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## Nature Conservation Saves for Tomorrow

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## **Subsidence Management Plan Application (SMPA) Partial Extraction of Areas 700 West and 800 Clarence Colliery November 2011**

### **1. Introduction**

The Society has previously raised concerns in relation to the proposed LWs. It would like these matters to receive further consideration in relation to the precautionary conditions attached to any approval of this SMPA. The Society emphasises that these matters (in Section 2 below) will be supplemented by additional commentary in Section 3 dealing specifically with the SMPA.

### **2. Previously registered concerns**

#### **2.1 Location**

The 800 area abuts the Blue Mtns National Park (BMNP) within the Greater Blue Mountains World Heritage Area (GBMWhA). Although surface cracking is improbable due to the extraction method, 'anomalous' cracking is not precluded and remains a possibility. Also, although argument is made that there will be no adverse impact on the groundwater and surface water regimes related to Newnes Plateau Shrub Swamps<sup>1</sup> within the 700W and 800 areas, this and the potential for impact on the surface waters entering the GBMWhA remain significant concerns. In such circumstances, it is incumbent on DTIRIS-DRE, through its administration of the SMP process, to insist on forms of protection which preclude the need for expanded monitoring and remediation measures (oops!). In relation to the 800 area, this would involve fully cushioning the GBMWhA by imposing a wide buffer zone.

The 800 area includes headwater-tributaries of the Wollangambe River and Bungleboori Creek river systems. As both enter the WHA and the Wollengambe is a declared 'wild river, it is critical that neither system is compromised with respect to the quantity and quality of discharges from mining. Any mine-water discharges to the Wollengambe system must be treated to a standard consistent with the specifications for a highly sensitive pristine environment. DTIRIS-DRE should fully impose such specifications, particularly as the total volume of discharge will increase as a function of the volume of the coal seam subjected to mining.

Similarly, despite protestations by the company's consultant to the contrary, the potential for vertical connectivity remains. It is essential to the credibility of the SMP system that mining does not compromise the current and longer-term groundwater regime which underpins the swamps and provides base flow to the river systems.

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<sup>1</sup> This is used collectively for swamps, including hanging swamps, which are listed and protected under State and Federal legislation.

## 2.2 NPWS intentions

Submissions by environmental groups over many years for reservation of Newnes Plateau within the national park system were re-focused by the Gardens of Stone Stage 2 Proposal in 2005. In respect of the 800 region, GoS2 advocates its addition to the BMNP. This is justified because the National Parks and Wildlife Service (NPWS) recognises that the 800 area contains identified wilderness, with significant pagodas and vegetation communities, and should be reserved. Should the SMPA be approved, the future reservation of this region, either as part of the BMNP or as an SCA, will remain possible, **provided that mining-related damage is appropriately constrained under the proposed SMP conditions.**

## 2.3 Content from other communications

### 2.3.1 Email to Centennial Coal<sup>2</sup>

- (a) Concerns about the level of competence of the flora and fauna studies: *“It was stated that on the first pass analysis there was no endangered flora in the areas. The Wildlife atlas shows that there are endangered species in these areas. There is some concern that a remark made about fauna not being impacted was excessively casual - there is now concern about impacts on macro- and micro-fauna, and on fauna-specific habitat such as NPSS.”*
- (b) Concern about inadequate buffer zones: *“There seemed to be much uncertainty regarding the size of the buffer against the National Park boundary. The figure of 20m was mentioned but this is woefully inadequate. No construction or any surface workings/monitoring should be permitted within a 100m buffer zone.”*
- (c) Concerns about pagodas and Gooches Crater: *“...pagodas and significant cliffs are not amenable to remediation when cracked/collapsed, and Gooches Crater is an unsurpassed scenic feature of substantial scientific/archeological importance. Any risk to these physiographic forms is unacceptable. The concept of a sequence of triggers resulting in various actions, most of which do not involve cessation of extraction (until it is far too late), are best handled by acknowledging that damage should be avoided rather than clumsily remediated (if practicable!). The precautionary principle demands that protection zones be established to ensure there is NO risk of damage.”*
- (d) Concern about fracture zones and vertical hydraulic connectivity: *“...it is critical that the SMPA presents the latest information from air photo and aeromagnetic data on the distribution of significant fracture zones (FZs) within the 700W and 800 areas. There should be clear statements regarding the implications of the specific FZs for mining/subsidence and facilitating vertical hydraulic connectivity between the exploited seam and near-surface aquifers. Where uncertainty exists, there should be a clear understanding that the seam where affected by FZs will not be exploited.”*

### 2.3.2 Submission re Clarence Water Transfer Scheme (CWTS)<sup>3</sup>

Gross redirection of groundwater captured as mine-water make: *“The scheme provides for ~14 ML/dy of mine-make to be transferred from an east-flowing hydrologic regime to an initially west-flowing one. Pre-mining, the groundwater regime and the surface water it underpins would have contributed to the Wollangambe and Bungleboori systems which become an integral part of the National Park and World Heritage Area.”* This scheme *“...must have a time-cumulative impact on the east-flowing system and thereby constitutes a threat to the National Park and World heritage Area. It should not be permitted.”* A better solution would be *“...to treat the mine-make to a standard where it is chemically and physically equivalent to the quality of Wollangambe water prior to being discharged. The World Heritage Area, arguably the region’s greatest asset, would benefit and be enhanced.”*

