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23 May 2014

Mining and Industry Projects
NSW Department of Planning & Infrastructure
GPO Box 39
Sydney NSW 2001

Re. State Significant Development 5594

Objection to proposed Springvale Longwall Mine Extension Project, Newnes Plateau, NSW, by Springvale Coal Pty Ltd.

I am writing to object to the proposed extension of the Newnes Plateau longwall coal-mine by Springvale Coal Pty Ltd. This submission focuses specifically upon the likely impacts on endangered groundwater dependent swamp ecosystems and their dependent species.

This project has the potential to lead to the irrevocable degradation and potential destruction of an important group of Newnes Plateau Shrub Swamps (NPSS), an Endangered Ecological Community (EEC) (NSW Scientific Committee 2005b), which forms part of the Commonwealth listed Temperate Highland Peatswamps on Sandstone (THPSS) EEC (Threatened Species Scientific Committee 2005), with resultant negative impacts upon their associated groundwater dependent species. These species include threatened flora and fauna, such as the endangered Giant Dragonfly (*Petalura gigantea*), endangered Blue Mountains Water Skink (*Eulamprus leuraensis*), and vulnerable Dean's Boronia (*Boronia deanei deanei*), all of which are obligate mire (peat swamp) dwelling species (Benson & Baird 2012). These species have been recorded from most of the swamps that lie above the proposed longwall panels (including new localities of *P. gigantea* and *E. leuraensis* recorded in January 2014 by Ian Baird) (see Atlas of NSW Wildlife; Baird 2012: Appendix 1; Benson & Baird 2012) and there are likely to be additional occurrences within the project area. These groundwater dependent swamp ecosystems (NSW Government 2002; Serov et al. 2012) are important habitat for these and other groundwater dependent species. The proposed longwall panels extend beneath a series of NPSS which lie near the centre of the geographic distribution of this swamp type and constitute a significant portion of its total extent. Some patches of Newnes Plateau Hanging Swamps (NPHS) (DEC 2006), which also form part of the THPSS EEC, and which occur across the project area, may also provide habitat for these groundwater dependent species. My objection is grounded in over 10 years of research studying mire ecosystems, particularly in the Blue Mountains region, with a focus on *P. gigantea* (e.g., Baird 2012; Baird 2013; Baird in press; Baird & Burgin 2013; Benson & Baird 2012).

This submission includes a supporting literature review which focuses upon the specific threats to the groundwater dependent peat swamps and their associated groundwater dependent species (Part A), comments in relation to specific related issues identified in the EIS documentation (Part B) and recommendations to address identified issues (PART C).

Part A: Literature Review

Threats to groundwater dependent species

Petalura gigantea

Like most of the 11 species of petalurid dragonflies worldwide, the endangered (TSC Act 1995) *Petalura gigantea* (Petaluridae) is characterised by a burrowing larval lifestyle (Baird 2012: Chapter 1; in press; Tillyard 1911) that is unique in the Odonata (Corbet 1999). Studies to date suggest a larval stage of at least six years, and possibly more than 10 in *P. gigantea* (Baird 2012: Chapter 1). The long larval stage and the unpredictability of emergence events (Baird 2012: Chapter 7) means that the species is most unsuitable for the purpose of monitoring ecological changes associated with mining subsidence. Thus, any deleterious effects upon populations of the species, as a result of lowered water tables, will not be detectable until well after the event and thus too late.

Successful *P. gigantea* breeding sites are characterised by a groundwater regime that provides sufficient surface moisture to minimise risk of desiccation of eggs and early larval instars, supports development of organic-rich mire soils suitable for larval burrowing, and maintains a water table height that larvae can access within established burrows or adaptively through burrow deepening. Extensive burrow investigations and observation of hundreds of oviposition and burrow locations across a range of mire types in the Blue Mountains confirm *P. gigantea* as an obligate, groundwater dependent, mire-dwelling species (Baird 2012: Chapter 6). All investigated burrows included groundwater in the burrows, usually throughout the majority of the burrow depth (Baird 2012: Chapter 1; in press; Benson & Baird 2012). Although there is some evidence of putative adaptive burrow deepening by late stadia larvae in some circumstances, it is availability of suitable microhabitat for ovipositing and early larval establishment which is critical to persistence of populations of the specie. All observed oviposition occurred into waterlogged substrate, fissures in the substrate, amongst or under moist litter overlying the substrate, amongst roots at the base of plants in moist substrate, or into *Sphagnum*. Breeding habitat for the species is restricted to the wetter parts of these swamp systems where the water table is either emergent or causes saturation of the surface of the substrate, at least throughout the period of egg-laying, early larval development and burrow establishment. This is the critical life history stage and is dependent upon the presence of saturated organic-rich substrates associated with high, and frequently, emergent water tables.

