



# Blue Mountains Conservation Society Inc

ABN 38 686 119 087

PO Box 29 Wentworth Falls NSW 2782

Phone: (02) 4757 1872

E-Mail: [bmcs@bluemountains.org.au](mailto:bmcs@bluemountains.org.au) Web Site: [www.bluemountains.org.au](http://www.bluemountains.org.au)

**Nature Conservation Saves for Tomorrow**

May 22, 2015

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

By email: [pac@pac.nsw.gov.au](mailto:pac@pac.nsw.gov.au),  
Attention: Naomi Cleaves/Rob Sherry

## **Submission opposing proposal R031/15** **Springvale Mine Extension Project [SMEP]**

### ***Preamble***

The Blue Mountains Conservation Society (BMCS and also 'The Society' in the present submission) has a membership which fluctuates in the range 800-850. The membership is mainly drawn from the City of the Blue Mountains and the Greater Sydney region, but a scattering of members exists throughout NSW and also interstate.

The Society has a strong interest in the Greater Blue Mountains World Heritage Area (GBMWA) in terms of protecting its many parks and reserves. It is also extremely active in campaigning for the reservation of the Gardens of Stone Stage 2 (GoS2) Proposal over the western portion of the Blue Mountains and the Western Escarpment between Blackheath and the Capertee valley, and pursuing the National Heritage Listing of parts of these areas with a view to having them ultimately being assessed for addition to the GBMWA.

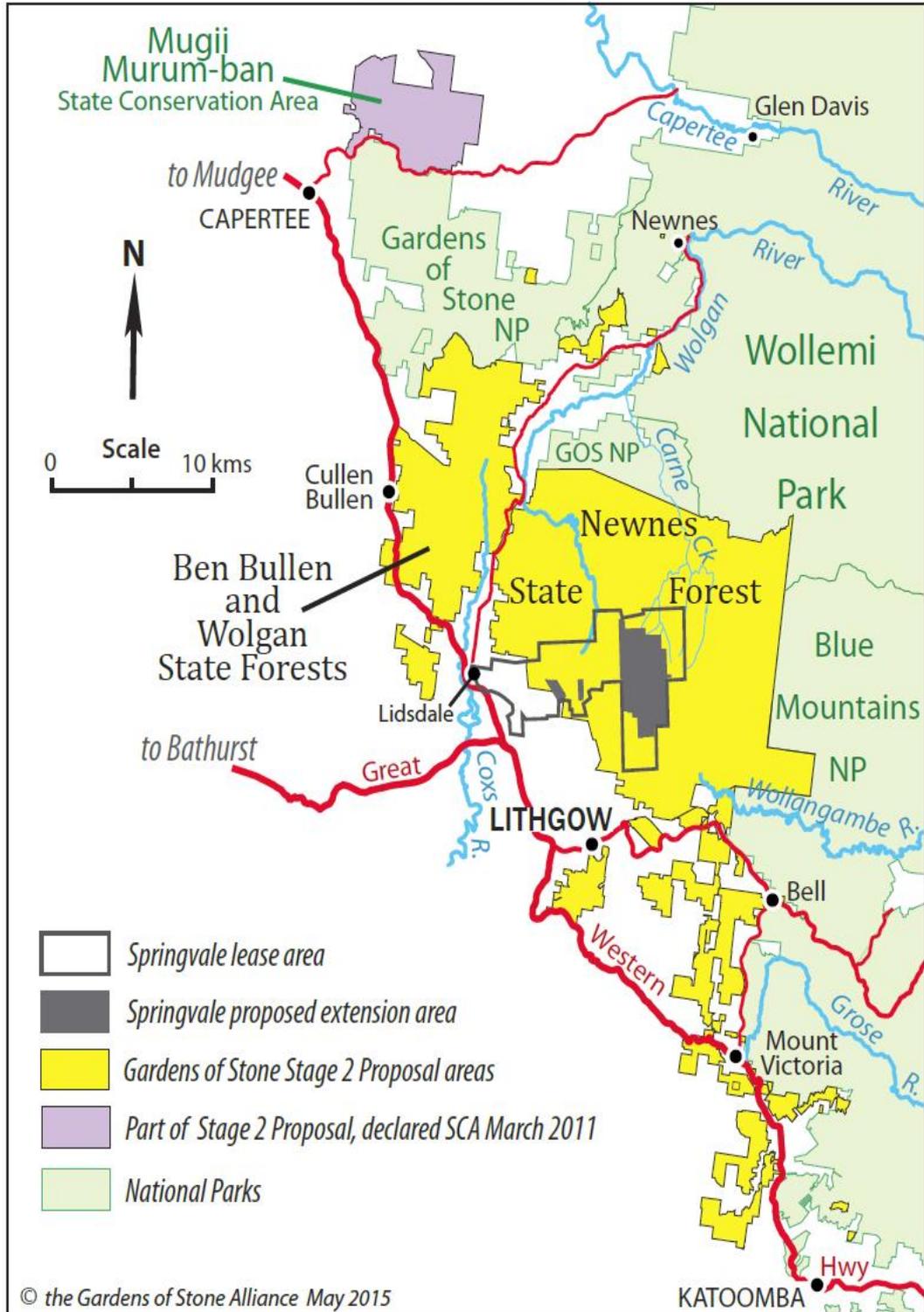
The Springvale Mine Extension Project (SMEP) is on Newnes Plateau, which comprises a major part of the GoS2 Proposal and, under this proposal, is recommended for reservation as a State Conservation Area (SCA). SCAs are a form of reservation meant to be compatible with low-impact environmentally-sensitive underground mining. However, it will be suggested in this submission that past activities by Springvale have caused substantial damage to surface flows and groundwater dependent ecosystems, and that the impacts of the Extension Project will cause unacceptable damage to endangered ecological communities, the pristine waters of Carne Creek which feeds the Emirates Wolgan Valley Resort, and the Coxs River which feeds Lake Burragorang and is part of Sydney's water supply.

Before proceeding further, and without impugning the knowledge of the Planning Assessment Commission (PAC), the Society presents Figures 1 and 2 showing the Gardens of Stone region, the GoS2 Proposal encompassing Newnes Plateau, and the relationship of the SMEP to current and proposed mining developments on Newnes Plateau. **This is necessary because some have suggested that the SMEP is geographically separate from the Gardens of Stone.**

# The Gardens of Stone Region Locality Map

Showing proposed extensions to Springvale coal mine 2015

The Gardens of Stone Region is collectively the GoS2 areas, Mugii Murum-ban SCA, the GoS National Park and the western parts of the Wollemi and Blue Mountains N Pks within the map area



