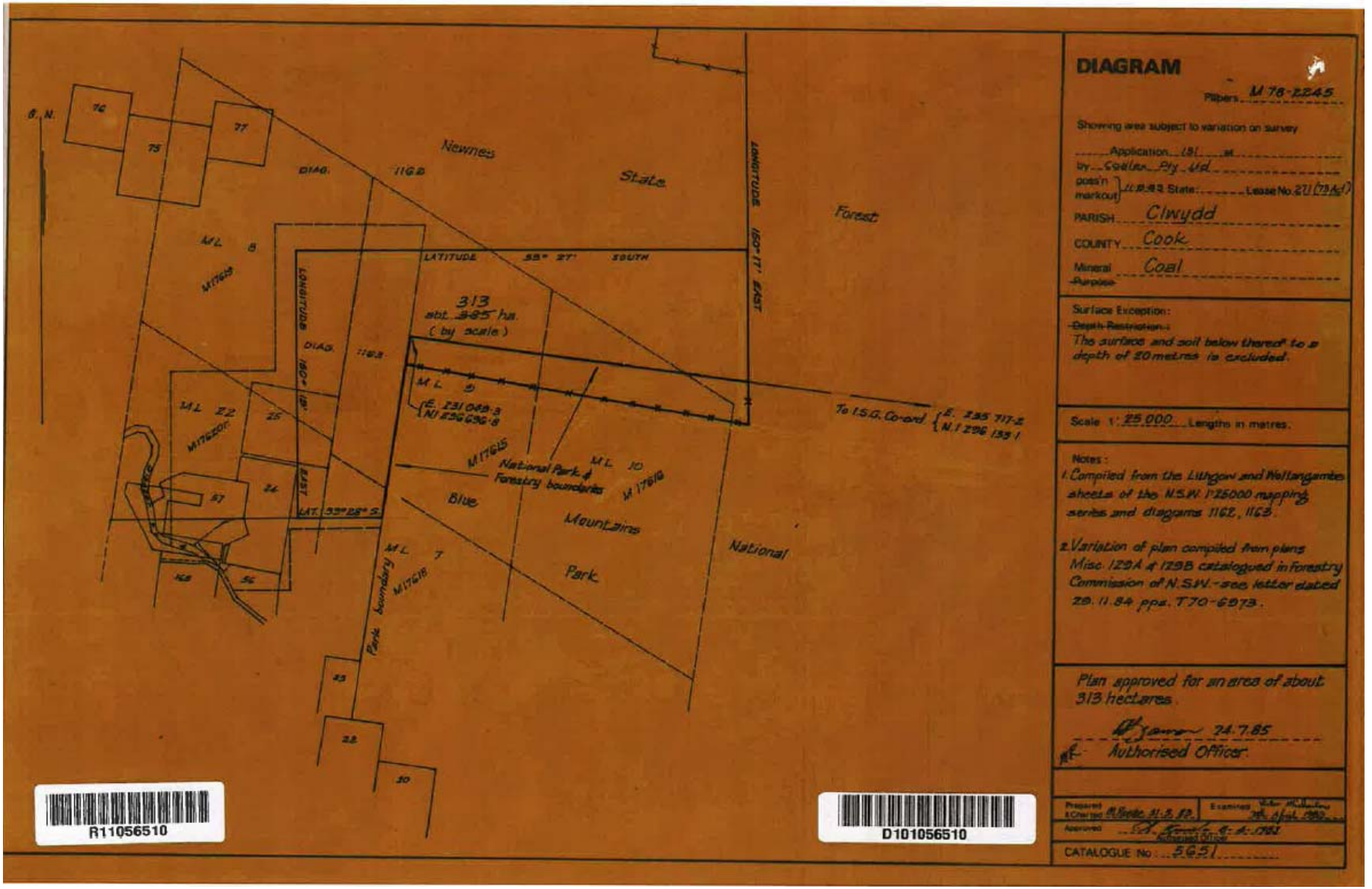


Figure 13 DRE Diagram M78-2245

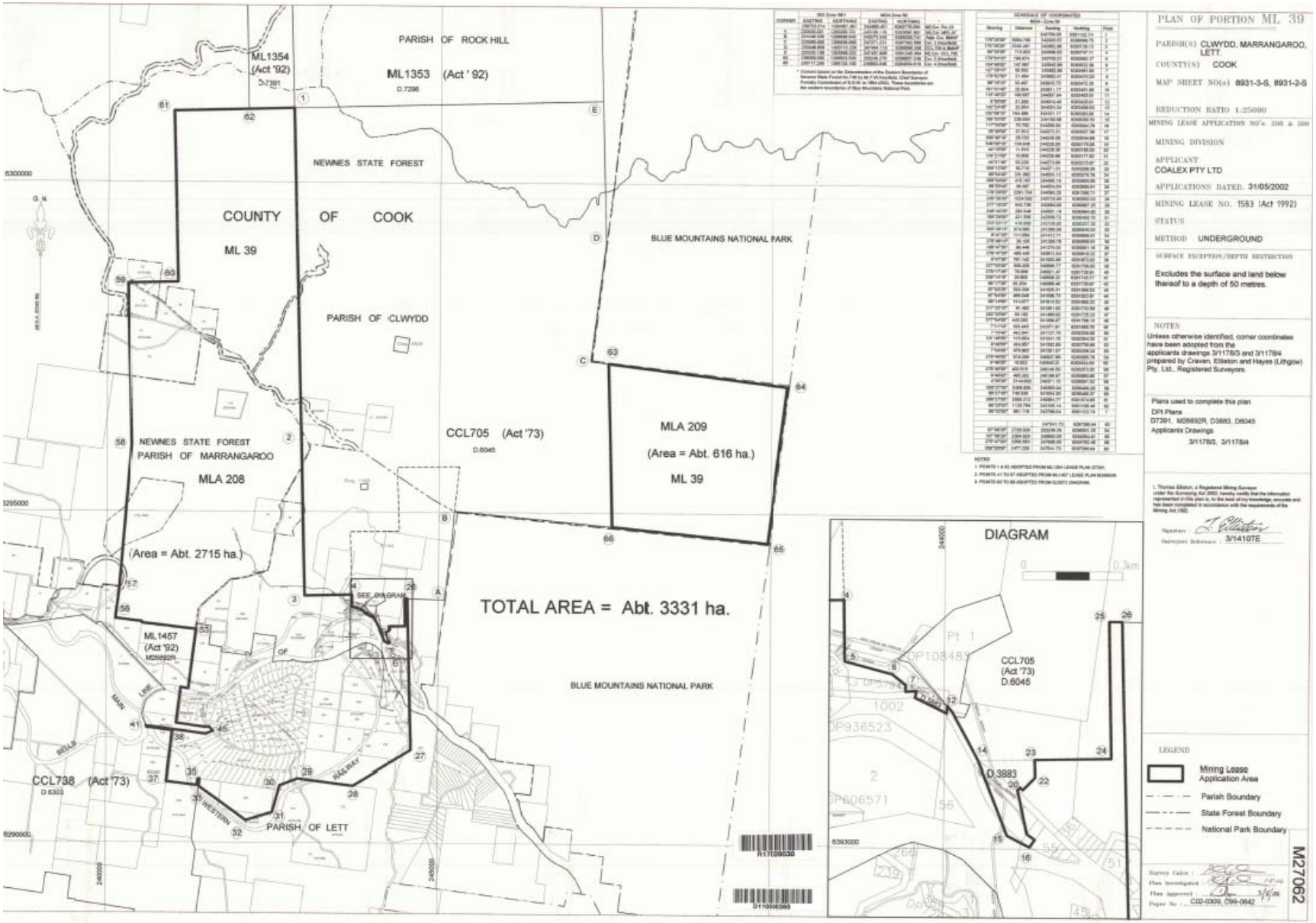


Figure 14 DRE Diagram M27062

Statutory Requirements / Guidelines

The SMP Guidelines require that FMZ's 1, 2 and 3 be identified when compiling an SMP Application.

Forestry Management Zones are established under the *Forestry Act 1916* within NSW state forests. The objective of Forestry Management Zones is to delineate areas of high and low conservation value for forestry management purposes. FMZ 2 is reserved for the protection and management of areas of conservation value. Within FMZ 2, mining is permissible. Activities can be permitted provided that it is planned to be fully cognisant of the values that the zone is designed to protect, and would be approved with special conditions focused on environmental management. Timber harvesting is prohibited and new roads and fire trails must only be constructed where no practicable alternative exists. Such roads must be of minimum length, width and disturbance to facilitate safe and economic access.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

Forests NSW has been consulted in relation to this SMP Application and the provision of Forestry Management Zones for the SMP Application Area. Forests NSW have not indicated any objection to the SMP proposal.

Any surface works required for monitoring i.e. Temporary subsidence monitoring lines, will be undertaken in consultation with Forests NSW.

Baseline Monitoring

No specific baseline monitoring is necessary in relation to Forestry Management Zone 2.

Impact Assessment

The potential impact on the natural and cultural conservation values of the land are addressed in other sections of this document.

It is very unlikely that mining operations will impact upon the natural and cultural conservation values of the land identified as FMZ 2 or FMZ 4.

Monitoring, Mitigation and Management

Monitoring, mitigation and management in relation to natural and cultural conservation values of the land are addressed in other sections of this document.

