Springvale Mine Extension Project

Review Report

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EXECUTIVE SUMMARY

The Springvale Mine Extension Project is a proposed extension of the existing Springvale underground coal mine, which is located approximately 15 kilometres northwest of Lithgow, within the Lithgow City Council Local Government Area. The proposal involves extending the existing underground mine operations to the south and southeast, with the mine continuing to operate in largely the same way it has since 1995. It would continue to extract up to 4.5 million tonnes of run-of-mine coal per year from the Lithgow Seam, and would continue to use the existing coal transportation, water and ventilation systems.

On 27 April 2015, the Minister requested the Commission to conduct a public hearing and review the merits of the project, paying particular attention to subsidence impacts on upland swamps, and impacts on the region's water resources, particularly discharges of mine water to the Coxs River catchment. The Commission was constituted by Brian Gilligan (chair), with Abigail Goldberg and David Johnson. The Commission examined the documents referred to in the Terms of Reference, including the Preliminary Environmental Assessment Report (PEAR) provided by the Department of Planning and Environment (the Department). The Commission also received written submissions, held a public hearing, visited the site and surrounds (accompanied by an officer from the Office of the Environment and Heritage (OEH)), and met with the Applicant, the Department, the Environment Protection Authority (EPA), the NSW Office of Water, the Department of Trade and Investment (DTI), WaterNSW and Council.

The Commission notes that the PEAR was lacking recent information about the position of agencies on some key issues, which made the task of undertaking the review in a timely and effective manner challenging. In particular, the most recent submission from OEH was not provided to the Commission until 19 June when the Commission was close to finalising its review report. With the exception of the matters raised in this late submission, the Commission has been able to ascertain most of the relevant information during the course of the review. Residual matters are flagged in the relevant sections of the report.

Subject to the resolution of these residual concerns, the Commission agrees with most of the findings and recommendations of the PEAR. However, the Commission has also provided significant recommendations to enhance the determination of this proposal and to ensure that potential impacts are avoided, minimized or mitigated as summarised in Section 5 of this report.

The Commission considers the three key issues that require further consideration are the final plan of action in relation to discharge impacts on Coxs River, adaptive management options and offset policy provisions in relation to the impact on swamps, and resolving some of the uncertainty regarding non-conventional subsidence effects. The Commission has also considered other issues, including subsidence-related impacts on watercourses, rock features and built features, socio-economic impacts, biodiversity impacts from clearing, and noise impacts.

In relation to discharge impacts on Coxs River, the Commission has recommended that the Department consults further with the EPA and WaterNSW, and that the target levels for salinity and other toxicity factors are formally agreed upon with an accompanying tight schedule for action by the Proponent. In relation to swamps, the Commission recommends that the Department consider opportunities for adaptive management in relation to certain swamps based on a comprehensive monitoring program in key areas and deferred Extraction Plan approvals to reflect a progressive risk assessment process. In relation to non-conventional subsidence effects, the Commission recommends that the Department give further consideration to upsidence and valley closure effects, and ensure that appropriate monitoring is included in any consent.

The Commission believes it is important to view the proposal in the strategic context of power supply for NSW, and notes that the Springvale mine is now the only local mine currently supplying coal to the Mt Piper Power Station, which provides approximately 15% of NSW's electricity. While noting objections raised about some elements of the economic assessment, the Commission agrees with both DTI and the Department's independent peer review that the proposal, taken overall, would make a positive contribution to the region and the state of NSW.

The Commission has carefully weighed the key areas of concern, including discharge impacts on the region's water resources and swamp impacts, against the significance of the resource and the socio-economic benefits. The Commission is satisfied that the project's benefits as currently understood outweigh its potential impacts, and on balance is approvable. The project should proceed to determination, subject to the recommendations outlined in this report including the resolution of residual issues raised by OEH and the application of the Draft Offsets Policy.

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GLOSSARY

Applicant	The Applicant under Part 4 of the EP&A Act 1979, in this report being Centennial Mandalong Pty Limited.
Commission:	The Commission to review this application, constituted by Mr Brian Gilligan (chair), Ms Abigail Goldberg and Mr David Johnson
Council:	Lithgow City Council
DOE:	Commonwealth Department of the Environment
DRE:	Division of Resources & Energy (within the Department of Trade & Investment)
Department:	Department of Planning and Environment
EEC:	Endangered Ecological Community (under both the TSC Act and EPBC Act)
EIS:	Environmental Impact Statement
EPA:	Environment Protection Authority
EP&A Act:	*Environmental Planning and Assessment Act 1979*
EPBC Act:	*Environment Protection and Biodiversity Conservation Act 1999 (Cth)*
IESC:	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development
LGA:	Local Government Area
NOW:	NSW Office of Water
OEH:	Office of Environment and Heritage
PEAR	Preliminary Environmental Assessment Report, prepared by the Department of Planning and Environment
Pagoda:	Isolated freestanding rock formations more than 5m high
Proposal	The subject of the application under Section 89C of the EP&A Act 1979, in this report being the Springvale Mine Extension Project
Secretary's Requirements:	Requirements provided by the Secretary of the Department of Planning for an environmental assessment or environmental impact statement
Mining SEPP	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*
TOR:	Terms of Reference of the Minister's request for the review of the project made under Section 23D of the *Environmental Planning and Assessment Act 1979* and Clauses 268R and 268V of the *Environmental Planning and Assessment Regulation 2000*
TSC Act:	*Threatened Species Conservation Act 1995* (NSW)
WaterNSW:	formerly Sydney Catchment Authority (SCA)

1. INTRODUCTION

On 27 April 2015 the Minister for Planning, the Honourable Rob Stokes MP, requested the Chair of the Planning Assessment Commission (the Commission) to carry out a review of the Springvale Mine Extension Project, including the holding of a public hearing.

Ms Lynelle Briggs AO, chair of the Commission, nominated Mr Brian Gilligan, Ms Abigail Goldberg and Mr David Johnson to constitute the Commission for the review. Mr Gilligan chaired the Commission.

1.1 Existing Mine Operations

The Springvale coal mine is an existing underground coal mine located approximately 15 kilometres northwest of Lithgow, within the Lithgow City Council Local Government Area. Underground mining has been undertaken at the Springvale Mine since 1995, under development consent DA 11/92, which was granted on 27 July 1992. This consent has been modified four times since it was granted.

The existing development consent (as modified) allows for:

- extracting up to 4.5 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal from the Lithgow Seam;
- transporting coal from the underground operation to the pit top area via conveyor;
- processing of coal (crushing and screening) and stockpiling at Springvale;
- operating support infrastructure, including offices, bathhouse, waste management infrastructure, ventilation facilities, electrical distribution network, dewatering bores, pipelines and access tracks;
- transporting coal by:
  - overland conveyor to the Mt Piper Power Station; and/or
  - overland conveyor to the Springvale Coal Services Site for further processing and stockpiling and then by conveyor to Centennial's Lidsdale Rail Siding for railing to the Port Kembla Coal Terminal for export; and/or
  - road haulage to other local domestic customers (limited to 50,000 tpa); and
- rehabilitating the site.

Figure 1 on the next page shows the regional location of the existing Springvale mine, the proposed underground mine extension area and the Springvale Coal Services Site, and their relationship to nearby mines, power stations and towns and villages. **Figure 2** on the following page shows the existing surface infrastructure for the mine, including ventilation shafts. **Figure 3** on the following page shows the existing surface infrastructure at the pit top in detail.

Under the existing development consent, 17 longwalls have been extracted (LW 1, and LWs 401-416), and an 18th longwall is currently being extracted. The consent is due to expire on 30 September 2015 and has already been extended by one year through a previous modification.

The Springvale Coal Services Site operates under a separate development application (SSD 5579), which was approved by the Commission on 4 April 2014.

There is also a separate development consent (DA 461/02) for the operation of Springvale's Ventilation Shaft 3 Facility on the Newnes Plateau.

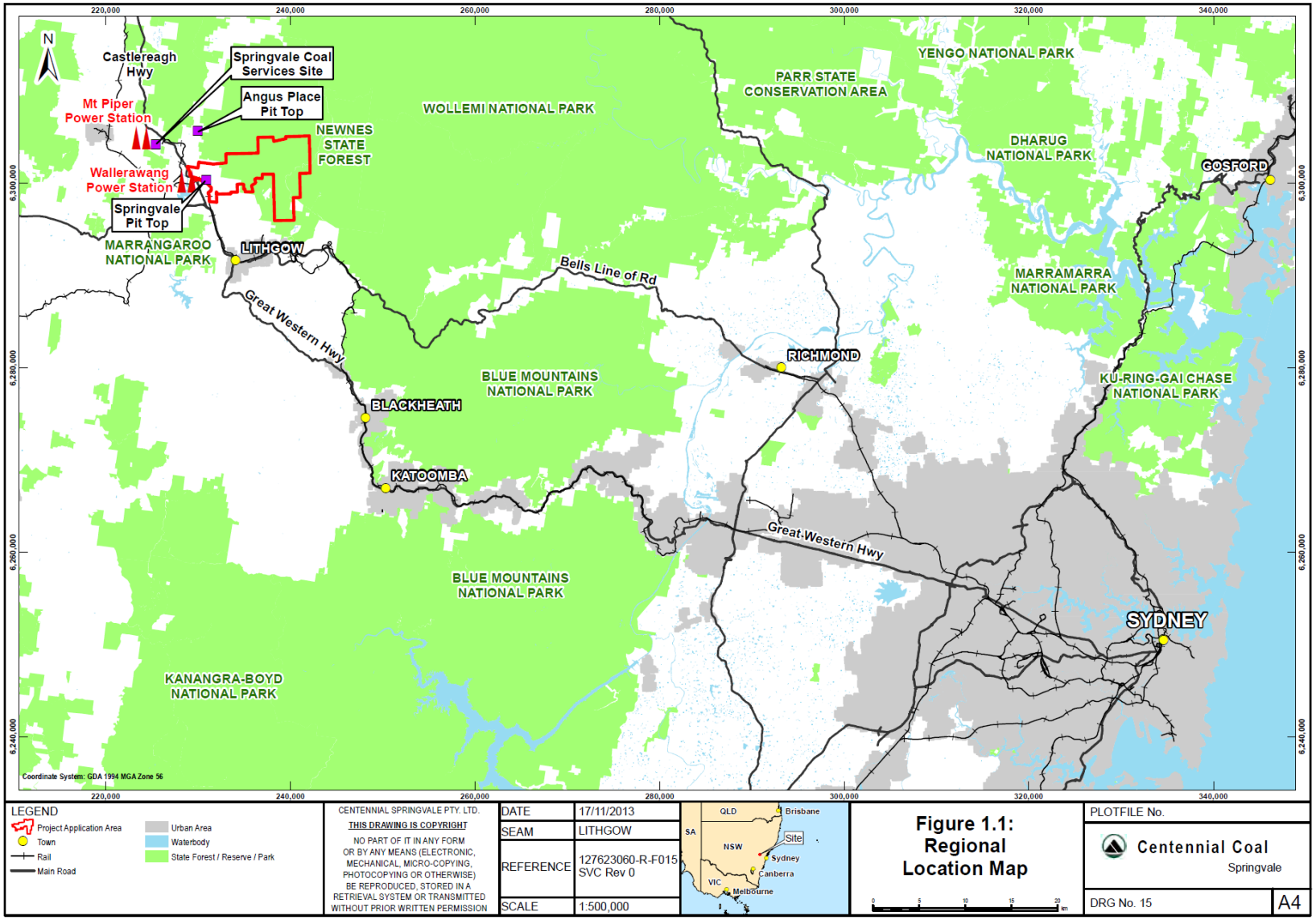

Figure 1: Regional Location of the Springvale Mine
Source: EIS, Centennial Coal

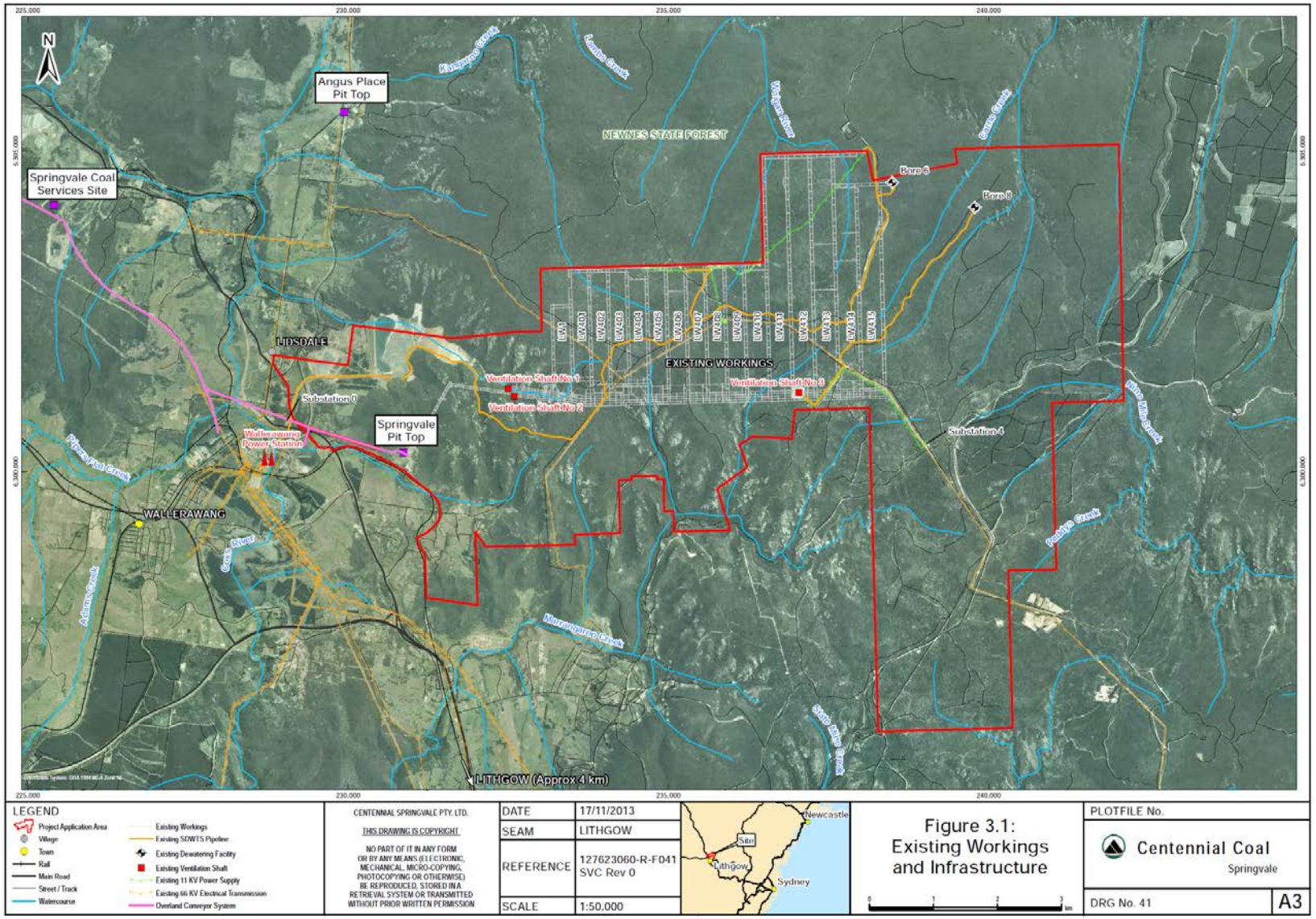

Figure 2: Existing Surface Infrastructure
Source: EIS, Centennial Coal

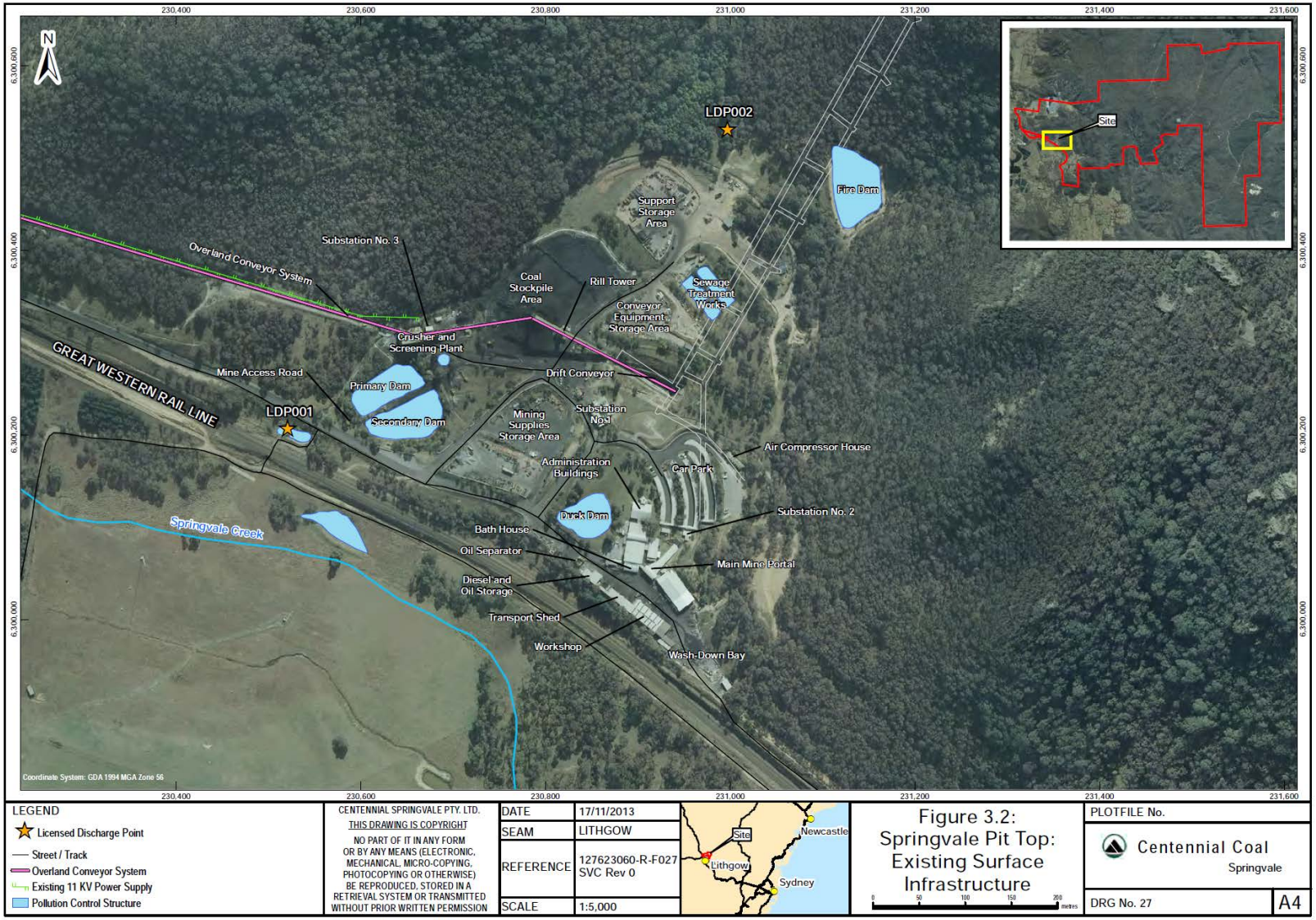

Figure 3: Layout of the Surface Facilities Site
Source: EIS, Centennial Coal

1.2 Current Proposal

The Applicant proposes to extend the existing underground mine operations, which would involve:

- continuing to extract up to 4.5 Mtpa of ROM from the Lithgow Seam;
- continuing the operation of the existing surface facilities sites;
- continuing the processing and stockpiling of ROM coal at the pit top area;
- extending underground mining operations to the south and southeast;
- extending the life of the mine for 13 years;
- extending the use of the Springvale Delta Water Transfer Scheme, bore dewatering facilities and ventilation infrastructure;
- continuing the transportation of processed coal by overland conveyor or by road haulage; and
- rehabilitation after mining has ceased.

The proposal would consolidate the two existing development consents (DA 11/92 and DA 461/02) into one new development consent.

1.3 Strategic Context

It is important to consider the proposal in the context of a broader understanding of the social and economic significance of coal mining in the Blue Mountains region. Lithgow has historically been a coal mining centre and an important contributor to power generation for Sydney and NSW.

In recent times, a number of coal mines and power stations have ceased to operate in the region, including the Wallerawang Power Station, and the Baal Bone, Cullen Valley, Invincible and Angus Place mines. The Springvale mine is the only local mine currently supplying coal to the Mt Piper Power Station, which provides approximately 15% of NSW's electricity. The Springvale mine and Mt Piper Power Station are now the main employers locally.

In terms of the broader economic context, it is noteworthy that the price of coal has declined significantly over recent years from a price of approximately US$140 dollars per tonne in 2011 to approximately US$65 dollars per tonne in early 2015. This decline in the global coal market is likely to constrain the economic benefits derived from the Springvale mine extension.

It is also important to consider the broader environmental context surrounding the Springvale mine. The Blue Mountains region is known for its high conservation values, including the Gardens of Stone National Park (to the north of the project area), the Wollemi National Park (to the northeast) and the Blue Mountains National Park (to the east). These three national parks are part of the Greater Blue Mountains World Heritage Area.

Notwithstanding the significance of conservation areas in surrounding areas, the project area covers over 5,800 hectares, most of which is located within the Newnes State Forest. There is a clear distinction between the fundamental nature of State Forests as a resource for forestry and other uses such as mining, and National Parks as conservation areas with other activities limited to regulated recreational uses. The Newnes State Forest is selectively logged for native and plantation timber, and has also been the site of underground coal mining throughout its history.

In terms of other surrounding land uses, there are a number of residential properties within the villages of Lidsdale and Wallerawang, which are located within 10km of the mine. In addition, there are a small number of rural-residential properties along Springvale Lane, west of the project area within 1-2kms from the pit top (refer to **Figure 2**).

1.4 Secretary's Preliminary Environmental Assessment Report

The Department has prepared a Preliminary Environmental Assessment Report (PEAR) for the project application, which has been considered by the Commission as part of the review process.

The PEAR considered the merits of the proposal, its strategic and statutory context, public and agency submissions and the Applicant's response to submissions. The report identified the following key issues:

- Subsidence impacts, particularly on natural features on the Newnes Plateau including swamps and watercourses;
- Water impacts, particularly in relation to mine water discharges;
- Biodiversity impacts;
- Noise impacts; and
- Socio-economic impacts.

The Department concluded that the proposal is consistent with the aims, objectives and provisions of all relevant local, regional and State planning instruments and that "*the project represents a logical extension to existing mining operations at Springvale"* (PEAR, p.61). The Department also provided a recommended set of conditions that might be applied to an approval.

2. THE COMMISSION'S REVIEW TASK

2.1 Terms of Reference

The Minister's request was made under Section 23D of the *Environmental Planning and Assessment Act 1979* and Clauses 268R and 268V of the *Environmental Planning and Assessment Regulation 2000*.

The Terms of Reference are as follows:

1. *Carry out a review of the Springvale Mine Extension Project, and:*
   a) *Consider the EIS for the proposed development, the issues raised in submissions, the issues raised in the advice from the IESC, the formal Response to Submissions document, the subsequent response to agency comments on the response to submission document, the Department of Planning & Environment's Preliminary Assessment Report, and any other relevant information provided on the proposed development during the course of the review;*
   b) *Assess the merits of the proposed development as a whole, paying particular attention to its potential:*
      - *subsidence impacts on upland swamps; and*
      - *impacts on the region's water resources, particularly discharges of mine water to the Coxs River catchment; and*

2. *Conduct public hearings during the review.*

3. *Submit its final report on the review to the Department of Planning and Environment within 8 weeks of receiving the Department's preliminary Assessment Report, unless the Secretary of the Department agrees otherwise.*

2.2 Public Hearing and Submissions

In accordance with the Commission's terms of reference, a public hearing was held on Wednesday 27 May 2015 at the Lithgow Workmens Club, Lithgow. A total of 37 verbal submissions and 24 written submissions were made to the Commission at the hearing, comprising various local businesses, special interest groups, employees of the Applicant and a number of individuals. Of the 37 verbal submissions, the majority were supportive of the proposal, however numerous submissions raised concerns about a variety of issues relating to the proposal. A list of speakers at the public hearing is provided in **Appendix 1** of this report.

The Commission has also received a total of 1,186 written submissions from the community before and after the public hearing. Many were proforma submissions highlighting general concerns about the coal industry along with its contribution to loss of biodiversity values and to climate change. The Commission also received two late submissions, well after the public hearing, which related to water level and subsidence monitoring results for Sunnyside Swamp to the impacts of current undermining by LW417. A summary of the project specific issues raised at the public hearing and written submissions is provided in **Appendix 2** of this Report. The key project specific concerns related to social and economic impacts of the mine, the discharge of water into local water catchments, and subsidence impacts on swamps and watercourses.

Submissions made to the Department in response to the exhibition of the EIS have also been referred to the Commission for its consideration as part of its review of the proposal.

2.3 Documents, Meetings and Site Inspections

Through the course of the review the Commission accessed a wide range of documents including:

- the Applicant's Environmental Impact Statement (EIS);
- the Applicant's Response to Submissions (RTS);
- the Applicant's Response to RTS Submissions;
- a range of other documents provided by the Applicant;
- the Secretary's PEAR and recommended conditions;
- additional information provided by the Department; and
- submissions from government agencies and the public.

The Commission notes that the PEAR was lacking certain information in relation to the current position of some agencies on issues that had been the subject of change between the originally exhibited proposal and the RTS. In particular, there was no information provided from OEH since its initial submission on the EIS, and the final positions of EPA, NOW and WaterNSW were also not clear in the PEAR. Consequently, the Commission deemed it necessary to seek clarification from the Department in that regard, and to consult further with each of these agencies.

During the review, the Commission met with the Department, EPA, NOW and DRE (on 15 May 2015), Lithgow City Council (on 21 May 2015) and WaterNSW (on 3 June 2015). The Commission also met with the Applicant and OEH on-site on 22 June 2015, and undertook an inspection of the Newnes Plateau, including various swamps and watercourses, some of which had already been undermined and others that are earmarked for undermining in the current proposal. Records of these meetings are provided in **Appendix 3** of this Report. A copy of the documents received from the Department that included further information is provided in **Appendix 4**.