## 3. The current SMPA

The SMPA relies heavily on the fact that subsidence will be minimal (<100 mm) compared with substantially more destructive LW mining. The Society does not dispute this claim. However, there is a tendency throughout the SMPA to use these low levels of subsidence as a basis for down-playing mining-related<sup>4</sup> impacts. This, in turn, enables an emphasis on monitoring, mitigation (where the low level of subsidence is the principal mitigant) and ‘management’, rather than application of the precautionary principle and selecting ‘avoidance. By way of example (V1, Part1, Section 1.10 p9): *“...the majority of the existing controls in place will adequately address the potential subsidence risks to significant*

<sup>2</sup> Sent to Alanna Howard and Edwina White 30/09/2010 about 700W and 800.

<sup>3</sup> Emailed to Lithgow City Council and available to Centennial – CWTS\_BMCSSubmissionToLCC\_110824.pdf

<sup>4</sup> Mining-related’ is used because in other documents Centennial and its consultants (particularly Aurecon) have distinguished between ‘direct subsidence impacts’ and those linked to other aspects of the mining process such as swamp damage partly attributed to emergency mine-make discharges interacting with subsidence induced effects.

natural and manmade features and infrastructure. Existing controls include mine design, management plans and monitoring programs developed over the years in accordance with the existing approvals.” The Society notes that the Newnes Plateau Shrub Swamp Management Plan failed to protect East Wolgan Swamp, Junction Swamp and Kangaroo Creek. The Society also notes that the technical investigation<sup>5</sup> into EWS has not yet been released to concerned environmental groups, yet mining to the east continues.

### 3.1 Depth of cover and faulting

The variable cover depth throughout 700W and 800 is taken into consideration in Sections 5 and 6 (V1-2, Parts 1-2). Nevertheless, little attention in this analysis appears to have been given to the impact of pre-existing structures such as fracture/fault zones. This was a significant factor in relation to anomalous behaviour along the East Wolgan Lineament. The influence of structure in creating anomalous behaviour expressed as mining-related impacts should receive further consideration [x-refer to section 2.3.1(d) above]. Section 4.6.5 p24 is particularly cursory in that of the three brief paragraphs, para 3 repeats para 2!

### 3.2 Subsidence predictions and monitoring

Three sections are cited and will then be commented upon:

- (a) Section 6.4 p34: “...the layouts in current use and planned for future areas are expected to result in subsidence within the 100 mm performance criteria...The limited magnitude of the subsidence associated with partial extraction...has not resulted in any discernible surface damage to date, and consequently no significant surface impacts are predicted to occur as a result of the partial extraction proposed in the 700 West / 800 Areas.”
- (b) Appendix C Section 4.1 p14: “Through-going crack systems, which would significantly alter vertical permeability, are highly unlikely to develop with such small ground movements recorded at surface, and with the observed behaviour of the working seam roof.”
- (c) Appendix C Section 4.2.2 p29: “The data do not indicate any adverse impact on the near-surface aquifers. “If there was any serious, adverse impact, then the plot of the piezometric pressures would show a rapid decline. The increase in pressure suggests that there has not been any cracking which could serve to drain the strata downwards into the mine.”

The Society accepts the basic contention in item (a). The Society recognises the simplicity embodied in items (b) and (c), but draws attention to several aspects: (i) the ‘Through-going crack systems’ are unlikely to develop from scratch, but this disregards the re-activation of pre-existing structures as suggested in Section 3.1; (ii) importance of ‘significantly alter vertical permeability’ [as per (a)] – this presumably means of a magnitude such that, irrespective of the piezometers’ locations, there would be a major decline in piezometric pressure which even the consultant would be unable to ascribe to something other than mining; and (iii) the concept of major fracture paths allowing free draining from near-surface water resources down to the mine workings is nonsensical and has been rejected elsewhere<sup>6</sup>.

### 3.3 Subsidence impact assessment – natural features – V1, Part 2, Section 8.1

#### 3.3.1 Rivers, creeks and aquifers – sections 8.1.1 and 8.1.2

- (a) Section 8.1.1 p43: “During the Stakeholder Presentation for this SMP Application, no issues were raised regarding the partial extraction of pillars underneath the drainage lines.” This statement is misleading. Participants were asked to present concerns in writing by a stipulated date (irrespective of whether they were or were not raised specifically in the forum) – [x-refer to section 2.3.1(d) above].
- (b) Section 8.1.1 p43: “Access to the tributaries within the SMP Application Area is very difficult and measurement of surface water (flow and quality) is not warranted given the negligible impact of mining on the tributaries (demonstrated over the previous 12 years).” The Society rejects this because: (i) the statement is not supported by a specific x-reference; (ii) even if the ‘negligible impact’ is a correct evaluation, there is no obvious consideration of

<sup>5</sup> Although from the limited information appearing in other Centennial documents it would seem that the principal aim was to attribute the EWS superficial disaster to emergency discharges and to disregard the enormous water losses down to depths of 60-80 m.