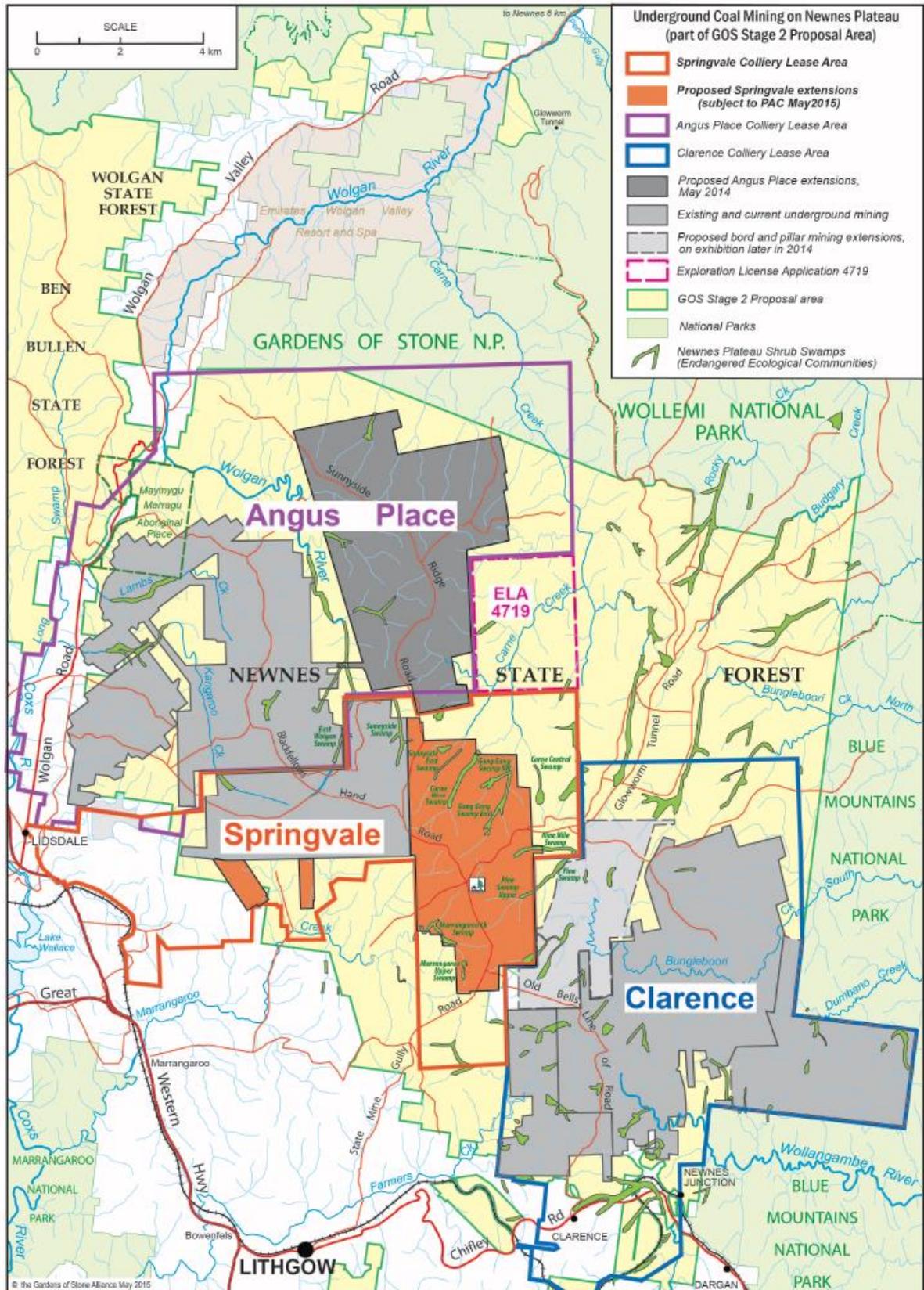


Fig. 2

# 1. Political reality

Given:

- the dependence of the current State and Federal Governments on revenue from fossil-based resources;
- the changes to the Mining SEPP (in November 2013) that made the economic benefits of a mining project the ‘principal consideration’;
- the particular economic and social sensitivity of the Lithgow Region to the coal and power industries;
- the calls from the NSW Minerals Council, mining-company senior management, and some members of government to disband the PAC and return decision-making to the Minister;
- the role of the Mining industry’s deep pockets in creating a range of dependent expert consultants who seemingly provide overly enthusiastic support; and,
- the exponentially growing use of risk-management planning with triggers linked to pre-determined actions which create substantial lag-times and thereby facilitate unfettered production;

the decision-makers in government organisations<sup>1</sup> would seem to have found it increasingly difficult to maintain objectivity and adequately evaluate the relative merits of social, environmental, heritage and economic factors.

The Department of Planning & Environment (DPE) was seemingly faced with either rejecting the SMEP and potentially inducing closure of the Springvale mine<sup>2</sup>, or requiring Springvale to make long overdue treatment of its mine-water effluent and ensuring the safety of THPSS<sup>3</sup> and Carne Creek by adopting **truly** conservative LW panel widths. The DPE has apparently resolved this quandary in its Preliminary Assessment<sup>4</sup> by determining that:

- the **key impacts** can be adequately mitigated, managed and/or offset through the implementation of a number of commitments made by Springvale and the imposition of the DPE’s recommended conditions;
- the **predicted residual impacts** can be avoided, minimised and/or offset by imposing conditions which ensure compliance with relevant criteria and standards consistent with **current** best practice standards for mining projects in NSW; and,
- when **any residual impacts** are weighed against the project’s social and economic benefits, the project (if approved) would deliver substantial economic benefits to the region and NSW.

In effect, it would seem that the DPE has been prepared to immerse itself in the jargon of avoiding, minimising, offsetting and managing the environmental impacts under a spectrum of conditions which ensure that the economic outcomes becoming the ‘principal consideration. **Regrettably, while this avoids conflict with the government’s ethos, it ensures that the environment carries the risk.**

The Society fully acknowledges the difficulties confronting the DPE in dealing with the conflict between reports from the company and its paid consultants, other government instrumentalities, non-government organizations (NGOs), and the wider public. It also recognises the work and integrity leading to the DPE’s decisions, but assessments are made in a politicised environment and the reality of that environment constrains outcomes and requires much courage to thwart it.

The Society is aware that the DPE’s **preliminary assessment** is one of many documents to be considered by the PAC in preparing **the review report** in accordance with the stipulated terms of reference<sup>5</sup>. **It is apparent from the terms of reference that the PAC is required to assess the merits of the project as a whole,**

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<sup>1</sup>For example: Department of Planning, Division of Resources and Energy, Office of the Environment, and Environmental Protection Authority.

<sup>2</sup> When the current consent expires on 30/09/2015.

<sup>3</sup> THPSS = Temperate Highland Peat Swamps on Sandstone including Newnes Plateau Shrub Swamps (NPSS) and Hanging Swamps.

<sup>4</sup> Assessment Report Springvale Mine Extension Project (SSD 5594), DPE, April 2015, Exec Summary, pp1-2.

<sup>5</sup> Assessment Report Springvale Mine Extension Project (SSD 5594), DPE, April 2015, Section 4.8, p14.

**rather than feel over-constrained by economic factors and arguably short-sighted political imperatives.**

## **2. Reports in conflict**

The sequence of the various reports and responses, their overlapping nature, and the vast volumes of electronic paper make it difficult to deal with them comprehensively within the ridiculously short time provided for submissions to the PAC.

The company presents its proposal to the DPE, obviously placing the best spin on how its proposal will impact socially, economically and environmentally. Public submissions and those from NGOs tend to focus on the proposal's adverse consequences and may commonly dispute claims made by the company. Similarly, government departments raise concerns within their fields of expertise, although in some cases, departments such as the Division of Resources and Energy (DRE) may strongly support the proposal on economic and certain types of social outcome, and the importance to the State of utilising its natural assets. This overall constitutes round one!