The Commission notes that the lack of certain information in the PEAR about the final positions of various agencies made the task of undertaking the review in a timely and effective manner somewhat challenging, however the Commission, with the assistance of the Department, was able to ascertain the necessary information during the course of the review.

3. COMMENTS, FINDINGS AND RECOMMENDATIONS

3.1 Subsidence

3.1.1 Introduction

'Conventional subsidence effects' includes vertical displacement, tilt, and tensile and compressive strain. When two adjacent points undergo a different amount of vertical displacement, the slope of the ground surface between them changes, which then induces tilt in features located on the surface. Curvature of the ground in an outwards direction results in the ground 'hogging' (i.e. due to tensile strain), and curvature of the ground in an inwards directions results in the ground 'sagging' (i.e. due to compressive strain). 'Non-conventional subsidence effects' includes valley closure, 'upsidence' and far-field horizontal movements, which are discussed further in **3.1.3**.[1]

The EIS includes a Subsidence Impact Assessment (SIA) undertaken by Mine Subsidence Engineering Consultants (MSEC). The SIA utilises a subsidence model known as the Incremental Profile Method (IPM), which is generally accepted as an accurate and conservative predictive approach to subsidence. It utilises a large historical database of empirical data drawn from underground mining across NSW, including data from previous mining at Springvale and Angus Place mines. The Commission notes that a similar model has been used for numerous underground mines in NSW, including the Bulli Seam Operations Project and other mines in the Southern Coalfield, and it was deemed appropriate by the Commission in reviews and determinations for those projects.

The Commission notes that DRE and its subsidence experts have considered the subsidence model and were satisfied that it is adequate. However, the Commission also notes that OEH and IESC both raised some specific concerns about subsidence predictions for swamps, particularly near lineaments, and the height of fracturing. These concerns relate to the accuracy of predicted impacts on swamps and groundwater rather than the use of the IPM or its validity as a subsidence model. Consequently, these concerns are addressed in the relevant sections of this report in **3.2.2** and **3.3.4**. After considering the EIS, RTS, further information provided by the Applicant since the RTS, and DRE's comments, the Commission is satisfied that the subsidence model used in the SIA is appropriate for this project.

3.1.2 Mine Plan

The Commission considers it important to note upfront that the layout of the proposed underground workings at the mine has been revised since the last development consent was granted and throughout the current development application process in an attempt to reduce predicted subsidence-related impacts. While the Applicant has an existing consent to extract coal from another five longwalls (LWs 419 to 423), the Commission understands that the Applicant has since significantly revised the mine plan by incorporating narrower longwall panel widths, wider chain pillars and some shortened panels. **Figure 4** shows the proposed mine plan.

These changes were based on previous experience at both the Springvale and Angus Place mines, which indicated that subsidence-related impacts on natural surface features may have been a result of high panel width-to-depth ratios. The key change is the reduction in the width-to-depth ratio of the longwalls from between 0.75 and 1 (i.e. 'critical' or 'super-critical'), to between 0.65 and 0.75 (i.e. 'sub-critical'). The Commission acknowledges that these changes project significant reductions in the amount of coal to be extracted by reducing the width of the proposed longwall panels from 350 metres to 260 metres, increasing the chain pillar widths to 58 metres, and shortening certain panels to avoid specific surface features.

[1] Detailed descriptions of subsidence effects are available in earlier PAC review reports on the Metropolitan Coal Project (May 2009) and Bulli Seam Operations Project (July 2010).

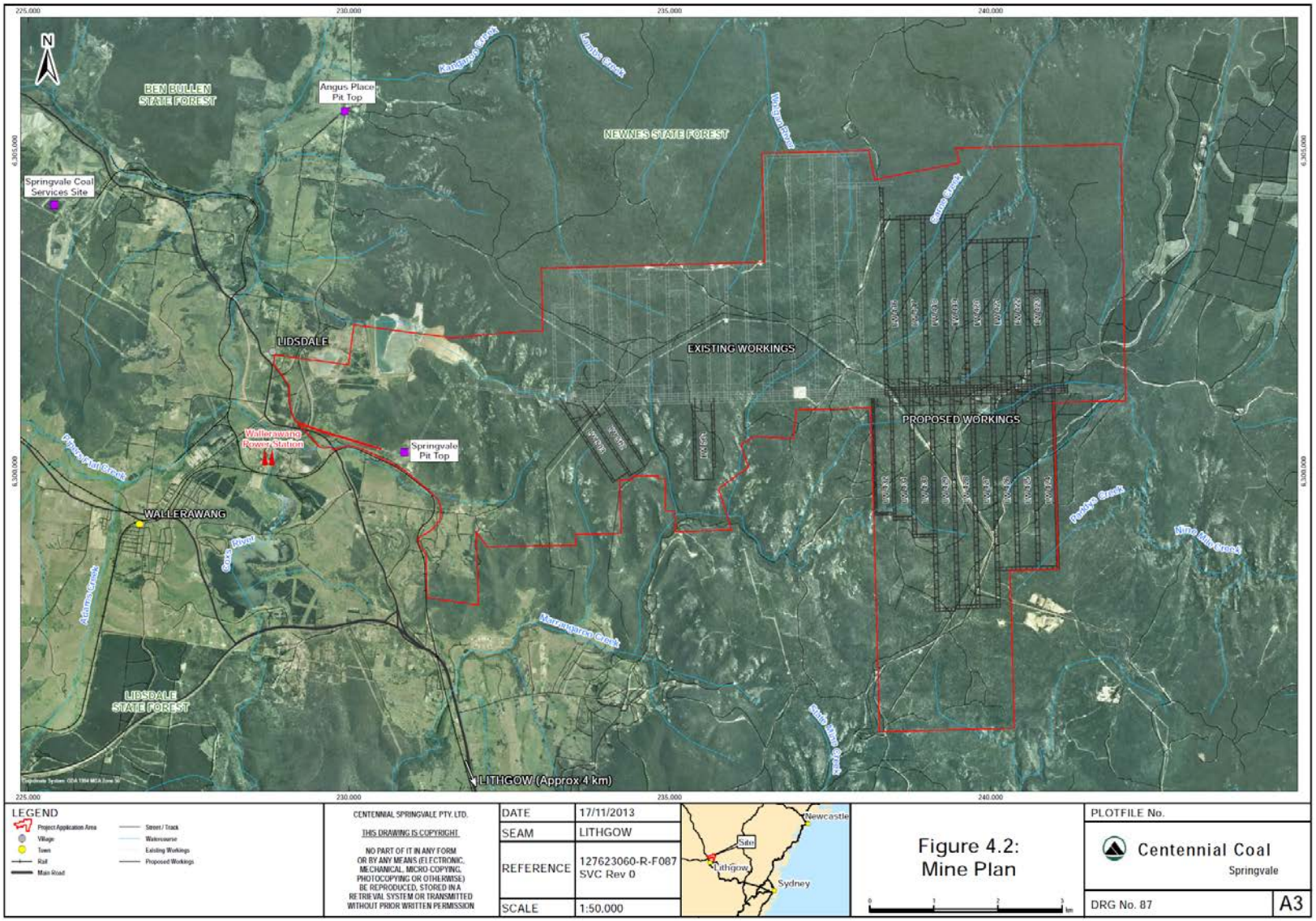

Figure 4: Mine Plan
Source: EIS, Centennial Coal

While the Commission recognises that the Applicant's changes to the mine plan have reduced the potential financial benefits to the Applicant, it believes that such an approach is necessary to provide an appropriate balance between the protection of environmental assets and the recovery of economic benefits. Nevertheless, the Commission does not rule out the possible need for further refinements to the mine plan, in order to avoid, minimise or further mitigate potential environmental impacts (e.g. through adaptive management, as discussed in relation to swamps in **3.3.6**).

3.1.3 Previous Subsidence Effects

Before forming a view on the predicted subsidence effects from the proposed underground mining, the Commission considers it important to first analyse the accuracy of the subsidence model based on observed subsidence effects in already mined areas. The IPM has been calibrated to local conditions using data from Angus Place, Springvale, and other coal mines in the Western Coalfield. The SIA states that this calibration involves comparing observed subsidence effects at Springvale with those back-predicted using the standard IPM for the Western Coalfield. The Commission accepts that the monitoring data over the previously extracted longwalls is appropriate for the calibration of the subsidence prediction model for the proposed longwalls.

The SIA found that the maximum observed subsidence for the previously extracted longwalls was similar to the maximum back-predicted subsidence obtained using the IPM. The observed subsidence and tilt were also reasonably matched to the predicted levels using the IPM. However, the subsidence levels observed above the chain pillars were slightly greater than those predicted using the IPM. These exceedances were only minor and may have been due to the presence of thick massive strata unit that may have reduced the sag subsidence directly above the previously extracted longwalls. Overall, the Commission is satisfied that the majority of subsidence predictions are likely to be accurate, however given the possibility of minor exceedances, it is essential that an effective regime of adaptive management is implemented, which is discussed in detail in **3.1.7**.

3.1.4 Predicted Subsidence Effects

The depth of cover to the coal seam ranges from 190 metres in the southeast up to 420 metres in the north. The panel width, chain pillar width and targeted seam thickness vary depending on the depth of cover and surface features (see **Table 2** on the next page). The Commission considers it useful to conceptually divide the underground mine extension area into three domains (see **Figure 4** above), which reflects the timing of the extraction and the variable panel geometry across the extension area:

- The Northern Domain includes 8 longwalls (LWs 416-423) and would be the first area mined. This domain features the highest depths of cover, however it also contains thick targeted seams. It includes a large amount of sensitive surface features (i.e. swamps, watercourses and steep slopes). It is worth noting that the chain pillar width for the already mined LW16 was only 45 metres, however the chain pillar widths for LWs 417-423 have been increased significantly due to the presence of sensitive surface features.

- The Southern Domain would be the next area mined and includes 10 longwalls (LWs 424-432). This domain also features high depths of cover, albeit shallower in some areas than the Northern Domain, however it also features thinner targeted seams in those shallower areas. It includes a moderate amount of sensitive surface features (i.e. several swamps and watercourses). It is worth noting that LW432 is located across an area of significant variation in the depth of cover, so the panel width of this longwall has been even further reduced from 261 metres to 229 metres.

- The Western Domain includes only 3 longwalls (LWs 501-503) and would be the final area mined. This domain features the shallowest depths of cover, thick targeted seams and narrow chain pillar widths. However, this domain includes the least amount of sensitive surface features (i.e. no swamps, only minor watercourses and numerous steep slopes). The panel widths have also been reduced in this area from 260 metres to 231-236 metres.

Domain	Longwalls	Depth of cover (m)	Panel width (m)	Chain pillar width (m)	Seam thickness (m)
Northern	416	370 - 420	261	45	3.2 - 3.4
	417 - 423	320 - 400	261	58	2.9 - 3.3
Southern	424 - 431	330 - 410	261	58	2.3 - 3.3
	432	270 - 380	229	58	3.3
Eastern	501 - 503	190 - 300	231 - 236	35	3.0 - 3.4

Table 2: Depth of Cover and Proposed Longwall Widths and Thicknesses
Source: SIA, MSEC

Conventional Subsidence Effects

Table 3 below shows that the lowest levels of conventional subsidence effects are predicted to occur in the Northern Domain, where the depths of cover are generally the highest. The effects are predicted to slightly increase in the Southern Domain, where there are areas of shallower depth of cover. The highest levels of conventional subsidence effects are predicted in the three longwalls in the Eastern Domain where there are the shallowest depths of cover, thick targeted seams and narrower chain pillar widths.

Domain	Vertical subsidence (m)	Tilt (mm/m)	Hogging curvature (/km)	Sagging curvature (/km)	Tensile strain (mm/m)	Compressive strain (mm/m)
Northern (LWs 416-423)	1,450	10	0.15	0.20	1.5	2
Southern (LWs 424-432)	1,650	13	0.20	0.35	2	3.5
Eastern (LWs 501-503)	1,650	25	0.60	0.60	6	6

Table 3: Maximum Predicted Subsidence Effects
Source: SIA, MSEC

The Commission notes the gradual increase in predicted subsidence effects across the proposed life of the mine, and considers that this correlates appropriately with the gradual decline in the amount of sensitive surface features from the earlier stages to the latter stages of the project. The Commission believes that it is most important to take a cautious approach in the early stages of the project, particularly in relation to the swamps and watercourses that are present on the surface above the first area of proposed mining (the Northern Domain).

Conventional subsidence effects can cause fracturing of the surface, which may result in fracturing of the base of swamps or streambeds, and potentially cause displacement of water from swamps or shallow aquifers to deeper aquifers. The Commission notes that there are already several examples of this that have occurred as a result of previous mining at Springvale and Angus Place. The potential impacts on surface water features and swamps are discussed in detail in **3.2** and **3.3** below.

Non-Conventional Subsidence Effects

The PEAR provides some references to non-conventional subsidence effects that may occur in the proposed mine extension area, however the Commission believes that there was not sufficient consideration given to these effects, particularly upsidence and valley closure effects.

Non-conventional subsidence effects are generally associated with shallow depths of cover, sudden or abrupt changes in geological conditions, steep topography, and valley related mechanisms. The two most relevant factors for this project are valley related mechanisms and steep topography. The SIA states that watercourses within the proposed mining extension area may be subjected to valley related movements, which are commonly observed along stream alignments in the NSW Coalfields. The watercourses in the project area are also often associated with steep topography. In addition, the Commission notes that valley closure has already been observed along the stream alignments at the Angus Place and Springvale mines.

The significance of non-conventional subsidence effects in the project area is emphasised by the predicted maximum strains within the drainage lines, which are considerably higher than the predicted strains from conventional subsidence. As shown in **Table 3** above, the maximum predicted tensile and compressive strains from conventional subsidence in the Northern and Southern Domains are 2mm/m and 3.5mm/m respectively. However, the maximum predicted tensile and compressive strains from non-conventional subsidence in the same areas are 5mm/m and 16mm/m, respectively.

The Commission understands that the SIA in the EIS has incorporated the higher predicted strain levels in assessing the likely impacts on surface features, however it also notes that the SIA includes a long section about the reliability of predictions around valley closure and upsidence effects. The SIA states that predictive methods for valley closure and upsidence have only been recently developed and are not yet as reliable as conventional subsidence prediction techniques. MSEC has utilised an empirical method , which is outlined in the Australian Coal Association Research Program (ACARP) Research Project No. C9067. The SIA concedes that while the major factors that determine the levels of non-conventional subsidence have been identified, there are some factors that are difficult to isolate.

The Commission also notes that the ACARP method is largely based on experience from the Southern Coalfield, where the geological conditions are quite different. The Commission acknowledges that there is a strong argument that this probably results in conservative predictions as the Southern Coalfield is perhaps more susceptible to these effects. However, given the lack of experience and existing data, the Commission reiterates the need for an adaptive management approach based on extensive monitoring.

Furthermore, the Commission believes this project presents an opportunity to gather relevant data in order to provide more certainty in future predictions of non-conventional subsidence. The Commission recommends that further consideration is given to upsidence and valley closure effects, and that the conditions of any consent include an explicit requirement to monitor for any non-conventional subsidence effects.

3.1.5 Built Infrastructure Impacts

There are relatively few built infrastructure features across the project area. The key pieces of infrastructure that need to be considered include the Lithgow Supply Dam and the various power lines, including a 66kV power line (which crosses LW431 to LW427), an 11 kV power line (which crosses LW430 and LW431) and a 66 kV/11kV substation (above LW430). The Commission notes that the Lithgow Water Supply Dam is located outside of the subsidence affectation area (approximately 3 kilometres away). There are also various unsealed roads and associated culverts, numerous fences, and one airstrip located adjacent to Sunnyside Ridge Road that is currently not in use.

The Commission is satisfied that potential subsidence impacts on these built features can be suitably managed through the recommended Extraction Plan process. The Commission agrees with the Department's draft conditions that classify the Lithgow Water Supply Dam as 'key public infrastructure' and the need for strict performance criteria. The Commission also accepts the 'safe, serviceable and repairable' criteria for subsidence impacts on other built features, including power lines and associated towers, unsealed roads, fences and an airstrip.

3.1.6 Impacts on Pagodas and Rock Features

The Commission has considered pagodas and rock features briefly in this section as the impacts are relatively limited and can be dealt with through appropriate conditions. The Commission notes that the SIA predicts that subsidence-related impacts on pagodas and other rock features would represent less than 3% of total exposed rockface areas of these features which are located directly above the proposed longwalls. That is because the rock features are generally located outside the 26.5 degree angle of draw, and there is only one cliff which partially extends within this angle.

The level of impacts to these rock features are also expected to be generally minor in nature due to the low level of predicted conventional and non-conventional subsidence effects. In terms of conventional subsidence effects, the maximum predicted strains are 1.5 mm/m tensile and 0.5 mm/m compressive, based on a 95 % confidence level. In terms of non-conventional subsidence effects, there are likely to be some minor far-field horizontal movements. The Commission is satisfied that any potential subsidence impacts on pagodas and other rock features can be managed through the recommended Extraction Plan process.

3.1.7 Adaptive Management

While there is inevitable uncertainty about the subsidence predictions, the Commission is satisfied that they provide a sound basis for assessing the potential subsidence-related impacts of the project. The Commission notes that several submissions raised concerns about the potential for the Applicant to defer adaptive management action to post-approval plans. The Commission agrees that this is not an appropriate approach and considers adaptive management measures must be considered prior to determination and included in the recommended conditions of consent. The Commission considers that there is further scope to revise the predictions based on experience as the mine progresses, and it recommends that a rigorous adaptive management regime should be imposed to ensure impacts and consequences remain within the performance criteria in any consent.

In its review of the proposed Wallarah 2 coal mine, the Commission considered the utilisation of an 'adaptive management' approach and suggested that the Department should 'tighten' its draft conditions in that regard. In particular, the Commission recommended that the connections between the performance criteria and the requirements of the Extraction Plan were more closely linked. While the proposed Wallarah 2 project has not yet proceeded to mining operations, the Commission considers this proposal would benefit from adoption of similar recommendations for changes to the approval conditions.

In the Wallarah 2 Review, the Commission noted that 'Adaptive management' has been considered by the Land and Environment Court on several occasions and a summary of the key cases is included in the PAC Review Report on Bulli Seam Operations (July 2010). In *Newcastle and Hunter Valley Speleological Society Inc. v Upper Hunter Shire Council and Stoneco Pty Limited* [2010], the Court defined 'adaptive management' in the following terms:

> *'Adaptive management is a concept which is frequently invoked but less often implemented in practice. Adaptive management is not a "suck it and see", trial and error approach to management, but is an iterative approach involving explicit testing of the achievement of defined goals. Through feedback to the management process, the management procedures are changed in steps until monitoring shows that the desired outcome is obtained. The monitoring program has to be designed so that there is statistical confidence in the outcome. In adaptive management the goal to be achieved is set, so there is no uncertainty as to the outcome and the conditions requiring adaptive management do not lack certainty, but rather they establish a regime which would permit changes, within defined parameters, to the way the outcome is achieved.'*

The Commission considers that there are substantial differences between the generalised statements in the EIS, RTS, other documents provided by the Applicant and, to a lesser extent, the PEAR, on the one hand and the specificity required by the Court on the other. These conditions need to have clear outcomes that must be met that are measurable and enforceable, assisted by an adaptive management system that monitors and modifies operations in advance, based on predetermined triggers to achieve the outcomes. The Commission has made some specific recommendations about adaptive management in relation to swamps in **3.3.6**.

3.1.8 Summary of Recommendations

1. That the Department give further consideration to upsidence and valley closure effects.
2. That appropriate monitoring of non-conventional subsidence effects should be included as a requirement in any consent and that the relevant Extraction Plan is required to contain appropriate measures to limit and manage the risks from non-conventional subsidence so as to ensure that the environmental performance criteria are not exceeded.
3. That a rigorous set of performance measures is included in any consent. Rigorous in this context means able to be measured or assessed in a scientifically and legally sound manner and be capable of enforcement. These performance measures must be supported by:
   (i) a requirement that the Extraction Plan for each longwall contains revised subsidence predictions based on experience from previous mining on the site and that these revised predictions will not allow the performance criteria to be exceeded;
   (ii) a requirement that the Extraction Plan for each longwall contains:
      (a) appropriate triggers to warn of the development of an increasing risk of exceedance of the performance criteria (e.g. the subsidence predictions themselves and/or other relevant subsidence-related measurements);
      (b) specific action plans to respond to increased risk of exceedance that will ensure the criteria are not exceeded (e.g. cessation of mining, narrowing the longwall, altering seam height, etc.); and
      (c) an assessment of remediation measures that may be required if exceedance does occur and the capacity to implement the measures.

3.2 Water Resources

3.2.1 Introduction

As described in **2.1**, the Minister's Terms of Reference specifically require the Commission to pay particular attention to discharge impacts on the Coxs River and subsidence impacts on upland swamps. These specific issues are considered in detail in **3.2.3** and **3.3**, respectively. However, the Commission emphasises that there are interrelationships between all the water resources that may be affected by the project, including groundwater, surface water and swamps, and believes it is important to consider each of them in that context.

The Commission also considers it important to highlight that there has been a substantial amount of work undertaken on the water resource impacts of the project throughout the development consent process to date, particularly in response to issues raised by various agencies. **Table 3** below provides an overarching summary of the key documents that the Applicant has prepared in relation to water resources.

Document	Stage provided and date	Prepared by	Purpose of the document
Groundwater Impact Assessment	EIS, April 2014	RPS	Assesses impacts on groundwater, includes groundwater model prepared by CSIRO
Surface Water Impact Assessment	EIS, April 2014	Cardno	Assesses impacts on surface water
Regional Water Quality Impact Assessment	RTS, September 2014	RPS	Assesses impacts of the increased mine water discharge as a result of the closure of the Wallerawang Power Station
Height of Fracturing Report	RTS, September 2014	DgS	Updated assessment of subsurface fracture zone height predictions, refers to estimations by Hydro Simulations, peer reviewed by MSEC
Springvale EPA Water Quality and Toxicity Assessment Interpretive Report	RTS, September 2014	GHD	Provides options to manage mine water discharge quality at Springvale.
Coxs River Ecotoxicology Assessment	RTS, September 2014	GHD	Determines toxicity and chemical constituents of discharges in Coxs River.
Geology of the Shrub Swamps	RTS, September 2014	McHugh	Discusses the influence of the upper geological strata on swamps
Responses to IESC Report	After RTS, October 2014	Centennial	Includes responses to various issues, including water issues, swamps and biodiversity, mitigation and remediation, and subsidence and mine design
Additional Simulations of the Regional Water Quality Impact Assessment Model	After RTS, March 2015	Jacobs	Presents the outcomes of additional simulations, in response to OEH and WaterNSW comments

Table 3: Summary of Documents Relating to Water Resources
Source: EIS, RTS and other documents from the Applicant

3.2.2 Groundwater Impacts

Groundwater Model

The EIS includes a Groundwater Impact Assessment (GIA) prepared by RPS, which is based largely on a numerical model prepared by the CSIRO. At the EIS stage, the IESC raised concerns that the groundwater model scale is not appropriate to address impacts to individual swamps and proximal reaches of the Coxs River. The Applicant has since engaged RPS to prepare a response to this criticism, which essentially argued that the CSIRO model is very conservative as it incorporates worst-case assumptions of connectivity between shallow and deep aquifers. The Applicant also provided a peer review by MSEC of the CSIRO model, which concluded that the numerical model represented industry best practice.

The Commission acknowledges that the groundwater model cannot provide entirely accurate, site-specific predictions of impacts to individual swamps or proximal reaches of the Coxs River. However, the Commission agrees with the Department that the groundwater model provides appropriate predictions that are likely to be conservative. The Commission also notes that NOW is satisfied that the assessment of impacts to aquifers has been carried out to a high standard, and has confirmed that the project's impacts have been assessed as Level 1 impacts, which is defined as acceptable under the NSW Aquifer Interference Policy. As NOW is the lead agency with responsibility for groundwater issues, the Commission accepts its advice that the project is acceptable in terms of groundwater impacts subject to implementation of its recommendations.

Geological Profile

The Commission considers it important to note the significance of both the Burralow Formation and Mount York Claystone, in terms of their role in preventing or limiting connectivity between shallow aquifers and deeper aquifers. The Burralow Formation consists of medium to coarse-grained sandstones interbedded with fine-grained sandstone/siltstone/claystone units, the latter of which can be several metres thick. The Burralow Formation contains a number of continuous fine grained units that have been identified that act as aquitards. The Mt York Claystone unit is a sequence of interbedded claystone and sandstone, with an average thickness of 22 metres across the project area. The Commission notes that the Mt York Claystone is considered to form an effective barrier between the deep and shallow groundwater systems. **Figure 5** shows the typical stratigraphy across the project area.

Potential Groundwater Impacts

In terms of depressurisation, the Commission notes that the EIS and RTS predict that the groundwater drawdown in all aquifers below the Mount York Claystone would be similar to those in the mine workings. While there are 112 registered bores in these deeper aquifers (within 10 kilometres), only nine of those are predicted to experience drawdown of greater than 2 metres, and none of them are utilised for water supply purposes. The Commission does not consider these predicted drawdown impacts to be significant.

In terms of potential baseflow loss in shallow and perched aquifers, the Commission notes that the EIS and RTS predict that these aquifers would generally remain saturated. However, the Commission also notes that the IESC raised some concern about this prediction, specifically in terms of the predicted height of fracturing. However, since the IESC made these comments, the Applicant has engaged Ditton Geotechnical Services (DgS) to provide an assessment addressing this specific issue, which was peer reviewed by MSEC. The DgS report confirmed that the height of fracturing above the coal seam would only extend approximately 179 metres into the sandstone units (see **Figure 5**), which are below the Mt York Claystone (except in relation to LWs 501 to 503, where there are no significant watercourses or swamps at the surface).