<sup>6</sup> SV\_AP\_EPBCPrelimDocs\_BMCSSubm’n\_1112014.pdf p11 “In response to the consultant’s implication that the absence of a total loss of pressure means there cannot be continuous cracking into the goaf, BMCS noted...that this would be correct if one were dealing with (say) a metre-wide open fracture from surface to goaf. But such a simplistic model is not being advocated because it totally disregards the complexity (including rates) of vertical hydraulic conductance and seems to disregard the dynamics associated with ongoing precipitation, infiltration and groundwater flow, which supplement pressure heads irrespective of the pressure collapse at the goaf.”

the cumulative effects in such an assumption; and (ii) the extreme terrain may reflect the variable which engenders an impact [x-refer to sections 2.3.1(d) and 3.1 above].

- (c) Section 8.1.1 p44: *“The key issue in relation to the effects of the mining proposal on creeks relate to the loss of water from the upper (near-surface) aquifers that provide baseflow to the creeks.”* This is certainly true, but the supporting evidence is said to be in the next section (8.1.2), which then presents excerpts from Appendix C by Aurecon (2011), this being a report **specifically prepared in support of the SMPA**. Rather than deal with this piecemeal, particularly as it is also the principal basis for statements made in Section 8.1.5, the Society will comment on the Aurecon findings in Section 3.4 (below).

### 3.3.2 Cliffs/pagodas – section 8.1.3

- (a) Section 8.1.3 p53: *“During the stakeholder consultation for this SMP Application, no concerns relating to impacts on cliffs and pagodas were raised.”* This statement is misleading. Participants were asked to present concerns in writing by a stipulated date (irrespective of whether they were or were not raised specifically in the forum) – [x-refer to section 2.3.1(c) above].
- (b) Section 8.1.3 pp55-56: *“All cliff lines to be undermined in the 700 West / 800 areas are categorised as low in terms of mining impact [mining influence in Tables 17 and 18] and very low to low in overall. This highly favourable outcome is again indicative of the conservative nature of the mine plan.”* The statement is **inaccurate** in the context of 700W Table 17 – there may be no major change in the conclusion regarding a favourable outcome, but several ‘moderates’ are shown in terms of ‘mining influence’ and ‘overall’.

### 3.3.3 Springs, swamps, wetlands, water related ecosystems

- (a) Section 8.1.5 p59: *“Monitoring of the swamps within the Eastern SMP Area commenced in July 2004 for flora and September 2005 for fauna. The objective of these studies was to quantify that the partial extraction mining operation has no impact on either NPSS or NPHS over the Clarence Colliery mining lease area.”* Surely the objective should be to ascertain whether partial extraction has any impact on NPSS/NPHS? Quantifying a lack of impact is easily done by not implementing an appropriately sensitive methodology!
- (b) Section 8.1.5 p59: *“Inspections of swamps undermined by full pillar extraction and longwall mining have also been undertaken by Gingra Ecological Surveys (2008) prior to preparing previous SMP Applications. These inspections revealed that there appeared to be no mining related damage in the swamps included in the monitoring program.”* The Society notes that, in a recent assessment by the UQ, this work was considered insufficiently sensitive to provide a meaningful answer<sup>7</sup>. The Society had previously presented a paper to Centennial and UQ in which it concluded that the flora monitoring program was comprehensively inadequate<sup>8</sup>. Furthermore, the Society has a substantial section elaborating upon these concerns in a recent submission to Centennial and SEWPAC<sup>9</sup>. Even though Gingra could find no mining-related damage and the UQ, despite re-emphasising the limitations of Gingra’s work, made similar statements, BMCS can only express its incredulity at such facile seemingly disingenuous findings. Is the Society to believe that the \$1.45 million Enforceable Undertaking, as imposed on Centennial by SEWPAC because of damage to THPSS (NPSS/NPHS), is baseless?
- (c) Section 8.1.5 pp59-60: much of what is presented in ‘baseline monitoring’ and the ‘impact assessment’ relates to the low level of subsidence (acknowledged by BMCS) and Aurecon’s advice in many supportive documents and Appendix C. The latter will be considered in Section 3.4 below, as previously indicated in Section 3.2.1(c).

### 3.3.4 Flora and fauna

- (a) From RPS Appendix D Executive Summary: *“The Proposal is unlikely to significantly impact on any species, population or ecological community listed under the TSC Act, EPBC Act or SEPP 44.”*  
And from Section 8.1.6 p66, in turn derived from the Seven Part Test Conclusion (Appendix B as identified in RPS Appendix D): *“Following an assessment of the likeliness of occurrence...RPS concluded that the potential subsidence associated with the project is unlikely to significantly impact on any threatened species, populations or ecological communities. In the unlikely event that minor surface impacts do occur...effects on any threatened species, populations or ecological communities are not expected to be significant as the area of impact will be minor relative to the remaining similar habitat areas within and neighbouring the SMP Application Area. Even for those species associated with wet areas, including swamp habitats, it is unlikely that these minor changes would alter habitat conditions such that species would not survive.”*

<sup>7</sup> 109493\_AP-SV\_Preliminary\_Documentation\_October\_2011\_Part\_7.pdf

<sup>8</sup> Brian Marshall, LandscapeFloraMonitoring\_BMCSConcerns20100304.doc

<sup>9</sup> Brian Marshall, SV\_AP\_EPBCPrelimDocs\_BMCSSubm'n\_1112014.pdf; refer to Section 4.3. Flora (THPSS) considerations.