Before or concurrent with the above, an abridged proposal is sent to the Commonwealth Department of Environment (DoE) in respect of whether or not aspects of the proposal constitute a controlled action under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The DoE calls for submissions and a decision is made.

The DoE has in fact determined that the **project is a controlled action** which needs assessment and approval. However, as the Commonwealth has accredited NSW's environmental assessment process, the assessment associated with the Commonwealth's approval can occur under the *Environmental Planning & Assessment Act 1979* (EP&A Act), but the Commonwealth Minister for the Environment maintains an independent approval role, which would be exercised following the PAC's final determination of the project.

Following round one above, the company digests the spectrum of submissions and, seemingly at its own convenience, submits a response to submissions (RTS) with appendices prepared by its army of consultants. The saturation process<sup>6</sup> is alive and well. The RTS aims to systematically reject the content of the public and NGO submissions; but it treats the concerns of government departments, in some cases following face-to-face discussions, in a less cavalier fashion.

NGOs may elect to respond to the company's RTS, while the government departments may indicate whether or not they are happy with the RTS as it pertains to them. Should there be unresolved issues, the company may elect to supply additional consultant-reports together with peer reviews of those consultant-reports. Throughout this period the proposal sits on the DPE's website with the indication that additional information is awaited. However, concurrent with this, the DPE may seek additional information to assist with its assessment.

In the present case, once the DPE's preliminary assessment report (PAR) is completed, it goes to the PAC which calls for additional submissions in order to prepare a review report. **We are now at this stage.**

Once finalised, the Society understands that the **review report** will go to the DPE to prepare its final assessment which will then be sent to the PAC for **final determination** by different commissioners from those who prepared the review report.

The Society notes that although the DPE and the company have, until the current stage, proceeded at a relatively slow rate, seemingly according to their needs, public and NGO submissions are required within short time-frames which (particularly for volunteer organisations) put much pressure on their resources. **The same applies in the case of submissions to the PAC; very little time is allowed (as noted above) and resources are stretched.**

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<sup>6</sup> Companies have deep pockets and are aware that most environmental organizations are either volunteer-based or underfunded and understaffed. The voluminous and numerous reports based on the belief that no adverse comment must go unanswered, comprise the saturation process – it effectively drowns non-government organizations in a sea of electronic paper.

It is also apparent that, in the case of the DPE's PAR, although the views and evidence provided by other government departments, NGOs and the public are commented upon, there is a tendency for the latest report by the company and/or its consultants to hold sway. This could be because the content is in some way definitive. **It could also be because the latest responses are effectively uncontested and fresh in the assessor's mind; perhaps a case of "he who laughs last laughs longest", but the proposed environmental degradation is hardly a laughing matter!**

Some examples of the DPE responding to the latest response on the proponent's behalf are apparent in the following sections.

### **3. Impacts on outcropping natural features – cliffs and pagodas**

This has been a significant concern in most submissions to the DPE.

The DPE says it "...is satisfied that mining would not impact the vast majority of cliffs and pagodas in the region, and that the extent of the other cliff formations and pagodas potentially impacted is very small, and therefore acceptable."<sup>7</sup>

This reflects Springvale's claim that the proposed LWs will avoid 97% of the cliffs and pagodas, and MSEC's<sup>8</sup> view that the likelihood of cliffs and pagodas being impacted is extremely low.

Let's examine this more closely:

- There are several significant cliffs in LWs 501 and 502, and there is potential for damage in LWs 418 and 432 – refer to the PAR Figure 7 and text on pp22, 25.
- Overall emphasis in the PAR is on 'direct' impacts from being in the area of the LW or at least within the area of the 26.5° angle of draw, but there is potential for indirect impacts from movements focused by fracture zones (PAR p22).
- The region of the LWs is crossed by significant NNE- and NW-trending lineaments (PAR Figure 6) which could be reactivated during the mining.
- Ditton Geotechnical Services Pty Ltd DgS and Office of Environment & Heritage (OEH) both raised concerns about seam-to-surface connective cracking.
- Pagodas and cliffs have varying degrees of 'natural' stability given that they are cut by fractures (joints) and variably weathered – impacts resulting from movements linked to subsidence/upsidence and any form of accommodation along pre-existing fracture systems could destabilize sections of cliffs and pagodas.

**Given the above dot-points and the fact that the cliffs and pagodas are natural systems with instabilities waiting to be exacerbated by mining-induced ground movements, the level of confidence expressed by the DPE and Springvale and its consultants is overly optimistic; 'sod's law' is a reality!**

**It is disappointing that the DPE has focused on the SMEP's claims that the LWs have been designed to minimise impacts. Instead, while acknowledging the 'positive' actions, the DPE could have suggested that even better outcomes could be had by shortening or narrowing some panels to avoid environmentally sensitive features.**

**The PAC review report should highlight the need for such improvements.**

### **4. Impacts on THPSS (NPSS and HS – hanging swamps)**

This is deemed a key issue of the DPE assessment.

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<sup>7</sup> Assessment Report Springvale Mine Extension Project (SSD 5594), DPE, April 2015, Section 6.1, p25.

<sup>8</sup> MSEC is Mine Subsidence Engineering Consultants: this organization peer-reviewed Subsurface Fracture Zone Assessment by Ditton Geotechnical Services Pty Ltd (DgS)

PAR Section 3.2 p10 cites the listing of the THPSS as follows:

*“All upland swamps in the Southern Coalfield, and the **shrub swamps in the Western Coalfield**, are listed as Endangered Ecological Communities (EECs) under both NSW’s Threatened Species Conservation Act 1995 (TSC Act) and the Commonwealth’s Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The **hanging swamps in the Western Coalfields** are listed as EECs under the EPBC Act.”*

There are no ifs or buts about this; they **must** be protected under Commonwealth and State legislation. The Society therefore wondered what monumental perversions of logic were to be used to justify mining beneath and in the catchments of such swamps. Having now read the justifications in the relevant sections, the principal reactions are incredulity, anger and then sadness. **It is incomprehensible that, at a time when the coal industry is declining and there is a massive need to leave coal in the ground<sup>9</sup>, the NSW Government continues** (seemingly through the compliant collaboration of government departments) **to risk damaging EECs by unconscionably promoting the exploitation of marginally economic coal deposits<sup>10</sup>.**

The importance of these swamps in the context of damage caused by LW mining has resulted in extensive discussion in the DPE’s PAR. The ‘key’ reports are listed in PAR Section 3.2 p10, and on p11 details are provided of the recently developed draft *Policy Framework for Biodiversity Offsets for Upland Swamps and Associated Threatened Species Impacted by Longwall Mining Subsidence* (April, 2015) or, more simply, ‘**draft Swamp Offset Policy**’; and the main components of the DPE’s assessment, utilising aspects of the key reports, are covered in PAR Section 6.2 pp26-34.

The Society will attempt to deal with the PAR’s approach to damage to and protection of the NPSS and HS by selectively following subdivisions recognised in PAR Section 6.2.

#### **4.1 Historic swamp damage.**

The PAR and Springvale acknowledge that surface impacts occurred at Narrow North, Narrow South, East Wolgan and Junction Swamps (PAR Section 6.2 p26). The Federal Government commissioned the Goldney Report<sup>11</sup> to (*inter alia*) evaluate the impacts and assign a cause where possible. The Goldney Report found that the principal causes of damage were (PAR p26) “...*licenced discharges of mine water (Narrow North, Narrow South and East Wolgan Swamps); and, changes to swamp hydrology caused by cracking of the rock substrate beneath the swamp as a result of mine subsidence (East Wolgan and Junction Swamps).*” Largely based on these findings about damaging nationally endangered swamps, the company agreed to a \$1.45 million enforceable undertaking; not much of a fine when compared with the profit being generated.