Any long-term lowering of the water table will result in a proportional contraction or reduction in the spatial extent of potential breeding habitat within individual swamps, and potentially, to extirpation of the species from those swamps, with potential implications for metapopulation dynamics of this patchily distributed species (Baird 2012: Chapter 8).

Eulamprus leuraensis

The endangered (TSC Act 1995, EPBC Act 1999) lizard, *Eulamprus leuraensis* (Scincidae), is endemic to mid to upper elevation Blue Mountains Sedge Swamps (of Keith & Benson 1988) and NPSS (Dubey & Shine 2010a, b; Dubey & Shine 2011; Dubey et al. 2013; LeBreton 1996). The species is closely associated with, and dependent upon, the wetter parts of these swamp systems, where there is typically moist to saturated substrates and at least some surface water associated with an emergent water table. It is known to use burrows of the crayfish *Euastacus australasiensis* (Decapoda: Parastacidae), and possibly also of *P. gigantea* during and post fire, as both fire and predation refugia (pers. obs.). Any long-term reduction in groundwater levels in individual swamps will negatively impact upon the species through a reduction in the area of core habitat and in the abundance of the species within affected swamps. Although individuals may be recorded in adjoining non-swamp habitats, these areas do not represent core habitat of this obligate mire-dwelling species.

A recent genetic study has identified low rates of genetic exchange and high genetic divergence between discrete swamp populations, and recommended that most populations be treated separately as discrete conservation units (Dubey & Shine 2010b). Any loss of discrete swamp populations may contribute to eroding its genetic potential and capacity to adapt to projected climate change. Predicted contractions in the extent of the mire habitats of this species under projected climate change scenarios (see Ramp & Chapple 2010), and associated degradation in habitat value for the species, will further threaten the viability of populations of this species (Dubey & Shine 2011). These effects mirror, and would compound, those that will occur as a result of any lowering of water tables within these swamps as a result of subsidence associated with longwall mining. The distinctiveness of individual swamp populations is mirrored in Hose's (2009) work on genetics of stygofauna on the Woronora Plateau.

Euastacus australasiensis

The burrowing crayfish *Euastacus australasiensis* occurs in streams and upland swamps of the Sydney region (Growns & Marsden 1998; Merrick 1998; Morgan 1997) and can be abundant in the wetter parts of the swamps of the Newnes Plateau (pers. obs.); on current knowledge it is the only indigenous upland swamp dwelling crayfish within the Blue Mountains (see Merrick 1998; Morgan 1997).

Burrow investigations within Blue Mountains swamp systems have not been undertaken, but investigations of Tasmanian mire dwelling crayfish (*Parastacoides* spp.) have revealed complex burrow structures, groundwater dependence and unique functional roles (Growns & Richardson 1988; Richardson & Swain 1980, 1991). It is likely that *E. australasiensis* performs similar functional roles in NPSS. For example, the groundwater in its burrows may provide habitat for other specialised groundwater dependent fauna, in addition to providing refugia for *E. leuraensis* during and following fire events. The burrows of these crayfish can be referred to the Type 2 burrows (burrows connected to the water table) of the ecological classification system for burrows of Australian freshwater crayfish (Horwitz & Richardson 1986).

Studies of freshwater crayfish worldwide have revealed that their groundwater filled burrows may provide habitat for a diversity of organisms, including pholoteros (Lake 1977; Lake & Newcombe 1975), stygofauna (Gilbert et al. 1994a; Humphreys 2008), hibernating frogs (Irwin et al. 1999), aestivating commensal crayfish (Johnston & Robson 2009), and dragonfly larvae during drought and winter months (Harrington 2010; Pintor 2000). These diverse ecological relationships, and the shared reliance of different taxa upon groundwater, highlight the complexity of functional roles of these burrowing groundwater dependent organisms and their importance in these groundwater dependent ecosystems (GDEs). A lowering of water tables in these swamps can be expected to reduce and potentially eliminate the habitat available to *Euastacu*s in affected swamps and negatively affect any associated species.