The RPS analysis of ecosystems (Appendix D) is largely derivative. Its conclusions rely on: (i) predictions of subsidence and cracking (Appendix B, Strata Engineering 2011), which the Society broadly accept; and (ii) opinions about mining-related impacts on groundwater and surface water and any such impact on ecosystems (Appendix C, Aurecon 2011), to be considered in Section 3.4. A few examples of the dependency now follow in item (b).

- (b) RPS Appendix D Table 3.5 p26: the NPSS EEC has a high chance of occurrence (in fact is there). The likely level of mining-related impact is: *“Surface impacts are considered unlikely to occur. It has been concluded that no changes to natural drainage, groundwater systems or erosion patterns will occur as a result of mining procedures as these procedures are considered conservative (Strata Engineering 2011). A worst case scenario would involve flooding that could potentially increase subsidence levels to up to 90mm, having flow on effects to surface systems. However, worst case scenarios are considered unlikely to occur.”*  
RPS Appendix D Table 3.5 p28: *Derwentia blakelyi* has a high chance of occurrence (recorded in 700W). The level of mining-related impact is as for NPSS.  
RPS Appendix D Table 3.5 p29: *Eulamprus lauraensis* (Blue Mountains Water Skink) has a moderate to high chance of occurrence. The level of mining-related impact is as for NPSS in item (b). The level of mining-related impact is as for NPSS.  
RPS Appendix D Table 3.5 p33: *Petalaura gigantean* (Giant Dragonfly) has a high chance of occurrence. The level of mining-related impact on it and its habitat is essentially as for NPSS.

The above were chosen because all are linked to NPSS and watercourses and made subject to the Seven Part Test under the TSC Act. The details of the test in Appendix B (to the report in Appendix C) items a) to g) are instructive. Item a) gives the standard answer as per the NPSS EEC (Table 3.5 p26 above), followed by: *“Even for those species associated with wet areas, including swamp habitats it is unlikely that these minor changes would alter habitat conditions such that these species would not survive. The Proposal is therefore unlikely to adversely affect the life cycle of any of the above threatened flora species or fauna species.”* Item c)<sup>10</sup> again gives the rote response as per the NPSS EEC, followed by: *“These subsidence levels are unlikely to have an adverse effect on the extent of the Newnes Plateau Shrub Swamp EEC...”* Item d) is largely irrelevant, but it does note that: *“The swamp areas of habitat within the project area are of moderate importance to the Temperate Highland Peat Swamps on Sandstone EEC, threatened flora species, Blue Mountains Water Skink, Southern Barred Frog and Giant Dragonfly which are likely to be distributed throughout Newnes Plateau.”* Item f)<sup>10</sup> notes in relation to the Blue Mountains Water Skink that: *“...bord and pillar mining is unlikely to cause levels of subsidence that would affect the swamp habitat used by this species. It is therefore unlikely that the proposal will interfere with the objectives of the recovery plan.”* Finally, item g) looks at alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands and concludes that surface impacts are unlikely, but that *“...if surface impacts do...result in the alteration of the natural flow regimes...or impact on surrounding habitat areas...”* this could constitute a key threatening process.

As stated in item (a), the conclusions about threatened species and ecosystems are contingent upon the consultants' beliefs about the amounts of cracking and subsidence and any related impacts on the hydrologic regime. The Society contends that the conclusions are 'optimised' to facilitate mining, knowing full well that 'monitoring, mitigation and management' are there to cover 'mishaps' while mining continues. The Society also notes that impacts on the hydrologic regime are dealt with over an insufficiently long time-frame.

- (c) Section 8.1.6 p66: it is noted that the north, east and south boundaries of the 800 area abut the GBMWhA. The nature of impacts related to this is disregarded. BMCS considers that the GBMWhA will be adversely affected as raised in Sections 2.1, 2.3.1(b) and (c), and 2.3.2. Proper buffer zones, appropriate treatment of discharges to the Wollangambe, and minimising transfer of groundwater from the east to the west of the local divide are needed to ensure better outcomes for the watercourses and their associated ecosystems.

### 3.4 Groundwater impact assessment and Appendix C

Appendix C was specifically prepared by Aurecon for the SMPA (V1 Part2 Section 8.1.2 p44). Aurecon is strongly supportive as cited in V1 Part2 Section 8.1.5 p60:

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

*“...the proposed mining will have no significant impact on the groundwater regime on both a local and regional scale, and...mining will have no significant impact on aquifers feeding base flow to rivers, creeks or swamps.”*

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<sup>10</sup> Items b) and e) are considered to be inapplicable.

The above is in no way surprising because Aurecon (in its various incarnations) has for many years been closely involved with the design, evaluation and interpretation of the monitoring of groundwater and surface water over Newnes Plateau; and most of this work was and still is being done on behalf of Centennial's various collieries. In effect, Aurecon is assessing the body of work and interpretations for which it has 'ownership'.