The SMP (SMP Application Volume 2) contains further details on the monitoring, mitigation and management of potential impacts.

8.2 PUBLIC UTILITIES

8.2.1 LITHGOW NO.2 DAM

Characterisation

The Lithgow No.2 Dam lies within Clarence Colliery development consent area (DA 504-00) and is located within ML 1583, in the 700 West area of this SMP Application (**Figure 9**). Lithgow No.2 Dam is a prescribed dam under the Dam Safety Act and a Dam Notification Area is in place around the Dam.

Lithgow No.2 Dam was built by the Public Works Department of Lithgow City Council in 1907 as a water supply dam to service Lithgow. The Dam is a concrete arch dam, located in a Hawkesbury sandstone formation with a free overfall spillway and a straight gravity section on the right abutment. The dam is a maximum 26.5 m high and the crest length is 71 m. The angle of the arch is 92 degrees.

There are also two water transfer ponds located above the 700 West Area, which are associated with the water transfer between Lithgow No.2 Dam and Clarence Colliery.

Statutory Requirements / Guidelines

The Dams Safety Committee pursuant to Section 369 of the Mining Act 1992, declared the Lithgow No. 2 Dam a prescribed dam under the Dams Safety Act 1978 in a Government Gazette dated 23 May 1997.

Mining leases granted within Notification Areas include conditions which require the leaseholder to apply for special permission to mine within the Notification Area at least 12 months prior to mining. The Dam Safety Committee considers mining layout, the proximity to dams and storages, and the local geology when making its recommendations to the DRE.

Monitoring requirements stipulated by the Dam Safety Committee normally include the preparation of geological plans and reports, the establishment and monitoring of subsidence and strain survey lines and the measurement of water inflows and outflows. As part of this monitoring and surveillance requirement, the Dam Safety Committee regularly inspect underground workings of mines. Typically, mining companies will also be required to develop contingency plans to mitigate any significant inflows.