Additional groundwater dependent fauna

Our knowledge of the groundwater dependent invertebrate fauna in Australian mire ecosystems is negligible. Additional groundwater dependent species within these Blue Mountains swamp ecosystems may include stygofauna (e.g., Gilbert et al. 1994b; Hose 2009; Humphreys 2008), pholoteros (e.g., Creaser 1931; Lake 1977; Lake & Coleman 1977; Lake & Newcombe 1975; Suter & Richardson 1977), and other specialised mire (e.g., Larson & House 1990; Rosenberg & Danks 1987; Spitzer & Jaroš 1993) or moorland (e.g., Butterfield & Coulson 1983; Gardner 1991; Greenslade &

Smith 1999) invertebrates. A lowering of water tables in any swamp is likely to have significant impacts upon any such groundwater dependent fauna, with possible extirpation from swamps where the water table is permanently lowered below a threshold level.

Boronia deanei deanei

The rare and vulnerable (TSC Act 1995) shrub, *Boronia deanei deanei* (Rutaceae), is restricted to NPSS and some bogs on the Boyd Plateau. It is associated with particular groundwater conditions and any lowering of water tables can be expected to reduce the distribution and abundance of the species in affected swamps, with implications for the persistence of the species more broadly (Benson & Baird 2012).

Dillwynia stipulifera

Dillwynia stipulifera (Fabaceae) is another small shrub restricted to swamps on the Newnes Plateau, with disjunct occurrences on the South Coast. Any contraction in its abundance or distribution on the Newnes Plateau will also have implications for its persistence in the area (Benson & Baird 2012). Benson and Baird (2012) have suggested that the species may qualify for listing as vulnerable under the TSC Act 1995.

Threats to peat swamps associated with longwall coal mining

Subsidence associated with Longwall coal mining is listed as a Key Threatening Process (KTP) under the TSC Act 1995. This determination recognises that subsidence may cause deleterious changes to the quality and/or quantity of groundwater available to GDEs and surface streams. Mine dewatering may have similarly negative effects on surface ecosystems due to the alteration of surface water flow regimes and water quality. The impact of long wall coal mining, in particular, upon groundwater dependent swamp and stream ecosystems is of concern (NSW Scientific Committee 2005a; Young 1982; Young & Wray 2000) and controversy, consistent with the increasingly well-documented negative impacts of longwall coal mining worldwide (e.g., Bell et al. 2000; Booth 2006; Booth & Bertsch 1999; Booth et al. 1998; Karaman et al. 2001).

Extensive longwall coal mining under the Woronora Plateau and nearby areas in the Southern Coalfields has resulted in well documented cases of subsidence, with fracturing of stream beds and loss of groundwater from streams and endangered Coastal Upland Swamps. Threats from longwall mining have been specifically identified in respect of the EEC determinations for NPSS (NSW Scientific Committee 2005b) and Montane Peatlands and Swamps in NSW (NSW Scientific Committee 2004), which includes the Coxs River Swamps (of Benson & Keith 1990). A large proportion of NPSS and Coxs River Swamps occur above underground coal mining leases. This occurs particularly in Newnes and Ben Bullen state forests where the area has either been subjected to mining or such mining is proposed. Hydrological changes generally have been identified as threats in the EEC determinations for NPSS (NSW Scientific Committee 2005b) and THPSS (Threatened Species Scientific Committee 2005). Extensive mine de-watering into headwater streams and directly into swamp systems has occurred across this area, with significant and irreparable damage resulting. The well documented and irreparable damage to East Wolgan Swamp on the Newnes Plateau, resulting from loss of groundwater, associated with mine waste water discharge and subsidence following longwall coal mining by Centennial Coal, highlights the threat to all GDEs, including peat swamps, as a result of subsidence from long wall mining in this geological setting. 'Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands' is also listed as a KTP on Schedule 3 of the TSC Act 1995 (NSW Scientific Committee 2002) and is applicable in the context of the potential loss of groundwater from these swamps and of base-flow to headwater streams.

Globally, threats to groundwaters and their dependent ecosystems are increasingly being recognised (Boulton 2005; Boulton et al. 2003; Danielopol et al. 2003; MacKay 2006). Hatton and Evans (1998) identified a range of ecosystem dependencies on groundwater. Their class of *Ecosystems with proportional dependence on groundwater* appears to include all mire ecosystems in Australia, including NPSS. For this class of ecosystem, they suggested that '*it is likely that a unit change in the amount of groundwater will result in a proportional change in the health or extent of that ecosystem*'. Commenting on the level of groundwater dependency of wetland ecosystems, Clifton and Evans (2001) highlighted the importance of maintaining adequate groundwater levels in unconfined aquifers and adequate groundwater discharge flux for most wetland ecosystems to maintain the necessary level of wetness or waterlogging for key ecological stages: '*Changes in water table level may have important implications for these communities. Prolonged lowering or raising of the water table is likely to result in changes in species composition, favouring species adapted to drier or wetter conditions, respectively*'.