### 3.4.1 Aquifer, aquifuge, aquiclude, aquitard and the Mount York Claystone (MYC)

Appendix C p8; V1 Part2 Section 8.1.2 p45: "*The Mount York Claystone is a low permeability unit in the Triassic section, and forms an **aquiclude** in the overburden about 100 metres above the Katoomba seam. It is generally about four metres thick in this area, and forms an effective barrier to the downward percolation of near-surface groundwater.*" The consultant and company place great importance on the MYC because they see it as a barrier separating two parts of the gross hydrologic regime; or as expressed by the consultant it "...separates the two local hydrologic regimes — the near-surface unconfined/leaky aquifer system in the Banks Wall Sandstone, including the Clarence Aquifer, and the confined aquifers in the underlying coal measures." Because the consultant and the company in the present SMPA and in many documents to government (State and Federal) over the past 8<sup>11</sup> years have used this approach to reject the possibility of any connection between the superficial and deeper aquifers, the Society wishes to clarify some apparent misconceptions.

**An aquifer**<sup>12</sup> (or a 'water source') is a saturated portion of rock (typically a sedimentary unit) capable of storing and transmitting (yielding) reliable quantities of water. This does not mean that other units above and below lack water; it rather means that they might lack sufficient storage capacity to sustain significant flows and/or are insufficiently permeable to transmit 'reliable' flows. In the case of the Clarence unconfined aquifer, which provides the best yields at 60 m above the MYC (Section 8.1.2 p45), it does not mean the intervening 60 m are bereft of groundwater.

Aquifuge through aquiclude to aquitard relate to a trend of decreasing impermeability and storage capacity; the three gradational terms are collectively covered by **confining unit**. An **aquifuge** lacks interconnected openings and therefore can neither store nor transmit water; a plastic pond-liner is a perfect aquifuge. An **aquiclude** may be porous and capable of storing water but its very low permeability results an equally limited transmitting capacity; a ductile clay layer devoid of fracturing would form an aquiclude. An **aquitard** has storage capacity and low to moderate permeability with a transmitting capacity consistent with retarded but not precluded flow; claystones and siltstones with variable fracturing are typical aquitards.

The consultant and the company, in terming the MYC an aquiclude, are consistent with the barrier model which they wish to convey. The Society conversely uses aquitard because it considers that vertical connectivity exists through the MYC<sup>13</sup>, and the creation of a 'sump', irrespective of the mining method, will inevitably lead to reorientation of the flow-net. In relation to the latter point, a study at Thirlmere Lakes<sup>14</sup> shows that despite the nearest LW 'sump' being about 750m east of the Lakes and about 300m below surface<sup>15</sup>, the development of the LW 'sump' progressively induced a steepening of the flow paths from subhorizontal such that the Lakes gained, to downwards and eastwards towards the 'sump'. It should be noted that the Bald Hill Claystone (an aquitard similar to the MYC)<sup>16</sup>, which lies about 150 m above the Bulli Seam and separates the unconfined and near-surface aquifers of the Hawkesbury Sandstone from the Narrabeen sequence, did not prevent the progressive reorientation of the flow-paths and modification of the Lakes' water balance. The work did not quantify the flow rates or quantities but emphasises the protracted time-frame of flow-net reorientation. There is some indication that the low permeability of the Bald Hill Claystone imposed a lag of about 4 years.

BMCS acknowledges that the extent to which flow-net reorientation will take place due to the 700W and 800 areas is hard to determine given: (i) the equipotential boundary constraints imposed by the cliff-bound topography; (ii) the extensive previous mining of the Katoomba Seam; and (iii) the endless claim in previous and current studies that due to the mining method there is a negligible impact on water resources<sup>17</sup>.

### 3.4.2 Historic groundwater monitoring (Appendix C Section 4.2.2)

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<sup>11</sup> To at least my knowledge

<sup>12</sup> This and the other definitions used are largely derived from the Oregon Water Science Center, US Geological Survey at [http://or.water.usgs.gov/projs\\_dir/willgw/glossary.html](http://or.water.usgs.gov/projs_dir/willgw/glossary.html)

<sup>13</sup> Refer to footnote 6. In addition, the Society emphasises that the MYC, which comprises thinly bedded claystones, siltstones and lenticular beds of fine- to medium-grained sandstone, is an aquitard in that it stores water, has a low vertical hydraulic conductivity (typically several magnitudes less than the horizontal hydraulic conductivity), but transmits water over time.

<sup>14</sup> Pells Consulting, *Report on the water levels of Thirlmere Lakes*, P053.R1, October 2011.

<sup>15</sup> This is far too great a distance for water losses to be ascribed to subsidence-induced fracturing.

<sup>16</sup> The Bald Hill Claystone is 20-25m thick at the Lakes, whereas the MYC is only 4 m thick in the 700W-800 region!

<sup>17</sup> See Appendix C Section 3.2.4 p15, Section 4.2.3 p32, Section 6 p38, and references in Section 9; BMCS notes that this should perhaps be **irrespective** of the mining method, as one of the conclusions in Section 6 p38 is that, based on monitoring of swamps, mining in general over Newnes Plateau has had no impact on groundwater levels! Or is there an alternative explanation?

The Society notes the brief presentation in the preceding section (4.2.1 p17) on the interpretation of changes in groundwater level and/or pore pressure, what is needed for a catastrophic impact on groundwater levels (but see BMCS' comment in Section 3.2 above), and the instrumental variables that can only be recognised and interpreted by an experienced hydrogeologist. The Society takes issue with the claim that "...where the groundwater level or pore pressure shows no significant change before, during, or after mining, it is possible to state that mining has had no impact on groundwater levels." This should surely read '*no perceived impact on groundwater levels, provided that there is due regard to other possibilities such as the program's adequacy, the dynamics of precipitation, run-off and infiltration, and the time needed for longer-term and cumulative effects to become manifested*'. Confidence based on protracted involvement can be misplaced and result in hyperbole.

