The National Trust
of Australia (New South Wales)

23rd October, 2007

Major Project Assessments
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Moolarben Coal Project (Major Project No. 05_0117)

The National Trust makes the following comments on the Moolarben Coal Project (open cut and underground coal mine, approximately 40 km northeast of Mudgee).

The Trust is presently investigating the listing on the Trust Register of the Goulburn River Landscape Conservation Area, not only the area currently included in the Goulburn River National Park but also other areas of high nature conservation, scenic and Aboriginal significance including "The Drip" feature which is within the boundary of EL 6288.

In the 1980s the National Trust was involved in a site inspection at Blackfellows Hand Rock, east of Cullen Bullen of the the longwall coal mining operation which had caused the collapse of significant 'pagoda' style sandstone rock outcrops. The Trust was concerned that there would be further damage if adequate buffer zones were not adopted.

In 1966 the National Trust had proposed a Pinnacles State Park for this area. Its scenic and scientific significance was subsequently recognised by the New South Wales National Parks and Wildlife Service which proclaimed the Gardens of Stone National Park on 30th November, 1994 and added the Pantoneys Crown Nature Reserve to the National Park on 22nd December, 1995.

Regrettably much of the area subject to the longwall coal mining was not incorporated into the National Park despite its scenic, nature conservation and historic significance. It is interesting that in the Gardens of Stone area, Centennial Coal was reported to have abandoned the use of longwall mining in the Clarence Colliery "which enabled the possibility of partial coal extraction to be adopted for sensitive areas like cliffs and swamps."

A buffer zone of approximately 250 metres has been proposed between the Development Application boundary and the Goulburn River in the area of 'The Drip'.

The Trust believes that this buffer zone is totally inadequate and places at great risk the Goulburn River and associated groundwater systems. Modelling indicates that there will be up to 27 megalitres per day water inflow to the mine. Pumping from the underground mine will lower ground water for many kilometres. This groundwater provides essential flow to the Goulburn River and there will be a considerable threat to the survival of the riverside vegetation ecosystem.

A band of 4.5 metres of coal is proposed for removal and there is a predicted 2.44 metre subsidence which will collapse the land surface in the sensitive area near 'The Drip'.

The Trust's concerns at the potential for damage in association with longwall coal mining were confirmed by the July 2005 gazettal of the NSW Scientific Committee's Final Determination – 'Alteration of habitat following subsidence due to longwall mining – key threatening process declaration'.

This declaration confirmed a number of issues and concerns: -

- The collapse zone above the extracted area is highly fractured and permeable and usually extends above the seam to a height five times the seam thickness.
- The fractured zone (above the collapse zone) can extend 20 to 30 times the height of the collapse zone (dependent on rock strength). Permeability is also increased in this zone but to a lesser extent than in the collapse zone.
- Above the fractured zone the surface strata will also crack as a result of bending strains.
- The surface area affected by ground movement is greater than the area worked in the seam. In the NSW Southern Coalfield it has been found that horizontal displacements can extend for more than one kilometer from mine workings (and in extreme cases in excess of three kilometres). A point on the surface may continue to experience residual subsidence for several years.
- Subsidence is dependent on topography being more evident in hilly terrain than in flat or gently undulating areas. The extent and width of surface cracking over and within the vicinity of the mined void will also decrease with an increased depth of mining.
- An already reduced river or creek flow rate due to drought conditions will increase the impact of water loss through cracking. Even temporary cracking, leading to loss of flow, may have long-term effects on ecological function in localized areas. The steeper the gradient, the more likely that any solids transported by water flow will be moved

downstream allowing the void to remain open and the potenttial loss of flows to the subsurface to continue. Impacts on the flows of ephemeral creeks are likely to be greater than those on permanent creeks. Cracking and subsequent water loss can result in permanent changes to riparian community structure and composition.

- Subsidence can also cause decreased stability of slopes and escarpments, contamination of groundwater by acid drainage, increased sedimentation, bank instability and loss, creation or alteration of riffle and pool sequences, changes to flood behaviour, increased rates of erosion with associated turbidity impacts, and deterioration of water quality due to a reduction in dissolved oxygen and to increased salinity, iron oxides, manganese, and electrical conductivity. The occurrence of iron precipitate and iron-oxidising bacteria is particularly evident in rivers where surface cracking has occurred. These bacteria commonly occur in Hawkesbury Sandstone areas, where seepage through the rock is often rich in iron compounds and are able to grow in water lacking dissolved oxygen. Where the bacteria grow as thick mats they reduce interstitial habitat, clog streams and reduce available food. Loss of native plants and animals may occur directly via iron toxicity, or indirectly via smothering. Long-term studies in the United States indicate that reductions in diversity and abundance of aquatic invertebrates occur in streams in the vicinity of longwall mining and these effects may still be evident 12 years after mining.
- The extraction of coal and the subsequent cracking of strata surrounding the mining void may liberate methane, carbon dioxide and other gases. Most of the gas is removed by the ventilation system of the mine but some gas remains within the mining void areas. Gases tend to diffuse upwards through any cracks occurring in the strata and be emitted from the surface. Gas emissions can result in localised plant death as anaerobic conditions are created within the soil.
- Subsidence due to longwall mining can destabilise cliff-lines and increase the probability of localised rockfalls and cliff collapse. This has occurred in the Western Coalfield and in some areas of the Southern Coalfield. These rockfalls have generally occurred within months of the cliffline being undermined but in some cases up to 18 years after surface cracking first became visible following mining.
- Damage to some creek systems in the Hunter Valley has been associated with subsidence due to longwall mining. Affected creeks include Eui Creek, Wambo Creek, Bowmans Creek, Fishery Creek and Black Creek. Damage has occurred as a result of loss of stability, with consequent release of sediment into the downstream environment, loss of stream flow, death of fringing vegetation, and release of iron rich