Changes in groundwater regime will potentially impact the biota of GDEs at species and community level. This will be caused by changes to critical habitat attributes, either variably, or (potentially) across threshold levels (Clifton & Evans 2001). Where groundwater levels are lowered, even seasonally, effects may include changes in the wetland vegetation community composition (Boulton & Brock 1999; Breeuwer et al. 2009; Wheeler 1999). Although many of the plants which are obligate swamp dwellers in NPSS and other upland swamps may persist across a spectrum of the hydrological gradient, the effects of a lowering of the water table upon individual species may not be measurable for some time. This may be most pronounced for long-lived species such as Buttongrass, *Gymnoschoenus sphaerocephalus* (Cyperaceae) (pers. obs.). The effect upon groundwater fauna, however, will be more rapid. With longer term lowering of the water table, effects may include succession from swamps to drier heath, sedgeland, grassland or forest communities(as has occurred to a former swamp on Lamb's Creek located above longwall mining carried out by Angus Place Colliery); extirpation of groundwater dependent species; changes in groundwater quality and soil chemistry (Wheeler 1999); and degradation of peat (Shearer 1997) and peatlands (Moore 2002; Whittington & Price 2006). There may be increased competitive interactions for terrestrial swamp fauna (e.g., the swamp rat *Rattus lutreolus, E. leuraensis*) with otherwise generally allopatric congeners of adjoining non-mire habitats (Baird 2012). Such increased competitive interactions, in conjunction with reduced habitat suitability for the mire dwelling species, will further contribute to extirpation of populations of these species. Bioclimatic modelling indicates a progressive contraction in the extent of Blue Mountains swamps (Ramp & Chapple 2010), and swamps of the Woronora Plateau and the Sydney region more broadly (Keith et al. 2014; Keith et al. 2010), under projected climate change scenarios; these contractions mirror and would compound the effects that can be expected from any lowering of water tables in association with subsidence from longwall coal mining.

Additional potential impacts associated with a lowering of the water table include weed invasion and increased fire risk (Keith et al. 2006; Kodela et al. 2001; NSW Scientific Committee 2005a). Weed invasion of NPSS has been documented (Henson 2010) and anthropogenically disturbed and drying swamps, in particular, are most vulnerable to weed invasion. Where drying of organic-rich, peaty swamp substrates occur, fire effects may include burning of the organic soil component, resulting in the destruction of soil seed banks, rhizomes and lignotubers, thus also affecting re-sprouter species (Keith 1996). In the Blue Mountains region, including NPSS, substantial mortality of mature lignotubers of re-sprouter shrubs may occur as a result of fire during periods of reduced water levels in swamp soils (Benson & Baird 2012). Drying related oxidisation and/or combustion of the organic component of these peatlands leads to their shrinkage and has the potential to leave sterilised and (often) hydrophobic sandy or peaty soils, with an increased risk of erosion due to surface water flows. This, in turn, may lead to channelisation and further lowering of shallow water tables (e.g., Young & Wray 2000). Degradation of the hydrological function of these peatland ecosystems (capacity to store and slowly release water) will also occur (Keith et al. 2006; NSW Scientific Committee 2005a).

Fire is considered one of the main threats to Australian peatlands (Pemberton 2005). A more intense fire regime may cause unsustainable loss of peatland soils, as documented, for example, in moorland fires in the North York Moors (Maltby et al. 1990), for rare peatland in south-western Australia (Horwitz et al. 1999; Horwitz & Smith 2005; Semeniuk & Semeniuk 2005), in alpine peatland soils in Tasmania (Kirkpatrick & Dickinson 1984), in Buttongrass moorland (blanket bogs) in Tasmania (Bridle et al. 2003) and other organic terrains (peatswamps) in Tasmania and Victoria (Wein 1981). In addition to combustion of organic-rich peatland soils, fire induced changes include the potential for increased erosion, changes in water quality and loss of biodiversity (e.g., Horwitz & Sommer 2005). Fire effects are exacerbated where groundwater levels are lowered due to drought or anthropogenic influences (e.g., long wall mining) and by more intense fire regimes, for example, as reported also in New Zealand peatlands and bogs (Clarkson 1997; Johnson 2001; Timmins 1992). Similar effects have been reported for the upland swamps of the Woronora Plateau (Keith et al. 2006; Young 1982). Destruction of peat substrates as a result of fire in Blue Mountains Sedge Swamps has also been reported (Keith 1996; Stricker & Wall 1995). It may also lead to surface collapse over peatland piping, resulting in gully head initiation and channelisation (pers. obs.). An increase in periods where peatland soils are bare following fire events (or in response to drought or otherwise lowered water tables) will also contribute to increased rates of peatland photodegradation and loss of organic matter (Rutledge et al. 2010). A lowering of the groundwater table, for any reason, will compound these effects. The ecological damage resulting from any loss of groundwater from these swamp ecosystems as a result of subsidence from longwall mining will be compounded by subsequent long term effects of fire, and the potential compounding effects of predicted climate change (Baird 2012: Chapter 8; Benson & Baird 2012).