The history leading up to the point where damage was finally acknowledged by Springvale and its consultants is outlined in Colong’s submission (pp9-13)<sup>12</sup>. Very simply, Springvale and its consultant consistently denied that there was serious damage at East Wolgan Swamp, until the consultant was shown where at least 8-10 ML/dy of discharged mine water were descending underground to 60-80 m below surface and not reappearing further downstream at any monitoring point.

The Society strongly believes that had there been ‘normal’ creek flows, in the order of about 1 ML/dy, the company would have remained in denial. However, faced with the irrefutable, the company instigated investigations and ultimately produced a report which, unfortunately, focused on the damage to the peat, rather than dealing with the mining-induced dilational fracturing of the rocks along the East Wolgan Lineament.

At the time, the consultant ascribed the damage and water loss to an unspecified ‘unique set of circumstances’. Springvale now appreciates that the suite of NW- and NNE-trending lineaments mark fracture zones which focus dilational damage during LW mining. However, consistent with the need to avoid

<sup>9</sup> <https://www.climatecouncil.org.au/unburnable-carbon-why-we-need-to-leave-fossil-fuels-in-the-ground-1>

<sup>10</sup> This being the case when the contribution to global CO<sub>2e</sub>, and the impacts on EECs, the quality of water supply, social values, and the development of more sustainable industries are adequately evaluated.

<sup>11</sup> Goldney et al, January 2010, *Determining Whether or Not a Significant Impact Has Occurred on Temperate Highland Peat Swamps on Sandstone Within the Angus Place Colliery Lease on the Newnes Plateau*, prepared for the Commonwealth Department of Environment, Water, Heritage and the Arts.

<sup>12</sup> Muir K, May 2015, *Submission as an objection to proposal R031/15 - Springvale Mine Extension Project*, on behalf of the Colong Foundation.

damage to creek flows and associated swamps, Springvale currently ascribes the damage to the underlying LWs exceeding critical width-depth ratios (PAR p26)<sup>13</sup>.

It is gratifying to see that the information about the damaged East Wolgan Swamp is now in the public domain. Indeed, the company is using the outcome regarding width-depth ratios to support its selection of panel-width. Nevertheless, **the Society notes that it took in the order of three years for the company to accept that the swamp and creek had suffered significant mining-induced damage. It then took another two years for the company to investigate the problem and obtain meaningful results. Yet throughout the 5-year period, mining continued unabated!**

**The DPE provides little comfort in relation to the previous paragraph as its principal response is to impose conditions requiring even more monitoring! This does not work. By far the best and dare we say most obvious answer is to avoid undermining them.**

**The PAC review report should focus on avoidance, in the face of failing to protect swamps by endless and surface-damaging monitoring.**

## 4.2 Offsets and avoidance.

### 4.2.1 Offsets

On PAR p10, the DPE indicates that “...predicting impacts on swamps is complex, and that it is still unclear exactly how sensitive swamps are to mining subsidence.” The DPE then suggests that the high degree of uncertainty is the reason why “...subsidence and related impacts on swamps are currently excluded from...OEH's recently released NSW Biodiversity Offset Policy for Major Projects, 2014...” Yet despite this uncertainty the DPE and OEH have prepared the draft Swamp Offset Policy (See Section 4 above) and DPE considers that it is (PAR p11) “...the best guidance currently available for assessing and offsetting mining-related impacts on swamps, and believes it should be used in the assessment of the merits of the Springvale project.”

The Society has serious concerns about this:

- The Society has made submissions relating to: the *NSW Biodiversity Offset Policy for Major Projects, 2014*, the application of the offsets policy, and the Commonwealth’s enquiry regarding offsets. In all cases, it has been strongly argued that EECs and Threatened species in natural habitat should not be open to offsetting. No amount of offsetting will alter the simple mathematics whereby, if there are 10 known populations of a threatened species and two are trashed, only 8 will remain. **Offsetting should only be a last-resort option in the context of truly exceptional circumstances.** The draft Swamp Offset Policy reflects a different philosophy – mining will take place and swamps will be damaged, so let’s create a compensatory offset process!
- The policy is still a draft and was seemingly put together for April 15, almost as a basis for facilitating approval of the SMEP!
- The policy will only be finalised following consultation with the Commonwealth and key stakeholders – until this consultation has taken place and there has been the opportunity for the Society (as a stakeholder) to comment, there must be a big question mark over such a ‘miner-friendly’ process.
- **On the basis of the key requirements (PAR p11) the policy is conducive to damaging the swamps as opposed to protecting them.** For example:
  - No upfront offset for ‘nil’ or ‘negligible’ consequences is contentious because the difference between ‘nil’ and ‘negligible’ is substantial – **it acknowledges that some damage is possible.** It also relies on supporting evidence, no doubt provided ‘in house’ or by a ‘dependent’ consultant.
  - As a check on the above, there will be a ‘performance measure’ [presumably some form(s) of monitoring] in the consent such that if ‘more than negligible’ is indicated, an offset will be

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<sup>13</sup> Width of the LW panel divided by the depth of the panel below the overlying cover; the smaller the ratio, the less the likelihood of the panel inducing damage.

identified and secured. **This disregards the concept of a significant lag-time between cause and detectable outcome by an appropriately sensitive monitoring process. But in any case, the swamp has now been excessively damaged and there is no provision for removing the cause. This company effectively has ‘carte blanche’ to trash swamps!**

- If greater than ‘negligible’ damage is predicted, an offset will be required. Even so, although the offsets must be identified and available, “...*they are not required to be secured or credits retired until the outcomes of mining are confirmed through targeted monitoring...in recognition of the level of uncertainty in relation to the extent and severity of subsidence-induced impacts to swamps.*” Clearly, this is a case of damage the swamps at will, but the company mustn’t incur risk or inconvenience.

**If this is the “best guidance available”, the Society would hate to see what other options were canvassed.**

**As the DPE has used the deficient draft Swamp Offset Policy to categorize the potential for swamp damage and assess the need for monitoring and offsets, the Society believes that this aspect of the PAR should be revisited. The PAC review report should explicitly recommend this.**

#### 4.2.2 Avoidance

The DPE acknowledged (PAR pp27-28) that the Commonwealth’s Department of the Environment (DoE) approved extraction of LWs 415-417, provided that LW mining not be undertaken directly below known high quality swamps (e.g., Sunnyside East or Carne West) **unless a proven technology or engineering methodology would prevent severe impacts from subsidence.**

Goldney et al’s research<sup>14</sup> into the impacts of LW mining on swamps, plus Springvale-sponsored additional studies, have enabled recognition of critical and sub-critical panel-widths for the mine’s conditions. **By reducing the panel-width to ensure sub-critical behaviour, swamp-damage can be reduced but not necessarily eliminated.**

The DoE accepted the research and approved the revised panel- and chain pillar-widths for LWs 415-417. The DPE effectively endorsed the outcome by noting that (PAR p28) “...*the geometry of the longwalls proposed to be mined as part of the extension project are consistent with those approved by DoE in 2013.*”