Clarence Colliery has applied to Dam Safety Committee to extract coal using first workings within the Lithgow No.2 Dam Notification Area (Centennial Coal 2010). The Dam Safety Committee recommended approval and the former I&I NSW (now known as DRE) approved the application. Clarence Colliery proposes to submit a series of applications to the DRE to be assessed by the Dam Safety Committee regarding mining activities within the Lithgow No.2 Dam Notification Area as follows:

- Stage 1 – First workings within the Dam Notification Area up to (but not underneath) the dam wall and reservoir (approved), a variation (or similar) will be made to enable secondary extraction from those portions of Panels 716 and 718 within the Dam Notification Area;

- Stage 2 – Secondary extraction within the Dam Notification Area (likely to include Panels 907 and 909 Panels) and first workings in the south of the notification area, and

- Stage 3 – second workings in the south of the notification area.

Approval for Stage 1 was recommended to the former I&I NSW by the Dam Safety Committee on the 14 July 2010. Approval from the former I&I NSW was granted in August 2010. The general conditions of approval are attached as **Appendix H**.

As part of this SMP Application there will be:

- No mining within 400 m of the dam wall;
- No secondary extraction within the First Workings Zone; and
- Only limited development (i.e. first workings only) along the northern margin of the water body (within the approved First Works Zone).

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

The potential impacts on Lithgow No.2 Dam were seen as the highest potential risk due to mining in the SMP Application Area in the Risk Assessment conducted for the project primarily based on consequence (See **Section 11**). Lithgow City Council has been consulted throughout the SMP process in regards to these potential impacts. Consultation with Lithgow City Council will continue to be undertaken throughout the project.

Baseline Monitoring

Clarence Colliery has measured subsidence as a result of first workings as baseline information. Strata Engineering Australia (2010b) produced an assessment of first workings and relevant excerpts are presented below:

Assessing surface subsidence magnitudes and associated impacts due to "first workings" or panel development has not been a focus of subsidence management activities at the mine; the final state of subsidence (i.e. post-extraction), has always been the primary issue, as the levels of subsidence are higher. Furthermore, the levels of subsidence due to first workings are so small that they would commonly be regarded as being within the limits of historical survey accuracy (i.e. <20mm).

In reviewing the available subsidence information it becomes clear that in most cases there is insufficient detail to separate subsidence due to first workings from subsequent ground movements due to secondary partial extraction; the survey frequency is inadequate for this purpose. However, it is possible to be confident in the case of several data sets that the contamination in the results due to activities in adjacent areas is negligible.

To support these conclusions, an assessment of previous data was carried out for a range of panels. The findings from each Panel are presented below:

*Overall, the **609D** Panel outcomes suggest that subsidence due to first workings is minimal and that no appreciable ground movement, either vertical or horizontal, would be expected beyond the boundaries of the panel. Even following partial extraction, subsidence related movements outside of the panel area were very small.*

*Accepting that the magnitudes are very small and within the limits of survey accuracy, it is concluded that the drivage of **611C** Panel almost certainly resulted in 5 to 10mm of subsidence, with only a very limited amount due to the extraction of the adjacent panel.*

*Post-extraction, the results continue to indicate minimal subsidence outside the extracted area, with 19mm recorded at Peg V-17 as of May 2009, with negligible ongoing movement. Peg V-6 indicates <10mm of subsidence, 120m to the north of the **611E** Panel boundary. Horizontal displacements are also very small, averaging just 5mm within 50m of the panel boundary.*

In conclusion, Strata Engineering Australia (2010b) noted that:

Analysis of subsidence outcomes due to first workings for previous seven heading partial extraction panels at the mine is hampered by the limited available data; due to the fact that the associated movements are considered negligible, this has not been the historical focus of subsidence monitoring at the mine; the emphasis has been on determining the impacts due to lifting. However, there is sufficient available data to confidently state that subsidence related to first workings is indeed very small within the actual area of a panel and negligible beyond the panel boundaries. First workings subsidence is expected to be further reduced by the application of the five heading layout.

This can then be applied to further subsidence assessments to be carried out for the dam wall and reservoir in future applications to the Dam Safety Committee and DRE.

Surface to seam nested piezometers have been installed (prior to mining commencement) in two exploration boreholes in close proximity to the Dam (CLRP15 and CLRP16). The location of these approved boreholes in shown in **Figure 11.**

Impact Assessment

Aurecon (2011) have assessed the potential impact of the proposed mining on the Lithgow No.2 Dam from a groundwater perspective. A potential flow path between the Dam and the mine has been identified; in particular, two NW-SE trending zones will intersect the proposed 700 West area workings at their western extent. While it would be theoretically possible for the storage to drain into the mine workings, the risk of this is negligible for several reasons.

Firstly, it would require the open joint/fracture to be open for the full distance between the dam and the workings. While the joints observed during the geological investigations were all open to some degree, the opening is often the result of weathering and surface movement. At depth, where the horizontal stresses are high, most joints will be forced closed. Additionally there is no history in the mine of any major structures producing continuous flows. Most inflows are from the roof of the seam and any large flows are usually short-lived.

Lateral movement have the potential to jack open joints which may result in a continuous flow path for the Dam to the mine, however due to the depth of the mine opening and the degree of subsidence (and ground movement) from partial extraction activities at Clarence Colliery, it is considered impossible for any such movement to be caused by mining. As a result, it is considered that the potential for any drainage of storage from the Lithgow No. 2 Dam is negligible.

SEA (2011a) investigated the magnitude and nature of horizontal displacements with specific regard to the gradual approach of the workings to Lithgow No.2 Dam. It was concluded that horizontal movements due to first workings are negligible. Following extraction, small movements have been recorded. For example, in the case of 609D Panel, movements to the east were typically 10 mm to 15 mm within 50 m of the boundary, reducing to <10 mm between 50 m and 150 m of the boundary. Beyond this point, horizontal movement was negligible. Similar results would be expected for future mining areas.