Fire is a natural and recurring event within the swamp communities in the Sydney region (Keith 1995; Keith et al. 2006). The temporal and spatial scales, and the intensity at which these fire disturbance events occur in particular swamp types are, however, critical to whether fire regimes result in long-term loss of organic terrains at a rate that exceeds net accumulation of organic matter, or exceeds fire regime thresholds for swamp plant (e.g., *Sphagnum* spp.) and animal species (e.g., *Rattus lutreolus*) (Keith 1996; Keith et al. 2002; Morrison 2002; Morrison et al. 1995; Watson 2006a, b). Fire impacts are directly correlated to swamp water levels and surface wetness (e.g., Horwitz & Smith 2005; Horwitz & Sommer 2005). Under a more intense fire regime, combined with reduced groundwater availability, long-term degradation and contraction of these ecosystems will occur. It will also threaten the persistence of groundwater dependent mire species such as *P. gigantea* and *E. leuraensis* (Baird 2012: Chapter 8; Benson & Baird 2012).

Conclusion

Reduced groundwater availability as a result of subsidence from longwall mining will result in long-term degradation and contraction of these NPSS, compounding predicted effects of climate change. The result will be reduced spatio-temporal distribution of suitable breeding habitat for *Petalura gigantea,* and will threaten the persistence of other groundwater dependent species, including *Boronia deanei*, *Eulamprus leuraensis*, *Euastacus australasiensis,* and other organisms such as stygofauna. These unique and geographically restricted montane mire ecosystems must be protected. Maintenance of the necessary hydrological regime and groundwater levels will be fundamental to the persistence of these mire ecosystems and their groundwater dependent species.

In view of the extensive evidence of damage from subsidence associated with longwall coal mining in the western Blue Mountains, across the Sydney region more broadly, and internationally, the threat to these ecosystems and their dependent species from an expansion of longwall mining under the Newnes Plateau is too great. Assessing the likely impacts of this proposal must be informed by the Precautionary Principle and the substantial body of available evidence of its damaging effects.

Part B: Specific comments on EIS

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p.51: States that "In the upper reaches of Burralow-type shrub swamps, there is less opportunity for sequential aquifers to supply seepage, thus the upper reaches are typically periodically waterlogged". This statement is in contrast to extensive evidence of permanent waterlogging in the upper, lower gradient reaches of the most significant examples of NPSS, particularly those of the Carne Creek system, including swamps which are proposed to be undermined in the current proposal.

p.61: The piezometer placement in the identified swamps will determine whether they indicate periodic or permanent waterlogging. Representative sites for the piezometers to monitor groundwater in swamps and streams must be chosen by a third party agency. Surface waterlogging is highly spatially heterogeneous in NPSS. Most NPSS in the Carne Creek system have substantial areas which are permanently waterlogged, particularly in parts of their upper reaches. Carne West Swamp is representative of a swamp with a significant proportion of permanently waterlogged areas. Contrary to the assertion in the Report, it is a low gradient, and often the presence of broad valley floors, which tends to be responsible for the development of the more extensive peat swamps with areas of permanent waterlogging. It is often in their upper reaches where these low gradients occur. The data presented in the report in this regard is misleading.

p.89: The Endangered shrub, *Persoonia hindii*, should be added to list of threatened flora which could potentially be affected by this project.

p.90: The Endangered giant dragonfly, *Petalura gigantea* (Pg) should be added to the list of threatened fauna which could potentially be affected by this project. It is a significant omission.

p.95, Photograph 2.14 is not of a typical NPSS of the project area.