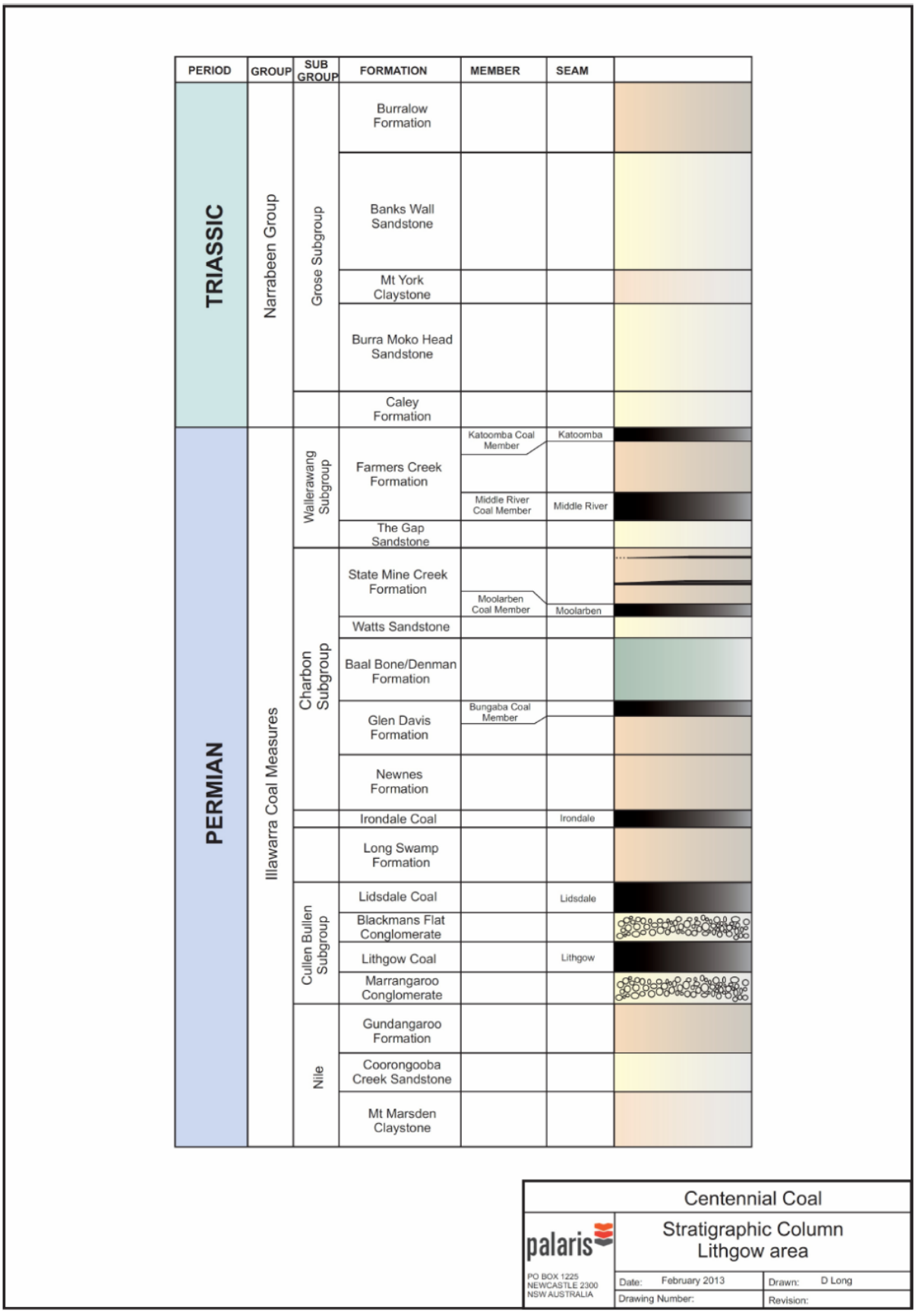

Figure 5: Cross-section of Typical Stratigraphy
Source: RTS, Centennial Coal

Summary of Groundwater Impacts

While OEH has some residual concerns about the methodology that DgS has utilised in calculating the predicted height of fracturing, the Commission generally accepts the additional information prepared by DgS and peer reviewed by MSEC. Nevertheless, given there is still an element of uncertainty about the precise extent of the height of fracturing, the Commission has carefully considered potential impacts to aquifers in more detail in relation to watercourses and swamps in **3.2.3** and **3.3.3**, and has recommended an adaptive management approach.

In summary, the Commission is satisfied that:

- impacts on alluvial groundwater are within the Aquifer Interference Policy's (AIP) minimal impact considerations and are unlikely to be greater than minor;
- depressurisation is not expected to result in adverse impacts to groundwater users;
- the Applicant's existing water access licences for groundwater take are adequate for the proposed operations;
- groundwater inflows are able to be stored until suitable for discharge within licence limits; and
- groundwater monitoring and management is proposed to ensure impacts are identified and mitigated.

3.2.3 Surface Water Impacts

Key Watercourses and Catchments

The Springvale mine is predominantly located within the catchments of the Wolgan River and the Coxs River. The Wolgan River flows to the north from the mine location through the Wolgan Valley, before entering the Colo River, which flows into the Hawkesbury River. From the mine location, the Coxs River generally flows south path Lithgow, before flowing into Lake Burragorang, which is impounded by Warragamba Dam (the primary reservoir for Sydney's drinking water supply).

Discharge into Coxs River

A large number of the written submissions and presentations at the public hearing raised concerns about the discharge of highly saline mine water into the Coxs River, which may in turn have impacts on Sydney's water supply, and has previously caused major impacts to swamps.

The proposed extension of mining would generate up to 19ML/day of mine water make at its peak, which is a significant increase of 6-7ML/day above the existing operations. The Commission notes that the Applicant has been discharging surplus mine water to the Coxs River via discharge point LDP 9 since the recent closure of the Wallerawang Power Station. While the Applicant has an Environment Protection Licence (EPL) with a discharge limit of 30 ML/day and an electrical conductivity (EC) limit of 1,200 µS/cm, the EPA has indicated that these licence limits are interim and has asked the Applicant to consider treatment options that would substantially reduce the EC to 350 µS/cm (in accordance with the ANZECC guidelines for protecting aquatic ecosystems).

Since the EIS and RTS, the Applicant has engaged a consultant to prepare a report (the Jacobs Report) to support its position that this level of treatment would be both prohibitively expensive and impractical due to the scale of pre-treatment required. The Jacobs Report concludes that the predicted increase in salinity in Lake Burragorang with treatment is 5%, while the predicted increase is only 6% without treatment.

The Commission notes that the EPA has reviewed the Jacobs report, and has raised issues in relation to the model calibration and validation. The Commission also notes that comments were not sought from WaterNSW on this report, however WaterNSW has raised concerns directly with the Commission regarding the model.

Notwithstanding its concerns about the model methodology, the EPA has acknowledged that reducing the salinity of mine water discharges to 350 µS/cm EC may not be achievable in the short term. The Applicant has advised the EPA that it could meet a performance measure of 700 µS/cm to 900 µS/cm at LDP 9 by 31 December 2016, using a combination of pre-treatment of discharge water, duplication of existing reverse osmosis infrastructure and blending of water from Clarence Colliery.

The EPA has since agreed to a timeframe of two years (i.e. until 30 June 2017) for the Applicant to meet a 50th percentile of 700 µS/cm, a 90th percentile of 900 µS/cm for salinity and a 100th percentile limit of 1000 µS/cm EC. In the longer term, the EPA would require that the salinity of the mine water discharge be further reduced, firstly to 500 µS/cm (90^{th} percentile) by 30 June 2019. The Commission notes that these limits would be set by a variation of the Springvale EPL (EPL 3607). In addition, the EPA would require the Applicant to undertake a year-round monitoring program with a status report by 30 June 2017 on the impact of the mine's discharge on the aquatic environment. Finally, the EPA remains concerned about other toxicity factors in the mine water, including ionic composition and high bicarbonate alkalinity, and has indicated that it will continue to correspond with the Applicant regarding this matter (see EPA correspondence in **Appendix 4**).

The Applicant has recently agreed in principle to the EPA's proposals, as described above (see correspondence from the Applicant in **Appendix 4**). The Commission also notes that this plan of action would meet Energy Australia's stated salinity threshold of 550µS/cm. While the Applicant's agreement in principle is qualified, overall, the Commission is encouraged that a tangible plan of action with a clear timeline can be finally established, before determination, after many years of disagreement between the Applicant and the EPA. The Commission recommends that, prior to determination, this plan is included in the Statement of Commitments attached to the recommended conditions of consent.

In addition, the Commission notes that WaterNSW has not been adequately consulted on the discharge issues, and recommends that the Department seeks further advice from WaterNSW prior to determination. In a recent meeting, WaterNSW indicated that it supports the proposed approach in principle, and would be able to provide more accurate data for the purpose of developing a program to meet the proposed performance criteria. WaterNSW has also requested that a condition of consent is included requiring a 'negligible change' in the salinity level at Lake Burragorang, in accordance with WaterNSW's principles for managing mining impacts.

Subsidence-related impacts on streams

A number of written submissions and presentations at the public hearing raised concerns about potential surface cracking in streams as a result of subsidence impacts. The Commission notes that there are two key streams that may experience subsidence-related impacts (the Wolgan River and Carne Creek), and a number of small, unnamed drainage lines that are mostly ephemeral (refer to **Figure 6** on the next page).

The Wolgan River is located to the west of the proposed longwalls and is predicted to experience less than 20 mm subsidence, 65 mm upsidence, and 75 mm of valley closure due to the extraction of the proposed longwalls. The SIA predicts changes in the grade of the river would be minor and would not result in ponding, scouring, or any significant changes in the stream alignment. In terms of potential surface cracking, the Commission notes OEH's doubts about whether diverted surface water would re-emerge elsewhere in the catchment, however is satisfied that fracturing is unlikely to occur, and even if it did occur, it would be isolated and minor in nature. The Commission notes and endorses the Department's recommended conditions requiring that no greater than negligible subsidence impacts occur in the Wolgan River, including negligible diversion of flows.

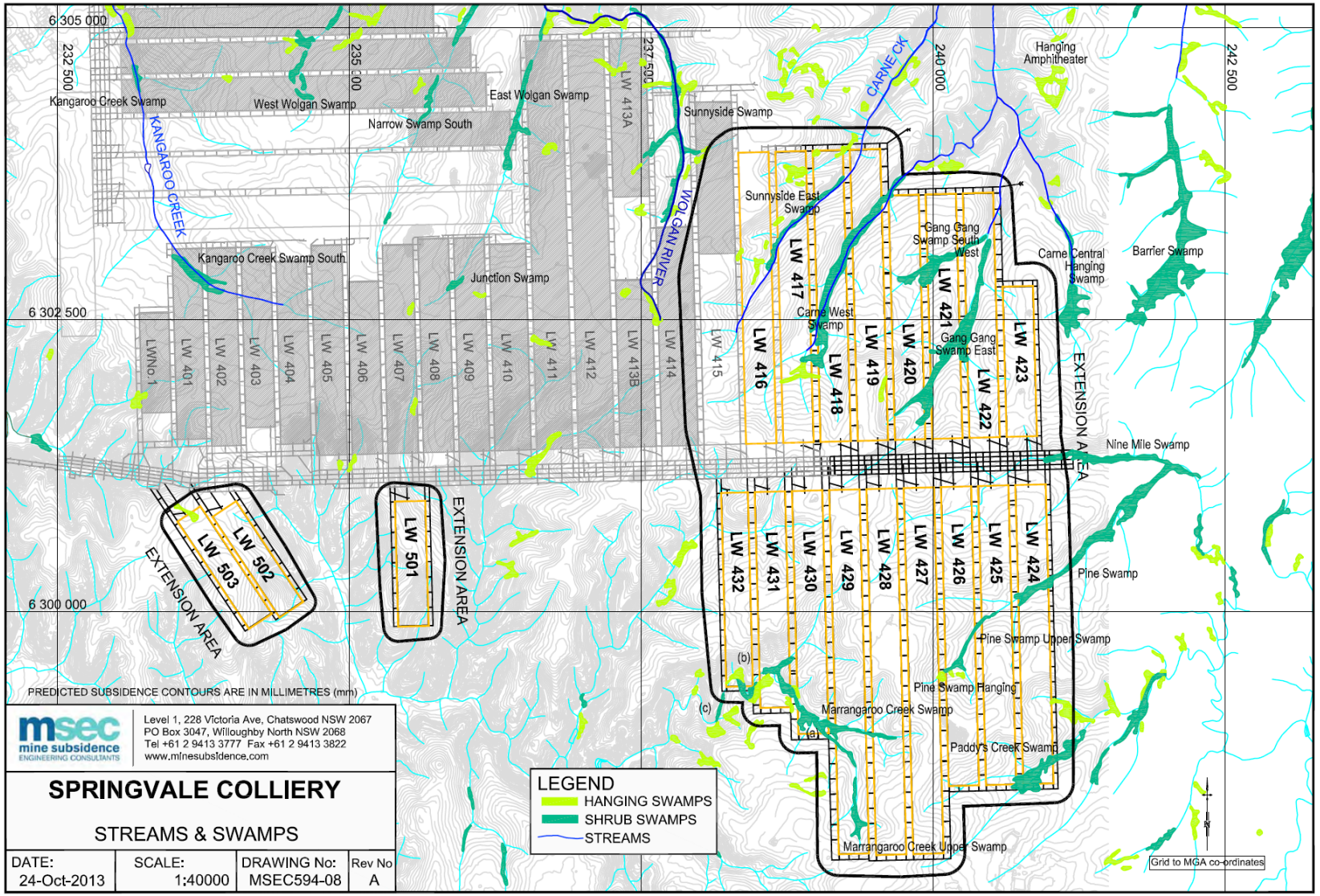

Figure 6: Key Watercourses and Swamps
Source: EIS, MSEC

Carne Creek is located directly above four proposed longwalls (LW416 to LW419), and is expected to experience minor surface cracking. The Commission was initially concerned with a statement in the PEAR that there would be a 49% reduction in baseflow predicted in one of the five reaches of Carne Creek (Reach CA5). However, the Department has provided further advice that this reach is ephemeral, flows only after prolonged or significant rainfall events, and only represents a small proportion of the total baseflow of the creek (see additional information provided by the Department in **Appendix 4**). The Commission is satisfied that as a whole, Carne Creek is predicted to have only minor net loss (a predicted 0.8%) of baseflow levels at the end of mining, so the predicted baseflow losses at Reach CA5 are unlikely to have significant implications downstream.

The Commission has also considered the potential impacts of baseflow loss from streams within the project area on the Gardens of Stone and Blue Mountains National Parks. While the Commission is generally satisfied by the information received to date that any potential impacts on the National Parks are unlikely, it notes that OEH has residual concerns about this issue which there has been insufficient time to resolve in this review phase. Consequently, the Commission recommends that the Department consults further with OEH about monitoring options or other measures to ensure that these concerns are adequately addressed before the proposal is referred for determination.

Water make

The Applicant does not currently hold any surface water licences and NOW previously indicated to the Department that the Applicant may have difficulty obtaining the appropriate licences to deal with the water make associated with the project. While the Commission acknowledges that these licences are governed by separate legislation (the *Water Management Act 2000*) to the development consent process, it believes that it is important to consider whether the Applicant is likely to meet its water licensing requirements. During its review, the Commission has consulted with representatives of NOW and is satisfied that there are a number of options available to the Applicant to account for the predicted surface water take. Nevertheless, the Commission recommends that this matter is further resolved before determination and the Applicant includes relevant commitments in its Statement of Commitments appended to any consent.

3.2.4 Summary of Recommendations

1. That, prior to determination, the Department liaises with WaterNSW about the salinity level of discharges into Coxs River, and consider WaterNSW's request to include a condition of consent requiring a 'negligible change' in the salinity level at Lake Burragorang.
2. That, prior to determination, an agreed plan of action relating to the salinity level of discharges into the Coxs River is included in the Statement of Commitments, and adequately addressed in conditions of consent relating to the relevant management plan and monitoring program.
3. That, prior to determination, the Department liaises further with the EPA in relation to other toxicity factors in the mine water, including ionic composition and high bicarbonate alkalinity, and ensures that the agreed criteria are included in the Statement of Commitments.
4. That, prior to determination, the Department liaises further with NOW about the options available for the Applicant to acquire water licences, and that the Applicant include appropriate resolutions as commitments in its Statement of Commitments.
5. That, prior to determination, the Department liaises with OEH about monitoring options or other measures to ensure that OEH's concerns about potential impacts on streams within the Gardens of Stone and Blue Mountains National Parks can be adequately addressed.

3.3 Swamps

3.3.1 Introduction

There are two types of endemic swamps on the Newnes Plateau: the Newnes Plateau Shrub Swamps; and the Newnes Plateau Hanging Swamps. Both of these swamps are listed as endangered ecological communities (EECs) under the Commonwealth EPBC Act, while only the shrub swamps are listed under the NSW TSC Act. Under the EPBC Act, the Newnes Plateau swamps are one of seven types of swamps listed in a broader set known as Temperate Highland Peat Swamps on Sandstone.

According to the OEH website, the Newnes Plateau Shrub Swamp covers less than 650 hectares in total, of which approximately 160 hectares occurs within Blue Mountains and Wollemi National Parks, with the remainder on state forest and freehold land. While OEH estimates that the area of Newnes Plateau shrub swamps within the project area represents approximately 12-15% of the total population, the Commission understands that these may be approximate numbers based on remote vegetation mapping, which have not been fully substantiated by evidence 'on the ground'. The Commission accordingly recommends that the Department liaises further with OEH to clarify the best available information on the distribution and abundance of the EEC

3.3.2 Previous Impacts and Monitoring

The Commission is aware that 39 swamps have previously been undermined at the Springvale and Angus Place mines, including 13 shrub and 26 hanging swamps. Of these 39 swamps, impacts have been observed at four, including Narrow North, Narrow South, East Wolgan and Junction Swamps.

The Commission notes that the impacts at these four swamps were a combination of both discharge impacts and subsidence-related impacts, however the relative contribution of each of these impacts has not been quantified. The EIS and RTS indicate that Narrow Swamp North and Narrow Swamp South were primarily impacted by mine water discharge, although it is possible that there were some subsidence-related impacts. Impacts on East Wolgan Swamp and Junction Swamp appear to be the result of a combination of mine subsidence ground movements, mine water discharge and, to a lesser extent, erosion from nearby roads. Given that the discharge impacts on swamps should be substantially reduced by the EPA's plan of action described above, the Commission considers that this project represents an opportunity to hone in on any subsidence-related impacts and quantify these impacts against other causes.

The Commission acknowledges that the observed impact from mine subsidence is relatively low in relation to the number of swamps that have been undermined. The SIA states that over 500 swamps have been directly undermined in the Southern Coalfield, yet impacts have been only been observed in a small number of swamps. In addition, it would also appear that some impacts can be argued to be attributable to a mix of causes, including bush fires, heavy rainfall, vehicular access or other disturbance activities.

However, the Commission also refers to the written submission and presentation by Dr Ann Young, which highlight the lack of information that has been gathered (particularly in relation to hanging swamps), and the difficulty in accurately predicting the impacts of the proposed mining. The PEAR concludes that potential risks to the function of hanging swamps are low and that most, if not all, hanging swamps will maintain their function. This conclusion is purportedly based on observations of hanging swamps that have been previously undermined by Angus Place and Springvale. The Commission accepts that the risks of fractures occurring in hanging swamps is less than in the base of the valleys, where there are higher levels of closure and associated strains. However, the Commission agrees with Dr Young that further piezometric monitoring of hanging swamps should be undertaken, even if the hanging swamps are not currently listed under the NSW TSC Act.

At a broader level, the Commission recognises the work being done by the Applicant to gain a better understanding of swamps in general, including a comprehensive research program currently being undertaken at the Australian National University (required by an enforceable undertaking with Commonwealth Department of the Environment). The Commission recommends that this work is carefully considered and incorporated, along with input from OEH, in appropriate conditions for a substantial monitoring regime.

3.3.3 Predicted Impacts

There are 11 shrub swamps located within the project area, and a summary of the predicted subsidence-related impacts on these swamps is provided in **Table 4** on the next page. The Commission has included the non-conventional subsidence effects in the final two columns of the table (upsidence and valley closure) as they are an important consideration in analysing the predicted impacts (as discussed in **3.1.4**).

Shrub Swamp	Maximum Predicted Vertical Subsidence (mm)	Maximum Predicted Tilt	Maximum Predicted Hogging Curvature (km^{-1})	Maximum Predicted Sagging Curvature (km^{-1})	Maximum Predicted Total Upsidence (mm)	Maximum Predicted Total Closure (mm)
Sunnyside	50 total <20 additional	<0.5	<0.01	<0.01	320 total 65 additional	400 total 75 additional
Sunnyside East	1,350	9	0.15	0.20	750	1,000
Carne West	1,350	9	0.15	0.20	450	600
Gang Gang South West	1,250	9	0.15	0.20	200	300
Gang Gang East	1,150	9	0.09	0.20	250	350
Pine Upper	1,050	7	0.07	0.15	250	350
Pine	900	6	0.06	0.10	350	500
Paddys	950	9	0.15	0.15	100	150
Marangaroo Upper	1,050	8	0.08	0.20	200	250
Marangaroo	1,650	13	0.20	0.35	250	300
Nine Mile	<20	<0.5	<0.01	<0.01	75	100

Table 4: Summary of Subsidence Effects on Shrub Swamps
Source: EIS, RTS and other documents from the Applicant

As discussed in **3.1.2**, the Commission acknowledges that the Applicant has made revisions to the mine plan that should reduce the subsidence-related impacts to swamps, particularly by reducing the width-to-depth ratio of the longwall panels. The Commission agrees with the Department that two of the eleven swamps (Sunnyside Swamp and Nine Mile Swamp), are located outside the predicted subsidence zone of the proposed longwalls and are unlikely to experience any significant fracturing. However, due to the compressive strains of up to 15mm/m resulting from valley closure, the remaining nine swamps are likely to experience some level of fracturing.

3.3.4 Accuracy of Predictions

As mentioned in **3.1.1**, the IESC raised concerns about the accuracy of predicted impacts on swamps, particularly near lineaments. The IESC and OEH believed that the observed loss of water in three previously undermined swamps (Narrow, East Wolgan and Kangaroo swamps) may have been due to increased subsidence resulting from lineaments present in that area.

The Commission notes that while Centennial provided its own response to these concerns, it did not engage a subsidence expert to provide a specific response in relation to the subsidence model. However, the RTS does include a geological study on the upper strata in the project area (the McHugh Report), which considered structural lineaments in relation to swamps. The key finding of this report is that 10 of the 11 swamps in the project area are located entirely within the Burralow Formation, which is approximately 110 thick and contains various aquitards that are likely to prevent the complete loss of water from any swamps to deeper aquifers. It is instead predicted that any loss of water in the shallow aquifers may be redirected laterally and re-emerge downstream.

While the Commission acknowledges that the presence of aquitards in the Burralow Formation may reduce and redirect shallow aquifer water loss, it also believes that it is difficult to predict the extent to which this will prevent or minimise damage to the swamps. In relation to the 10 swamps near lineaments, the Commission considers it important that adaptive measures are utilised as much as possible, which is discussed in further detail in **3.3.6**.

The Commission also notes that there is an important distinction drawn in the McHugh report between the swamps in the current project area and the three previously undermined swamps that experienced significant impacts. Those three swamps were not entirely within the Burralow Formation but also extended partially into the Banks Wall Sandstone, which may explain the greater amount of drainage experienced. There is one similar swamp in the mine extension area (Marangaroo Swamp), which both the Applicant and the Department accept may experience more significant damage. In relation to this swamp, the Commission acknowledges that the only regulatory response can be to ensure that any impact is appropriately compensated through the Offsets Policy under development which is discussed below in **3.3.5**.

3.3.5 Offsets

The Commission acknowledges that there is a considerable lack of certainty around swamps, including a general lack of available distribution and condition data, difficulties in accurately predicting the extent and timing of swamp impacts, and uncertainty about the possibility of remediation measures. The Commission also agrees with OEH that there is currently very little evidence to suggest that rehabilitation of previously damaged swamps is effective. Given that all these uncertainties and complexities exist, the NSW Government is seeking to develop an offsets policy to deal with swamp impacts.

This policy was not available to the Commission when it first received the project for review, however a draft policy framework is now publicly available for comment (refer to **Appendix 5**). The policy is therefore not finalised, however the framework explicitly states that it will be applied, where reasonable and feasible, to mines that have applications on foot for longwall mining that may cause subsidence impacts on upland swamps. Consequently, the Commission considers that the draft policy framework should be applied to the Springvale project.

Under this framework, no up-front offset is required where nil or negligible environmental consequences are predicted. The Commission notes that the Department has already included performance criteria requiring that no greater than negligible environmental consequences are experienced for the Sunnyside and Nine Mile Swamps, as well as all the hanging swamps.

However, if greater than negligible environmental consequences are predicted, then an offset will be required as a condition of consent. In this case, 9 of the 11 shrub swamps are expected to experience greater than negligible environmental consequences (i.e. all the swamps listed in **Table 4** except Sunnyside and Nine Mile Swamps) and would require offsets.

According to the framework, the offsets should be calculated using the Framework for Biodiversity Assessment, and the Applicant must prepare a Biodiversity Offset Strategy that demonstrates how it will fully meet the requirements of its 'maximum predicted offset liability'. The Commission notes that the Applicant is confident there are various options available to secure an appropriate offset for these nine swamps, including purchasing relevant sites, purchasing biodiversity credits from a landholder, or arranging for supplementary measures to be carried out. While the Applicant considers that up to 720 hectares of offsets may be required and is confident that suitable sites are available for purchase, OEH has raised concerns that more than 1,100 hectares of like-for-like offsets could be required, which may not be available.

As the draft offsets framework was made public since the Department prepared its PEAR, the Commission recommends that further consultation with OEH occur and that the relevant conditions are reviewed and updated to reflect the current draft framework, prior to proceeding to determination.