#### 3.4.2.1 NPSS/NPHS groundwater monitoring 700W

- (a) Appendix C Section 4.2.2 pp21-22: "*The records for all swamp piezometers show that there are no significant differences in the groundwater record in each hole before, during, and after mining. All observed groundwater behaviour can be attributed to rainfall effects, particularly the surplus / deficit of rainfall from trend, and storm induced effects where rainfall rate was greater than approximately 20 mm/day...The continuity of groundwater behaviour indicates that mining has had no discernible impact on water levels in the swamps.*"

The Society has on many occasions questioned the value of shallow piezometer data because of the impacts of numerous uncontrolled variables: e.g. poor coverage of the swamp, location effects in terms of proximity to the margins versus a swamp channel or swamp-head versus swamp-tail, interplay of the watertable and run-off in the piezometric record, a swamp's longitudinal and transverse profiles, and the relative magnitude of the various inputs such that rainfall effects mask any mining-related variations. **The relative magnitude concern can alternatively be expressed in terms of a mining-related impact needing to be of catastrophic proportions before it is accepted.**

- (b) In the case of the Happy Valley results (pp19-21), evidence of catastrophic mining-related impacts is not seen. It is clear that sensitivity to run-off characterises all four piezometers from the two swamps, with the 'upstream' HVU data being more affected than the more stable HV data. Nevertheless, the climbing trends of HVU2 and to a lesser degree HVU1 are in keeping with infiltration adding to the watertable, whereas the HV data which are more dependent on the local watertable are less affected by the contribution from infiltration.
- (c) What else do the results in item (b) suggest? BMCS considers that the methodology is variously dominated by the interaction of run-off and infiltration with the local watertable and **lacks the level of sensitivity** needed to assess longer-term mining-induced changes, irrespective of whether one's preference is for or against such changes. Is the consultant's statement [as cited in (a)] justified? Yes in relation to '*no discernible impact*'; yes in relation to the dominance of '*rainfall effects*'; and yes in relation to '*no significant differences...before, during, and after mining*'. Conversely, there is no justification for the observations to the interpretation cited in Section 3.4.2 "*...that mining has had no impact on groundwater levels.*' Very simply, **if the methodology is insufficiently sensitive to provide the answer (other than for a catastrophic impact), how is the absence of a definitive answer consistent with proof that there is no mining-related impact?**

#### 3.4.2.2 Clarence aquifer monitoring (Section 4.2.2 pp22-25)

- (a) Appendix C Section 4.2.2 p25: "*Monitoring of the Clarence Aquifer in the six open boreholes shows that the groundwater levels have not varied markedly over the period since June 2008, although the levels in all of the bores are currently higher than when monitoring commenced...Extraction of the Outbye, 314, and 316 areas occurred in 2009 and 2010. Groundwater levels before, during, and after mining are not markedly changed. There is no evidence in these data that mining has had an impact on groundwater in the Clarence Aquifer.*" Although the Society does not anticipate any evidence of a catastrophic loss of pore pressure, it notes that CLR10 is the only hole which has been undermined; hardly a good basis for a conclusion that mining has had no impact on groundwater in the aquifer. This concern is further exacerbated when one notes that five of the six piezometers record (pp24-25) "*a high-frequency, low amplitude...fluctuation, which generally shows rapid onset and decay...The source of this fluctuation is unclear, but is most likely an instrumental effect related to the barometric pressure correction*". The fluctuations have a rapid decay rate and are not attributed to rainfall events; perhaps it is time to think beyond instrumental error!
- (b) The Society notes that four of the six piezometers record a rising trend until late-January 2010, stay flat until late-November, and then again start rising. This to some degree reflects rainfall/infiltration. As the principal influence on the unconfined aquifer is rainfall/infiltration and a catastrophic loss of groundwater is precluded, **what evidence would the consultant look for to substantiate/disprove long-term reorientation of the flow-net?**