The Society recognises the importance of width-to-depth ratios in relation to impacts on swamps and notes that a 261 m panel-width and 58 chain pillar-width yield the optimum reductions of subsidence and strain. However, like IESC<sup>15</sup> and OEH, the Society remains concerned and emphasises that whereas the narrower panels reduce impacts on swamps, **it is perhaps premature for the DPE to accept that there is no evidence of “...large-scale loss of or impacts on swamps undermined by the relatively narrow longwalls...at Springvale.”**

In elaboration of its concerns, the Society notes:

- We are dealing with a natural system involving interaction between the biota, the hydrologic regime, stratigraphic variations, natural fracture and fault systems, and imposed fracturing and stress variations related to the mining process – in consequence, as with the damage at and below East Wolgan Swamp, when the various factors ‘align’, substantial damage can arise and the swamps suffer.
- There is also a time factor! Changes inducing swamp damage may be slow to initiate (the lag effect) and may be masked by weather events (see dot-point 4).
- The event-scale for companies is short term and ‘obvious’ – cause and effect (from their viewpoint) should be closely related and easily recognised, but it is rarely that easy and not helped by the inadequacy of many monitoring programs.

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<sup>14</sup> Goldney et al, January 2010, *Determining Whether or Not a Significant Impact Has Occurred on Temperate Highland Peat Swamps on Sandstone Within the Angus Place Colliery Lease on the Newnes Plateau*, prepared for the Commonwealth Department of Environment, Water, Heritage and the Arts.

<sup>15</sup> Commonwealth Independent Expert Scientific Committee (IESC)

- About 10 years ago when environmental groups argued that LW mining was damaging NPSS (and HS), their claims were strongly rejected by companies and their consultants in terms of the ‘monitoring’ data: falling piezometric levels in swamps were ascribed to the protracted drought (climate related) and undermining played ‘no significant’ part; then, when the drought broke, rising piezometric levels reflected rainfall events effectively thereby affirming that undermining was not a ‘significant’ factor. The possibility that the scale of the climate events masked any undermining component was dismissed.

Despite lessons to be learnt from past mistakes, the companies and their consultants are (over) confident in relation to swamp-monitoring and the benefits of sub-critical panel design. It is gratifying that IESC and OEH are less easily swayed (PAR pp29-30); it is disappointing that the DPE, despite concluding (PAR p34) “...that nine shrub swamps have a higher risk of impact, primarily due to the predictions in relation to cracking and fracturing of the bedrock beneath them and associated changes to their shallow groundwater regimes”, has chosen to invoke the draft Swamp Offset Policy and emplace a detailed swamp-monitoring program (developed on conjunction with OEH) “to determine with certainty whether performance measures and conditions are being met.”

**How many endangered swamps will be compromised by this approach whereby the risk is vested in the environment? It is hoped that the PAC review report will consider this question.**

### **4.3 Subsidence/upsidence, baseflow losses, and vertical connectivity**

#### **4.3.1 Subsidence/upsidence**

The DPE essentially relies on the MSEC report in relation to subsidence/upsidence-impacts on creeks and other watercourses (PAR pp41-42). Anything which affects surface-water flows in direction and volume must necessarily affect NPSS and HS. In the same way that swamps act as sponges and smooth flow-patterns through naturally regulated release, swamps are sustained by confined flows and sheet-wash from the upstream catchment.

According to MSEC, the potential impacts are: tilting leading to local changes of gradient; upsidence-induced cracking/fracturing thereby enhancing permeability and creating subsurface flow, and baseflow losses. MSEC envisages ‘negligible’ direct subsidence-related tilting, but predicts that upsidence-related cracking is likely in Carne Creek and other watercourses where bedrock is exposed. MSEC nevertheless believes that a net loss of water is improbable as the depth of fracturing and dilation is unlikely to exceed 15 m; the **belief** is that such ‘lost’ water will re-surface further downstream.

**OEH has queried the belief and so does BMCS.** The nearby example of ‘lost water’ is that from East Wolgan Swamp (see Section 4.1 above and, for more detail, the Colong Foundation’s submission<sup>16</sup>). There is no doubt whatsoever that, if the surface cracking links with a subvertical fracture zone (the East Wolgan Lineament), the mining-induced dilation can and will extend to greater depth. The water at East Wolgan went down to 60-80 m and then (presumably!) migrated NNE along the fracture zone. Whether or not the water joined the Wolgan River where it meets the lineament is unknown, but it certainly didn’t register at the flow monitor downstream from East Wolgan Swamp.

**The Society emphasises that: cracking occurs as a consequence of LW mining; its magnitude and downward extent depend on whether or not the swamp/stream system is focused by an older fracture zone; and, there are real consequences in terms of damage to swamps and their ecosystems.**

#### **4.3.2 Baseflow-losses and vertical connectivity**

The DPE is satisfied that (PAR p44) “...the potential for loss of surface water baseflows as a result of longwall mining under the project is relatively minor and would not result in any significant environmental consequences.”

**In view of what happened at East Wolgan Swamp (see Section 4.3.1), the Society finds the DPE’s level of satisfaction astounding.** It could be that East Wolgan Swamp involves a unique set of circumstances,

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<sup>16</sup> Muir K, May 2015, *Submission as an objection to proposal R031/15 - Springvale Mine Extension Project*, on behalf of the Colong Foundation.

but damage to Junction Swamp (also on the East Wolgan Lineament – see PAR Fig. 6) was cracking-related, and anomalous behaviour occurred at Narrow Swamp (also on a NNE-trending lineament – see PAR Fig. 6). With swamps aligned along several NNE-trending lineaments in the SMEP area, it would seem rational to at least consider the implications for baseflow-losses and anticipate the worst! Conversely, the DPE considers that baseflow-losses are overestimated because the claystone intercalations in the Burrell Formation are aquitards which promote lateral flow and inhibit vertical flow (PAR p30 and Fig. 9).

The Society considers that in the Burrell Formation's intercalated sandstone/claystone sequence, the magnitude of the bedding-parallel flow-component greatly exceeds the bedding-normal one; but over time, the flow vector moves obliquely through the aquitards and enters the Banks Wall Sandstone. **Such water is effectively 'lost'. The Society does not subscribe to the view that the Burrell Formation's aquitards preclude vertical connectivity; if they did, they would be aquicludes!**

Now we consider vertical connectivity (PAR p22).

Following extraction of the coal and the progressive retreat of the LW mining machine, the 'roof' collapses and the A-Zone of 'continuous' fracturing extends up to the Burra-Moko Head Sandstone (PAR Fig. 9). Above that, the B-Zone of discontinuous fracturing extends up through the Banks Wall Sandstone into the base of the Burrell Formation. The A- and B-Zones are separated by an aquiclude named the Mount York Claystone. It is conceivable that the B-Zone overlaps the downward extending D-Zone or zone of surface cracking where the depth of cover is less than 180 m. As noted by OEH, this raises the risk of linked seam-to-surface cracking and raises the spectre of swamps drying up as surface water and groundwater drains into the mine void. LWs 432 and 501-503 (see PAR Fig. 7) possibly fall into this category.

Conventional wisdom suggests that this doesn't happen because the Mount York Claystone is an 'aquiclude' which physically separates the shallow and deep groundwater regimes. However, as with the claystones of the Burrell Formation, the Mt York Claystone is an aquitard, albeit a thick one; it slows the transmission of water but does not prevent vertical connectivity<sup>17</sup>.