3.3.6 Adaptive Management

The Commission supports the development of a comprehensive swamp offset policy, however it also believes that this does not diminish the role of monitoring, iterative risk assessment and adaptive management measures. As a general point, there is an incentive in the draft offset framework for the Applicant to undertake comprehensive monitoring, as this can reduce the overall offset liability. If monitoring demonstrates that the predicted impacts have not occurred within 12 months of completion of all mining within 400 m of a swamp, or has occurred in only part of that swamp, then there is an opportunity deduct this from the project's overall 'maximum predicted offset liability'.

In terms of monitoring data, the draft framework states that the primary focus of monitoring must be the piezometric measurement of the effect of mine subsidence on the shallow groundwater aquifer. However monitoring of secondary environmental consequences (such as loss of or change in vegetation community type, impacts on identified threatened species, impacts on soil stability or erosion) should also be undertaken to inform the timing and extent of expression of these impacts following changes to the shallow groundwater aquifer. The Commission recommends that the Department ensure that both the primary and secondary methods of monitoring are incorporated into the Extraction Plan process and associated management plans. The Commission notes OEH concerns that raw monitoring data needs to be made available to the Department to permit periodic independent analysis and review.

The Commission has also considered the proposed mine plan and believes there are a number of specific opportunities for adaptive management in relation to swamps. The first opportunity relates to Carne West Swamp (and to a lesser extent, Gang Gang South West and Gang Gang East Swamps), which is proposed to be undermined by LW420. The Commission notes that careful monitoring as LW419 progresses may provide relevant data about any impacts on Carne West Swamp. Depending on this information, there may be a possibility to reduce the northern extent of LW420 to avoid potential impacts at the northern end of Carne West Swamp and the adjacent waterfall structure.

Other opportunities for adaptive management also exist in relation to Paddys Creek Swamp (undermined by LWs 424-425) and Marangaroo Creek (undermined by LWs 428-432). The proposed undermining of Paddys Creek Swamp would not occur until the completion of mining in the Northern Domain (i.e. LWs 416-423), which should provide a substantial amount of relevant local information about subsidence-related impacts on swamps. There is an opportunity to reduce the southern extent of LWs 424 and 425, and potentially avoid impacts to Paddys Creek Swamp. A similar opportunity exists later in the mine plan in relation to Marangaroo Creek, which is predicted to experience the most severe subsidence-related impacts.

The Commission recommends that the Department consider these opportunities for adaptive management in relation to swamps as the proposed mine progresses. This may be achieved through a comprehensive monitoring program in key areas (e.g. along LW419) and via deferred Extraction Plan approvals, dependent on the collection and analysis of monitoring data coupled with iterative risk assessment.

3.3.7 Summary of Recommendations

1. That the Department considers the most up-to-date monitoring results and ensures that the monitoring of any swamp impacts is able to identify and quantify the role of subsidence movements, as against other mechanisms including discharge or erosion impacts.
2. That the Department considers the need for further piezometric monitoring in hanging swamps.
3. That, prior to determination, the Department considers the work that has been done as part of the ANU research project.
4. That, prior to determination, the Department liaises further with OEH to:
    - clarify the best available information on the distribution and abundance of the EEC; and
    - ensure that the conditions are updated to reflect the current draft framework for swamp offsets, including incorporating the listed primary and secondary methods of monitoring, and appropriate availability of raw monitoring data to provide for independent review.
5. That, prior to determination, the Department considers opportunities for adaptive management in relation to certain swamps as the proposed mine progresses, through a comprehensive monitoring program in key areas and via deferred Extraction Plan approvals, dependent on the collection and analysis of monitoring data coupled with iterative risk assessment.

3.4 Socio-Economic

3.4.1 Introduction

The Commission notes that the Department has undertaken a rigorous socio-economic assessment of this project, including advice from the Department's Chief Economist, and independent expert advice from the Centre for International Economics (CIE). Both the Chief Economist and CIE found that the original Economic Impact Assessment (EIA) in the EIS did not provide an adequate assessment of the costs and benefits of the project. Consequently, the Applicant provided a revised EIA in its RTS, and the Department again obtained a peer review by CIE on the revised EIA.

3.4.2 Economic Benefits

The Commission notes that the Australia Institute has provided a written submission and a presentation at the public hearing that raised a number of concerns about the socio-economic impacts of the project. In particular, the Australia Institute made a valid point about some inaccurate wording in the PEAR, which stated that CIE had concluded that the cost-benefit analysis in the revised EIA "*closely aligns with well-established principles of undertaking CBAs and the draft 2012 NSW Government guideline*". The Commission agrees that this was an inaccurate quote from the CIE review report, which in fact stated that the cost-benefit analysis in the revised EIA "*more closely aligns with well-established principles of undertaking CBAs*".

However, the Commission has carefully considered the CIE report and notes that while a number of adjustments were required, CIE concluded that the Project is still expected to deliver net benefits to the community. In accordance with the Mining SEPP, the Commission has also taken into account the significance of the resource, in relation to the economic benefits of developing the resource both to the State and the region, and advice from the NSW Department of Trade & Investment (DTI) as to the relative significance of the resource in comparison with other mineral resources across the state.

The advice from DTI emphasised the importance of the Springvale mine in supplying a large proportion of domestic thermal coal to the Mount Piper power station. Overall, the Commission agrees with the Department in its view that the proposal would result in a positive net economic benefit to for the region and NSW.

3.4.2 Social Impacts

The Commission notes that a large number of the written submissions and presentations at the public hearing raised concerns about the social impacts that may occur if the project was refused and the mine subsequently closed. The key concerns raised in this regard related to the potential impacts of a mine closure on the employment and hence financial position as well as wellbeing of individuals and their families, and the community as a whole. One presentation at the public hearing also discussed the limitations of the tourism sector as an alternative employer at this stage for Lithgow, as accommodation providers still rely primarily on mine-related business on weekdays.

On the other hand, the Commission has noted concerns raised at the public hearing that the difficult local economic circumstances might be used as leverage to achieve a lax regulatory regime. The Commission has made specific recommendations aimed at protecting the significant environmental assets, and is satisfied that a suitably rigorous regulatory regime will not jeopardise the economic benefits of the project.

Many submissions also noted the direct benefits that the Applicant has brought to the community, including through donations to charity, support of sporting organisations and other community events. The Commission met with Council during its review, and was informed that an updated contributions plan is currently under negotiation for this project. This appears likely to deliver further community benefit.

3.5 Other Issues

3.5.1 Biodiversity

The impacts relating to swamps have been discussed in detail in **3.3**, and has made recommendations in that regard. However, it is also expected that approximately 11.44 hectares of native vegetation would be cleared for the construction and operation of the proposed surface infrastructure in the Newnes State Forest. In order to address this loss of native vegetation, as well as other biodiversity impacts for its other mining projects, the Applicant is in the process of preparing a Regional Biodiversity Strategy.

While the Applicant is still negotiating the details of this Strategy with OEH and the Commonwealth Department of the Environment, the Commission notes that some aspects of the Strategy have been incorporated into existing conditions of approval for other projects. While OEH has raised concerns with the limited scope of the Strategy currently being drafted, the Commission agrees with the Department's recommended approach for this project in requiring the Applicant to finalise the relevant aspects for this project, in consultation with the OEH and DOE, by June 2016, and ensure that the commitments made are implemented within a timeframe agreed by these agencies.

The Commission also notes that OEH has raised concerns about the construction of numerous dewatering bores in close proximity to the national park boundary. The Commission recommends that the Department ensures that no access tracks are created into the national park and that instead the use of existing access tracks is encouraged. OEH also raised concerns about the potential impacts of future exploration activities in the project area. The Commission recommends that the Department considers this issue and ensures that any such impacts are dealt with through appropriate conditions of consent, such as management plan requirements and rehabilitation objectives.

3.5.2 Noise

The Commission notes that the predicted noise emissions from the pit top and associated operations at Springvale would continue at similar levels to those that currently exist. In terms of the two predicted exceedances of the relevant noise criteria, the Commission is satisfied that there are a number of noise mitigation measures available to ensure compliance. The Commission agrees with the Department's recommendations to require the implementation of noise-reduction measures from the Noise Impact Assessment in the EIS, as well as the preparation and implementation of a Noise Management Plan to detail how the noise-reduction measures would be implemented and monitored.

One objection raised concern about low frequency noise and potential related health impacts. The Commission notes that this issue was not formally addressed in the PEAR, however it has confirmed that the Department's acoustic expert considered the issue during the assessment. The Department's acoustic expert did not consider low frequency noise to be an issue of concern for this project, and the Commission has not found any evidence to the contrary.

The objection relating to low frequency noise also raised a broader concern about the status of low frequency noise within the Government's Industrial Noise Policy (INP). The Commission has noted these concerns and is aware that this part of the INP is currently under review by the NSW Government. If there are any changes in relation to low frequency noise resulting from this review, the Commission expects that the EPA would be able to deal with such changes through the relevant EPL, if necessary.

4. CONCLUSIONS AND RECOMMENDATIONS

The Commission has carefully considered the proposal and the submissions made, including the issues raised in written submissions to the Commission, presentations at the public hearing, the submissions made on the Environmental Impact Statement, the Response to Submissions (RTS) report, the Applicant's Response to the RTS report, and various other documents provided by the Applicant.

The Commission has sought specific expert advice from, and arranged meetings with, the EPA, DRE, OEH, NOW and WaterNSW. The Commission has also sought clarification on a number of issues from the Department, which provided a package of further information.

In addition to the specific issues to be considered in the Ministers Terms of Reference, the Commission also considered subsidence-related impacts on watercourses, rock features and built features, socio-economic impacts, biodiversity impacts from clearing, and noise impacts.

The Commission found that the project would have a number of project specific impacts, but that these can be managed to an acceptable level through stringent and robust conditions along with careful management of operations on site. The Commission has made a number of recommendations in this regard, particularly relating to the need for best practice management of subsidence and impacts on water resources and swamps.

With these measures, and requirements for best practice management in place, the Commission is satisfied that the project can be approved, subject to conditions.

5. RECOMMENDATIONS – CONSOLIDATED SUMMARY

In considering the project and its potential impacts, the Commission has identified a number of areas that require additional work by the Applicant or amendments to the proposed draft conditions. The Commission has consolidated these recommendations from the various sections of the report into this final consolidated list of recommendations on the project:

Subsidence

1. That the Department give further consideration to upsidence and valley closure effects.
2. That appropriate monitoring of non-conventional subsidence effects should be included as a requirement in any consent and that the relevant Extraction Plan is required to contain appropriate measures to limit and manage the risks from non-conventional subsidence so as to ensure that the environmental performance criteria are not exceeded.
3. That a rigorous set of performance measures is included in any consent. Rigorous in this context means able to be measured or assessed in a scientifically and legally sound manner and be capable of enforcement. These performance measures must be supported by:
   (i) a requirement that the Extraction Plan for each longwall contains revised subsidence predictions based on experience from previous mining on the site and that these revised predictions will not allow the performance criteria to be exceeded;
   (ii) a requirement that the Extraction Plan for each longwall contains:
      (a) appropriate triggers to warn of the development of an increasing risk of exceedance of the performance criteria (e.g. the subsidence predictions themselves and/or other relevant subsidence-related measurements);
      (b) specific action plans to respond to increased risk of exceedance that will ensure the criteria are not exceeded (e.g. cessation of mining, narrowing the longwall, altering seam height, etc.); and
      (c) an assessment of remediation measures that may be required if exceedance does occur and the capacity to implement the measures.

Water Resources

4. That, prior to determination, the Department liaises with WaterNSW about the salinity level of discharges into Coxs River, and considers WaterNSW's request to include a condition of consent requiring a 'negligible change' in the salinity level at Lake Burragorang.
5. That, prior to determination, an agreed plan of action relating to the salinity level of discharges into the Coxs River is included in the Statement of Commitments, and adequately addressed in conditions of consent relating to the relevant management plan and monitoring program.
6. That, prior to determination, the Department liaises further with the EPA in relation to other toxicity factors in the mine water, including ionic composition and high bicarbonate alkalinity, and ensure that the agreed criteria are included in the Statement of Commitments.
7. That, prior to determination, the Department liaises further with NOW about the options available for the Applicant to acquire water licences, and that the Applicant include appropriate resolutions as commitments in its Statement of Commitments.
8. That, prior to determination, the Department liaises with OEH about monitoring options or other measures to ensure that OEH's concerns about potential impacts on streams within the Gardens of Stone and Blue Mountains National Parks can be adequately addressed.

Swamps

9. That the Department considers the most up-to-date monitoring results and ensures that the monitoring of any swamp impacts is able to identify and quantify the role of subsidence movements, as against other mechanisms including discharge or erosion impacts.
10. That the Department considers the need for further piezometric monitoring in hanging swamps.
11. That, prior to determination, the Department considers the work that has been done as part of the ANU research project.
12. That, prior to determination, the Department liaises further with OEH to:
    - clarify the best available information on the distribution and abundance of the EEC; and
    - ensure that the conditions are updated to reflect the current draft framework for swamp offsets, including incorporating the listed primary and secondary methods of monitoring, and appropriate availability of raw monitoring data to provide for independent review.
13. That, prior to determination, the Department considers opportunities for adaptive management in relation to certain swamps as the proposed mine progresses, through a comprehensive monitoring program in key areas and via deferred Extraction Plan approvals, dependent on the collection and analysis of monitoring data coupled with iterative risk assessment.

Biodiversity

14. That the Department ensures that no access tracks are created into the national park during the construction of dewatering bores and that the use of existing access tracks is encouraged.
15. That the Department considers future exploration activities within the project area and ensures that any potential impacts are dealt with through appropriate conditions of consent, such as management plan requirements and rehabilitation objectives.

REFERENCES

Department of Planning & Environment. (2014a). *Assessment Report: Russell Vale Colliery - Preliminary Works Project - Extension of Mining Term Modification (MP 10_0046 MOD 3)*. Sydney: Department of Planning & Environment.

Department of Planning & Environment. (2014b). *Major Project Assessment: Russell Vale Colliery Underground Expansion Project (MP 09_0013)*. Sydney NSW: Department of Planning & Environment.

Department of Planning & Environment. (2015). *Assessment Report: Springvale Mine Extension Project (SSD 5594)*. Sydney: Department of Planning & Environment.

Office of Environment & Heritage. (2014, June 2). *Springvale Mine Extension Project (SSD 5594), Angus Place Mine Extension Project (SSD 5602) and Angus Place Development Continuity Project (PA_0021 Modification 4)*. Dubbo, NSW: Office of Environment & Heritage.

Planning Assessment Commission. (2010). *Bulli Seam Operations Review Report*. Sydney: Planning Assessment Commission.

Planning Assessment Commission. (2012). *Determination Report - NRE No 1 Colliery, Preliminary Works Project Modification 1 - MP10_0046 MOD 1*. Sydney: Planning Assessment Commission.

Planning Assessment Commission. (2014). *Determination Report - Russell Vale Colliery Modification to Preliminary Works Project - Longwall 6 (MP10_0046 MOD 2)*. Planning Assessment Commission.

Planning Assessment Commission. (May 2009). *The Metropolitan Coal Project Review Report.* Sydney: Planning Assessment Commission.

Planning Assessment Commission. (November 2010). *Wallarah 2 Coal Project Review Report*. Sydney: Planning Assessment Commission.

Newcastle & Hunter Valley Speleological Society Inc v Upper Hunter Shire Council and Stoneco Pty Limited [2010] NSWLEC 48. Land and Environment Court of New South Wales.

Waddington & Associates*. Impacts of Mine Subsidence on the Strata & Hydrology of River Valleys - Management Guidelines for Undermining Cliffs Gorges & River Systems*. Australian Coal Association Research Program, November 2014.

APPENDIX 1
List of Speakers at the Public Hearing

Date & Time: 9.15 am, Wednesday, 27 May 2015

Place: The Lithgow Workmen's Club, 3-7 Tank Street, Lithgow

1. Lithgow City Council – Andrew Muir
2. Maree Statham, Mayor of Lithgow
3. Dr Ann Young
4. Colong Foundation for Wilderness – Keith Muir
5. Energy Australia – Peter Gray
6. Todd Jones
7. Cassandra Coleman
8. Michael Keats
9. Association of Mining Related Councils – Neville Castle
10. Blue Mountains Conservation Society – Dr Brian Marshall & Dr Ian Wright
11. Madi Maclan
12. Bathurst Community Climate Action Network – Jock Roxborough
13. CFMEU – Graeme Osbourne
14. The Australia Institute – Rod Campbell
15. Lithgow Community Private Hospital – Garry Brown
16. Lithgow Environment Group Inc – Chris Jonkers
17. Capetee Valley Alliance Inc – Donna Upton
18. Mark Jenkins
19. Howard Fisher
20. Darrin Francis
21. Barry Reid
22. Thomas Ebersoll
23. Jon Pringle
24. Curtis Jones
25. Bruce Hart
26. Rob Cluff
27. David Reed
28. Adam Powell
29. Norman Allan
30. Dr Richard Stiles
31. Ben Smith
32. Jeff Young, JR Conveyors
33. John Tilley
34. Stephen Jackson
35. Dick Austen
36. Robert Grant
37. Ian Wright

APPENDIX 2
Summary of Presentations Made at the Public Hearing
Date: 27 May 2015

Comments provided during the public hearing and in written submissions are synthesised and summarised below:

Strategic Context

- The project is an extension of an existing mine rather than creation of a new mine.
- Mining and environmental interests have been shown to co-exist in some areas.
- The Newnes Plateau was originally included in the Gardens of Stone National Park.
- The Nature Conservation Council has proposed a State Conservation Area for Newnes Plateau.
- Mt Piper is one of the more modern and least polluting power stations in NSW.

Swamps

- There is little to no piezometer information from the hanging swamps.
- There is a lack of clear analysis of available swamp hydrographs.
- There are disputes that Sunnyside swamp is different to Carne West and Sunnyside East as Long Walls (LW) went past the swamp with only the edges affected.
- An improved adaptive management and monitoring system is needed.
- Further baseline data required as a reference point for monitoring impacts.
- There will be a purported long-term impact on Kangaroo Creek.
- Recommend further mine plan revisions stepping around swamps and cutting short LWs.
- The water discharge impacts on East Wolgan Swamp have been damaging.
- Surface cracks have resulted in a loss of water and desiccation of the peat layer

Surface Water

- There is no assessment of the waterfall 200m below LW20.
- Energy Australia supports a maximum salinity level of 550µS/cm in Lake Lyell, and would prefer a condition of approval requiring an "agreement" rather than a "consultation" regime.
- The surface cracks are more than 'minor'.
- LPD006 has salinity levels of over 2,000µS/cm and it has not been considered.
- The potential valley closure impacts on Carne West could be significant.
- Lake Burragorang provides up to 80% of Sydney's water.
- Neutral or Beneficial Effect (NorBe) test should be properly applied to water quality in the catchment.
- Extensive water testing in Sydney has shown no impact on drinking water and no impacts of concern have been raised by NSW Health.
- The recommended conditions have "no teeth" to address water quality and are inadequate for addressing aquatic ecology as the data is inadequate.
- Reverse osmosis should be used to treat the water quality for all discharges.
- The cumulative impact on water quality from this, and other sources, as a result of reduced water quality discharges should be considered.
- Water make and related water issues can be managed 'sensibly'.
- There are various strata that will generally prevent the interconnectivity of surface to workings.
- The economic difficulties facing the coal industry should not be an excuse for poor environmental practice.
- The Applicant should not be using the socioeconomic difficulties facing the Lithgow community to seek to achieve lax environmental regulation.

Social

- The Council is negotiating with the Mine to achieve further social benefits for the local community should the mine extension be approved.
- A lot of infrastructure and money has gone into the town based on its projected future growth.
- Refusal of the project may have a devastating socio-economic impact on the community and region.
- At least one local person started as an apprentice with Centennial Coal and has since moved up the ranks with the mine supporting their further education.
- There has been unemployment due to closure of Baal Bone, Angus Place and Wallerawang with people then having to leave the community or find work away from their families. This impacts on the economy of local businesses.
- The training of apprentices is essential to the town and operation of the TAFE college.
- The presence of Lithgow Hospital allows retention of medical, and specialist, practitioners and services in the region but not all of these specialists would continue to be available if the mine were to close.
- Social benefits flow from the Applicant and/or union supporting local sporting (junior and senior soccer, cricket, rugby league, basketball and swimming) and community groups with annual calls for funding.
- There are charity benefits from the mine with $70,000 raised last year and over $1 million in the last 20 years.
- There are mental health impacts for the unemployed.
- There is stress for individuals and families over uncertainty about job losses.

Economic

- The Council is in discussions/negotiations with the applicant, aiming for a further contribution to benefit the community.
- More than 50% of revenue in the region comes from coal and power with Springvale the major supplier to Mt Piper power station.
- Lithgow should instead spend money on re-training and planning for a future post coal mining.
- There are indirect economic benefits to other related businesses and contractors with up to a 4 in 1 flow-on effect equating to 1,300 jobs.
- Closure of the mine would significantly threaten the ability for insurance fund, Westfund, to survive.
- The cost benefit analysis (CBA) was originally poor and the revised CBA is still not adequate.
- Inaccurate wording in the DP&E Report indicated a more positive response from the peer review than was actually reported by the reviewer.
- No consideration has been given to the changing coal price.
- The projection of 1,200 indirect positions is based on the DRE submission which is not supported by empirical data.
- There is a broad move away from coal and fossil fuels with the need to plan for a more sustainable future.
- Tourism in the area will grow but this won't replace mining to sustain accommodation occupancy rates during the week.
- There is a potential loss of real estate value.

Other

- Many of the objections come from people outside of the region and NSW.
- Many people regard Centennial Coal as a reputable company.
- EECs and threatened species may be lost. This includes the Giant Dragonfly, Blue Mountains Water Skink, Boronia Deanei and Grevillea Acanthifolia.
- Refusal would cause increased trucking of coal across the region with traffic and air quality impacts.
- Industrial vibration and infrasound has not been adequately addressed in PEAR, EIS or RTS. This was also ignored in the NSW Industrial Noise Policy. Low frequency noise should be more carefully considered by the PAC.

A number of documents were submitted at the public meeting and/or sent by email prior to, and following, the meeting. All relevant correspondence is on the Commission's web site at www.pac.nsw.gov.au.

APPENDIX 3
SUMMARY NOTES OF MEETINGS WITH THE DP&E, EPA, NOW & DRE

Meeting note taken by: PAC Secretariat **Date:** Thursday, 14th May 2015 **Time:** 1.35 pm

Meeting place: PAC

Attendees:

PAC: Brian Gilligan (Chair)
Abigail Goldberg
David Johnson
Clay Preshaw (PAC Secretariat)
Naomi Cleaves (PAC Secretariat)
Rob Sherry (PAC Secretariat)

Department: David Kitto (Executive Director)
Howard Reed (Manager)
Sara Wilson (Senior Planner)

NOW: Mitchell Isaac

EPA: Richard Whyte

DRE: William Hughes

The purpose of the meeting is for agencies to brief the PAC on the extension project proposal.

The main points of discussion are outlined below:

General

- The Department acknowledges that some information in the report is not complete due to short timeframes and will update its Assessment Report by providing further written information to the PAC.
- While the project has NSW planning approval until September this year, there are time pressure constraints for coal supply to Mt Piper power station with the mine only able to operate until June of this year due to a Commonwealth direction.

Swamps

- Has the Applicant done enough to avoid swamp impacts? The Department advised that swamp impacts had been minimised through the mine plan re-design as part of the assessment process, and through management and mitigation measures in the recommended conditions.
- Are there options for potential swamp offsets? It was advised that any proposed offsets would need to be sited on private, not public, land. It was further advised that 'like-for-like' offsets are indeed possible as there are many swamps throughout the region.
- The draft Swamp Offsets Policy is expected to be publically exhibited during June 2015.
- The Department will provide an update on the current draft Swamp Offsets Policy during the Review process.
- The Department advised consideration was being given to increasing offset area requirements should there be impacts greater than that identified in the EIS.

Water Discharge & Licensing

- NOW stated that water licence requirements under the Water Management Act are not integrated with planning legislation however aquifer interference activities must be licensed under the Aquifer Interference Policy.
- Amendments will be made to the Water Sharing Plan in June and there is expected to be scope for the Applicant to be able to satisfy water management requirements.
- It is ultimately the Applicant's commercial risk to proceed without yet being able to obtain adequate water licences.
- The EPA took issue with modelling ecotoxicology and still aspires to the project achieving a salinity level for discharges to the Cox's River of 350 µS/cm (the NHMRC threshold for protecting aquatic ecosystems). Overall however it accepts 700-900 µS/cm being achieved initially with further pollution reduction over time.
- There is some scope to transfer mine water with the possibility of using the disused reverse osmosis plant at Wallerawang.
- NOW gave an undertaking to provide additional advice regarding the water licence process and an update on the relevant Water Sharing Plan changes.

Other Issues

- Longwalls (LW's) 501, 502 and 503 seem to be outliers, quite separate from the other LWs and are at shallower depths? The Department advised the LW's are separate and located under cliffs, not swamps, therefore avoiding swamp impacts.
- The Assessment Report indicates 97% of pagoda's would not be impacted which conversely indicates 3% would be impacted. While the report does not clarify the extent of potential impact on the 3%, the Department reiterated its view the majority of the pagodas would not be impacted and would actually be protected through the mine plan and recommended conditions.

Documents provided: - N/A

Outcomes/Agree Actions:

- The Department undertook to provide its response to the IESC advice.
- The Department will act as the liaison between the IESC and the PAC if further advice is needed.
- The Department will update the PAC on the outcome of the Applicant's advice to the EPA regarding water issues and limits.
- The Department will provide advice on the predicted significant decline of baseflow in parts of Carne Creek (up to 49%) which has not been adequately addressed in the Assessment Report.
- NOW to provide an outline of the water licensing process and an update on the proposed changes to relevant Water Sharing Plans.