MAIN DOCUMENT Volume 2

p.242, Shortening longwalls to avoid undermining THPSS: All discussion in the Report, of the option of shortening longwalls to avoid undermining NPSS, related to existing longwalls, but did not address the option of shortening longwalls in the proposed extension project to avoid undermining NPSS. Clearly this would result in reduced resource extraction, but would also avoid risk of lowering of watertables in an important group of NPSS at the centre of the distribution of this restricted swamp type. The fact that such a modification may reduce the economic feasibility of the entire project should not be a justification for allowing these swamps to be undermined, with the associated risk of damage. I object to this argument and propose that all longwalls that undermine NPSS should be shortened accordingly to avoid that risk and to include an appropriate setback. In the event that this is not done, then all longwall panels that pass under swamps should be further reduced in width, with wider pillar widths, to further minimise risk of subsidence that may result in significant lowering of swamp water tables. The panel widths proposed by the proponent appear to be arbitrary and are not properly justified. No risk of lowering of water tables in these swamps is acceptable.

p.276: The proponent claims, without substantiation, that " it is unlikely that the effects of subsidence would have an adverse effect on shrub swamps or hanging swamps such that the ecological functioning of these swamps would be impaired." Unlikely is not good enough. The ecological functioning of the swamp is not defined and is not an indicator of the capacity of any individual species to persist in any such modified ecosystem. A small, long term lowering of the water table in these swamps will result in a reduction in the spatial extent of suitable breeding habitat for Pg and may result in extirpation of the species from such swamps, when a critical threshold, in terms of area of such suitable habitat, is passed. Similar affects may occur in respect of other groundwater dependent species, including *Eulamprus leuraensis* (El).

p.303, Table 10.2a: The predicted lowering of the water table in identified NPSS, as a result of mining, is claimed to be not significant, but without any justification as to why. I suggest the opposite, that the predicted lowering of water tables will be significant, with a possibility that the extent of lowering will exceed the model results. The proponent acknowledges that there will be a lowering of water levels. Based upon previous evidence, it can be assumed that the actual lowering of water table will be more, and possibly much more. Any lowering of water tables in the long term will affect the ecological functioning of these swamps and negatively affect their suitability for individual species, such as Pg.

p.306: There is no evidence on the Newnes Plateau or elsewhere in the Sydney Region that natural filling of subsidence induced cracks under swamps will result in groundwater levels returning to pre-mining levels, in the medium or long term. Lowering of water levels will result in either a reduction in the spatial extent of suitable habitat within affected swamps or extirpation of populations of various species, such as Pg and El.

p.334, Table 10.9: Incorrectly states that Pg could potentially occur, when in fact there are multiple records for this species in NPSS in the project area, including new records by I.R.C. Baird in January 2014 (see Atlas of NSW Wildlife; Baird 2012; Benson & Baird 2012).

p.337, Terrestrial mammals: Fauna surveying was obviously inadequate, if they did not at least find swamp rats *Rattus lutreolus* (evidence recorded by I.R.C. Baird in most swamps) and *Antechinus* spp. in NPSS etc.

p.338: Herpetofauna: It is surprising that surveys did not record *Eulamprus leuraensis* in NPSS in the project area. The species has been recorded in most of the NPSS in the project area and is readily captured in funnel traps placed in suitable swamp habitat, as evidenced by recent research by S. Gorissen (PhD candidate, University of Sydney). This indicates a poorly designed and inadequate survey approach. The lack of observation of small terrestrial mammals in these swamps is also a serious deficiency.

p.341, Photograph 10.1 does not show a typical NPSS.

p.352-353: *Petalura gigantea* has subsequently been recorded in Carne Central Swamp and Gang Gang Swamp East by I.R.C. Baird (see Atlas of NSW Wildlife).

p.353-354: I reject the proposition that the predicted lowering of water tables in swamps following mining will not negatively affect groundwater dependent species. Pg, for example, is reliant upon moist to waterlogged substrate for ovipositing and larval establishment (Baird 2012: Ch. 6). It only requires a drying of the surface peat to a shallow depth to reduce the spatial extent of potential breeding habitat in a particular swamp. In some swamps, the area of suitable breeding habitat for this species is relatively small and associated with what are currently the wettest parts of those swamps. If there is a contraction in the areal extent of those more or less permanently saturated substrates, then there will be a proportional reduction in the spatial extent of potential ovipositing and larval establishment sites for this species. Similarly, core habitat for El is also associated with the wetter parts of these swamps and the species will be negatively affected by any long term lowering of water tables.

p.359, Table 10.15: 7 part test of significance: I totally reject the results of the 7 part test for Pg, El and *Boronia deanei* (see below for Appendix H).

p.363: I reject the conclusion that there will not be a significant impact in relation to the KTP in relation to subsidence from longwall mining. An additional impact on peat swamps, associated with a drying of surface peats, is the increased combustion of the organic component of the soil during fire events. A long term lowering of water tables will result in significant cumulative effects of subsequent fires, which will be further compounded by predicted climate change scenarios.

p.365, Table 10.16: I reject the conclusion of no impact for El in relation to EPBC Act as above. Note also the work of Dubey and Shine (2010) which showed genetic diversity between El swamp populations, recommending they be treated as discrete conservation units.