Whilst previous assessments indicate that it is very unlikely that mining operations will impact on the Lithgow No. 2 Dam wall or reservoir, further detailed impact assessment work will be carried out to support an application to DRE to be assessed by the DSC. Whilst Stage 1 has been approved, further applications (or variations as necessary) to enable secondary extraction and further first workings (in the south of the Notification Area) will be prepared.

Monitoring, Mitigation and Management

The existing monitoring program for the Lithgow No.2 Dam Notification Area is presented in **Table 24**.

Table 24 Summary of Monitoring Parameters

Parameter	Technique	Frequency
Visual (additional to LCC routine inspections)	Appropriately trained person to visually inspect using checklist	Monthly
Photographic	Photograph from same positions to monitor changes in the dam wall	Two monthly
Surface Water Chemistry	Grab Sample	Two monthly
First workings subsidence / Far field displacement	Survey subsidence pegs	Pre mining, post first workings, pots secondary extraction
Pillar / roof / rib geotechnical monitoring	Gel extensometers, tell tales	As required and in accordance with the requirements of the DRE
Mine Groundwater Quality	Grab sample from underground storage dam or from dripper	Three monthly
Mine Groundwater Make	Weir and water meter	Continuous
Groundwater levels	Multi-level piezometer installations accompanied with packer testing	Continuous
Groundwater quality	Grab samples from various formations between the surface and mine (Banks Wall Sandstone and the Burro Mukko Formation)	Monthly
Dam wall movement	Survey of survey pins on dam wall and control points	Winter / summer
Seepage	Control points on plunge pool wall – volume by calculation or visual inspection	Monthly
Dam wall assessment	Dam wall condition, crack map	Initial inspection, after mining in 700 area

Full details of the monitoring program proposed for the mining within the Dam Notification Area can be found in **Appendix H**.

8.2.2 ROADS (ALL TYPES)

Characterisation

There are no gazetted public roads within the SMP Application Area, however there are a number of unpaved NSW Forests access tracks and fire trails throughout the 700 West and 800 areas.

Statutory Requirements / Guidelines

There are no statutory requirements in relation to the undermining of forestry fire trails. Forests NSW does however, construct and maintain the trails to meet its internal standards. Should impacts from subsidence damage the roads, Clarence will repair the roads to an appropriate standard in consultation with Forests NSW.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

During the stakeholder consultation for this SMP Application, concerns relating to impact on roads have not been raised by stakeholders. Forests NSW have been consulted in relation to this SMP Application and have not indicated any objection to the SMP proposal.

Baseline Monitoring

The fire trails and access tracks within the SMP Application Area have been previously driven to ascertain their general condition. Particular attention was paid to cracks in the road and no cracks were noted. Some parts of the track over the 700 Area are impassable.

Impact Assessment

It is highly unlikely that mining operations will impact on four wheel drive fire trails and tracks in the SMP Application Area This is based on experience, whereby previous inspections of four wheel drive roads and forest trails over partially extracted areas have not suffered impacts due to subsidence. As the 700 West / 800 Area will be extracted using the same mining technique, it is unlikely that the there will be any impacts from subsidence on the tracks/trails.

Monitoring, Mitigation and Management

The monitoring program for roads will include an inspection during undermining and post mining. If surface cracking is present actions from continued observation to repair will be undertaken as appropriate in consultation with Forests NSW.

The SMP Application Volume 2 contains further details on the monitoring, mitigation and management of potential impacts particularly in terms of safety and serviceability.

8.2.3 ELECTRICITY TRANSMISSION LINES

Characterisation

An Integral Energy overhead powerline traverses the SMP Application Area. This is a 66kV powerline on wood poles and provides electricity to Clarence Colliery, Hanson Quarry, the Springvale to Delta water transfer system and other powered surface facilities owned by the Angus Place and Springvale mines.

Statutory Requirements / Guidelines

Electricity networks are managed under the *Electricity Supply Act 1995*, which provides network service provider to protect electricity assets from damage. The network service provider for the 66kV powerline is Integral Energy.

There are no statutory requirements specifically related to subsidence management under powerlines.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

Integral Energy have been consulted through the consultation process and concerns relating to impact on the powerline have not been raised by Integral Energy or other stakeholders.

Baseline Monitoring

There is no baseline monitoring required in association with the powerline. Despite this, it would be prudent to complete a pre-mining assessment of the powerlines and condition of power poles.

Impact Assessment

Given the low levels of subsidence from previous mining at Clarence Colliery, and the predicted low levels (100 mm) of subsidence for the SMP Application Area, the risk of damage to the powerline and powerpoles is considered low.

Monitoring, Mitigation and Management

The regular visual inspection of fire trails for surface cracks will incorporate an inspection of the powerline, and will include an inspection post mining. If there is evidence of ground movement, pole movement or damage, Clarence Colliery would record the observation, consult with the relevant stakeholders and take actions to stabilise the site and/ or remediate the infrastructure.

The SMP (SMP Application Volume 2) contains further details on the monitoring, mitigation and management of potential impacts.

8.2.4 TELECOMMUNICATIONS LINES

Characterisation

There are Telstra telecommunications cables that cross the south-east corner of the 700 West Area. These are:

- Aboveground Cable;
- Underground Cable; and
- Underground Optic Fibre Cable.

The location of these is shown on **Figure 9**. There are no telecommunication cables within the 800 Area.

Statutory Requirements / Guidelines

Telecommunication networks (above and below ground) are managed under the *Telecommunications Act 1997 (Commonwealth)* (the Act). This Act provides telecommunication carriers and service providers with the power to install and manage telecommunication assets. The network carrier for the Telecommunication assets on the site is Telstra, who are a registered telecommunications carrier under the Act.