Briefing finished at approximately: 4.00 pm

Summary Notes of Meeting with the Applicant

Meeting note taken by: PAC Secretariat **Date:** Thursday, 21 May 2015 **Time:** 10.30 am

Meeting place: Springvale Mine (Castlereagh Highway near Springvale Lane, Springvale)

Attendees:

PAC:	Brian Gilligan (Chair) Abigail Goldberg David Johnson Clay Preshaw (PAC Secretariat) Rob Sherry (PAC Secretariat)
Centennial Coal Staff:	Mick Cairney (Mine Manager) Jacques Le Roux Mark Sargeant (Economist) Mary-Anne Crawford (General Manager Environment & Approvals) Peter Corbett Greg Shields
Department:	Howard Reed
OEH:	Liz Mazzer

The purpose of the meeting is to brief the PAC on the extension project proposal and to provide for a site inspection of the proposed mine extension area.

A general briefing of the underground operations was provided. The main points of discussion, and including a power point presentation, are outlined below:

Short Video

- A short video presentation illustrating the longwall layout and demonstrating the level of monitoring undertaken by the Applicant into subsidence and water loss in the vicinity of the main affected swamps.
- The video highlighted, among other points, the water flow over longwall 415, which indicated that perched water has not been lost through subsidence.
- The video described how panel widths had been decreased following monitoring and consideration of various geological and surface features.
- One of the keys to surface and groundwater management is the presence of the strategically located Mt York Claystone.

Animations

- Visualisations were provided showing that groundwater levels are believed to have stayed relatively the same over time based on swamp piezometer data.

Presentation

Project overview

- Mining would be through a retreat longwall system;
- ROM would be 4.5 Million tonnes per annum (Mtpa);
- Longwall proposed layout was tabled as provided in the DP&E assessment report;
- Up to 310 full time employees would be required;
- New infrastructure would include 2 dewatering bore sites, a ventilation shaft and an upgrade of existing tracks along with provision of new tracks.

Subsidence

- Changed mine layout with shorter and narrower panel widths and wider pillars.
- Reduced strains through mine design which indicate the greatest reduction in subsidence impacts is made by reducing the width of panels from 315 metres to 260 metres.
- Predicted subsidence modelling has been compared to actual subsidence data to support current mine design.

Water

- East Wolgan has licenced discharge points PDP4, 5 & 6; however discharging ceased in 2010, noting that these points became emergency only discharge points in 2006. The discharge had a pH of 9 which was too acidic for the swamps.
- The Applicant indicated current monitored pH levels are around 7 plus but they are trending back to normal (measured over an 8 year period).
- The Applicant advised there are no other toxins in the discharged water.
- The Applicant indicated the discharge incident in 2008 was due to management issues at the time with Delta Power. To prevent this situation recurring, Centennial Coal now has full control of the mine's water management scheme.

Swamps

- The Australian Coal Association's Research Program (ACARP) undertook monitoring of surface conditions with high resolution imagery of upland swamps that have been subject to subsidence (Report C20046). The report indicated loss of vegetation and concluded that the primary cause of vegetation loss appeared to be the flow path of mine discharge water.
- An Enforceable Undertaking had been issued by the Commonwealth which was targeted towards understanding the nature, and extent of, 'Temperate Highland Peat Swamps on Sandstone'. This included water balances, the functionality of swamps, environmental history, ecology, contribution to the landscape and thresholds for recovery.
- Various studies conducted to understand swamp formation and interactions of geology and hydrogeology; mine design and subsidence and swamp flora to ensure minimum disturbance.

Biodiversity Offsets

- The Applicant advised there are currently no biobanking swamp credits available therefore sites with existing swamps would have to be acquired (up to 720 hectares) which could be offered as offset areas. The Applicant is satisfied that such areas are available for acquisition to meet any requirements that would flow from the projected impacts of project under the Government's foreshadowed offsets policy.

Viability

- Centennial advised the current coal reserve is 43.8 Mt with the mine design minimising impact on natural features including swamps through measures such as reducing the void width from 315 metres to 261 metres with 58 metre pillars. Avoiding the swamps entirely would reduce the resource by 29.1 Mt to just 14.7 Mt which would result in an unviable project.

General

- It was explained why the position of LW's 501, 502 and 503 which appeared to be outliers, was that they are not constrained by surface features.
- ANU research project in 2011 - $1.2 million of 4.5 – 15 PHDs.
- University of Queenland's targeted research of the Newnes Plateau and Blue Mountains.
- An overview of the East Wolgan discharge points was provided.

Documents provided: - Hard copy of power point presentation**.**

Outcomes/Agree Actions:

- Applicant to provide the PAC with copy of the video; animation; and presentation.

Briefing finished at approximately: 1.30 pm and was followed by a site visit (including the swamps) which finished at approximately 5:30pm.

Summary Notes of Meeting with Council

Meeting note taken by: PAC Secretariat **Date:** Friday, 22nd May 2015 **Time:** 9.00 am

Meeting place: Lithgow City Council**,** 180 Mort Street, Lithgow

Attendees:

PAC: Brian Gilligan (Chair)
Abigail Goldberg
David Johnson
Clay Preshaw (PAC Secretariat)
Rob Sherry (PAC Secretariat)

Council: Roger Bailey (General Manager)
Andrew Muir (Group Manager – Environment & Development)
Ray Thompson (Deputy Mayor)

The primary purpose of the meeting to discuss the project and how it relates to the local area.

The main points of discussion are outlined below:

- The PAC outlined the Review process for Council and the current status of the Review.
- Council advised that both the Mayor and the Group Manager – Environment & Development would be present at the Public Hearing.
- Council said that the mine is the "life blood" of the community and that there would be a "knock on effect" should the mine not be approved as one miner equates to 5 indirect jobs in the community. The community were already concerned as Angus Place has gone into 'care and maintenance' resulting in 150 jobs lost.
- The community is very nervous and the project's timing is critical.
- The power stations and mines equate to 880 employees within the region (280 at the power plant and 600 in mines) and should Springvale close then Mount Piper may also close if there is no affordable supply of coal.
- Council expressed concern that the EPA's requirement for a discharge limit of 350 µS/cm would make the project "uneconomic". PAC will consider the comments noting a final discharge limit is a matter to be resolved with the EPA.
- The Council has advanced discussions regarding possible social benefits from the project (the 'VPA') with the company however the Applicant has advised they are taking a more holistic view of potential contributions as they are aiming to ensure that all their sites are covered under any agreement.
- Council noted that Centennial Coal would prefer to call the VPA a "Community Contribution".
- Centennial Coal has been a good "corporate citizen" and sponsored many local groups.
- Swamps are being considered by the PAC noting that Commonwealth approval is also required.
- Council indicated reducing the mine design any further would leave only approximately 14.7 Mt of resource resulting in the project not being economically viable.

Documents provided: - N/A
Outcomes/Agree Actions: N/A
Meeting finished at approximately: 10.00 am

Summary Notes of Meeting with WaterNSW (formally Sydney Catchment Authority and State Water)

Meeting note taken by: PAC Secretariat **Date:** Wednesday, 3rd June 2015 **Time:** 2pm

Meeting place: PAC

Attendees:

PAC: Brian Gilligan (Chair)
Abigail Goldberg
David Johnson
Clay Preshaw (PAC Secretariat)

DP&E: Howard Reed

WaterNSW: Malcolm Hughes
Girja Sharma

The primary purpose of the meeting was to discuss the water aspect of the project proposal.

The main points of discussion are outlined below:

- The SCA Board has reconfirmed SCA's role now as part of WaterNSW. Quality water, quantity, ecology, infrastructure, public health, comprehensive environment assessment are all reviewed by Water NSW.
- For Springvale there are no Special Catchment Areas, dam infrastructure or immediately sensitive public health issues to consider (i.e. by contrast with the Metropolitan Water Catchment Special Areas).
- LWs 427-432, 501-503 and pit top are all within a water catchment as well as 2 swamp areas.
- Key concerns include:
    - Water quality from discharge point LDP009 into Lake Burragorang.
    - Water quality, if mitigated within the project site or transferred and treated to an appropriate level, can result in neutral or beneficial effect (NorBe).
    - The Neutral or Beneficial Effect (NorBe) Assessment guidelines form part of the Sydney Drinking Water Catchment SEPP 2011 requirements which must be considered by WaterNSW.
- One key issue, which the applicant has not yet discussed with WaterNSW despite an earlier obligation to do so, is the lack of water treatment and subsequent discharge occurring at LDP009.
- The Department advised the PAC that an agreement has been reached between WaterNSW, the DP&E, EPA and Centennial Coal regarding acceptable water criteria/discharged water quality levels.
- The WaterNSW response is that flow-on effects would need to be considered. The Jacobs report would need to be updated indicating over prediction of the storage capacity of Lake Burragorang and therefore under estimated potential salinity impacts. WaterNSW advised it has more accurate data and believes the modelling needs to be re-run using the updated information and based on a program developed by the EPA. WaterNSW would also need to do its own analysis.
- WaterNSW recommend a number of conditions be imposed in addition to those recommended by the Department including:

Documents provided: - N/A

Outcomes/Agreed Actions:

- The Department to provide the PAC with the most recent exchange of correspondence between the EPA and Centennial Coal.
- The Department to provide the PAC with the other information from its briefing of 14 May.
- WaterNSW to write a letter by COB Tuesday 9 June 2015 confirming issues of concern.

Documents provided: - N/A
Outcomes/Agree Actions: N/A
Meeting finished at approximately: 3.00 pm

APPENDIX 4
FURTHER INFORMATION FROM THE DEPARTMENT

NSW GOVERNMENT | Planning & Environment

Mr Brian Gilligan
Chair
Planning Assessment Commission
GPO Box 3415
Sydney NSW 2001

Dear Mr Gilligan

I refer to the briefing meeting held with the Planning Assessment Commission (PAC) and key agencies on 20 May 2015 in relation to the proposed Springvale Mine Extension Project (SSD 5594).

As agreed, the Department has attached the following information in relation to this project:

- Department's response to the Independent Expert Scientific Committee Advice dated 3 July 2014 (**Attachment A**); and
- Environmental Protection Authority (EPA) review comments on the report prepared by Jacobs Pty Ltd titled *Additional Simulations of the Regional Water Quality Impact Assessment Model* (April 2015) (refer to Appendix C of **Attachment A**).

The Government's draft Swamp Offsets Policy, prepared by the Department and the Office of Environment and Heritage, was placed on exhibition on 28 May 2015 to receive public comments and can be accessed at http://planspolicies.planning.nsw.gov.au/index.pl?action=view_job&job_id=7086. The exhibition concludes on 9 July 2015.

As soon as a short background paper on the alternatives for the supply of coal to the Mt Piper Power Station becomes available, I will forward it to you under separate cover.

Should your officers have any enquiries regarding this response, I have arranged for Ms Sara Wilson to assist them. Ms Wilson can be contacted on telephone number 0414997714.

Yours sincerely,

Howard Reed 3.6.15

Howard Reed
Director Resource Assessments

Department of Planning & Environment
23-33 Bridge Street Sydney NSW 2000 | GPO Box 39 Sydney NSW 2001 | T 02 9228 6111 | F 02 9228 6455 | **www.planning.nsw.gov.au**

Springvale Mine Extension Project (MP 09_5594)
Department's Response to IESC Advice

On 7 July 2014, the Department of Planning & Environment (the Department) and the Commonwealth Department of Environment (DOE) jointly referred the project application for the Springvale Mine Extension Project (the Project) to the Independent Expert Scientific Committee (IESC) for its consideration and advice.

The referral included 9 specific questions relating to the adequacy of Springvale Coal Pty Ltd's (Springvale Coal's) groundwater model and treatment of subsidence in relation to predictions of potential impacts to overlying and adjacent swamps. The IESC was also asked to comment on the adequacy of the groundwater modelling to assess the potential impacts of groundwater discharges to surface waters.

The IESC provided its advice on the Project to both the DOE and the Department on 25 August 2014. A copy of this advice is at **Appendix A**.

In September 2014, Springvale Coal submitted at *Response to Submissions* (RTS) report to the Department, which provided a substantial amount of additional subsidence, groundwater and surface water-related information in relation to the Project. Several of the reports contained within the appendices to the RTS specifically relate to issues raised by the IESC, including:

- *Regional Water Quality Impact Assessment* (RPS, 10 September 2014, Appendix 2 to the RTS), which assesses impacts of the increased mine water discharge to the Coxs River as a result of the closure of the Wallerawang Power Station;
- *Subsurface Fractured Zone Assessment above the Proposed Springvale and Angus Place Mine Extension Project Area Longwalls* (DGS, 10 September 2014, Appendix 6), which provides an up to date assessment of subsurface fracture zone height predictions over Springvale longwalls LW415 to LW432 and LW501 to LW503 using Geometry Pi-Term models;
- *Peer Review of Mine Subsidence-Induced Height of Fracturing Issues for Angus Place and Springvale Collieries* (MSEC, 20 September 2014, Appendix 7), which provides a peer review of the above report and the *Groundwater Assessment* prepared by the CSIRO (May 2013);
- *Springvale EPA Water Quality and Toxicity Assessment Interpretive Report* (GHD, August, 2014, Appendix 9), which details options to manage mine water discharge quality at Springvale;
- *Coxs River Ecotoxicology Assessment* (GHD, September 2014, Appendix 10), which provides a study to determine toxicity and chemical constituents of mine water discharges to assess the impact of those discharges on the surrounding receiving environment;
- *Springvale Total Discharge Volumes* (RPS, 12 September 2014, Appendix 12), which provides clarification in predicted discharge volumes to the Coxs River;
- *Springvale and Angus Place Height of Fracturing Estimation* (Hydro Simulations, 2014, Appendix 17); and
- *Geology of the Shrub Swamps within Angus Place, Springvale and the Springvale Mine Extension Project Areas* (EA McHugh, September 2014, Appendix 18), which discusses the influence of the upper geological strata on the occurrence and morphology of Newnes Plateau swamps.

Springvale Coal subsequently provided a specific response to the IESC advice on 3 October 2014. A copy of this report is provided at **Appendix B**. Springvale Coal's response to the IESC's advice was largely based on the additional information contained in the RTS report, as well as the following reports which address specific aspects of the IESC's advice:

- *Detailed Response to the IESC Advice: Water Issues* (RPS, 26 September 2014, Attachment 1);
- *Response to the Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining Knowledge Report Temperate Highland Peat Swamps on Sandstone: Ecological Characteristics, Sensitivities to Change, and Monitoring and Reporting Techniques* (Centennial Coal, September 2014, Attachment 2);
- *Response to Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining Knowledge Report: Evaluation of Mitigation and Remediation Techniques* (Centennial Coal, September 2014, Attachment 3);
- *Response to Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining Knowledge Report: Longwall Mining Engineering Design – Subsidence Predictions, Buffer Distances and Mine Design Options* (Centennial Coal, September 2014, Attachment 4); and
- *Swamps, Mine Design, Water and Biodiversity* (Centennial Coal, Attachment 5).

Following receipt of advice from the IESC, the RTS and Springvale Coal's response to IESC's advice, the Department completed its Preliminary Assessment Report (PAR). The PAR was formally referred it to the Planning Assessment Commission (PAC) for review on 17 April 2015.

A summary of the advice received from IESC and the Department's response to this advice is provided below. The majority of the information provided below draws on information contained in the PAR.

Table 1: Department's Reponses to IESC's Advice on the Springvale Mine Extension Project

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
Swamps			
1	*Does the EIS, and in particular the groundwater model and the treatment of subsidence and fracturing predictions, provide a reasonable assessment of the likelihood, extent and significance of impacts on overlying and adjacent swamps?*	• The EIS, including the groundwater model, does not provide a reasonable assessment of impacts to THPSS. Confidence in the groundwater model's capacity to predict site specific impacts to individual THPSS is low. • The groundwater model scale is not appropriate to predict impacts to individual THPSS, including baseflow impacts; • The proponent's assertion that drawdown and fracturing related impacts are not predicted within strata above the Mt York Claystone is not supported by evidence. • The incremental profile method utilised in the EIS provides reasonable predictions of subsidence likely to occur as a result of the proposed longwall design. However, there is a lower degree of confidence in subsidence predictions proximal to "type 1" and "type 2" lineaments. • Site specific data on existing conditions for the majority of THPSS is not provided. This is required to determine the extent of change in THPSS condition that is caused by longwall mining impacts.	*Groundwater Scale* • The *Groundwater Impact Assessment* prepared by RPS Aquaterra Pty Ltd (RPS) and included in Appendix E of the EIS presents results from a numerical model (COSFLOW) undertaken by the CSIRO (May 2013), which attempts to quantify baseflow reductions in swamps in the project area. • CSIRO clearly articulates the assumptions and limitations of the model, and the fact that the model scale cannot readily accommodate individual swamp systems. The CSIRO also acknowledges the inability to calibrate swamp-related baseflow predictions in the model due to the limited available data on existing swamp flows and groundwater levels. • In response to this issue, Springvale Coal engaged RPS to prepare a report titled *Detailed Response to the IESC Advice: Water Issues* (refer to Appendix 16 of the RTS and Attachment 1 of Springvale Coal's response to the IESC). RPS indicates that the CSIRO presents simulations of variable saturated flow, including a worst-case assumption of good hydraulic connectivity between perched and regional water tables. The model is therefore considered conservative and the CSIRO's predictions of baseflow losses from swamps are likely to be overestimated due to the likely existence of a low-permeability base for each swamp supporting a perched water table (ie the Burralow Formation). • It is also noted that a peer review of the CSIRO model undertaken by MSEC (refer to Appendix 7 of the RTS) found that the numerical model, which has been calibrated to site data over many years, represents the current 'industry best practice.' However, CSIRO acknowledges that calibration of the model could be improved with additional data on swamp flows and groundwater levels. • The Department agrees with RPS that the baseflow predictions are likely to be overestimated, particularly considering that they did not fully take into account the influence of the extent of the Burralow Formation. However, the Department believes that these 'worst-case' predictions are appropriate to quantify water licensing requirements. *Drawdown and Fracturing* • In response to questions raised in relation to predicted drawdown and fracturing related impacts, Springvale Coal engaged Ditton Geotechnical Services Pty Ltd (DgS) to prepare a *Subsurface Fracture Zone Assessment* (September 2014, refer to Appendix 6 of the RTS); and • The DgS assessment includes a model to estimate subsurface fracture heights for the project, which was based on an extensive amount of existing data gathered from 30 vibrating wire piezometers at Springvale and Angus Place Mines.

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
			• The DgS assessment was peer reviewed by MSEC (refer to Appendix 7 of the RTS). MSEC concluded that the report "*provides detailed information on the existing environment, the groundwater systems, the overburden and the presence of layers of low permeability for this Western Coalfields area*" and that the model *"represents the current industry best practice".* • DgS predicts that the height of the zone above the coal seam from which water would flow freely into the mine is likely to extend approximately 179 m from the seam into the upper Caley Formation and possibly the Burra-Moko Head Sandstone. These sandstone units are located between 210 m and 264 m from the surface, and lie beneath the Mount York Claystone, which is considered to be a significant regional aquitard. • With the exception of proposed longwalls LW501 to LW503, DgS predicts that discontinuous fracturing would develop into the Banks Wall Sandstone (above the Mount York Claystone) and is likely to be below the Burralow Formation. The Burralow Formation contains a suite of aquitards, which reduce the degree of percolation of groundwater to the geological units below. • DgS predicts that discontinuous cracking may reach the surface above LWs 501 to LW503, however, it is important to note that there are no swamps (either shrub or hanging) or significant watercourses above LW501 to LW503. *Lineaments* • Mine Subsidence Engineering Consultants (MSEC) prepared a detailed *Subsidence Impact Assessment* (October 2013) to predict subsidence effects and to assess potential subsidence impacts associated with the project (refer to Appendix D of the EIS). • MSEC identified several geological structures within the extents of the proposed longwalls, including the Deanes Creek Lineament Zone and the Wolgan Lineament, and noted that these are likely to affect mine subsidence movements resulting from longwall extraction. • MSEC increased the subsidence predictions by 25% in the locations of structural lineaments directly above the longwalls to account for their effect. This increase was considered to be within the upper level of observed increases in vertical movements at lineaments above Angus Place longwalls LW940, LW950 and LW960 and Springvale LW411, which exceeded the maximum predicted subsidence by between 5% and 27%. • Springvale Coal engaged Elizabeth McHugh to undertake a study on the influence of the upper geological strata on swamps in the project area (refer to the report titled *The Geology of Shrub Swamps within Angus Place, Springvale and the Springvale Mine Extension Project Areas*, September 2014, Appendix 18 of the RTS), which included further consideration of structural lineaments in relation to swamps. • The McHugh study consolidated the results of previous studies and reviewed the most up-

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
			to-date geological and groundwater monitoring results from both Angus Place and Springvale to describe the occurrence, functionality and sustainability of the individual swamps in relation to topography, hydrological regimes and geology. • McHugh's key finding is that, with the exception of the Marrangaroo Creek Swamp, all swamps in the Springvale project area are located entirely within the Burralow Formation This formation is the uppermost geological stratum, approximately 110 m thick across the project area, and is considered by McHugh to be critical in the development and maintenance of both the shrub and hanging swamps on the Newnes Plateau • The Burralow Formation contains a suite of aquitards, which reduce the degree of percolation of groundwater through the varying lithologies to the units below. Recharge to this perched groundwater system is via lateral transmission of percolating infiltrated rainfall, along contacts between the aquitards. Direct in-gully input of groundwater via aquitards creates a permanent water source for the formation and maintenance of both hanging and shrub swamps. • RPS believes that the presence of this formation and its aquitards would inhibit infiltrated water from being lost to deeper aquifers since the subsidence-induced fracturing would be only superficial (uppermost 10 to 15 m) and confined to the much thicker Burralow Formation (refer to Appendix 16 of the RTS). RPS considers it likely that any infiltrated flow would be re-directed laterally and re-emerge to the surface further downstream and, with some degree of delay, contribute to prolong the water contribution to the swamps and drainage lines • McHugh considers that the upper reaches of the Marrangaroo Creek Swamp are located within the Burralow Formation but that its lower reaches are located within the underlying Banks Wall Sandstone. The lack of aquitards in the Banks Wall Sandstone means that these 'mixed' type swamps do not generally benefit from the degree of groundwater seepage that swamps in the Burralow Formation experience. It follows that subsidence-induced surface cracking at the base of Marrangaroo Creek Swamp may result in more significant drainage than in other swamps in the project area. • The Department notes that all three swamps identified by the IESC as being coincident with lineaments and previously impacted by undermining (including Narrow, East Wolgan and Kangaroo Swamps) are 'mixed' type swamps located partly in the Burralow Formation and partly in the Banks Wall Sandstone. • The Department believes that the McHugh report provides a comprehensive understanding of the influence of the upper geological strata of the Newnes Plateau on the occurrence and morphology of swamps. The Department accepts that the presence of lineaments may result in increases in surface subsidence, but that key swamps and drainage lines are surface expressions of these structures, and the presence of the Burralow Formation and

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
			its aquitards is likely to reduce the impact of subsidence-induced cracking and fracturing of bedrock beneath the great majority of swamps in the project area. *Site Specific Data on Swamps* • The Department accepts that a limited amount of site-specific data is currently available for several of the swamps in the project area. The Department agrees with the IESC that this is required to determine the extent of change in swamp condition that is caused by longwall mining impacts. • Consequently, as discussed in detail in Section 6.2 of the Department's PAR, the Department has recommended that a Swamp Monitoring Program be prepared and approved prior to the commencement of longwall extraction under the project. • The Department is aware that Springvale Coal has prepared a document titled *Springvale Mine Temperate Highland Peat Swamps on Sandstone Monitoring and Monitoring Plan* (April 2013) in order to satisfy the Department of Environment (DoE) for the Commonwealth approval of extraction of LW415 to LW417. This plan provides a comprehensive monitoring program (for subsidence, flora, fauna, surface water and groundwater) for the swamps above LW415 to LW417 that was peer-reviewed by independent experts and approved by DoE. The Department is satisfied that this plan can be readily expanded to form the Swamp Monitoring Program required by the project approval to cover the 11 swamps in the extended project area.
2	*If not, what does the IESC consider is a reasonable assessment of the likelihood, extent and significance of impacts on overlying and adjacent swamps?*	• Impacts to undermined THPSS have historically been severe. • Subsidence related impacts are highly likely to be severe and potentially irreparable. • Due to the low level of confidence in the groundwater model's capacity to predict hydrological impacts to individual THPSS, the likelihood, extent and significance of groundwater impacts to swamps cannot be determined with certainty.	• The Department accepts that predicting impacts on swamps is complex and somewhat uncertain. Although extensive studies have been undertaken in the last decade to gain a better understanding of the nature and characteristics of swamps and subsidence impacts, the Department considers that it is still unclear exactly how sensitive many swamps are to subsidence impacts. It is the Department's view that there is currently an incomplete data set regarding short-term, medium-term, long-term and catastrophic impacts on swamps undermined by longwall mining in NSW. There is a lack of data on which to draw quantitative conclusions regarding the nature and degree of impact of the previous episodes of undermining beneath many of the swamps. • Although a large number of swamps have been undermined in both the Western and Southern Coalfields, adverse impacts have only been observed at a relatively small number. There appears to be no evidence of large-scale loss of or impacts on swamps undermined by the relatively narrow longwalls which have been employed at Springvale, Russell Vale and Wongawilli Colliery. Further, the current condition of the majority of swamps appears to be much better and more resilient than some observers might have predicted.
3	*What strategies does the*	• Avoidance of undermining and	• The Department agrees with the IESC that the only strategy to avoid impacts to swamps

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
	IESC consider are available to avoid or reduce the likelihood, extent and significance of these impacts?	locating longwalls such that compressive and tensile strains are below 0.5 mm/m and 2 mm/m respectively at THPSS sites are considered the most effective ways to manage the potential impacts to THPSS. This strategy should also be applied to any upstream tributaries that provide a significant proportion of surface flow to THPSS. • Other measures used to mitigate impacts caused by longwall mining have historically involved isolation of ground movements through, for example stress relief slots; and remediation or maintenance responses.	with a high degree of certainty is to locate longwalls such that compressive and tensile strains are below 0.5 mm/m and 2 mm/m respectively. • The Department notes that Springvale Coal has committed to mine design modifications in order to avoid and mitigate impacts of proposed mining on swamps. This has involved reducing the overall void width of the longwalls to 261 m, and increasing chain pillar widths to 58 m in order to achieve sub-critical width-to-depth ratios within the range of 0.65 and 0.75 and minimise subsidence impacts, particularly in relation to swamps. Springvale Coal states that this approach avoids direct impacts to 5 shrub swamps and numerous hanging swamps. • However, the Department accepts that the project may adversely affect 9 shrub swamps and believes that these should be offset in accordance with the draft *Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species Impacted by Longwall Mining Subsidence* (April, 2015) (refer to Section 6.2 of the PAR).
4	*Which, if any, of these strategies does the IESC recommend, and why?*	• The only known strategy to reduce the risk of impact to THPSS ecological communities within the project area would be to alter the mine layout such that swamps are not undermined by longwall panels and longwalls are sufficiently removed from THPSS such that tensile and compressive strains at THPSS sites are below 0.5 mm/m and 2 mm/m respectively. This avoidance strategy should also be applied to any upstream tributaries that provide a significant proportion of surface flow to THPSS. • There is no currently available scientific evidence to demonstrate that remediation activities are able to successfully restore the	• Refer to the Department's response to Question 3 above. • The Department accepts that there is little evidence to date of successful remediation of significant impacts to swamps and that impacts from extensive remediation work may be worse than the environmental benefits that result. • Information in relation to the progress of remediation works being undertaken at the East Wolgan swamp is provided in a report titled "*Rehabilitation of East Wolgan Swamp – Northern Soil Pipe Collapse, Work Progress Report*" (Centennial Coal).