Discharge of what is effectively untreated, highly contaminated mine water to Kangaroo Creek via LDP001, and subsequently to the Coxs River, is totally inappropriate and the measures proposed to mitigate the ongoing and increasing damage to these aquatic ecosystems are inadequate. It is unfathomable that the company is currently permitted to degrade this stream system, let alone increase those negative effects. A complete redesign of the waste water management system which pre-treats all mine waste water to a much higher level of water quality before discharge is essential.

Emergency discharge points in the Wolgan River and Carne Creek must be eliminated and those discharge licences voided. The proponent must be held accountable and be responsible to ensure that their water management system is designed to cope with all possible scenarios and that no waste water is ever transferred to these watercourses.

Appendix D

s.5.7-5.8: No longwalls should be located in positions where 26.5 degree angle of draw line from the limit of extraction for the proposed longwalls includes areas with pagodas or cliff faces. Longwall 501 should be shortened to protect cliffs and pagodas. The evidence of subsidence induced cliff collapse and damage to internationally significant pagodas across the western Blue Mountains is extensive.

Appendix G:

p.80: The consultants state that "The assessment of potential impacts on stygofauna is limited by the lack of information on their occurrence in the aquifers within the Project area, their response to environmental perturbations and likely conservation significance." Following recommendations of the consultant, more comprehensive, and better designed pre-mining surveying, and finer resolution taxonomic identification of stygofauna, must be implemented if this project proceeds to ensure that the diversity of stygofauna is properly assessed and potential risks of the project determined.

Appendix H.

S.3.5.1, P.61: Inaccurately states that "margins of swamps are also preferred habitat for *B. deanei".* This species may also be found in wetter parts of swamps and is frequently distributed throughout swamps, in association with particular hydrological conditions.

Also fails to mention that Pg is associated with the wetter parts of swamps.

p.69: Pg has been recorded from most NPSS in the project area, although the consultants only mention the previous record for Sunnyside Swamp.

p.70: El records are also not correctly identified, as the species has been recorded from most NPSS in the project area

p.88: Gang Gang Swamp East and Carne Central Swamp are also recorded sites for Pg (Baird 2012; NSW Wildlife Atlas).

p.89: The predicted lowering of water tables in these swamps may lead to permanent degradation of the ecological function of these swamps, and will result in a reduction in the spatial extent and potential loss of suitable habitat for Pg, El and other groundwater dependent species within individual swamps, including stygofauna. A lowering of water tables which exceeds these predictions is likely and will have even more significant impact. This stands in stark contrast to the claims of the consultants of no significant impact.

p.95: Invasive species: The consultant is wrong in stating the project will not contribute to increase in invasive species. In NPSS and other THPSS, there is ample evidence of increased weed invasion of swamps following lowering of water tables, leading to further degradation of the ecological functioning of these swamps.

7 Part Test of Significance:

Assessment for *Boronia deanei* ssp. *deanei* is flawed. Any NPSS population of this species, which is subjected to medium to long term lowering of the water table, will be at risk of a reduction and potentially the loss of that population in the long term.

Assessment for *P. gigantea* is flawed. The requirement for moist to saturated substrate for successful oviposition and larval burrow establishment <u>is the critical factor</u> in the persistence of this species in swamps. Because of the long larval stage, probably in excess of 6 years, some later stadia larvae in established burrows may be able to persist until emergence, even after some lowering of water tables during their period of burrow occupation; however, successful reproduction, and thus persistence of populations, will be limited by the availability of suitable saturated substrate for ovipositing and larval establishment. The consultant misleadingly claimed that the range of recorded burrow depths and evidence of adaptive burrow deepening (see Benson & Baird 2012) was an indication that the species would survive long term lowering of water tables. This demonstrates either a complete lack of understanding of the life history of this species or is intentionally misleading. If there is a contraction in the areal extent of those more or less permanently saturated substrates, then there will be a proportional reduction in the spatial extent of potential ovipositing and larval establishment sites for this species, which could lead to extirpation of this species from an individual swamp and negatively impact metapopulation dynamics (Baird 2012, in press; Benson & Baird 2013).