The Society emphasises that water 'losses' severely impacted East Wolgan Swamp and could significantly impact swamps in the SMED; the risks are real.

## 5. Surface water issues

Impacts on the water quality of the Cocks River and Lake Burrorang are deemed a key issue by the DPE (PAR p1).

The Springvale Mine Extension Project (SMEP) and the Angus Place Mine Extension Project (APMEP) were originally presented contemporaneously so that the impacts could be considered cumulatively. It is the DPE's intention that this approach be retained, despite Angus Place now being on 'care and maintenance' due to low coal prices. The approach recognises that the Angus Place mine can re-commence operations and the APMEP be continued should the export coal-price lift substantially or for whatever Centennial and its partner decide is in their best interests.

### 5.1 Disposal of mine-water make

Past practice at Springvale involved disposing of mine-water make via the Springvale Delta Water Transfer Scheme (SDWTS). The mine-water was piped direct to the Wallerawang Power Station for cooling purposes and the ultimate disposal issue became a matter Delta. According to PAR p39, this water-management strategy, **perhaps with an upgrading of the SDWTS's capacity**, was to have been continued for the combined Springvale and Angus Place discharges.

With Angus Place on 'care and maintenance' and Wallerawang Power Station permanently closed, there is need for operational modifications to accommodate the volume of water which was to have gone to Wallerawang. There is also need to consider the concerns of the Environmental Protection Authority (EPA)

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<sup>17</sup> This has been demonstrated by Pells Consulting for the Bald Hill Claystone, an aquitard similar in properties to the Mt York Claystone, in relation to water lost from Thirlmere Lakes.  
<http://www.pellsconsulting.com.au/downloads/reportOnTheWaterLevelsOfThirlmereLakesOctober2011.pdf>

about the toxicity characteristics of Springvale's discharge from LDP 9. The EPA stipulated that (PRA p40) “...Springvale Coal needs to address the salinity of LDP 9 discharges and that Reverse Osmosis (RO) treatment capable of reducing the discharges to an EC of 350  $\mu\text{S}/\text{cm}$  should be investigated.”

The **current situation** is that Springvale is discharging its surplus mine-water make (about 14 ML/dy – PRA pp39-40) to the Coxs River via LDP 9; to this must be added up to 8.3 ML/dy from Angus Place (less any amount directed to underground storage)<sup>18</sup> because of the ‘care and maintenance’ requirements. LDP 9 has a discharge limit of 30 ML/dy and an EC limit of 1,200  $\mu\text{S}/\text{cm}$ , but the EPA has indicated that these are interim limits until changes in the management of mine-make are implemented.

The **proposed situation** is that the **SMEP with Angus Place on ‘care and maintenance’** will need to discharge from 22 to 27 ML/dy<sup>19</sup> of surplus mine-water make into the Coxs River via LDP 9, whereas for the **SMEP and the APMEP combined**, the discharge would be 29 ML/dy.

The Society’s principal concerns arising from the proposals are:

- the envisaged doubling of the SDWTS to handle up to 50 ML/dy of mine-water make;
- the licence specifications for LDP 9 and how they will be achieved;
- the impact of the discharges on the Coxs River and Lake Burragorang; and,
- the seemingly accommodating attitude of the DPE in relation to the assessment of the SMEP/APMEP.

## 5.2 The Society’s concerns

### 5.2.1 Doubling the Springvale-Delta Water Transfer Scheme (SDWTS)

Doubling the capacity of the SDWTS to 50 ML/dy was part of the original proposal when the price of coal was much higher, the Springvale and Angus Place mines could benefit by sharing parts of the infrastructure, Wallerawang power station was still viable, and Delta wanted some of the water. The proposal has not been withdrawn and the DPE’s PAR comments on it but seems to provide no assessment of its merits or lack of them.

The Society believes that the DPE should, for the guidance of the PAC review report, be clearly stating what is intended by Centennial and EnergyAustralia (EA now owns this division of Delta). The ramifications of this uncertainty are considerable. For example:

- If Centennial wishes to have LDR 9 licensed to discharge the full SDWTS capacity, what is this telling us about further expansion of the mine?
- Has EA contracted to taking any of the mine-water make, bearing in mind its high salinity and metals content?
- Does Springvale have to treat the effluent before it goes to the SDWTS? This is of particular importance as the emergency alternative to discharging via LDP 9 is discharging to the Wolgan River which flows through the Emirates Wolgan Valley Resort and from there into the Greater Blue Mountains World Heritage Area.

**These matters should be of concern to the PAC review report.**

### 5.2.2 LDP 9 EPL 3607 licence aspects

**The Society contends that any discharges of mine-water make should be treated to a standard which is equivalent to the natural chemistry of the receiving waters.** Furthermore, since the Coxs River catchment and Lake Burragorang are within the catchment for Sydney’s drinking water, the *State Environment Planning Policy (Sydney Drinking Water Catchment) 2011* applies and requires that the Minister’s delegate be satisfied that the project would have a 'neutral or beneficial effect' on water quality.

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<sup>18</sup> See p3, Muir K, May 2015, *Submission as an objection to proposal R031/15 - Springvale Mine Extension Project*, on behalf of the Colong Foundation.

<sup>19</sup> 19 ML from the SMEP and 3 to 8 ML from Angus Place depending upon how much is stored underground

The DPE (PAR p17) notes that for LDP 9 “...existing discharges from Springvale meet the current EPL's limits for EC and that Centennial is currently investigating options to further reduce the salinity levels of discharges.” Unfortunately, the current EPL 3607, which has a discharge limit of 30 ML/dy, has an over ‘generous’ EC limit of 1,200 µS/cm and is long overdue for being brought more in line with contemporary needs. The only reason Centennial is ‘investigating options’ is that the EPA has put the company on notice regarding upgrading of standards. There should be no brownie points for meeting the current EPL’s limits.

Closure of Wallerawang Power Station in 2014 resulted in Springvale discharging mine-make to the Coss River and increasing its salinity. The background for the **Coss River headwaters** is 30µS/cm whereas the median EC for discharges from LDP 9 is 1055µS/cm. Also, the discharges are alkaline and have toxic concentrations of calcium, zinc, potassium, magnesium, sulphate, chloride and sodium<sup>20</sup>.

Under the ANZECC (2000) Water Quality Guidelines for Protection of Aquatic Ecosystems, the appropriate guideline for water salinity in the SMEP is 300µS/cm. This is still ten times the salinity of the Coss River headwaters, but it is less than a third of the median salinity of discharges from LDP 9.