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
		ecological and hydraulic functions of these threatened ecological communities to pre-impact condition.	
Groundwater modelling and assessment of the impacts of potential groundwater discharges to surface waters			
5	*Is the groundwater model suitably robust, and are the resulting quantitative predictions accurately and reasonably described?*	• The groundwater model is a regional scale model that provides generally robust predictions of mine groundwater inflows. These are reasonably described. However, due to the scale of the groundwater model, it is limited in its capability to predict groundwater related impacts to surface water systems including those affecting THPSS and proximal reaches of the Coxs River. This results in a low level of confidence in the predictions of impacts to Cox's River and THPSS baseflows described within the EIS.	• Refer to the Department's response to Question 1 in relation to the scale of the groundwater model and its capability to predict baseflow reductions in swamps. • In relation to potential baseflow reductions in the Cox River, RPS state that whilst the impact to the Coxs River is not nominated explicitly in the CSIRO model such that it can be extracted directly, the predicted change in groundwater level along the alignment of the Coxs River is <0.01m and is interpreted to indicate no predicted change in baseflow. Similar to the conclusion drawn in relation to baseflow reductions in swamps, this is considered a conservative prediction, which is adequate for the purposes of licensing. • The Department notes that Springvale Coal's proposed mine water discharges will result in a significant volume of mine water continuing to be discharged into the Coxs River system, therefore rendering any baseflow reduction impacts negligible.
6	*Are the cumulative water quality impacts of discharges to the Coxs River accurately and reasonably described?*	• The cumulative water quality impacts of Springvale and Angus Place mine water discharges to the Coxs River, an important contributing source to Sydney's drinking water supply, were not modelled for all relevant contaminants, did not consider all likely discharge conditions, and are therefore not accurately and reasonably described. • Salinity was the only water quality variable modelled for cumulative impacts. • The contributing water quality	• As noted in Section 6.4 of it's PAR, the Department acknowledge that the surface water impact assessment presented in the EIS predate Angus Place Mine being placed on 'care and maintenance' and the closure of the Wallerawang Power Station, both of which have significant implications for the water balance and water management arrangements at Springvale. • Since the recent closure of the Wallerawang Power Station, Springvale Coal has been discharging surplus mine water to Coxs River via LDP 9, which has a discharge limit of 30 ML/day and an electrical conductivity (EC) limit of 1,200 µS/cm. However, the EPA has indicated that these licence limits are interim and has asked Springvale Coal to investigate treatment options capable of substantially reducing the EC of discharge water to 350 µS/cm. • Springvale Coal believes that this level of treatment would be prohibitively expensive (capital costs estimated to be $60 million, plus ongoing operational costs) and otherwise impractical due to the scale of pre-treatment required. • To strengthen this position, Springvale Coal engaged Jacobs to prepare the updated report, which is titled *Additional Simulations of the Regional Water Quality Impact Assessment*

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
		impacts to Coxs River from other mines in the area are not quantified. • Increased discharge volumes resulting from reduced demand from the Wallerawang Power Station would affect the outcome of the cumulative water quality impact assessment and should be considered as a potential discharge scenario.	*Model* (April 2015 - refer to Appendix E of the PAR). The report includes treatment option simulations for a range of 'end of pipe' targets for water discharges from Springvale, including: - translocation of Clarence Colliery's relatively non-saline mine water discharges from the Wollangambe River to the Coxs River at Springvale in order to dilute the salinity of the Springvale discharges; and/or - continuous RO treatment of Springvale discharges at a fixed rate of 6 ML/day, based on treating a portion of the discharge water at the disused Wallerawang Power Station's existing RO plant. • As stated in Section 6.4 of the Department's PAR, Jacobs concludes that the predicted increase in salinity in Lake Burrgorang (either with or without treatment) is equivalent to an increase of 6% and 5% respectively, which it considers has a 'neutral' impact to water quality, since the predicted increase in salinity is in itself minimal. • The EPA has subsequently reviewed the Jacobs report, and has raised issues in relation to the model calibration and validation. The EPA states that "*the reliability of this model to predict past or future water quality with any degree if accuracy is highly questionable*". A copy of the EPA's comments is provided in **Appendix C**. • However, the EPA has acknowledged that reducing the salinity of mine water discharges to 350 µS/cm EC may not be achievable in the short term. • In a letter dated 10 April 2015, Centennial advised it has identified a program of works (including pre-treatment of discharge water, duplication of existing RO infrastructure and the blending of water from Clarence) that would allow for the achievement of a performance measure of 700 to 900 µS/cm EC at LDP 9 by 31 December 2016, noting that the works may take up to four years to implement, as they are dependent on approval timeframes and possibly agreement with other companies (**Appendix D**). • In a letter dated 28 May 2015, the EPA agreed to a timeframe of two (2) years to 30 June 2017 for Centennial to meet a 50th percentile of 700 and a 90th percentile of 900 for salinity, measured as µS/cm EC (**Appendix D**). The EPA also indicated that it requires a 100th percentile limit of 1000 µS/cm EC, with these limits to be set by a variation of the Springvale EPL (EPL 3607). • Further, the EPA requires that the salinity of the mine water discharge be reduced below 700/900 EC in the future. As an interim step, the EPA requires a 90th percentile of 500 EC of discharge by 30 June 2019. • Additionally, the EPA requires Centennial to undertake a year round monitoring program with a status report by 30 June 2017 on the impact of the Springvale discharge on the aquatic environment. The EPA will prescribe a condition on the Springvale EPL to capture this program.

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
			• Finally, the EPA remains concerned about the ionic composition and high bicarbonate alkalinity being related to the toxicity of the mine water at Springvale, and will continue to correspond with Centennial regarding this matter. • In a letter dated 29 May 2015, Centennial agreed to the EPA's proposal for 700/900 EC limits, the target of 500 EC at the 90th percentile level by 30 June 2019 and the monitoring regime.
7	*Is the information provided sufficient to predict any changes to either water quality or water quantity in the Coxs River at Kelpie Point which would arise as a result of the mining operations? (Kelpie Point - station number 563000 - is located on the Coxs River close to its entry location into Warragamba Dam. The Sydney Catchment Authority has undertaken flow and quality monitoring at this location for extended periods.)*	• No. The proponent's estimation of downstream impacts was limited to site water balance and cumulative salt mass balance modelling that did not model impacts beyond the upper Coxs River catchment (i.e. not downstream of Lake Lyell). In addition, the existing condition of the Coxs River was not adequately described and the downstream impact modelling that was undertaken included transfer of large volumes of water through the SDWTS to the Wallerawang Power Station, which may no longer be a viable option.	• Refer to the Department's response to 6 above.
8	*If so, what are the predicted changes to water quality or water quantity in the Coxs River at Kelpie Point and what are the consequences for stored waters within Warragamba Dam?*	• Water quantity and quality changes in the Coxs River at Kelpie Point cannot be reliably estimated based on the information presented in the EIS. The consequences for stored waters in Warragamba Dam also cannot be reliably estimated from information in the EIS.	• Refer to the Department's response to Question 6 above.
9	*What water treatment options does the IESC recommend and/or consider feasible to reduce the salt and contaminant levels of*	• Protection of the long-term ecosystem health of Coxs River should include consideration of the ANZECC and ARMCANZ (2000) Guidelines, through an agreed set	• As stated in the Department's response to Question 6 above, the EPA is requiring Centennial to undertake a year round monitoring program with a status report by 30 June 2017 on the impact of the Springvale discharge on the aquatic environment, including downstream salinity and pollutant levels in Lake Wallace and Lake Lyell (details of the monitoring program are provided in the EPA's letter at **Appendix D**).

Department's Question to IESC		Summary of IESC's Response / Advice	Department's Response
	mine water discharged to the Coxs River catchment?	of approval trigger discharge values and management protocols. Where salinity or other contaminants of concern are likely to exceed trigger values, management and treatment options may include, but are not limited to, reverse osmosis and ion exchange technologies.	

Our reference:
DOC15/150492;
EF13/3625

Mr Howard Reed
Manager Mining Projects
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

8 May 2015

Attention: Margaret Kirton

Dear Ms Kirton

I refer to the email dated 9 April 2015 from Mr Thomas Watt, Planning Officer Resource Assessments of the Department of Planning and Environment (DPE), regarding the Springvale Mine Extension Project (SSD 5594).

Thank you for inviting the Environment Protection Authority (EPA) to review and provide comment by 9 May 2015 on Centennial Coal's additional simulations of the regional water quality impact assessment model, referred to as the 'Jacobs' Report.

The EPA has engaged the Office of Environment and Heritage (OEH) to review the Jacobs Report dated 26 March 2015 and wishes to submit that review in the attached document *Review of Additional Simulations of the Regional Water Quality Impact Assessment Model* prepared by Jacobs (2015).

Should you have any questions please contact me at the EPA's Central West Regional Office on 63 327 601.

Yours sincerely

RICHARD WHYTE
Manager Central West
Environment Protection Authority

Attachment: *Review of Additional Simulations of the Regional Water Quality Impact Assessment Model.*

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Review of *Additional Simulations of the Regional Water Quality Impact Assessment Model* prepared by Jacobs (2015)

Introduction

On 28 April 2015 The EPA requested that OEH Science provide a review of a report entitled *Additional Simulations of the Regional Water Quality Impact Assessment Model* and prepared by Jacobs, as a further assessment of the Angus Place and Springvale Mine Extension Projects. OEH had previously provided advice on the EISs for these Projects (June 2014) and the Response to Submissions (November 2014). The Department of Planning and Environment (DPE) has requested the EPA's comments by 9 May 2015 before a PAC considers the advice of the government agencies. The following report provides the requested review.

Appropriateness of AWBM Model

Jacobs (2015) provided a document that describes *Additional simulations of the regional water quality impact assessment model*, which is based on an application of the rainfall-runoff Australian Water Balance Model (AWBM) developed by Boughton (2010). Details are provided on various assumptions about the model, the environment and the parameters in the model, but not all the assumptions are either clearly stated[1] or supported by quantitative scientific data. Before delving into the more complicated parts of such a model it is worthwhile considering what, in general terms, makes a mathematical model appropriate or 'fit for purpose' for a given area and estimation problem. Primarily the appropriateness of such models depends on their ability to be calibrated to local conditions (usually called the calibration phase and based on prior measured data) and on their ability to accurately predict what occurs in the future (through the collection of additional data; usually called the validation phase of model assessment). Mathematical model validation is defined as the "process of determining the degree to which a computer model is an accurate representation of the real world from the perspective of the intended model applications." (Paez 2009, ASME, 2006, U.S. DOE, 2000, AIAA, 1998). It is accomplished through the comparison of predictions from a model to experimental results. Models should be used for prediction only in those regions of the parameter space where they are sufficiently supported by experimental data and models that fail to pass the validation step of the modelling and simulation scheme should be redefined or abandoned. It is important to note that there has been **NO** validation of the AWBM model used in the water quality impact assessment.

The applicability of the Model to the Upper Coxs River catchment therefore rests entirely on an assessment of how well the model has been calibrated to the data that is available in the area. Jacobs (2015) identified that they derived the data in the report from information *sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report.*

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[1] Fo example no details are provided on the "suite of in-house programs to generate a continuous time-series" – see Section 3.1.2.2.

They expressed a strong caveat in that:

The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report.

It is notable that OEH was not approached to provide any data for this area and that Jacobs (2015) do not appear to have been provided with daily discharge data from Centennial for their LDPs in the Upper Coxs River catchment over the period of model calibration. This is concerning because Centennial were required under conditions of their various EPLs to collect daily discharge data to ensure they did not exceed EPL limits but do not appear to have provided this data to inform the work of Jacobs (2015). The EPA previously requested that Centennial supply daily flow data from their LDPs in the Upper Coxs River for such an assessment, but the company declined to supply it. Questions are therefore raised as to why such data have not been supplied to either Government or the developers of the hydrological model to provide the best assessment possible for the current proposal.

It is clear from the material presented in Jacobs (2015) that the model is poorly calibrated. Figures 3.5, 3.8, 3.9, 3.10, 3.12, 3.16 (salinity), 3.17. 3.20, 3.28, 3.30. 3.32 identify significant underestimation or overestimation of salinity, flow or both salinity and flow at various points (nodes) in the Upper Coxs River catchment. Figures 3.11, 3.14, 3.18, 3.26 and 3.29 potentially exhibit the worst calibrations of all those presented, where real data on flow/conductivity is very poorly matched to model predictions. This is actually identified by the authors (Jacobs 2015) themselves in places where they state:

- *From Figure 3.14, the water quality model does not encapsulate observed distribution of salinity particularly well. (p18)*
- *From Figure 3.17, the modelled fit to observed salinity in lake Wallace has deteriorated in the current version of the water quality model compared to the previous version (p20)*
- *Figure 3.13 indicates the fit of the calibration model to observed data was not particularly close, with the model under-estimating salinity. (p58)*

Assumptions of the AWBM model

A wide variety of assumptions are made in the model. Some of these are adequately described, others not. A number of the assumptions have not been justified with any scientific data/support[2].

[2] The AWBM model can be very sensitive to the choice of baseflow index (BFI) values. In the current model it is stated that the baseflow index ***has been set at 0.25 for all land-use classes***. The reasoning behind setting the BFI constant and indeed to a value of 0.25 has not been justified.

Angus Place discharges

Jacobs (2015) stated:

Continuous flow gauging of Angus Place LDP001 was available from September 2010 onward. In the previous version of the water quality model, there was a simplified assumption as to historical discharge, namely:

- *2ML/d in January 1979, linearly increasing to 5ML/d in June 2007*
- *2ML/d in July 2007, linearly increasing to 3ML/d in September 2010.*

With respect to salinity, it was assumed in the previous model that salt was 250mg/L in January 1979 and increased linearly to 804mg/L in September 2010.

It is noted that discharge at Energy Australia LDP020 and Springvale LDP009 was not updated from the previous version of the model. These discharge locations refer to discharge to Sawyers Swamp Creek when mine water from the Springvale Delta Water Transfer Scheme (SDWTS) was not required at Wallerawang Power Station. Discharge data was reconstructed from historical records, as available, from 2006.

No evidence of whether these assumption actually match reality have been provided, even though the flow data presumably resides with the client (Centennial Coal) as a requirement under the EPLs for both Angus Place and Springvale. It is important to note that in regards to Angus Place the EIS itself identified:

- *Angus Place LDP001 has a median flow of 3290 kL/day and a maximum flow of 20,400 kL/day (Table 4.6 RPS Angus Place EIS). Angus Place LDP002 has a median flow of 8 kL/day and a maximum flow of 3620 kL/day (Table 4.6 RPS Angus Place EIS).*
- *Discharge limit on LDP001 recently amended by OEH from 30,000kL/d to 2,000kL/d. As part of the Project Approval, the new LDP is required to have a discharge limit of 30,000kL/d.*

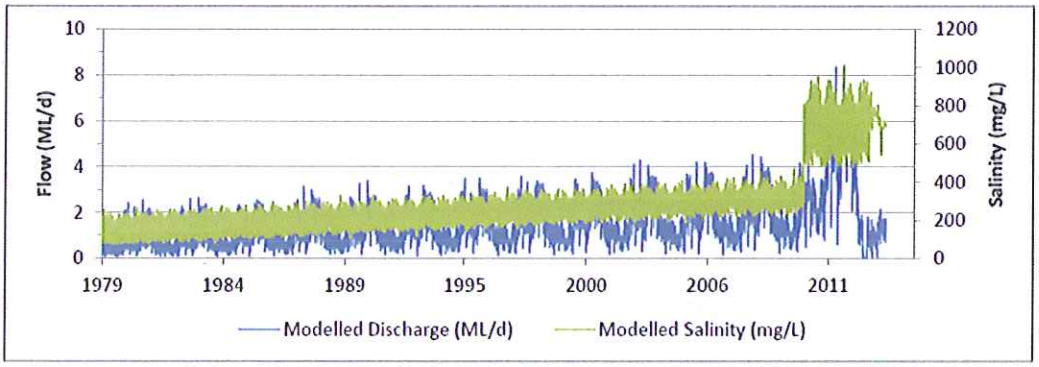

Figure 3.3 : Assumed Discharge and Salinity of Angus Place LDP001 in the Water Quality Model

The median and maximum flows and total discharge limits stated in the EIS for Angus Place bear little resemblance to the assumptions used in the AWBM model. In the artificial "Assumed discharge" (Fig 3.3 in Jacobs (2015) reproduced above) the maximum discharge identified in the EIS (20.4 ML) does not even appear on the scale of the y-axis. The effects these assumptions about LDP001 flow and conductivity have on the model have not been adequately assessed.

Neubecks Creek

As identified earlier, comparison of observed data with modelled data for Neubecks Creek identify a very poor calibration (see Figure 3.9 in Jacobs (2015) reproduced below). The model predicts an average of around 3ML/day (median=2.7 in Table 3.5), whereas observed flows are usually 1 ML/day or lower (median=0.7 in Table 3.5). There has been no assessment of how these overestimates of flow affect model predictions downstream of the NOW gauge. It is equally clear that the model overestimates conductivity and there has also been no assessment of how overestimates in conductivity affect model predictions downstream of the NOW gauge (see Fig 3.10 reproduced below). Current and historic flows from Centennial's Lamberts Gully LDP (which discharges to Neubecks Creek) do not appear to have been included in the current AWBM assessment.

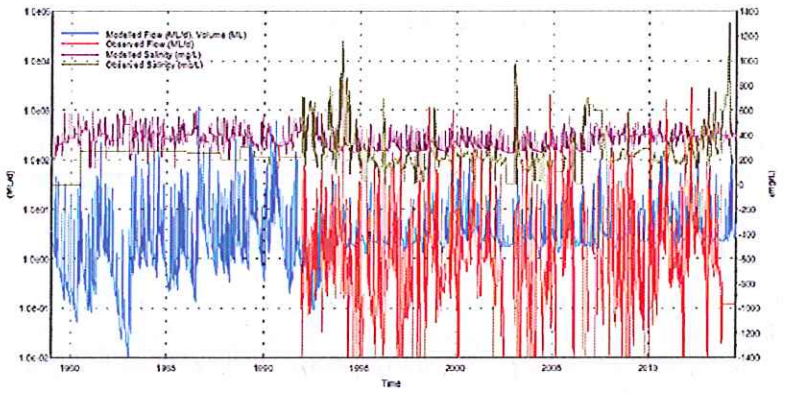

Figure 3.9 : Calibration Time-Series Chart at #105 (Wangcol Creek above Western Coal Services, Gauge No. 212055)

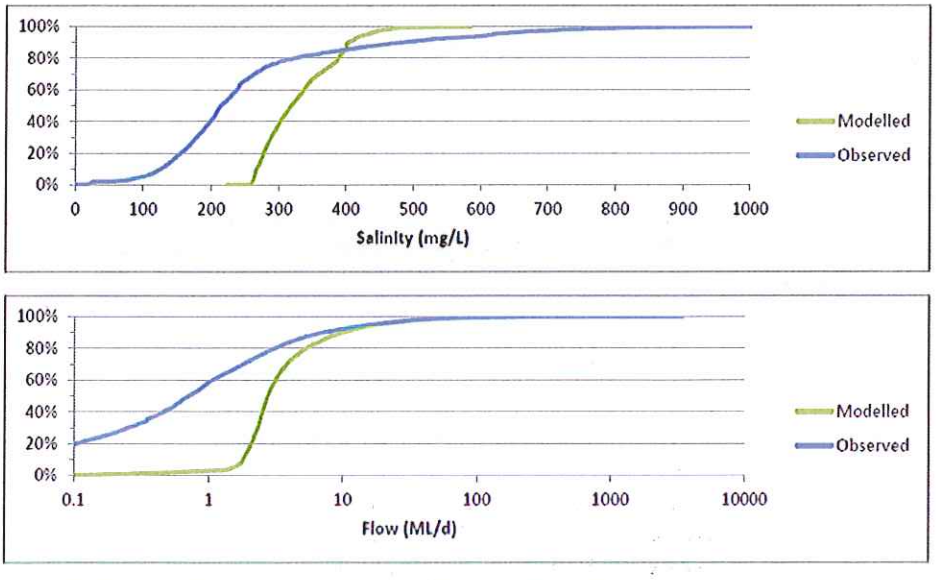

Figure 3.10 : Calibration Distribution Plot at #105 (Wangcol Creek above Western Coal Services, Gauge No. 212055)

Focus of Calibration Simulation

Jacobs (2015) states:

- *The observation dataset for salinity, in particular in the early part of the calibration simulation, was not as extensive as that available with respect to flow. The calibration approach therefore focussed on matching historical salinity in Lake Lyell, as a first priority, and then secondarily at gauging stations and Lake Wallace.*

The reasoning behind calibrating flow and salinity in Lake Lyell some 18-20km distant from the LDP009 discharge is not considered sound if the model is supposed to be an assessment of the impact of LDP009 (and other Centennial discharges) on the Upper Coxs River. Daisy-chaining of errors from a point in the river 18-20km downstream including passage through 2 major storages is a significant concern and, as a result, errors in the AWBM could be considerable. This is just one potential reason that could explain the poor level of calibration of the AWBM results with real data in many areas.

The model as it currently stands is being presented as an assessment of the impact of the proposal on the Upper Coxs River, but is potentially ignoring the largest localised effects of the mine on the Upper Coxs River (ie in those areas closest to where the LDP discharges occur). The EPA has previously raised concerns about the lack of appropriate upstream-downstream comparisons for each LDP discharge in the Upper Coxs River catchment to assess its true impact on the environment. This lack of appropriate assessment remains since the node immediately upstream of the LDP discharges is rarely if ever compared to the node immediately downstream of the LDP discharge.

Evaporation

Evapotranspiration/Evaporation is an extremely important parameter in any water balance model. Using an inappropriate evapotranspiration/evaporation rate can invalidate all subsequent predictions.

Jacobs (2015) state that:

- *The evaporation data used in the water quality model was updated from monthly mean daily from BOM Station No. 061089 (Scone SCS) to a spatially distributed historical daily record. Table 3.1 presents the evaporation stations used in the updated model. It is noted that the use of the BOM Station at Scone was an error in the previous version of the RWQIAM. The BOM Station at Bathurst was intended to have been used.*

- *Historic daily evaporation used in the RWQIAM has been processed by a suite of **in-house programs** to generate a continuous time-series. The historic input data to this processing is the BOM Rainfall record. Processing is achieved through disaggregation of accumulated data and infilling of missing data, both through relationships developed with neighbouring gauges.*

- *This time-series was supplemented from the SILO dataset where required. The SILO dataset is disaggregated and infilled via a gridded approach, where necessary, and adopts long-term averages where no data is available and extrapolation from adjacent sites is infeasible.*

The constant change of evaporation stations in various iterations of the AWBM is not only confusing but inadequately described/summarised. Of the BoM stations identified in Table 3.1 only the last two (Goulburn TAFE and Tarago) are included in the list of BoM stations that actually record evaporation (ie observed data). With the exception of Lithgow and Little Hartley, the majority of the stations in the list are actually many kilometres away from the area of LDP discharges in the catchment that is being modelled. No details are provided on the "in-house programs" and no summary statistics (mean, median, minimum, maximum) of the evaporation data provided by the "in-house programs" is given.

If Jacobs (2015) are using SILO, as suggested above, then they should be aware that SILO can not only provide patched point datasets for evaporation at existing BoM stations, but also data drill datasets at 0.05° increments of latitude and longitude. It is likely that the SILO models are much more sophisticated than the AWBM developed in the current report, although both require appropriate validation for any specific catchment. If evaporation data from SILO for the Upper Coxs River catchment (-33.4S, 150.05E) are considered and compared to the evaporation (patched point data) for Scone and Bathurst, it is clear that evaporation is predicted to be much lower in the Upper Coxs River catchment than at either Scone or Bathurst (Table 1)[3]. This is demonstrated (Figure 1) by the evaporation exceedance curve (Cumulative Distribution Function in statistical terms) for SILO evaporation at Bathurst (patched point data), Scone (patched point data) and Upper Coxs River Catchment (Data drill).

No information on the actual evaporation used ("in-house programs") and the effect this has on the AWBM results is possible from what has been provided in Jacobs (2015). It is clear that previous AWBM iterations have used an inappropriately high evaporation rate (based on Bathurst or Scone evaporation) for the Upper Coxs River catchment. Further, the constant changing of evaporation in the various iterations of the model brings into question the comparability/compatibility of the various ABWM results where the evaporation sources have been changed. Further, the lack of any validation of AWBM results provides little certainty that the model is either adequate or predicting appropriately in the areas of the Upper Coxs River catchment where the LDPs are located. Indeed, the calibration results suggest that it is not.

Table 1. Summary statistics for SILO evaporation at Bathurst (patched point data), Scone (patched point data) and Upper Coxs River Catchment (Data dril).