#### 3.4.2.3 General groundwater monitoring (Section 4.2.2 pp26-32)

- (a) Appendix C Section 4.2.2 pp31-32: “All the boreholes in mining areas show consistent flat trends in their upper piezometers, similar to those in the unmined area. This indicates that mining did not have any discernible impact on groundwater levels in the upper strata in these boreholes. Piezometers at the mining horizon show groundwater draining as mining occurs. Intermediate strata may show some temporary impacts as mining passes, followed by recovery of pore pressures... Available groundwater data indicate that mining has no impact on groundwater pore pressures and water table levels in the upper strata, including the Clarence Aquifer.” The Society notes the following: (i) the only impact considered in relation to the piezometers in the Banks Wall Sandstone is one involving a catastrophic collapse of pore pressure – this the consultant presumably classes as ‘discernible’; (ii) anomalous aspects of pzos<sup>18</sup> 1,3(CC114), pzos2,3,4(CC115), pzos1,2,3(CLRP3) and pzos1,2(CLRP6) are ascribed variously to installation problems and instrument malfunctions – that is ten pzos from fourteen in four holes out of the six – this does not build confidence in the ‘no mining impact’ interpretation! Other observations and comments are considered below.
- (b) CC114 and CC115 are for reference as they have not been undermined. The consultant says they have flat pore pressure trends, and no evidence of an impact from rainfall. In the Banks Wall Sandstone, pzo3 in Fig. 10 (supposedly malfunctioning) shows a significant rainfall/infiltration effect. In Fig. 11, pzos2,3,4 have an anomalous build up of pore pressure over the first 9 months of operation – they could be reflecting rainfall/infiltration, but interpretation is made difficult by lack of information about the stratigraphic location of the pzos. Regardless, the two holes constitute a poor reference.
- (c) CLPR1 (Fig. 12) provides a useful example of mechanical and hydrologic behaviour below and above the MYC. The Society is **not** advocating catastrophic failure, accepts the explanation regarding the elastic ‘beam’, and has no problem with the more ductile behaviour of the MYC. The rainfall/infiltration influence on pzo3, which is **below** the MYC, supports the Society’s contention that the MYC is an aquitard.
- Aurecon’s statement that the “...pattern in the upper two instruments is distinctly different from that displayed in the lower strata, indicating that there are different responses to mining at different levels” is accepted. Likewise, the statement that in the upper strata (including those immediately below the MYC) “...there is no event apparent...that could be related in any way to mining” is recognised to the extent that it relates to **catastrophic pressure reductions** rather than longer term flow-path changes.
- (d) CLPR2 (Fig. 13) shows some mining impact on pzos2,3 and possibly 4 (all within the Banks Wall Sandstone) coincident with draining of the Katoomba Seam recorded by pzo1. Aurecon notes that pzos2,3 are “...indicative of confined, low permeability strata above the seam roof. There is no evidence of any ‘catastrophic’ (insertion by BMCS) drainage of groundwater from these strata during or after mining”; accepted as amended because longer term flow-path changes are not precluded.
- (e) CLRP3 (Fig. 14) has steep slopes on three sides down to creek levels of 840-860 m. This facilitates drainage to the creek system rather than promoting mining-induced deeper infiltration. There is, of course, no evidence for a catastrophic mining-related impact on the groundwater regime!
- (f) CLRP6 (Fig. 15) is a disaster. Pzo1, which could be interpreted in terms of mining-related effects, is deemed by the consultant to be inconsistent and useless. Pzo 2 is anomalously high and then becomes erratic after panel 704 is extracted. Pzo3 is consistent throughout and shows no mining-induced catastrophic disturbance. If pzos 1,2 are taken at face value, pzo1 stabilises after the passage of panel 704 and pzo2 becomes erratic. A possible interpretation might be that 702 caused no **obvious** damage but 704 induced problems; perhaps a cumulative effect!

### 3.4.3 Review of groundwater investigations (Section 4.2.3 pp32-33) and impact assessment (Section 5 pp33-35)

Aurecon’s review comprises a reiteration of claims made in Appendix C Sections 3.2.4, 4.2.1 and 4.2.2. Many aspects of these claims have been questioned in the previous sections of the current BMCS response.

- (a) In relation to the Happy Valley swamps, it is contended that (Section 4.2.3 p32): “...groundwater behaviour...is consistent with that seen elsewhere, both on the Newnes Plateau, and in other swamps. Groundwater levels show different amounts of influence from rainfall and groundwater input, and have been recognised as periodically waterlogged (partially rainfall-dependant, Type A) swamps, or permanently waterlogged (groundwater dominated, Type C) swamps...Monitoring has confirmed that the swamp groundwater levels show no response to partial extraction mining taking place under or adjacent to the swamps.” As groundwater, particularly in unconfined aquifers, is dependent on rainfall and hence infiltration versus run-off, the Type A versus Type C subdivision (there used to be a Type B but it ‘evaporated’) is a crude approximation based on shallow pzo behaviour. In reality, Type A pzos respond rapidly to rainfall and immediate run-off (including hill-wash), whereas Type B pzos, being sustained by groundwater, fluctuate far less substantially.

<sup>18</sup> Pzo and pzos are abbreviations for piezometer and piezometers respectively; the hole number is in brackets.

In section 3.4.2.1 (above) it was suggested that: (i) mining as proposed at Clarence shows **no perceived impact** on groundwater levels in shallow pzos; (ii) the methodology involves identifying sudden catastrophic lowering of the local watertable coincident with undermining; (iii) the methodology **lacks the level of sensitivity** needed to assess longer-term mining-induced changes; and (iv) **denying something's existence because the methodology lacks the capacity to detect it is false science.**

Despite the above, the assessment of the monitoring program, in which there is a sustained level of 'ownership', concludes (Section 4.2.3 p32): "*Monitoring has confirmed that the swamp groundwater levels show no response to partial extraction mining taking place under or adjacent to the swamps.*"