and occasionally highly acidic leachate. In the Southern Coalfields substantial surface cracking has occurred in watercourses within the Upper Nepean, Avon, Cordeaux, Cataract, Bargo, Georges and Woronora catchments, including Flying Fox Creek, Wongawilli Creek, Native Dog Creek and Waratah Rivulet. The usual sequence of events has been subsidence-induced cracking within the streambed, followed by significant dewatering of permanent pools and in some cases complete absence of surface flow.

- The most widely publicised subsidence event in the Southern Coalfields was the cracking of the Cataract riverbed downstream of the Broughtons Pass Weir to the confluence of the Nepean River. Mining in the vicinity began in 1988 with five longwall panels having faces of 110 m that were widened in 1992 to 155 m. In 1994, the river downstream of the longwall mining operations dried up. Water that re-emerged downstream was notably deoxygenated and heavily contaminated with iron deposits; no aquatic life was found in these areas.

In 1998, a Mining Wardens Court Hearing concluded that 80% of the drying of the Cataract River was due to longwall mining operations, with the balance attributed to reduced flows regulated by Sydney Water. Reduction of the surface river flow was accompanied by release of gas, fish kills, iron bacteria mats, and deterioration of water quality and instream habitat. Periodic drying of the river has continued, with cessation of flow recorded on over 20 occasions between June 1999 and October 2002.

At one site, the 'Bubble Pool", localised water loss up to 4 ML/day has been recorded. Piezometers indicated that there was an unusually high permeability in the sandstone, indicating widespread bedrock fracturing. High gas emissions within and around areas of dead vegetation on the banks of the river have been observed and it is likely that this dieback is related to the generation of anoxic conditions in the soil as the migrating gas is oxidised. An attempt to rectify the cracking by grouting of the most severe crack in 1999 was only partially successful.

In 2001, water in the Cataract River was still highly coloured, flammable gas was still being released and flow losses of about 50% (3-3.5 ML/day) still occurring. Environmental flow releases of 1.75 ML/day in the Cataract River released from Broughtons Pass Weir were not considered enough to keep the river flowing or to maintain acceptable water quality.

- Mitigation measures to repair cracking creek beds have had only limited success and are still considered experimental. Cracks less than 10 mm wide may eventually reseal without active intervention provided there is a clay fraction in the soil and at least some water flow is maintained. Cracks 10-50 mm wide may be sealed with a grouting compound or bentonite. Cracks wider than 50 mm require concrete. Pattern grouting in the vicinity of Marhnyes Hole in the Georges River has been successful at restoring surface flows and reducing pool drainage following fracturing of the riverbed. Grouting of cracks also appears to have been relatively effective in Wambo Creek in the Hunter Valley. Installation of a grout curtain in the Cataract River, however, has been only partially successful and it was concluded in 2002, after rehabilitation measures had taken place, that the environment flows released from Broughtons Pass Weir by the Sydney Catchment Authority were insufficient to keep the Cataract River flowing or to maintain acceptable water quality.

  Mitigation measures themselves may have additional environmental impacts due to disturbance from access tracks, the siting of drilling rigs, removal of riparian vegetation, and unintended release of the grouting material into the water. Furthermore, even measures that are successful in terms of restoring flows involve temporary rerouting of surface flows while mitigation is carried out (generally for 2-3 weeks at each grouting site). Planning for remediation measures may also be hampered by the lack of predictability of some impacts, and difficulties gaining access to remote areas where remedial works are needed. The long-term success of mitigation measures such as grouting is not yet known. It is possible that any ongoing subsidence after grouting may reopen cracks or create new ones. Further, it is not yet known whether the clay substance bentonite, which is often added to the cement in the grouting mix, is sufficiently stable to prevent shrinkage. Grouting under upland and hanging swamps that have no definite channel is probably not feasible.
- Empirical methods have been developed from large data sets to predict conventional subsidence effects. In general, these models have proved more accurate when predicting the potential degree of subsidence in flat or gently undulating terrain than in steep topography. A major issue identified in the ACARP (2001, 2002) reports was the lack of knowledge about horizontal stresses in geological strata, particularly those associated with river valleys. These horizontal stresses appear to play a major role in the magnitude and extent of surface subsidence impacts. The cumulative impacts of multiple panels also appear to have been poorly monitored. The general trend in the mining industry

in recent years toward increased panel widths (from 200 up to 300 m), which allows greater economies in the overall costs of extraction, means that future impacts will tend to be greater than those in the past (ACARP 2001, 2002).

- In view of the above the Scientific Committee is of the opinion that Alteration of habitat following subsidence due to longwall mining adversely affects two or more threatened species, populations or ecological communities, or could cause species, populations or ecological communities that are not threatened to become threatened.

Given the current 'drought' which is increasingly being recognised as the long term effects of global warming, and the findings of the NSW Scientific Committee expressed above the 250 metre buffer zone adjoining the Goulburn River is hopelessly inadequate.

The Trust objects strongly to this Development Application because of the threat to the Goulburn River, 'The Drip' and the associated groundwater systems.

Yours sincerely,

Jacqui Goddard
Conservation Director