**The Society believes that the EPA has made a reasonable request, but on PAR p40, Springvale’s view is that the level of treatment would be prohibitively expensive (capital costs estimated to be \$60 million, plus ongoing operational costs) and impracticable due to the magnitude of pre-treatment that would be required. The Society finds the response disappointing, though predictable!**

To place its response in a more favourable context, Springvale used a consultant to model a range of possibilities listed in PAR p40. The Society makes the following comments:

- A “...target of 900 µS/cm would lead to a water quality in Lake Lyell that is consistent with historical observations, whereas a...target of 350 µS/cm would lead to a water quality in Lake Lyell that is substantially improved over that experienced in the last 15 years”. The Society believes that expenditure to achieve the high target will be substantially less than for the low target, but why aim to obtain a level of salinity that equates with many years of mining-related pollution? It is surely preferable to seek a significant improvement.
- Two examples are given of the throughputs needed for full Reverse Osmosis (RO) treatments to achieve ‘end-of-pipe’ outcomes of 900 µS/cm and 350 µS/cm – nothing is given on the need for pre-treatments or likely plant costs. The Society notes that 900 µS/cm is not far below the current median EC of 1055µS/cm; on a cost/-return basis 350 µS/cm would be the only sensible option.
- A simulation involving Clarence’s lower salinity discharges being added to Springvale’s and then undergoing continuous RO treatment at a fixed rate of 6 ML/day to achieve an outcome at Lake Lyell of 685 µS/cm. This is a reasonable outcome which perhaps deals with Clarence’s discharge, but there are other issues including what happens should Angus Place re-start mining, and is there a Plan B if the RO plant breaks down?
- Two other options deal with outcomes at Lake Burraborang. Both options involve “dispersed salinity throughout Lake Burraborang” (PAR p40): one disperses effluent from Springvale and Angus Place, but involves no treatment; the other has effluent from Springvale, Angus Place and Clarence (19 ML/dy) and has treatment (continuous RO at 6 ML/dy): the outcomes are essentially the same at Lake Burraborang because of the enormous dilution factor, but it is unclear what the ‘end-of-pipe’ outcome might be for the treated effluent.

While the possibility of blending discharges (say Springvale’s and Clarence’s) can lower salinity preparatory to RO treatment, all but one of the proposals involves using RO. In this context, it is worth citing the work of Dr S Khan, an expert in the treatment of polluted water before its return to the natural environment.

In a letter (attached as **Appendix A**) he refers to water management options for West Cliff Colliery in relation to renewal of EPL 2504. He was asked to “identify realistic options for treatment of coal mine wastewater

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<sup>20</sup>All data in this paragraph are derived from Muir K, May 2015, *Submission as an objection to proposal R031/15 - Springvale Mine Extension Project*, on behalf of the Colong Foundation, p11.

*prior to discharge into the aquatic environment*” He lists the water quality contaminants of most concern in the relevant catchment as “*salt...and heavy metals (aluminium, Arsenic, Copper, Nickel, Zinc and Lead)*” These are the same contaminants found in the discharge from Springvale Mine in the proposal before this PAC.

Dr Khan writes “*the only currently available technology with the capacity to significantly treat all of the identified inorganic anions, cations and heavy metals (e.g., Aluminium, Arsenic, Copper, Nickel, Zinc and Lead) and the overall electrical conductivity is reverse osmosis”.* His published study is attached as **Appendix B**.

**The Society emphasises that there are no free options. However, Centennial has made large profits from Springvale and Angus Place and has benefitted from operating under ‘generous’ EPLs. But values change and the EPA is becoming more attuned to protecting the environment rather than facilitating exploitation of the resource. Now is the time to act!**

**It is hoped that the PAC review report will see the necessity of making the proponent conform to new licence conditions, rather than allowing licensing limits which the company deems ‘practicable and economically achievable.’**

### **5.2.3 Discharge-impacts on Coxs River and Lake Bullagorang**

#### **(a) Coxs River**

The Blue Mountains Conservation Society engaged in protracted legal action against Delta Electricity from early 2009 until late 2011. The principal aims were for Delta to reduce the contaminated discharges from Wallerawang Power Station and remediate existing damage. The saline discharges had significant concentrations of copper, zinc, aluminium, boron, fluoride, arsenic and nickel. The action went to successful mediation in October 2011, when Delta agreed to progressively reduce the level of contaminants during the period needed to design and install RO treatment of the discharges.

EnergyAustralia (formerly TruEnergy) bought the Wallerawang and Mt Piper Power Stations and honoured the mediated agreement. However, Wallerawang was decommissioned at the end of 2014, leaving **the Springvale-Delta Water Transfer Scheme (SDWTS), including LDP 9, as the main source of pollution.**

The proposed SDWTS discharging through LDP 9 (~29 ML/dy – see Section 5.1 above) would comprise more than twice the Coxs River median flow, as determined at the nearest downstream monitoring point<sup>21</sup>. However, under the ‘worst case’ scenario of 50 ML/dy, the discharge would be more than three times as much. There is little doubt that flows of this intensity would significantly impact the diversity and abundance of aquatic life for tens of kilometres down-river where it flow through the Greater Blue Mountains World Heritage Area; perhaps even as far as Lake Burragorang. Even with current flows in the order of 17-22 ML/dy (see Section 5.1 above), the saline mine-water make will be the dominant component for many kilometres before, due to incoming ‘clean’ water from side-streams, it continues as a subordinate plume of pollution..

In terms of the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*, contamination of the magnitude created by the SMEP cannot be dismissed as neutral and it most certainly isn’t beneficial. The DPE has seemingly under-estimated the impact of this salty metal-contaminated discharge.

#### **(b) Lake Burragorang**

PAR p41 refers to the impact of the proposed LDP 9 discharges based on updates by the Jacobs Engineering Group: “*Jacobs states that the predicted increase in salinity in Lake Burragorang (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.*”

Having reported this, the DPE then proceeds to tie itself in knots (PAR p41):

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<sup>21</sup> OEH Science Division, June 2014, reported in Muir K, May 2015, *Submission as an objection to proposal R031/15 - Springvale Mine Extension Project*, on behalf of the Colong Foundation, p12.

*“The Department does not consider that an increase of 5 - 6% is arithmetically 'neutral'. However, this should not be the basis of the assessment. The critical question is whether the increase is 'environmentally neutral'. In this regard, it is important to note that the predicted increase in salinity in Lake Burragorang results not from higher EC in inflows from the Coxs River, but from an increased total salt load as a result of the expanded mining area and the proposal to divert up to 19 ML/day of Clarence Colliery's mine water from the Wollangambe River. The increase must also be considered in the light of the Australian Drinking Water Guidelines (2015) and the potential for any such increase to lead to any 'environmental harm'.*

*In the Department's opinion, there is no basis on which to conclude that there would be any negative effects from the predicted increase in salinity, which is well within the range of normal upland streams and catchments in eastern Australia and well within the expected standards of the Drinking Water Guidelines. On this basis, the Department considers the changes to be environmentally 'neutral'.”*

The Society offers the following comments for consideration:

- A change of 5-6% is significant – for humans, a 5% increase in salinity might enable us to float more easily, whereas for some species of macroinvertebrate it means death – so a change may be arithmetically **and** environmentally significant; the and in the example offered the environmental significance is positive for humans but negative for some macroinvertebrates.
- The significance of any change is a function of the sensitivity of the receiver.
- There seems to be confusion over EC, salinity and total salt load – salinity reflects total salt load which is expressed as EC in  $\mu\text{S}/\text{cm}$ .
- The “19 ML/day of Clarence Colliery's mine water” should not increase the total salt load per ML, as Clarence's mine water has a lower EC than the discharge from LDP 9 – see the first of the 4 dot-points on PRA p40.
- Irrespective of the above point, Springvale wants the SMEP and is therefore responsible for actions it implements in trying to make it acceptable.
- The volume of water in Lake Burragorang varies considerably as a function of rain events, drought, evaporation, thermal expansion/contraction, and consumption; conversely, the volume of mine-water progressively increases as the mine (the number of LWs) expands. It follows that the ‘increase in salinity’ will vary substantially.