Statistic	***Scone***	***Upper Coxs River***	***Bathurst***
Mean	4.36	3.18	3.78
Median	4	2.8	3.2
Minimum	0	0.2	0
Maximum	25.2	12.4	21.6

[3] It is also likely to be much lower than evaporation at Goulburn TAFE and Tarago

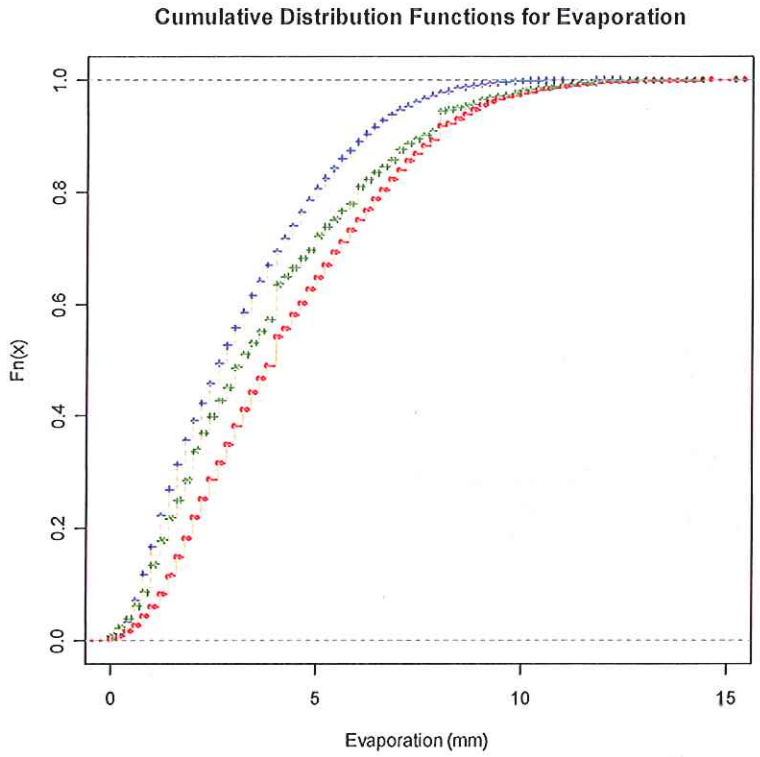

Figure 1. Evaporation exceedance curve (Cumulative Distribution Function) for SILO evaporation at Bathurst (patched point data; green line), Scone (patched point data; red) and Upper Coxs River Catchment (Data drill; blue).

Comparison with Real Data

As was identified in previous EPA comments, monitoring of flows at the NSW Office of Water (NOW) gauging station on the Coxs River upstream of Lake Wallerawang indicate that median flow in the Coxs River at this point is approximately 13.3 ML/day[4]. The proposed discharge from LDP009 (30ML/day rising to 50ML/day if both mine projects are approved) means that the discharge is approximately twice the median flow in the Coxs River at this point and is projected to increase to **almost 4 times the median flow** in the Coxs River at this point. Further, some of the flows measured at the NOW gauge actually already include discharges from Centennial's other operations in the upper Coxs River catchment (i.e. Angus Place and Lamberts Gully).

A plot of flows at the NOW 212054 gauge actually identifies a significant increase in flows in the most recent times, potentially as a direct result of the LDP009 discharge (Figure 2). This has still not been acknowledged or modelled appropriately in the AWBM assessment. A plot of Conductivity levels at the same Gauge also demonstrates a significantly increasing trend in Conductivity levels (ie an increasing salinization) of Upper Coxs River waters (Figure 3). This is most likely a result of the ongoing and increasing mine water discharges in the Upper Coxs River catchment but it too has not been identified or allowed for appropriately in the AWBM model. The failure of the report to address these two issues is considered a major flaw in the AWBM assessment.

[4] Cardno Ecology Lab (2014) stated a median of 12.2 ML/day.

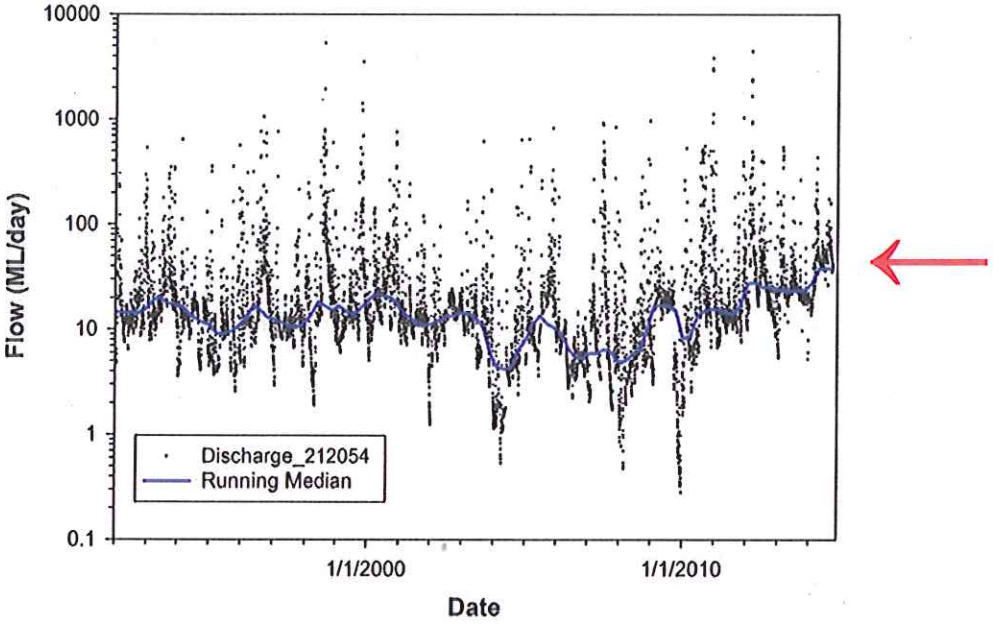

Figure 2. Flow at NOW Gauge 212054. Arrow highlights recent spike in flows likely to be a result of the LDP009 discharge.

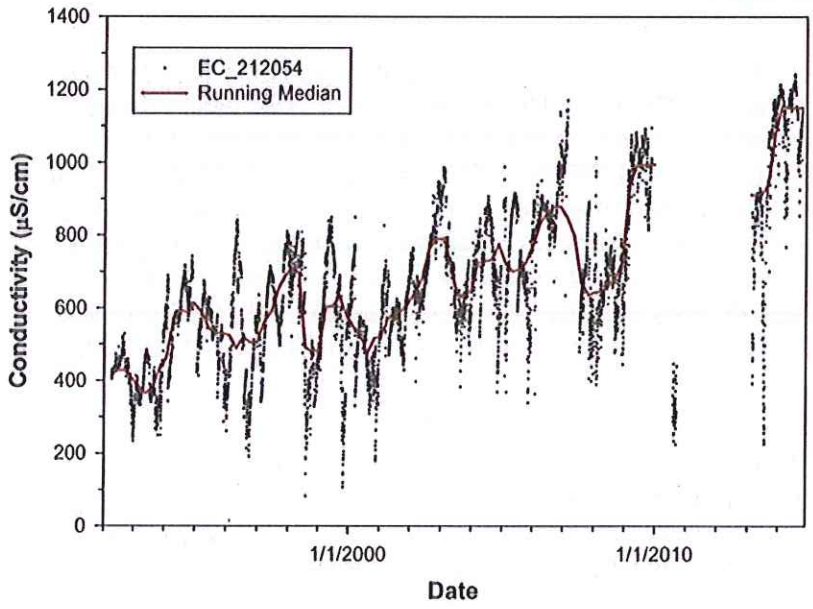

Figure 3. Electrical Conductivity at NOW Gauge 212054. Note the significantly increasing trend in conductivity levels.

End of Pipe Targets

Jacobs (2015) provides a section on end of pipe targets for a number of scenarios.

The End of Pipe targets used were stated to consist of:

- *350µS/cm, default ANZECC trigger value for SE Australia upland watercourses (equivalent to 234mg/L)*
- *700µS/cm (equivalent to 469mg/L)*
- *800µS/cm (equivalent to 536mg/L)*
- *900µS/cm (equivalent to 603mg/L)*

And,

Current assumed salinity of mine water discharge from Angus Place Colliery and Springvale Mine is 1,200µS/cm, by comparison.

No details are actually provided on how the treatment will be undertaken, but Jacobs (2015) note:

It is noted that prediction treatment volumes presented here are indicative, being based on simple mass balance. Predicted volumes do not take into account the pre-treatment and other water treatment process requirements and therefore are expected to have an accuracy of +/-15%. Further detail on treatment requirements are contained in the treatment option assessment, presented elsewhere[5].

Unfortunately all these assessments are made using a poorly calibrated model which has had no model validation. As discussed earlier the reliability of this model to predict past or future water quality with any degree of accuracy is highly questionable.

What follows are a large number of graphs for the various options, but the most obvious issue is in Figures 3.72 (reproduced below) and 3.73 where predicted future concentrations bear little resemblance to what is currently occurring in the Coxs River at the NOW Gauge 212054 (observed measurements – see *Comparison with Real Data* Section above). Even though the Springvale proposal involves considerably increasing the discharge volumes, the 700, 800 and 900 options modelled into the future suggest that average conductivity at #047 (Coxs River above Lake Wallace, Gauge No. 212054) will fall to approximately 300-570 µS/cm (Table 3.41 of Jacobs (2015)), despite it currently being approximately 1200 µS/cm[6]. The model therefore suggests a significant reduction in conductivity will occur in the Upper Coxs River at Gauge No. 212054 when the conductivity of the discharge under the 700, 800 and 900 µS/cm options is 2-3 times the median concentration predicted by the model. The credibility of this prediction obviously needs further assessment.

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[5] It is unclear where this "elsewhere" is.

[6] As measured at the NOW gauge. It is emphasized that the model does not appear to adequately account for the recent rise in flow volumes or the increasing trend in conductivity measured at the NOW Gauge 212054 likely to be due in large part to the LDP009 discharge.

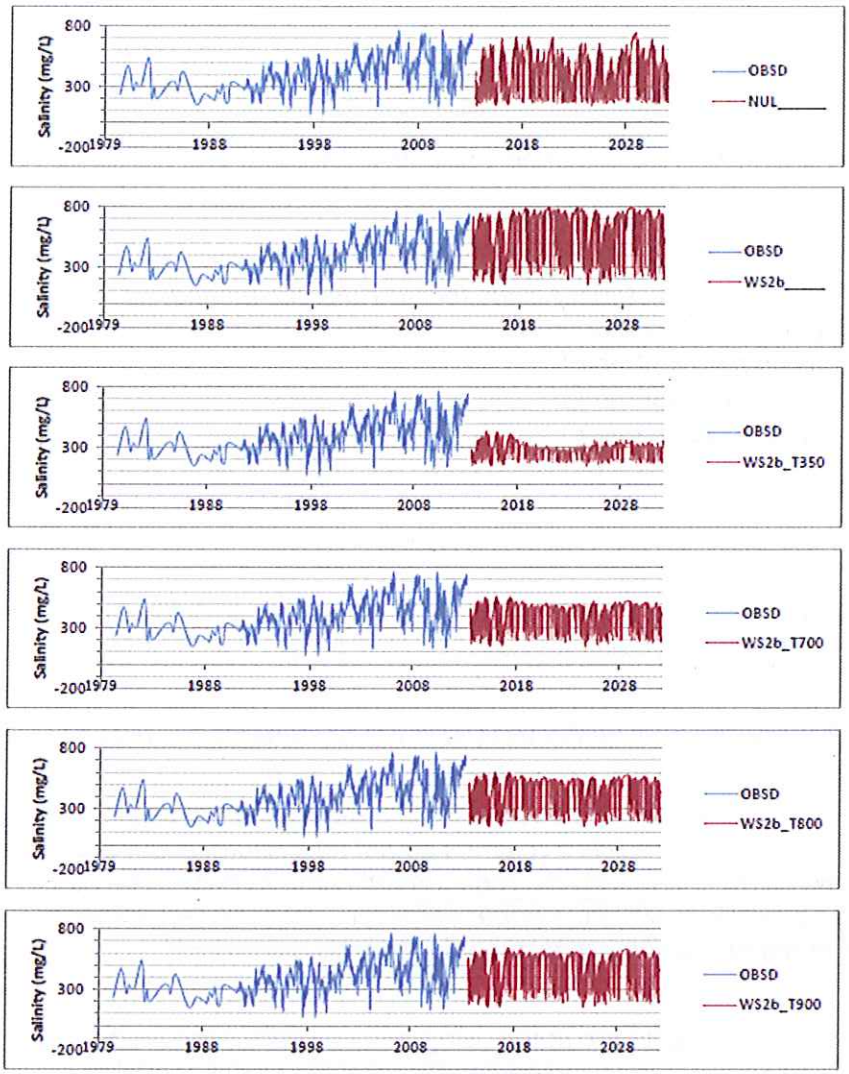

Figure 3.72 : End of Pipe Target Time-Series chart at #047 (Coxs River above Lake Wallace, Gauge No. 212054) - Concurrent

Salinity Impacts from LDP009 and other Centennial discharges

The increasing salinisation of NSW freshwater rivers and streams as a result of high volume, high salt content waste water has been demonstrated in a number of areas, including the Hunter River, Upper Georges River, Upper Coxs River, Upper Nepean River, Wingecarribee River and more recently the Wollangambe River (e.g. Krogh et al. 2013, Cardno Ecology Lab Pty Ltd 2010, OEH 2012, Krogh & Miller 2011, OEH 2015). Salinity is an indicative measure of the total concentration of cations (Na+, Ca^2+, Mg^2+, K+), and anions (i.e. SO42-, CO32-, HCO32-, Cl-) in solution (ANZECC/ARMCANZ 2000). Measures of Electrical Conductivity are also indicative of the total ions present in solution. Concentrations of individual ions contributing to these measures can vary significantly in their composition. Some organisms (osmoregulators) possess varied mechanisms for regulating ions hence the ionic composition of a saline solution is a significant factor in determining its toxicity. For this reason the use of integrative measures of salinity (TSS and EC) may not be reliable predictors of toxicity for all water types (Mount *et al.*, 1997). Studies by Burnham & Peterka (1975), Dwyer *et al.* (1992), Nielsen *et al.* (2003), Bayly (1969), Clunie *et al.* (2002), Dunlop et al (2008, 2011) and Zalizniak (2006) have indicated that ionic composition affects salinity toxicity.

A direct assessment of mine water salinity impacts can be found in the ACARP study on the effects of mine water salinity on freshwater biota (Cardno Ecology Lab Pty Ltd 2010). Cardno Ecology Lab Pty Ltd (2010) found that discharge waters from mines in the Hunter and Illawarra/Macarthur regions induced deleterious responses in a range of aquatic biota. Arthropods were the most sensitive organisms tested, with the mayfly *Atalophlebia* spp. being the most sensitive of these. The salinity levels at which effects occurred were below those reported in the literature for sodium chloride (NaCl) based solutions and highlighted the need for site-specific toxicity information that takes into account the variable composition of saline mine waters, including the consideration of other constituents (Cardno Ecology Lab Pty Ltd 2010). Different ions (sodium [Na+], calcium [Ca2+], magnesium [Mg2+], potassium [K+], chloride [Cl-], bicarbonate [HCO3-], sulfate [SO42-] and the salts they form) can induce varying degrees of toxicity to aquatic life (e.g. Young 1923; Mossier 1971; Nelson 1968; Held & Peterka 1974; Rawson & Moore 1944; Farag & Harper 2012). There are a number of recent scientific publications that suggest increased levels of salinity can adversely affect aquatic communities (e.g. Kefford et al. 2006, 2007a, 2007b, 2010; Cardno Ecology Lab Pty Ltd 2010; Dunlop et al. 2008, 2011; Cañedo Argüelles et al. 2013).

Farag and Harper (2012) constructed a database of toxicity evaluations of sodium bicarbonate ($NaHCO_3$) on aquatic life and used these data to establish acute and chronic criteria for the protection of aquatic life. Chronic toxicity was observed at concentrations that ranged from 450 to 800 milligrams $NaHCO_3$ per litre (also defined as 430 to 657 milligrams HCO_3- per litre or total alkalinity expressed as 354 to 539 milligrams $CaCO_3$ per litre) and the specific concentration depended on the sensitivity of the four species of invertebrates and fish exposed. **Acute and chronic criteria of 459 and 381 milligrams $NaHCO_3$ per litre, respectively, were calculated to protect 95 per cent of the most sensitive species** (Farag and Harper 2012). More recently, OEH (2012) also found toxic effects of West Cliff mine water, citing bicarbonate as an important potential contributor to the toxic effects. Other potential toxicants found in the mine water at levels exceeding the ANZECC/ARMCANZ (2000) guidelines were aluminium, nickel, zinc, cobalt and copper (OEH 2012).

It is noted that in the most recent sampling Bicarbonate alkalinity in the LDP009 discharge was measured at **625 mg/L** (GHD 2014) and **580 mg/L** (EPA/OEH 2014), well above the acute and chronic criteria of Farag and Harper (2012). It is noted that the ecotoxicology results also demonstrated that the LDP009 discharge was toxic to a range of test species.

GHD (2014) concluded that:

- *The results of toxicity testing of SV LDP009 discharge presented in Table 3-1 indicate that the discharge is toxic to the test species, with the alga, cladoceran and hydra species showing significant toxicity to the discharge. The alga was observed to have the most sensitivity to the discharge from SV LDP009. The duckweed test showed no toxicity to the discharge and the fish bioassay showed only slight sensitivity.*

And,

- *A concentration of SV LDP009 discharge of 2.7% was determined to provide protection to 95% of species in the downstream ecosystem. To reach a concentration of 2.7%, a dilution factor of 1:37 is required*[7].

Krogh and Miller (2011) identified a number of taxa that were frequently collected from the samples up to a particular conductivity level, above which they were no longer collected. These taxa and the highest EC from which they were collected were:

- The caddisfly Leptoceridae *Lectrides*; EC 530
- The mayfly Leptophlebiidae *Koorrnonga*; EC 375
- The mayfly Oniscigastridae *Tasmanophlebia*; EC 375
- The caddisfly Hydrobiosidae *Taschorema* complex; EC 358
- The crane fly Tipulidae; EC 316
- The mayfly Leptophlebiidae *Ulmerophlebia*; EC 184
- The chironomid Aphroteniinae; EC 80.

There were also fewer dragonflies and damselflies collected from samples with higher conductivities (Krogh and Miller 2011).

It is important to note that there has been little to no toxicity testing of aquatic species endemic to the area[8] or formal Toxicity Identification and Evaluation (TIE) procedures applied the Centennial discharges to determine which components of the discharge are causing the observed toxicity. Electrical conductivity levels in the LDP009 discharge are an order of magnitude greater than natural streams[9] that drain to the Upper Coxs River and it would be unrealistic to suggest that such a large change in conductivity is not affecting the river's ecology.

On the basis of current and previous monitoring, it can be concluded that the LDP009 discharge significantly alters the water chemistry (pH, conductivity, alkalinity, ionic composition, and suite of metals, metalloids, non-metallic inorganics) of the receiving waters close to where the discharge joins the Coxs River and for a considerable distance downstream. The discharge itself is also toxic to aquatic organisms. Because of the volume and concentrations of the discharge and its location, very little dilution is achieved once the discharge joins the Coxs River. The Springvale proposal reports do very little to address this issue and because of the significant issues associated with the calibration and assumptions used in the AWBM assessment the conclusions from the model in regards to flow and conductivity are not at this stage considered to be reliable. The high bicarbonate alkalinity recorded for the mine water suggests that bicarbonate ions could be a serious ecological health issue for the LDP discharges. It is clear that none of the scenarios tested by Jacobs (2015) has addressed/considered the issue of toxicity or ionic composition of the mine water discharges.

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[7] No relationship has been drawn between this suggested dilution and the arbitrary end-of-pipe targets used by Jacobs (2014).

[8] Such as those discussed by Krogh and Miller (2011) as potentially being impacted by higher salinities.

[9] Including the Upper Coxs River itself above Kangaroo Creek - See Krogh and Miller 2011.

Conclusion

There has been **NO** validation of the AWBM model used in the water quality impact assessment.

The applicability of the Model to the Upper Coxs River catchment rests entirely on an assessment of how well the model has been calibrated to the data that is available in the area.

Based on the data and graphs provided in the Jacobs (2015) report it is clear that the model itself remains poorly calibrated. This is actually stated by the authors (Jacobs 2015) themselves in some sections of their report. Calibration of the model, is particularly poor in areas close to the LDP discharges (Kangaroo Creek Wangcol Creek, Sawyers Swamp Creek, Lake Wallace). As a result, little faith can currently be placed on the AWBM model, its predictions and the conclusions regarding potential water quality impacts.

The AWBM has not used observed flows from the Centennial LDPs in Upper Coxs River Catchment. The AWBM assessment continues to make inappropriate assumptions about the proportion of the flows measured in various parts of the Upper Coxs River that are actually sourced from upstream LDPs. As a result of the continuing confounding of LDP discharges, flows and water quality in the model and assessment, an adequate assessment of the true impact of the LDP discharges is still **NOT** achieved (particularly that of LDP009).

On the basis of current and previous monitoring, it can be concluded that the LDP009 discharge significantly alters the water chemistry (pH, conductivity, alkalinity, ionic composition, and suite of metals, metalloids, non-metallic inorganics) of the receiving waters close to where the discharge joins the Coxs River and for a considerable distance downstream. The discharge itself is also toxic to aquatic organisms. The high bicarbonate alkalinity recorded for the mine water suggests that bicarbonate ions could be a very important ecological health issue for the LDP discharges. None of the scenarios tested by Jacobs (2015) have addressed/considered the issue of toxicity or ionic composition of the mine water discharges. In addition, no relationship has been drawn between the suggested dilution required (1:37; see GHD 2014) to avoid toxic effects from the discharge and the arbitrary end-of-pipe targets considered by Jacobs (2014).

The AWBM obviously needs to be better calibrated and validated before it should be used to support any decision regarding appropriateness of end-of-pipe targets or acceptability of proposed discharges. It is quite clearly performing poorly when compared to real data in the Upper Coxs River catchment.

References

AIAA (American Institute of Aeronautics and Astronautics), (1998), *Guide for the Verification and Validation of Computational Fluid Dynamics Simulations*, AIAA-G-077-1998, Reston, VA, American Institute of Aeronautics and Astronautics.

ANZECC/ARMCANZ (2000), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

ASME, (2006), *Guide for Verification and Validation in Computational Solid Mechanics*, The American Society of Mechanical Engineers, ASME V&V 10-2006. AIAA 1998

Bayly, I.A.E. (1969). The occurrence of calanoid copepods in athalassic saline waters in relation to salinity and anionic proportions", *Vernandlungen Internationale Vereinigung fur Theoretische and Angewandthe Limnologie.* 17: 445–449.

Boughton, W.C. (2010) Rainfall-runoff modelling with the Australian Water Balance Model. Engineers Media. Crows Nest, N.S.W.

Burnham, B.L. and Peterka, J.J. (1975). Effects of saline water for North Dakota lakes on survival of fathead minnow (Pimephales promelas) embryos and sac fry, *Journal of the Fisheries Research Board of Canada.* 32: 809–812.

Cañedo Argüelles, M, Kefford, BJ, Piscart, C, Prat, N, Schäfer, RB and Schulz, C-J (2013), 'Salinisation of rivers: an urgent ecological issue', *Environmental Pollution*, vol. 173, pp. 157–167.

Cardno Ecology Lab Pty Ltd (2010), *Effects of mine water salinity on freshwater biota investigations of coal mine water discharge in NSW*, Australian Coal Association Research Program and Cardno (NSW) Pty Ltd Trading as Cardno Ecology Lab, Brookvale.

Clunie, P., Ryan, T., James, K. and Cant, B. (2002). Implications for Rivers from Salinity Hazards: Scoping Study. Report to the Murray Darling Basin Commission. Department of Natural Resources and Environment, Heidelberg. R2003.

Dunlop, J, Hobbs, D, Mann, R, Nanjappa, V, Smith, R, Vardy, S and Vink, S (2011), *Development of ecosystem protection trigger values for sodium sulfate in seasonally flowing streams of the Fitzroy River basin*, ACARP PROJECT C18033, Australian Coal Association Research Program, Brisbane.

Dunlop, JE, Horrigan, N, McGregor, G, Kefford, BJ, Choy, S and Prasad, R (2008), 'Effect of spatial variation on macroinvertebrate salinity tolerance in Eastern Australia: implications for derivation of ecosystem protection trigger values', *Environmental Pollution*, vol. 151, pp. 621–630.

Dwyer, F.J., Burch, S.A., Ingersoll, C.G. and Hunn, J.B. (1992). Toxicity of trace element and salinity mixtures to striped bass (Morone saxatilis) and Daphnia magna, *Environmental Toxicology and Chemistry* 11: 513–520.

Farag, AM and Harper, DD (eds) (2012), *The Potential Effects of Sodium Bicarbonate, a Major Constituent of Produced Waters from Coalbed Natural Gas Production, on Aquatic Life,* US Geological Survey, Reston, Virginia, USA.

GHD (2014). Centennial Coal Company Limited Coxs River Ecotoxicology Assessment September 2014

Held, JW and Peterka, JJ (1974), 'Age, growth, and food habits of the fathead minnow, *Pimephales promelas*, in North Dakota saline lakes', *Transaction of the American Fisheries Society*, vol. 103, pp. 743–756.

Jacobs 2015 *Additional Simulations of the Regional Water Quality Impact Assessment Model.*

Kefford, BJ, Nugegoda, D, Metzeling, L and Fields, EJ (2006), 'Validating species sensitivity distributions using salinity tolerance of riverine macroinvertebrates in the southern Murray–Darling Basin (Victoria, Australia)', *Canadian Journal of Fisheries and Aquatic Sciences*, vol. 63, pp. 1865–1877.

Kefford, BJ, Fields, EJ, Nugegoda, D and Clay, C (2007a), 'The salinity tolerance of riverine microinvertebrates from the southern Murray–Darling Basin', *Marine and Freshwater Research*, vol. 58, pp. 1019–1031.