Assessment of *Eulamprus leuraensis* is flawed. Core swamp habitat for this species is associated with the wetter parts of the swamps. Any observations of the species in non-swamp habitat are incidental and irrelevant in terms of consideration of likely impacts of loss of groundwater upon core habitat for the species. The assessment of no significant impact upon this species is based on the flawed presumption that there will be no significant lowering of the water table in a particular swamp, although the predicted lowering of water tables is already significant. Any reduction in water table will reduce the area of core habitat for this species in individual swamps and may result in the extirpation of a local population. Note the work of Dubey and Shine (2010) which showed genetic diversity between El swamp populations, recommending they be treated as discrete conservation units, which has implications in terms of application of the 7 part test and consideration of potential impacts under the EPBC Act.

PART C: Recommendations

The mining footprint must be significantly lessened and mining methods reduced in intensity to protect Carne Creek, pagodas, cliffs and the nationally endangered swamps associated with these proposals. Centennial Coal must be required to consider alternative bord and pillar mining methods for its proposed Springvale extension. Centennial's Airly mine in the Capertee Valley operates to depth of 405 metres underground in the same geology, with bad mine roof conditions, including many structural defects. If Centennial can operate Airly Colliery as a bord and pillar mine, then it can also operate Springvale mine in this manner.

The intensity of mining must be reduced to avoid damage to pagodas, cliffs and the many nationally endangered swamps that the current proposal puts at risk.

The proposed Springvale mine extension should not be granted development consent unless:

- The development consent is staged, with a review every five years;
- Staged approval with triggers requiring review of consent conditions should impacts be observed in the environmental matters of state, national and international significance;
- Subsequent approvals contingent on performance to consent conditions;
- Consent should be subject to performance standards triggers that ensure the health and integrity of receiving waters and heritage values;

- If the trigger levels are exceeded then consent should be immediately reviewed to address the failures at any time;
- Opportunity for third parties to provide effective input to avoid regulatory failure as State agencies are too busy to undertake the regulatory task and follow these issues in detail;
- A comprehensive, systematic pre-mining stygofauna survey must be implemented across the project area, with finer resolution taxonomic identification of stygofauna, to ensure that the diversity of stygofauna is properly assessed and potential risks of the project determined;
- No surface cracking of stream beds, under swamps or of pagodas, rock outcrops or cliffs;
- The intensity of longwall mining is reduced so that all nationally endangered swamps are protected – this includes significantly narrowing longwalls in the northern longwalls 416 to 422 to prevent surface cracking under the best developed, largest and most intact swamps on Newnes Plateau;
- Shortening longwalls 432, 431, 430 and 429 to prevent damage to the Marrangaroo swamps, and shortening longwalls 425 and 426 to prevent damage to Paddys Creek Swamp;
- Longwall 501 should also be shortened to protect cliffs and pagodas;
- All proposed discharge of up to 43.8ML/day of mine effluent to the Coxs River via the Springvale-Delta Water Transfer Scheme (SDWTS) is treated by reverse osmosis technology to remove salt and metals to a standard that protects, the Coxs River, the downstream drinking water supply and near-pristine ecosystems in the World Heritage Area;
- Any malfunction of SDWTS, such as following a bushfire, must not result in emergency discharges to the World Heritage Area via Wolgan River or Carne Creek but be reinserted underground into the mine;
- Reinserted mine effluent must not then re-emerge in an unauthorised or unregulated manner but be properly treated;
- No emergence of near surface groundwater with elevated levels of salt or metal precipitate in Carne Creek;
- Representative locations for piezometers for monitoring groundwater in swamps and streams to be determined by a third party agency;
- Monitoring guidelines must clearly specify how the condition of groundwater dependent indicator plant species and the general condition of groundwater dependent ecosystems will be performed;
- All past tracks and trails created by Centennial Coal and its consultants, including those established by trail bikes, need to be recorded and plans set in place to rehabilitate these trails on an on-going basis and as soon as practicable as part of the on-going rehabilitation program for this mine.

Subsidence monitoring should be by a third party agency, such as the Office of Environment and Heritage, and monitoring should be paid for by Centennial Coal.

Monitoring of surface flow and near-surface groundwater monitoring must create a comprehensive picture of the sub-catchments affected by mining.

Monitoring of changes in ecosystem condition must include well exposed, wide angle impacts of affected areas with GPS co-ordinates.

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