#### **5.2.4 DPE ‘accommodation’**

Based on the way the process has proceeded subsequent to receiving unfavourable responses by NGOs and some government departments to the original proposal, it would seem that a decision was made within DPE to be rigorous but to ensure that a positive, though highly conditional approval eventuated. This was first alluded to in Section 2 above and commented upon at various points in later sections

The Society will use the issue of contaminated discharges and their impact on the Coxs River and Lake Burragorang to demonstrate what is perceived as the ‘desired/predetermined’ outcome driving the PAR language and thinking, rather than the DPE's assessment process leading to a logical outcome.

- Part of the problem has already been demonstrated in Section 5.2.3(b): the PAR seems too intent on dismissing the potential impacts of salinity and metallic ions on Lake Burragorang. **Is not adequately treating the mine-water make really worth the risk to Sydney's water supply?**
- The DPE seems happy to leave issues for the EPA and others to resolve whilst effectively giving Centennial the tick of approval. Thus:

PAR p2 – The DPE considers that “...these impacts can be adequately mitigated, managed and/or offset through the implementation of a number of commitments made by Springvale Coal and the conditions recommended...by requiring Springvale Coal to continue negotiations with the Environment Protection Authority and other relevant agencies regarding water management in the upper Coxs River, and to develop water management options for Springvale by the end of June 2016.”

PAR p41 – The DPE notes that “...Centennial is currently investigating options to further reduce the salinity levels of discharges.” And that the DPE “...agrees with the EPA that these alternative treatment arrangements may take some time to implement, but is satisfied that they would result in a 'beneficial' effect on water quality in the Coxs River and its downstream waterways, compared with existing discharges.”

- Yet the EPA seems to have only part of the information required to negotiate while the DPE has effectively said fine, let's go for it! Thus:

PAR p41 – The DPE also notes that “...as at the date of this report, the EPA has not had the opportunity to review the final Jacobs report and further consider potential discharge management options in light of the modelling results. However...the EPA has acknowledged that reducing the salinity of mine water discharges to 350  $\mu\text{S}/\text{cm EC}$  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 pretreatment 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  $\mu\text{S}/\text{cm EC}$  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.”

“The EPA has not yet had an opportunity to review this timeframe and program of works but has previously agreed in-principle to allow Springvale Coal to continue negotiations with NOW, the SCA and Energy Australia regarding water management in the upper Coxs River in order to propose appropriate water management options and Pollution Reduction Programs (PRPs) for Springvale and Clarence coal mines, including actions to ensure that Angus Place can be brought online seamlessly.”

“At this stage, the Department accepts Centennial's proposed approach and has recommended a condition of consent which requires Springvale Coal to have an action plan in place by the end of June 2016.”

In response to all of this haste and not allowing community and NGO stakeholders to engage with proper agreements (or perhaps Heads of Agreement or Memoranda of Understanding) rather than thought bubbles, the Society asks:

- As the EPA has to sign-off on the relevant EPL, why was the EPA seemingly unaware of what was in the Jacobs report and what Centennial had opted for as the best option?

Who believes that “a performance measure of 700 to 900  $\mu\text{S}/\text{cm EC}$  at LDP 9 by 31 December 2016” will be acceptable bearing in mind that the EPA suggested 350  $\mu\text{S}/\text{cm EC}$ , the existing licence stipulates an EC limit of 1,200  $\mu\text{S}/\text{cm}$ , and background for the Coxs River headwaters (the preferred target) is 30 $\mu\text{S}/\text{cm}$ <sup>22</sup>.

- Is the performance measure based on using the RO plant at Wallerawang for processing the LDP 9 discharge?
- Having an action plan by June-end 2016 is encouraging, particularly as it is followed by the performance measure by December-end 2016, but will the second RO unit be available and when will Clarence be linked to the SMEP?
- It is disturbing to see that implementation time for the modifications (if approved) is 4 years; and in the interim what will be the salinity? Perhaps 700 to 900  $\mu\text{S}/\text{cm EC}$  at LDP 9 after 31 December 2016?

It is clear from the above dot-points and aspects highlighted in the preceding sections that the PAC review report is being asked to evaluate the DPE's PAR when it is beset with many uncertainties. It is of concern that the pollution of the Coxs River is being left to negotiations between the EPA and other organisations which have strong vested interests in the outcome. The legislator (the EPA) should not be placed in a

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<sup>22</sup> Birch, G., Siaka, M., and Owens, C. (2001). The source of anthropogenic heavy metals in fluvial sediments of a rural catchment: Cox's River, Australia. *Water, Air and Soil Pollution* **126**, pp.13-35.

situation where, under the possible threat of the matter going to court if one of the other parties fails to obtain sufficient concessions is most unsatisfactory.

## **6. Conclusions and Recommendations**

### **6.1 Conclusions**

Whereas the Society believes that it is time to move from coal-based power generation and into renewable power generation, it recognizes that the change must be transitional. The Society is not, therefore, opposed to low-impact environmentally-sensitive LW mining where companies have contracts and can continue to mine profitably.

In the present case, the SMEP portrays its proposal as environmentally sensitive, but it fails to be convincing in relation to the protection of sensitive landforms, THPSS (NPSS and HS), and the pristine waters of Carne Creek. It also fails to provide remedial solutions to ensure that high salinity polluted mine water is no longer discharged into the Coxs River, this having potential impacts on parts of the Greater Blue Mountains World Heritage Area and on the receiving waters of Lake Burragorang.

The DPE's assessment report seems to reflect a predetermined position consistent with pressure applied from within government. In consequence, it in places lacks rigour by failing to confront and provide resolution of difficult issues. It effectively places economic and social benefits for some substantially ahead of the environmental and social benefits of others.

The DPE's report shows that there has been wide consultation. But in the face of concerns raised by other government departments and replied to by the company's specialised consultants, it would seem that the consultants' views have prevailed. When issues are raised by experts in OEH, EPA and the like, with no allegiance to the company, common sense would suggest the response by a company-paid consultant should be viewed cautiously.

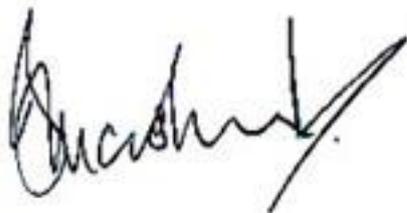
The PAC review report should take these conclusions and pertinent matters emphasised in the various sections of this submission into consideration. It should either reject the DPE's assessment and therefore the SMEP as presently formulated, or make recommendations that ensure a better balance between environmental, social and economic factors and introduce more rigour.

### **6.2 Recommendations**

The Society strongly opposes the SMEP in its present form and therefore recommends that the PAC review report rejects the DPE's assessment and, in doing so, also rejects the SMEP.

Should the PAC review report not be prepared to reject the SMEP, the Society recommends that the PAC review report asks for greater protection for landforms, THPSS (NPSS and HS) and water courses by modifying the LWs to ensure they avoid these features; avoidance is preferable to monitoring.

Similarly, the PAC review report should ensure that before mine-water is discharged into the environment, it must be treated to a degree which is compatible with the receiving system.



***Dr Brian Marshall,  
For the Management Committee.***