Kefford, BJ, Nugegoda, D, Zalizniak, L, Fields, EJ and Hassell, KL (2007b), 'The salinity tolerance of freshwater macroinvertebrate eggs and hatchlings in comparison to their older life-stages: a diversity of responses', *Aquatic Ecology*, vol. 41, pp. 335–348.

Kefford, BJ, Schafer, RB, Liess, M, Goonan, P, Metzeling, L and Nugegoda, D (2010), 'A similarity-index-based method to estimate chemical concentration limits protective for ecological communities', *Environmental Toxicology and Chemistry*, vol. 29, no. 9, pp. 2123–2131.

Krogh, M, Dorani, F, Foulsham, E, McSorley, A and Hoey, D (2013), *Hunter Catchment Salinity Assessment*, Office of Environment and Heritage, Sydney, November 2013.

Krogh, M and Miller, J (2011), *Coxs River Catchment – Water Quality and Macroinvertebrate Communities*, Monitoring Unit – Waters and Coastal Science Section, Scientific Services Division, Office of Environment and Heritage, Sydney, November 2011.

Mossier, JN (1971), 'The effect of salinity on the eggs and sac fry of the fathead minnow (*Pimephales promelas promelas*), northern pike (*Esox lucius*) and walleye (*Stizostedion vitreum vitreum*)', North Dakota State University, Fargo, PhD dissertation, 47 pp.

Mount, D.R., D.D. Gulley, J.R. Hockett, T.D. Garrison and J.M. Evans (1997).'Statistical models to predict the toxicity of major ions to Ceriodaphnia dubia, Daphnia magna and Pimephales promelas (flathead minnows)'. *Environmental Toxicology and Chemistry* 16:2009–2019.

Nelson, JS (1968), 'Salinity tolerance of brook sticklebacks, *Culaea inconstans*, freshwater ninespine sticklebacks, *Pungitius pungitius*, and freshwater fourspine sticklebacks, *Apeltes quadracus*', *Canadian Journal of Zoology*, vol. 46, pp. 663–667.

Nielsen, D.L., Brock, M.A., Rees, G.N. and Baldwin, D.S. (2003). Effects of increasing salinity on freshwater ecosystems in Australia. *Australian Journal of Botany* 51: 655 – 665.

OEH (2012), *Chemical and Ecotoxicology Assessment of Discharge Waters from West Cliff Mine, for samples collected between 14 May and 25 June 2012 from Licensed Discharge Point 11, Brennans Creek Dam and Upper Georges River (upstream and downstream of the Brennans Creek confluence),* report to the NSW Environment Protection Authority, Office of Environment and Heritage, Sydney, August 2012.

OEH (2015) Clarence Colliery Discharge Investigation. OEH 2015/0171 April 2015. Office of Environment and Heritage. ISBN 978 1 74359 934 1

Paez, T.L. (2009). Introduction to Model Validation Proceedings of the IMAC-XXVII February 9-12, 2009 Orlando, Florida USA ©2009 Society for Experimental Mechanics Inc. http://www.sem.org/pdf/lecture1-paper.pdf

Rawson, DS and Moore, JE (1944), 'The saline lakes of Saskatchewan', *Can. J. Res.*, vol. 22, pp. 141–201.

U.S. Department of Energy, (2000), "Advanced Simulation and Computing (ASCI) Program Plan," 01-ASCI-Prog-01, Sandia National Laboratories, Albuquerque, New Mexico.

Young, RT (1923), 'Resistance of fish to salts and alkalinity', *American Journal of Physiology*, vol. 63, pp. 373–388.

Zalizniak, L., Kefford, B.J., Nugegoda, D., (2006). Is salinity all the same? I. The effect of ionic compositions on the salinity tolerance of five species of freshwater invertebrates. *Marine and Freshwater Research* 57: 75-82.

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Principal Scientist Major Assessments

Office of Environment and Heritage

8 May 2015

NSW EPA

Our reference:
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Contact:
Richard Whyte

Mr David Moult
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28 May 2015

Dear Mr Moult,

I refer to Centennial Coal's letter dated 14 May 2015, and received by the Environment Protection Authority (EPA) on 25 May 2015, regarding the Springvale Mine Extension Project (SSD5564) and the commitments proposed by Centennial Coal.

The following is the EPA's response to these commitments and other raised in Centennial's letter.

Proposal for 700/900 EC Limits

The EPA agrees to Centennial's timeframe of two (2) years to 30 June 2017 to meet a 50th percentile of 700 and a 90th percentile of 900 for salinity, measured as micro-Siemens per centimetre Electrical Conductivity (µS/cm EC). Additionally, the EPA will require a 100th percentile limit of 1,000 µS/cm EC, with these limits to be set by a variation to the Springvale Colliery Environment Protection Licence (EPL 3607).

Proposal for 350 EC Limit

The EPA notes that Centennial does not agree that a longer term goal of 350 µS/cm EC within four (4) years of the date of the consent is necessary, and questions the need to further reduce salinity in the Springvale discharge on the grounds that the discharge is not acutely toxic and the salinity is not having a toxic effect on the environment. This matter has two components which need to be addressed separately.

Further Reductions in Salinity

The EPA maintains that further reductions in salinity are necessary to progressively improve the water quality of the upper Coxs River, and that salinity levels much greater than the background concentrations do impact on the diversity and abundance the aquatic biota (essentially influencing which species can and cannot live in the downstream waters where the salinity is higher because of mine water discharge).

The EPA remains of the view that the salinity of the mine water discharge needs to be reduced below 700/900 EC in the future. However, as an interim step the EPA will require a 90th percentile of 500 EC for the Springvale mine water discharge by 30 June 2019.

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Additionally, the EPA will require Centennial to undertake a year round monitoring program with a status report by 30 June 2017 on the impact of the Springvale discharge on the aquatic environment, including downstream salinity and pollutant levels in Lake Wallace and Lake Lyell. The monitoring will be ongoing and Centennial will be required to provide a second report by 30 September 2020 that will be used as a basis to test the relationship between the 90th percentile of 500 EC and a salinity limit of 350 µS/cm EC, which remains the EPA's end goal for the discharge, as expressed in our previous correspondence.

This approach is based on the management program outlined in Centennial's letter of 10 April 2015 - *4. Pollution Reduction Programs*:

a) *Water quality, macroinvertebrate and ecotoxicology monitoring across the Coxs River Catchment to measure the performance against the long term water quality objective and the impacts of change on the aquatic ecology and ecosystem health of the Coxs River.*
b) *The water quality parameters to be monitored at all proposed Licensed Discharge Points, the frequency of monitoring and concentration limits focussed on those that have been identified as having potential to cause harm to the environment.*
c) *A Trigger Action Response Plan should concentration limits be exceeded that focusses on the extent to which an exceedance of quality limits might affect aquatic ecology of the Coxs River catchment.*

The EPA will prescribe a condition on the Springvale EPL to capture this program. However this will be subject to the EPA's satisfaction that the monitoring program has been properly designed, and includes all the relevant variables to be monitored (e.g. including some of the flow data not included in the Jacobs Report). Centennial also needs to consider the likelihood of more cost effective treatment processes becoming available in the future (e.g. trialling de-alkalisation), which could become the subject of further Pollution Reduction Programs (PRP).

Toxicity of Licensed Discharge Point 9 (LDP9) of EPL 3607

The EPA does not agree with Centennial's statement that the mine water discharge does not show characteristics of acute toxicity. Centennial's own document prepared by GHD (Coxs River Ecotoxicology Assessment September 2014) reported acute toxicity of the discharge, especially to Cladoceran species. As you are aware on 4 May 2015 the Office of Environment and Heritage (OEH) on behalf of the EPA tested the LDP9 discharge and the preliminary results show acute toxicity to Cladoceran species. These results indicate that Centennial's changes to the flocculation process have not eliminated the toxicity.

The EPA expects to have the final test report from OEH shortly. We will then be in touch to organise a meeting with the respective ecotoxicologists to discuss the results delivered by GHD for Centennial and those from OEH. As previously stated, and most recently repeated in the EPA's comments to the Department of Planning and Environment on the Jacob's Report, the EPA has concerns about the ionic composition and high bicarbonate alkalinity being related to the toxicity of the mine water.

Proposal for Angus Place

The EPA agrees that a further reduction in salinity for the Angus Place Mine Extension Project needs to be undertaken, and will continue negotiations with Centennial to deliver the most beneficial environmental outcome for this mine.

Proposal for Clarence Colliery

In regards to the proposal to eliminate the mine water discharge from Clarence Colliery into the Wollangambe River and instead pipe the treated water in the Lithgow Water Supply Dam, Centennial needs to take into account the following:

- A discharge from the treatment plant directly into the Lithgow Water Supply Dam, bypassing the dam on the Wollangambe River, would require an additional LDP on EPL 726.
- The quality of the receiving waters of the Dam and Farmers Creek needs to be characterised.
- ANZECC 2000 would be used for guidance for a Slightly to Moderately Disturbed Waters, in addition to the Australian Drinking Water Guidelines.
- The need to eliminate any toxicity characteristics in the Clarence mine water discharge, both to deal with interim impacts on the Wollangambe River and to deliver a suitable water quality which meets both environmental standards and is of a quality suitable for domestic use in the Lithgow Water Supply Dam.

Other Matters

Should planning approval be granted for the Springvale and Angus Place Mine Extension Projects any resulting variations to EPLs will include the following conditions as outlined in the EPA's letter of 7 May 2015:

- Variations to the Environment Protection Licences (EPLs) for Springvale and Angus Place Collieries through a review of all the LDPs for the mines and where necessary applying new limits for pollutants to meet the relevant timeframes.
- Whereas salinity has been earmarked as an important pollutant, the variations to the EPLs will include other pollutants, such as aluminium, arsenic and manganese for Springvale, taking into account the existing capability of the treatment systems, the capacity for timely upgrading, and the relevant timeframe.

By 1 June 2015 the EPA seeks confirmation from Centennial Coal of its agreement to the EC Limits as described above.

Should you have any questions please contact Richard Whyte at the EPA's Central West Regional Office on 63 327 601.

Yours sincerely

Mark Gifford 28/5/15

MARK GIFFORD
Chief Environmental Regulator
Environment Protection Authority

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29 May 2015

Mr Mark Gifford
Chief Environmental Regulator
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Dear Mark

SPRINGVALE MINE EXTENSION PROJECT (SSD 5594)

I refer to your letter dated 28 May 2015, regarding the EPA's response to Centennial's proposed commitments for the Springvale Mine Extension Project.

Centennial acknowledges and agrees to the EPA's proposal for 700/900 EC limits as discussed in your letter.

Centennial agrees in principle to a target of 500 EC at the 90th percentile level from its western operations (Springvale and Angus Place), by 30 June 2019. This agreement is subject to the completion of Centennial's feasibility of such further reductions and the subsequent commercial evaluation required to assess the impact to those operations. To be clear any commitments made to further reductions need to ensure continuity of supply to the local power stations and provide long term security of employment to the Lithgow community.

Centennial will continue to work with the EPA and other relevant stakeholders with a view to meeting improvements in water management in the Upper Coxs River catchment.

Centennial acknowledges and agrees to the proposed monitoring regime, as highlighted in Centennial's correspondence of 10 April 2015.

Separate correspondence in relation to the matters raised by the EPA on the toxicity of the discharge at LDP009 of EPL 3607 and the proposal for Clarence Colliery will be forwarded shortly.

Please do not hesitate to contact me should you wish to discuss this further.

Yours sincerely

David Moult
Managing Director & CEO

Pagodas

As indicated in Section 6.1 (page 23) of the Department's Preliminary Assessment Report (PAR), Springvale Coal states that the proposed longwall layout would avoid direct impacts to 97% of cliffs and pagodas in the project area. Further explanation of this figure is provided in numerous sections of the Response to Submissions (RTS) (refer to pp. 218, 234-235, 262, 269 and 292).

The mine plan has been modified to avoid most of the pagodas. As shown in Figures 8.6 A, B and C of the EIS, the vast majority of pagodas (ie 97% within the project area) are located outside the 26.5 degree angle of draw line from the footprint of the proposed longwalls. Longwalls LW501 to LW503 have been positioned between clusters of pagodas. Previously approved LW419 to LW422 have been shortened, and by doing so avoid pagodas. The only pagodas within the 26.5 degree angle of draw (but outside the extents of the proposed longwalls) are the pagodas above LW501 and LW502.

Springvale Coal states that whilst these pagoda complexes could experience low levels of subsidence (ie 1.5 mm/m tensile strain and 0.5 mm/m compressive strain), they are not expected to experience any significant conventional tilts, curvatures or strains or any consequent spalling or cracking. These features are located along the valley sides and, therefore, are not expected to experience the valley-related upsidence or additional compressive strains due to valley closure.

It is considered unlikely, therefore, that the pagoda complexes would experience any adverse impacts from the extraction of the proposed longwalls. Springvale Coal states that this is supported by extensive experience from elsewhere in NSW coalfields where, at depths of cover greater than 200 m, no cliff instabilities have been observed where cliffs are located wholly outside the extents of extracted longwalls.

Baseflow Reductions in Creeks

As indicated in Section 6.4 (page 42) of the PAR, the *Groundwater Impact Statement* (RPS, 2014) included in Appendix E of the EIS predicts that one reach of Carne Creek (CA5 – Reach 5) may experience a decline of baseflow of up to 49% of baseline conditions as a result of the Project (refer to p. 87 and Table 7.2 of Appendix E of the EIS).

For the purposes of its groundwater modelling, CSIRO divided Carne Creek into five reaches (CA1 to CA5), all of which flow from south to north and are predicted to be gaining streams under baseline conditions. This division was continued in the RPS assessment. The location of each Carne Creek reach is shown on the figure below (extracted from the CSIRO report at Appendix K of Appendix E of the EIS). Reach CA1 is located to the east of all proposed longwalls. Reaches CA3 and CA4 are small tributaries which drain into CA2. Reach CA5 is a relatively short length of Carne Creek, at its headwaters and located high in the local topography. Sunnyside East Swamp is located on

CA5. The reach runs across Longwalls LW415 to LW419 and drains northeast into CA2.

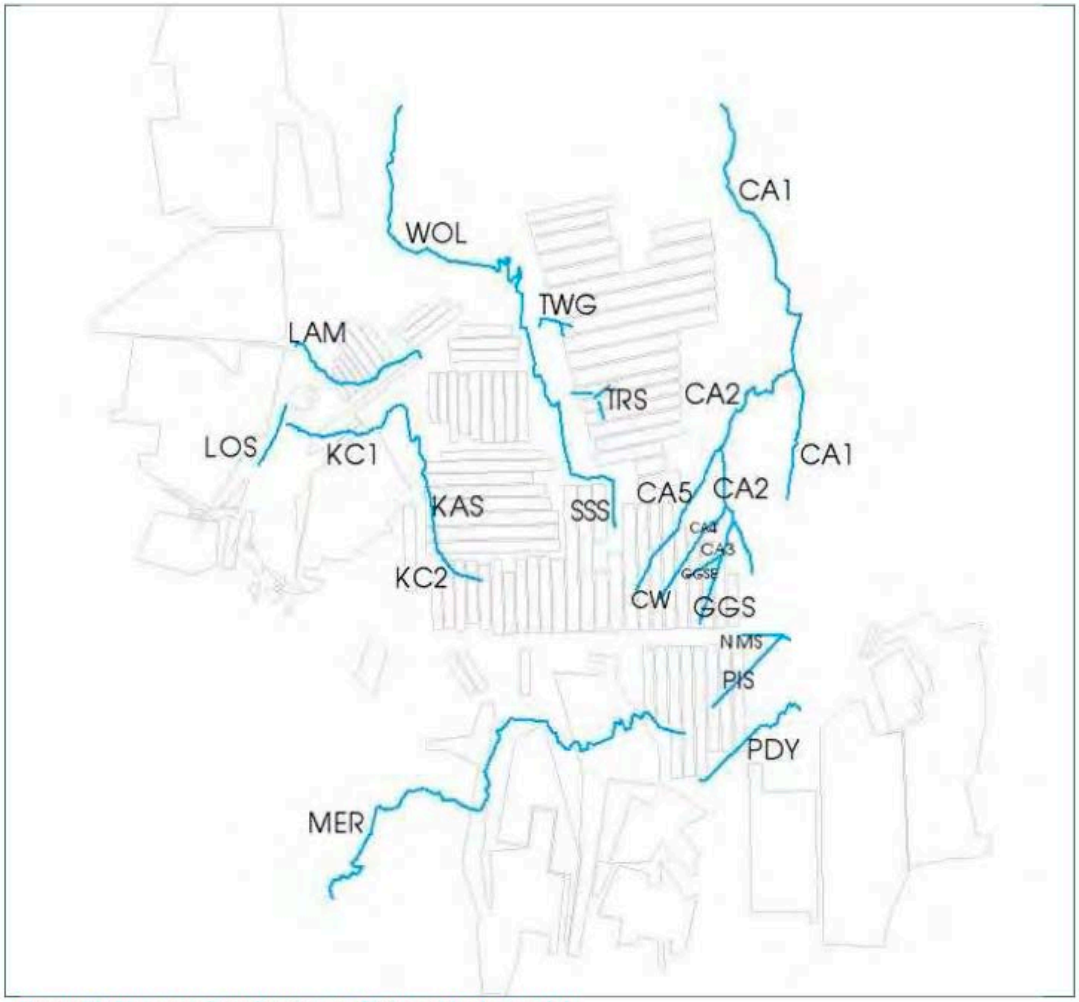

Figure C1 River reach and swamps of interest in the model

At the end of mining, Carne Creek Reaches CA1 and CA2 are predicted to experience minor reductions in baseflow of 0.7% and 7.6% (ie -0.0328ML/day and -0.0881ML/day), respectively. Reaches CA3 and CA4 are predicted to experience small increased baseflows (or reduced net leakage). The 49% reduction in baseflow predicted along Reach CA5 is equivalent to -0.1165ML/day. Although this is a large proportional increase, in real terms this baseflow loss is minor.

As a whole, RPS states that Carne Creek (including Reaches CA1 to CA5) is predicted to have only minor net loss of 0.8 % of baseflow levels (ie -0.049 ML/day) at the end of mining, so the predicted baseflow losses at CA5 are unlikely to be transferred downstream. Furthermore, RPS states that as the creek is ephemeral and flows only after prolonged or significant rainfall events, the differences in observed or recorded flows are unlikely to be noticeable.

RPS indicates that approximately 25% of reach CA5 is occupied by Sunnyside East Swamp. Therefore, it is predicted that a similar portion of the

baseflow losses may be derived from this swamp. However, as discussed in greater detail in Section 6.2 of the PAR, recharge of the perched groundwater system which sustains the swamps is via lateral transmission of percolating infiltrated rainwater, so, the Department considers that these predicted minor baseflow losses are unlikely to significantly impact Sunnyside East Swamp.

APPENDIX 5
DRAFT POLICY FRAMEWORK FOR BIODIVERSITY OFFSETS FOR UPLAND SWAMPS AND ASSOCIATED THREATENED SPECIES

Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species

IMPACTED BY LONGWALL MINE SUBSIDENCE

MAY 2015

INTRODUCTION

The calculation and provision of offsets for subsidence impacts of longwall coal mining on upland swamps and associated threatened species is being aligned with the framework outlined in the *NSW Biodiversity Offsets Policy for Major Projects* (Offsets Policy).

The following policy framework will be applied in implementing the Offsets Policy in respect of subsidence impacts on upland swamps and associated threatened species.

Where 'nil' or 'negligible' environmental consequences are predicted

Where 'nil' or 'negligible' environmental consequences for upland swamps and threatened species are predicted (supported by evidence), no up-front offset is required.

'Nil' or 'negligible' environmental consequences is considered to mean that subsidence will not result in changes to shallow groundwater regimes supporting an upland swamp community through fracturing of the bedrock base or controlling rockbar of a swamp, tilts of surface strata or any other subsidence-related impact.

Upland swamps that are predicted to experience 'nil' or 'negligible' subsidence will have a relevant (i.e. 'negligible environmental consequences') performance measure included as a condition of consent.

Monitoring is required to measure compliance with this performance measure, with a focus on shallow groundwater monitoring in swamps. If monitoring shows that mining has significantly impacted the shallow groundwater aquifer in a swamp and that impact has stabilised for a period of 12 months, then an offset must be identified and secured within 6 months of the completion of that period.

Where predictions exceed 'nil' or 'negligible' environmental consequences

If it is predicted that upland swamps are likely to experience greater than negligible environmental consequences, then an offset will be required as a condition of consent.

Calculating the 'maximum predicted offset liability'

Offsets should be calculated using the Framework for Biodiversity Assessment (FBA) in accordance with the Offsets Policy.

The offset liability should be assessed as a potential maximum (i.e. worst case scenario), given uncertainty in the prediction of subsidence and consequent environmental outcomes for upland swamps.

A 'maximum predicted offset liability' must be calculated for the total area of upland swamps predicted to be subject to greater than negligible environmental consequences. This must be calculated as the ecosystem credits equivalent to the predicted loss of the upland swamp vegetation types present in those swamps. Where relevant, species credits for threatened species known or predicted to occur within the swamps must also be calculated.

If it is predicted (supported by evidence) that a partial impact to an upland swamp is likely, then only the portion of the swamp likely to experience greater than negligible impacts should be included in the offset calculation.

Securing an appropriate offset for predicted impacts

The applicant must prepare a Biodiversity Offset Strategy that demonstrates how it will fully meet the requirements of its 'maximum predicted offset liability' for the required ecosystem and species credits, applying the rules of the Offsets Policy. If the proponent demonstrates that a like-for-like offset cannot be secured, other options under the 'variation rules' or supplementary measures may be considered.

The applicant must demonstrate how it will legally secure the proposed offsets – e.g. how it will purchase the relevant offset site, purchase the biodiversity credits from a landholder or arrange for relevant supplementary measures to be carried out. Suitable means of demonstrating this include ownership of the land or a long-term option to purchase, or provision of an adequate security bond or deposit.

Prior to approval of an Extraction Plan, the applicant must demonstrate that it can satisfy its 'maximum predicted offset liability' for all mining subject to that plan. Conditions of development consent may also require that a suitable 'bank' of offsets is established early in the life of the development, and then maintained as appropriate.

The offsets identified in the Biodiversity Offset Strategy are only required to be secured or credits retired once the outcomes of mining are confirmed through agreed monitoring.

Performance measures

Performance measures may be included within conditions of consent where reasonable predictions can be made and there is a high probability that the criteria are achievable.

In particular, where there is a strong likelihood that an upland swamp will experience nil or negligible subsidence, then a relevant performance measure (i.e. 'negligible environmental consequences') will be included as a condition of consent.

Compliance action may be taken for breach of performance measures.

Monitoring the environmental consequences of mining on upland swamps and associated threatened species

The primary focus of monitoring must be the piezometric measurement of the effect of mine subsidence on the shallow groundwater aquifer that supports the upland swamp vegetation communities and associated threatened species.

A minimum of two years pre-mining piezometric data should be used to establish the baseline shallow groundwater regime in every swamp within 400 m of longwall mining. Where less than two years of pre-mining data is available, then a more conservative assessment of the sensitivity of the feature to potential impacts must be applied.

It is generally accepted that impacts on shallow groundwater regimes are the most immediately definable impact on an upland swamp ecosystem and the most appropriate 'early indicator' of long-term environmental consequences for the features and characteristics (including the existence) of the swamp. Consequently, if monitoring demonstrates that the shallow groundwater aquifer is impacted, then there is a presumption of long-term impacts on the swamp.

A robust Before - After - Control - Impact (BACI) design must be used for the monitoring program to distinguish impacts of mining from natural seasonal or climatic variation. The monitoring program should also seek to identify any positive or negative trends in groundwater and populations of threatened species, particularly in the two years before and after mining.

Monitoring of secondary environmental consequences (such as loss of or change in vegetation community type, impacts on identified threatened species, impacts on soil stability or erosion) should also be undertaken to inform the timing and extent of expression of these impacts following changes to the shallow groundwater aquifer.

Consideration of actual and predicted impacts

If monitoring demonstrates that predicted groundwater impacts occur and that impact has stabilised for a period of 12 months, then the applicant must meet the full calculated value of the offset for that swamp.

If monitoring demonstrates that a predicted groundwater impact has not occurred within 12 months of completion of all mining within 400 m of a swamp, or has occurred in only part of that swamp, then the applicant may make application to the Secretary to have the full offset associated with the swamp, or part of that offset, deducted from the projects overall 'maximum predicted offset liability'.

If monitoring shows that mining has impacted the shallow groundwater aquifer more than predicted and that impact has stabilised for a period of 12 months, then an offset is to be identified and secured within 6 months of the completion of that period.

Any application for a reduction in the maximum predicted offset liability must be supported by monitoring data and must be independently peer reviewed by a reviewer agreed by both DPE and OEH. Any such application must be made within 5 years of the completion of mining within 400m of the upland swamp.

The applicant may, at any time, acquit the full value of the offset. If this occurs prior to the undermining of any swamps, the applicant may negotiate with the approval authority about the extent of ongoing monitoring required.

Re-crediting of retired/deposited offsets

If ongoing monitoring of shallow groundwater aquifers beyond the time when an offset is secured demonstrates that the aquifer has returned to a natural regime (as described by the two year, pre-mining baseline), then the applicant may apply to the approval authority for a reduction in a future offset liability under this framework. Any such application must be made within 5 years of the completion of mining within 400 m of the upland swamp.

If less than two years baseline data on the shallow groundwater regime was collected for any upland swamp, the applicant cannot apply at a later date for a reduction in future offset liability.

Any application for a reduction in future offset liability must be supported by monitoring data and must be independently peer reviewed by a reviewer agreed by both DPE and OEH.

Application

The framework will be applied to all new applications for development consent for longwall mining that may cause subsidence impacts on upland swamps.

The framework will be applied, where reasonable and feasible, to mines that have applications on foot for longwall mining that may cause subsidence impacts on upland swamps.

Where mines have existing development consent for longwall mining that may cause subsidence impacts on upland swamps, the framework will be applied to all new Extraction Plans approved following 31 October 2015.