There are no statutory requirements specifically related to subsidence management under telecommunications.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

Telstra Network Integrity Services have been consulted through the consultation process. Telstra indicated that they would like Clarence Colliery to carry out a risk assessment with Telstra to form the basis of developing a Management Plan for the infrastructure. This will be commenced at lease 6 months prior to secondary extraction.

Baseline Monitoring

There is no baseline monitoring required in association with the telecommunication assets.

Impact Assessment

Given the low levels of subsidence from previous mining at Clarence Colliery, and the predicted low levels (maximum of 100 mm) of subsidence for the SMP Application Area, the risk of damage to the telecommunication assets is considered low.

Monitoring, Mitigation and Management

The regular visual inspection of fire trails for surface cracks will incorporate an inspection of the area surrounding telecommunication assets, and will include an inspection post mining. If there is evidence of ground movement, surface cracking or damage Clarence Colliery would record the observation, consult with the relevant stakeholders and take actions to stabilise the site and/or remediate the infrastructure. Any loss of communications due to subsidence-related mine damage would be addressed by Clarence Colliery in consultation with Telstra Network Integrity Services.

Further details of the monitoring, mitigation and management of the infrastructure will be detailed in a Management Plan to be developed in consultation with Telstra.

8.2.5 SURFACE MINING VOIDS AND REHABILITATED AREAS

Characterisation

Two sand quarries marginally encroach into the 700 West area; the Hanson Sand Quarry in the south east of the area, and the inactive Boral Sand Quarry in the north.

There are no surface mining voids or rehabilitated areas within the 800 Area.

Statutory Requirements / Guidelines

The legislation that regulates potential impacts caused by subsidence upon surface mining voids and rehabilitation areas is the *Mining Act 1992 and Coal Mines Health and Safety Act 2002*.

Stakeholder Consultation

Consultation with both Hanson Construction and Boral Quarries has been undertaken during the SMP process, and concerns relating to the impact on the sand quarries were not raised.

The general consultation process and community consultation undertaken is described in **Section 9.**

Baseline Monitoring

There is no baseline monitoring required in association with the sand quarries in the 700 West area.

Impact Assessment

Given the low levels of subsidence from previous mining at Clarence Colliery, and the predicted low levels (maximum of 100 mm) of subsidence for the SMP Application Area, the risk of damage to the sand quarries in the 700 West area is considered low.

Monitoring, Mitigation and Management

Due to the low risk of impact, no monitoring is proposed in association with the sand quarries in the 700 West area. Consultation with Hanson Construction and Boral Quarries will continue to be undertaken throughout the mining in SMP Application Area.

8.2.6 PERMANENT SURVEY CONTROL MARKERS

Characterisation

The survey control network is a state-wide complex of trig stations and permanent survey marks that have known latitude, longitude and heights. This provides the basis for all mapping and surveying in the state.

There is one permanent survey control marker located in the SMP Application Area, which can be found in the south east of the 700 West Area. The 800 Area does not contain any permanent survey control markers.

Statutory Requirements / Guidelines

Identification and ongoing management of survey marks within the mine area is undertaken in accordance with the specific requirements of the NSW Surveying Act 2002, which requires that any recorded movement beyond designated controls observed at any survey mark (caused by any means) is to be reported so that official datums can be managed, adjusted and reported accordingly under the authority of approvals issued by the Surveyor General.

Approval will be sought from the NSW Surveyor General prior to removing, damaging, destroying, obliterating or defacing any survey mark. Applications for authorisation must be made to the Surveyor General at least 14 days before the date on which the survey mark will be impacted.

Stakeholder Consultation

The general consultation process and community consultation undertaken is described in **Section 9.**

The former Land and Property Management Authority have been consulted through the consultation process, and as the predicted subsidence is minimal there are no objections to the proposed mining.

Baseline Monitoring

There is no baseline monitoring required in association with the permanent survey control marker.

Impact Assessment

Given the low levels of subsidence from previous mining at Clarence Colliery, and the predicted low levels (maximum of 100 mm) of subsidence for the SMP Application Area, the risk of damage to the permanent survey control marker in the 700 West area is considered low.

Monitoring, Mitigation and Management

The status of the survey mark in the 700 West area has been changed to 'S' to indicate it is subject to mine subsidence following consultation with the former Land and Property Management Authority. No additional monitoring or management is required.

8.3 AREAS OF ENVIRONMENTAL SENSITIVITY

Areas of environmental sensitivity as described in the SMP Guidelines and applicable to this SMP Application Area are:

- State Forestry Management Zones 2 and 4;
- Clarence aquifer;
- Cliffs, pagodas and escarpments;
- Newnes Plateau Hanging Swamp and Newnes Plateau Shrub Swamp;
- Farmers Creek Dam Catchment; and
- Aboriginal archaeological sites.

All the above items have been addressed above.

8.4 IMPACT ASSESSMENT BASED ON INCREASED SUBSIDENCE

For pillar extraction applications, there is a requirement to assess the impacts of subsidence that are five times the predictions. For the SMP Application Area this is a level of subsidence of 500 mm. Subsidence impacts from longwall and full extraction pillar panels hoave been observed, however the levels of subsidence were not measured. Observed impacts included minor cliff and pagoda cracking and additional groundwater inflow to the workings.

The potential for 500 mm of subsidence in the SMP Application Area is extremely low. Given that the proposed mining method is not designed to cave and the factors of safety for the remaining pillars are intended for long term stability, 500 mm is not considered to be a realistic level of increased subsidence. To date, no subsidence results greater than 100 mm relating to partial pillar extraction have been recorded.