- (b) Section 4.2.3 p32 in relation to the Clarence aquifer: "...even though there has been mining for many years...beneath the northern end of the Clarence aquifer, there does not appear to be any significant depletion...as the groundwater high is still located beneath the ridge, and there is a significant head of water above the base of the aquifer zone. This has been confirmed by the current monitoring program." As the Clarence aquifer is principally unconfined, the quotation is a tribute to the recharge capacity as a function of area, and infiltration and percolation rates. The quotation is focused on the potential for 'catastrophic drainage through metre-wide cracks' extending from the aquifer to the Katoomba Seam, whereas BMCS has not advocated this. **It is regrettable that Aurecon and Centennial are unable to accept that slow fracture-facilitated downward permeability exists, despite the retarding effects of the MYC, and that this will be an inevitable part of flow-path reorientation consequent upon any form of 'sump' creation.**
- (c) The Clarence Aquifer and any water zones beneath it<sup>19</sup> discharge mainly into Bungleboori Creek, Dumbano Creek and the Wollangambe River. Section 5.1.1 p34 indicates: "...drainage to Bungleboori Creek does not impact on water supplies at Clarence...even if the mining resulted in a crack forming from the surface to the seam...the impact on the aquifer would only be local, and similar to the drawdown at Bungleboori Creek. There would be no measurable impact in the vicinity of the Clarence village. The conclusion is therefore drawn that the impact of the proposed mining in the 700 west area on the Clarence aquifer will be negligible." Even if one accepts these claims at face value, they are only testimony to the recharge efficiency of the Clarence Aquifer and the magnitude of discharge to Bungleboori. They neither disprove longer-term 'non-catastrophic' losses and flow-path reorientation, nor do they consider the cumulative effect of mining and the pump-out of mine-make; or perhaps this is all covered by the uncertainty of 'negligible'!

In Section 5.1.1 p34 it is suggested that the aquifers in the 800 area are less well known but that mining is still unlikely to affect the aquifers because the geology and mining method are the same as for 700W. This is a little strange: if the geology is the same, the aquifers should be the same! Indeed, the base of the Clarence aquifer is mapped in the area (Fig. 4c). Regardless, Aurecon continues to be focussed on catastrophic water losses rather than the longer-term and cumulative implications which concern BMCS.

- (d) Section 5.1.2 p34: "*It has been demonstrated...that the upper sandstone aquifers are unlikely to suffer any significant permanent impacts due to the mining. As a result, the regional impact on these aquifers is also judged to be negligible.*" The Society notes that the level of confidence is not justified by the data (see Sections 3.4.2.2 and 3.4.2.3 above). This is further substantiated by recognising that 'significant' and 'permanent' really mean catastrophic pressure collapse without recovery. Yet the irrecoverable damage in CLRP1 extended at least 50 m above the seam and the temporary damage higher in the sequence lasted about 6 months. Also, in CLRP2, we are assured that the large increase in pore pressure for pzo2 was insufficient "...to cause hydraulic fracturing in the strata, especially given the in-situ confining pressure". However, **any increase in pore pressure has the capacity to influence grain-scale permeability through decreasing the confining pressure; it is not necessary to cause macrofractures.**
- (e) Section 5.1.3 p35 – influence on NPSS: "...since the investigations have indicated that there will be no impact on the aquifers that provide groundwater to these swamps, then there should be no impact on the swamps." This is logical, but in Sections 3.4.2.2 and 3.4.2.3 the Society repeatedly emphasises the difference between catastrophic pressure losses, which have been the focus of Aurecon's investigations, and the longer-term and cumulative processes (including flow-path reorientation) which are less easily diagnosed.

And again: "*Groundwater monitoring data from the Newnes Plateau Shrub Swamps and Newnes Plateau Hanging Swamps is further evidence of no impacts as it shows that there are no changes in groundwater behaviour when comparing pre-mining data to post mining data.*" The interpretation and lack of sensitivity of the shallow piezometers monitoring was discussed in Section 3.4.2.1. Under El Niño drought conditions changes in the piezometric data are ascribed to lack of precipitation; when La Niña brings abundant rain rising piezometric data are witness this; and when piezometric data vary little (neither up nor down!) the swamps are said to be dominated by

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<sup>19</sup> Provided they are of suitable elevation relative to the degree of watercourse incisement.

groundwater rather than rainfall. All this is fine, but any non-catastrophic mining-related impacts are masked by the magnitude of the climatic effects, thereby enabling a 'no discernible impact' report.

#### **4. Conclusions**

- Contrary to claims made in the company's report that several issues were not raised at the formal meeting, at least five of those issues were raised by email within the time-frame allocated for formal subsequent comment.
- Arguments based on familiarity and experience may be made to justify using the same organisation which advised on monitoring programs and prepared supportive reports over a protracted period, to then carry out formal assessments of efficacy and interpretation of the data generated; it may conversely be argued that it is unwise to seek hopefully independent assessments from the same organisation as has demonstrable involvement and 'ownership'.
- The focus on the limited subsidence caused by the mining method to be implemented has resulted in the possibility of mining-related impacts being down-played; lack of evidence for short-term 'significant/catastrophic' changes has led to the possibility of longer-term impacts being denied or disregarded.
- The level of confidence attached to stating that there will be 'negligible' or no 'significant' impacts to aquifers and swamps is misplaced when the nature of the evidence is carefully evaluated; such assessments do not conform with the precautionary principle and seemingly facilitate mining through ongoing monitoring (regardless of its effectiveness) and risk-management plans.
- Should the SMPA ultimately receive approval, it should only be under conditions whereby proper forms of protection are emplaced and the need for remediation measures is obviated.



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