Further monitoring to substantiate pillar loading, long term stability and associated factors of safety, and overburden bridging characteristics are continuing (see Volume 2 of this SMP Application). Data from this monitoring will be used to substantiate existing subsidence and pillar stability models.

9 COMMUNITY CONSULTATION

Community consultation during the preparation of the SMP was undertaken in accordance with, the requirements of the DPI – Mineral Resources "Guidelines for Applications for Subsidence Management Approvals" dated December 2003 and the "Guidelines for Best Practice Community Consultation in New South Wales Mining and Extractive Industries" (New South Wales Minerals Council, 2006). The definition of "Community" adopted for the purpose of developing the SMP community consultation strategy is anyone with an interest in subsidence issues for the proposed SMP application.

Clarence Colliery have undertaken consultation with the land owner, local community, Aboriginal groups, the Local and State Government authorities and other relevant stakeholders in preparation of the SMP. The extensive consultation previously completed by Clarence Colliery for other projects were used the identify stakeholders, along with an advertisement for registering interest.

A stakeholder consultation strategy has been implemented by Clarence Colliery during the SMP Application process. This process is detailed in **Table 25** below.

Table 25 Stakeholder Consultation Strategy

Key Consultation Actions	Mode of Consultation
Develop and record key consultation actions within consultation log template.	Complete (**Appendix F**)
First round advertising of SMP Application to seek interested stakeholders.	Advertisement in Newspaper
Submit briefing paper to inter-agency panel to advise of SMP Application and seek feedback to address in SMP	Submission of Fact Sheet and various conversations and meetings
Finalise the stakeholder register to include any advertisement respondents, and those stakeholders known from previous consultation	Stakeholder meeting invitations
Send letters to stakeholders (incl. authorities) to advise of SMP Application and seek attendance at stakeholder meeting	Letter
Hold extra-ordinary Community Consultative Committee meeting to brief committee members and seek feedback	Meeting
Hold one-on-one consultations with key stakeholders/authorities	Meetings and correspondence
Hold stakeholder meeting at Clarence Colliery to brief attendees on the SMP and seek feedback	Meeting - presentation
Address any feedback received following workshop within the SMP Application	Correspondence received and responded to (**Appendix F**)
Make SMP publicly available following submission (as per DPI guidelines requirement)	Website, CD, hardcopy
Second round advertising - in local & state papers (as per DPI guidelines requirement)	Newspaper advertisement
Responded to any submissions once the SMP is available for stakeholder comment (as per DPI guidelines requirement)	As required

SMP Advertisements

Clarence Colliery prepared and posted an advertisement in the Lithgow Mercury and The Land newspapers during August 2010. The advertisement was to notify the community of the intention to submit an SMP application for approval and to encourage community members to register an interest in the process so that they can be party to further consultation. The advertisement is attached in **Appendix F**. There were no responses to this advertisement.

Clarence Colliery will also be placing an advertisement in the state and local papers following submission of SMP Application to inform the community of the submission of the SMP and the locations at which the SMP could be viewed and how to provide comment on the submission.

Interagency Panel

Clarence Colliery prepared a factsheet titled “Clarence Colliery – 700 West / 800 Area – SMP Preparation” which was sent to the Interagency Panel to inform them of the project and was discussed at their meeting in August 2010. The factsheet included background information, locality, details of the panels to be mined, existing environment, SMP preparation and contact details of key people. The factsheet is attached in **Appendix F**.

Community Consultation Committee

Clarence Colliery has a Community Consultation Committee (**CCC**), through which it relates information about the mine to the community by holding regular meetings. An extra-ordinary CCC meeting was held on the 10 September 2010 in order to inform the CCC of details of the SMP Application and to seek feedback. Further updates have been provided as detailed in the consultation log. A copy of the presentation given at this extra-ordinary CCC meeting is attached in **Appendix F**.

Letters to Stakeholders

A letter and factsheet titled “Clarence Colliery – 700 West / 800 Area SMP Preparation” was sent to all persons on the stakeholder register advising of the preparation of an SMP Application and inviting feedback and input into the proposal. Members of the CCC were not invited to the Stakeholder meeting due to the detailed presentations received at CCC meetings. However, all members of the CCC received a copy of the factsheet. The letter also invited the recipients to attend the Stakeholder Meeting where further information would be provided as well as an opportunity to raise issues regarding the project. A consultation log detailing the list of the recipients of this letter is attached in **Appendix F**.

Stakeholder Meeting

On the 10 September 2010, Clarence Colliery hosted a Stakeholder Meeting on site, to offer all stakeholders the opportunity to be briefed on the SMP Application by Clarence Colliery mining personnel as well as an opportunity to raise concerns and have questions regarding the project answered. The briefing consisted of a PowerPoint presentation covering all facets of the proposed mining and SMP process. A copy of the presentation is attached in **Appendix F**. A copy of the minutes detailing the questions and feedback received from the attendees is attached in **Appendix F.** Individual stakeholder meetings were also held with those stakeholders that indicated that they could not attend the 10 September meeting but would still like to be part of the consultation process.

Feedback including concerns with the SMP Application was received on the 30 September 2010 following the Stakeholder Meeting. A formal response to the concerns raised was provided by Clarence Colliery on the 27 October 2010.

Stakeholder Consultation Log

A detailed consultation log was maintained throughout the SMP consultation as a record key consultation actions made by Clarence Colliery and all enquires and submissions made by the stakeholders. The consultation log is attached in **Appendix F**.

10 STATUTORY REQUIREMENTS

Conditions from CCL705, Development Consent DAM.08.76, ML1583, and Development Consent DA 504.00 that directly relate to subsidence management are provided in **Table 26**.

Table 26 Relevant Statutory Conditions relating to Subsidence

Source	Condition	How addressed
CCL705	4.(a) The lease holder shall prepare a Subsidence Management Plan prior to commencing any underground mining operations which will potentially lead to subsidence of the land surface.	This SMP Written Report (Vol 1) and SMP (Vol 2)
CCL705	4.(c) The lease holder must not commence or undertake underground mining operations that will potentially lead to subsidence other than in accordance with a Subsidence Management Plan approved by the Director-General, an approval under the Coal Mines Regulation Act 1982, or the document *New Subsidence Management Plan Approval Process – Transitional Provisions*.	This SMP Application (Vol 1)
CCL705	4.(d) Subsidence Management Plans are to be prepared in accordance with the *Guideline for Applications for Subsidence Management Approvals*	SMP (Vol 2) prepared in accordance with SMP Guidelines (DPI 2003)
CCL705	4.(e) Subsidence Management Plans as approved shall form part of the Mining Operations Plan required under Condition 2 and will be subject to the Annual Environmental Management Report process set out under Condition 3. The SMP is also subject to the requirements for subsidence monitoring and reporting set out in the document *New Approval Process for Management of Coal Mining Subsidence – Policy.*	Noted
CCL705	12. Operations must be carried out in a manner that ensures the safety of persons or stock in the vicinity of the operations….	SMP (Vol 2), Risk Assessment in **Appendix H**
CCL705	16. Operations must be carried out in a manner that does not cause or aggravate air pollution, water pollution …. For the purpose of this condition, water shall be taken to include any watercourse, waterbody or groundwaters…..	**Section 8.1.1**
CCL705	17. Operations must not interfere or impair the stability or efficiency of any transmission line, communication line, pipeline or any other utility on the lease area without the prior written approval of the Director-General and subject to any conditions he may stipulate.	N/A
CCL705	19.(a) Operations must not affect any road unless in accordance with an accepted Mining Operations Plan or with the prior written approval of the Director-General and subject to any conditions he may stipulate.	**Section 8.2.1**

Source	Condition	How addressed
CCL705	30.(a) The lease holder shall carry out operations in such a way as to conform strictly to all provisions of the Sydney Water Catchment Management Act 1998 and the regulations there under applying to the prevention of pollution of the Warragamba Outer Catchment Area or the preservation of the purity of the water supply provided thereby or derived there from or for the protection of the property of Sydney Catchment Authority.	N/A (SMP Application Area not located in Sydney Catchment Area
DAM.08.76	6. That all conditions laid down by the National Parks and Wildlife Service, State Pollution Control Commission, Soil Conservation Department, Planning and Environment Commission of NSW and Department of Mines, must be complied with.	This SMP Application (Vol 1)
ML1583	4.(a) The lease holder shall prepare a Subsidence Management Plan prior to commencing any underground mining operations which will potentially lead to subsidence of the land surface.	This SMP Written Report and draft SMP.
ML1583	4.(c) The lease holder must not commence or undertake underground mining operations that will potentially lead to subsidence other than in accordance with a Subsidence Management Plan approved by the Director-General, an approval under the Coal Mines Regulation Act 1982, or the document *New Subsidence Management Plan Approval Process – Transitional Provisions*.	This SMP Application
ML1583	4.(d) Subsidence Management Plans are to be prepared in accordance with the *Guideline for Applications for Subsidence Management Approvals*	SMP prepared in accordance with SMP Guidelines (DPI 2003).
ML1583	4.(e) Subsidence Management Plans as approved shall form part of the Mining Operations Plan required under Condition 2 and will be subject to the Annual Environmental Management Report process set out under Condition 3. The SMP is also subject to the requirements for subsidence monitoring and reporting set out in the document *New Approval Process for Management of Coal Mining Subsidence – Policy.*	Noted.
ML1583	12. Operations must be carried out in a manner that ensures the safety of persons or stock in the vicinity of the operations….	SMP, Risk Assessment in **Appendix H**
ML1583	16. Operations must be carried out in a manner that does not cause or aggravate air pollution, water pollution …. For the purpose of this condition, water shall be taken to include any watercourse, waterbody or groundwaters…..	**Section 8.1.1** **Section 8.1.2**
ML1583	17. Operations must not interfere or impair the stability or efficiency of any transmission line, communication line, pipeline or any other utility on the lease area without the prior written approval of the Director-General and subject to any conditions he may stipulate.	**Section 8.2.3** **Section 8.2.4**
ML1583	19.(a) Operations must not affect any road unless in accordance with an accepted Mining Operations Plan or with the prior written approval of the Director-General and subject to any conditions he may stipulate.	**Section 8.2.1**

Source	Condition	How addressed
ML1583	27.(A) Notwithstanding any Mining Operations Plan, the lease holder must not mine within any part of the lease area which is within the notification area of the **Lithgow No 1 and Lithgow No 2 Dams** without the prior written approval of the Minister and subject to any conditions he may stipulate.	Approval for limited first workings has been obtained from DRE and was assessed by DSC (see **Appendix H**). Further applications (or variations as necessary) will be prepared and approval sought (**Section 8.2**)
ML1583	28.(a) The lease holder shall carry out operations in such a way as to conform strictly to all provisions of the Sydney Water Catchment Management Act 1998 and the regulations there under applying to the prevention of pollution of the **Warragamba Outer Catchment Area** or the preservation of the purity of the water supply provided thereby or derived therefrom or for the protection of the property of Sydney Catchment Authority……	**Section 8.1.1**
Development Consent DA 504.00 Schedule 3	1. The Applicant shall ensure that surface subsidence generated by the development does not exceed the criteria listed in Table 1 (First Workings – 20mm subsidence, 1.0mm/m tilt, 1.0mm/m horizontal strain. Partial Extraction – 100mm subsidence, 3.0mm/m tilt, 2.0mm/m horizontal strain.	**Section 6**
Development Consent DA 504.00 Schedule 3	2. Before carrying out any underground mining operations that will potentially lead to subsidence of the land surface, the Applicant shall prepare a Subsidence Management Plan for those operations in accordance with the following DPI documents (or the most current and updated versions of these documents): (a) *New Approval Process for Management of Coal Mining Subsidence - Policy*; and (b) *Guideline for Applications for Subsidence Management Approvals*, to the satisfaction of the Director-General of DPI. In addition to the above each Subsidence Management Plan shall: (a) describe how the subsidence impact assessment criteria will be monitored over time; (b) provide for the notification of relevant authorities, including DPI, SCA and the Director-General in the event of any exceedence of the impact assessment criteria; and (c) detail measures to reduce, mitigate and remediate any impacts. During the preparation of each Subsidence Management Plan the Applicant shall consult with the Department, Council, SCA, DEC, DNR and the CCC, and have regard for any comments provided by these agencies/committees.	This Written Report and Subsidence Management Plan. **Section 9**

Source	Condition	How addressed
Development Consent DA 504.00 Schedule 3	5. The Applicant shall ensure that the development does not result in any: (a) significant inflows to mine workings; (b) reduction in pumping yield in privately-owned groundwater bores; (c) reduction in surface flows and groundwater baseflow to upland swamps (Newnes Plateau Shrub Swamps) and wetlands; and (d) reduction in surface flows and groundwater baseflow to waterbodies including Marrangaroo Creek, Farmers Creek, Dargans Creek, Wolgan River, Dumbano Creek, Bungleboori Creek, and Wollangambe River (excluding reduction in flows associated with the proposed water transfer scheme), to the satisfaction of the Director-General.	**Section 8.1.1** **Section 8.1.2** and *Clarence Colliery Water Management Plan (2007)*
Development Consent DA 504.00 Schedule 3	6. Within 12 months of the date of this consent, the Applicant shall prepare and subsequently implement a Water Management Plan for the mine in consultation with Council, SCA, DEC, DPI, and to the satisfaction of the Director-General. This plan must be prepared by a qualified hydrogeologist/hydrologist and include: (a) a Water Balance; (b) an Erosion and Sediment Control Plan; (c) a Surface Water Monitoring Program; (d) a Ground Water Monitoring Program; and (e) a Surface and Ground Water Response Plan, to address any potential adverse impacts associated with the development.	*Clarence Colliery Water Management Plan (2007)*

11 RISK ASSESSMENT

In September 2010, a risk assessment for 700 West / 800 Areas was undertaken to assess the potential impacts of the SMP Application in accordance with the *Guideline for Applications for Subsidence Management Approvals* (DPI 2003). The risk assessment report is contained in **Appendix G**.

Table 27 details the invitees and participants of the risk assessment.

Table 27 Risk Assessment Participants

Participants
Edwina White (Centennial Coal)
Alanna Howard (Centennial Coal)
Rodney Dunlop (Centennial Coal)
Shaun Smith (GSSE)
Dean Fletcher (GSSE)
Ian Forster (Aurecon)
David Hilyard (Aurecon)
Nigell Campbell (Nigell Campbell)
David Hill (Strata Engineering)
Toby Lambert (RPS)
Gillian Goode (RPS)

A risk register has been completed to address only those issues relevant to 700 West / 800 Area. This information has been used in the preparation of this SMP Application for the operation.

12 REFERENCES

ACARP Project No. C9067 (2002). *Subsidence Impacts on River Valleys, Cliffs, Gorges and River Systems. Waddington Kay & Associates*.

Aurecon (2011) *Groundwater Impact Assessment, Clarence Colliery 700W/800 areas*

Bish, S. (1999) *Hydrogeological Assessment for Coxs River Catchment, Sydney – South Coast Region, Department of Land and Water Conservation.*

Centennial Coal (2010) *Supporting Documentation for Application to Extract Coal using First Workings within Lithgow No.2 Dam Notification Area – Stage 1*

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SEA (2008a) *Numerical Modelling of Surface Subsidence*, Report No: 04-001-CLA-38

SEA (2008b) *Optimisation of Partial Extraction Mining Layout at Clarence Colliery,* Report No. 04-001-CLA-34

SEA (2010a) *Five Heading FCT Partial Extraction Layout Options,* Report No: 04-001-CLA-95

SEA (2010b) *Subsidence Movements at Clarence Colliery Associated with First Workings Panels,* Report No. 04-001-CLA-89

SEA (2011a) *Review of Subsidence Information from Recent Partial Extraction Areas,* Report No: 04-001-CLA-109

SEA (2011b) *Seven Heading Layout for the Joy FCT with 40m Barriers: Stability and Related Subsidence Estimates,* Report No: 04-001-CLA-122

SEA (2011c) *Stability of 5 Heading FCT Layout Proposed for the 800 Area, including Subsidence Estimates (Amended)* Report No: 04-001-CLA-116b

SEA (2011d) *Stability of 7 Heading Layout with 30m Centres and a 2.7m Maximum Height, including Subsidence Estimates (Amended)* Report No: 04-001-CLA-114b

SEA (2011e) *Subsidence Estimates for Conventional 7 Heading Layout with 33m Centres,* Report No: 04-001-CLA-119

SEA (2011f) *Subsidence Estimates for Five Heading Layout Variants,* Report No: 04-001-CLA-101

SEA (2011g) *Subsidence Impact Assessment on the Cliff Lines above the Proposed 700 W and 800 Areas,* Report No: 04-001-CLA-108

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