ICONS UNDER THREAT

Natural areas and threatened species at risk from mining and gas in NSW

Acknowledgements

The author would like to sincerely acknowledge the input received for this report from community members who live in and around the iconic areas described within these case studies. Thank you for your tireless and often unrewarded dedication to ensuring these significant natural areas are not forgotten. It has inspired hope for their protection against all the odds.

Thank you also to the numerous photographers who provided their beautiful, inspiring and professional images free of charge to support the presentation of these case studies and help advocate for their protection.

Icons Under Threat was created with the help of many organisations:

Friends of the Pilliga

Northern Inland Council for the Environment

Hunter Environment Lobby

Total Environment Centre

Blue Mountains Conservation Society

Colong Foundation for Wilderness

Rivers SOS

Mudgee District Environment Group

Environmental Defenders Office

National Parks Association of NSW

Nature Conservation Council of NSW

Written by: Naomi Hogan
Graphic Design: Kiran Charles
November 2011

With thanks to The Wilderness Society Inc and the Dara Foundation for their financial support through the WildCountry Small Grants Program.

contents

Introduction

The NSW Coalition government was elected in 2011 with a Strategic Regional Land Use Policy that stated they "believe that agricultural land and other sensitive areas exist in NSW where mining and coal seam gas extraction should not occur".

However, plans to greatly expand the mining footprint over NSW are pushing into iconic natural areas that sustain life for threatened species and are highly treasured within their regional communities.

This report, Icons Under Threat, outlines unique case studies from seven iconic, sensitive natural areas of NSW under significant threat from mining and gas expansion.

These case studies provide insights into thousands of hectares of rare habitat proposed to be clear felled for mining activities, the damage already being done across water catchments and the current inadequacy of mining company assessments and biodiversity offsets. They bring to life the harsh reality of a choice between species extinction and survival.

These iconic natural areas are not only significant places to the threatened plant and animal species under our protection, they are also places rich in Aboriginal and European Heritage, provide popular tourist destinations, supply native timber and provide clean drinking water to thousands of NSW residents.

The recommendations within each case study are based on a strong local community commitment to the protection of their iconic area and their local industries from mining. They also provide practical suggestions for improving the NSW planning process to achieve more balanced land management outcomes for NSW, while recognising the need to place clear boundaries around natural icons deserving of protection from mining into the future.

THE PILLIGA

Why is it special?

A place of outstanding conservation significance, the Pilliga Forest covers an area of approximately 500,000 hectares. It is the largest remaining temperate woodland in eastern Australia and the largest forest remnant left in the heavily cleared Wheat-Sheep Belt 'west of Narrabri'. The area has recognised wilderness significance, and more than 117,698 hectares meet the criteria for the National Wilderness Inventory[1].

Internationally, the Pilliga is an Important Bird Area under the BirdLife International scheme, supporting the largest NSW population of Barking Owls and other declining woodland species in NSW[2]. 'It's a bird lovers' delight, refuge to hundreds of bird species who are attracted by the mix of temperate, semi-arid and sub-tropical climates and the rare native woodlands[3].

The Pilliga has very high species diversity[4] and forms part of the Brigalow Belt South Bioregion, recognised by the Federal Government as one of only 15 national biodiversity hotspots within Australia. It forms the southern recharge area of the Great Artesian Basin and contributes surface water flows to the Murray-Darling Basin. It also has high cultural significance and is rich in heritage sites, including rock shelters, burials, grinding grooves and scarred trees[5].

What's the threat?

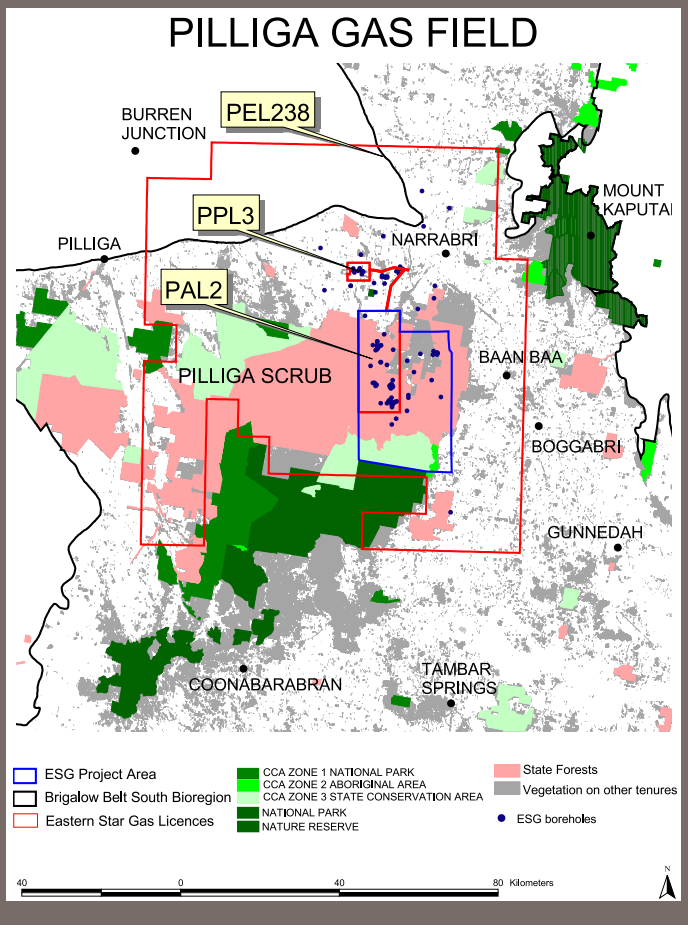
Mining company Santos plans to develop a coal seam gas field within their exploration lease covering over 800,000 hectares of the Pilliga Forest. In 2011 Santos bought Eastern Star Gas who proposed to drill 1,100 gas wells and clear 1,000 km of pipeline, fragmenting 85,000 hectares of Pilliga Forest and turning the iconic and significant habitat refuge into an industrial coal seam gas field.

The 2010 Preliminary Environmental Assessment for the proposed gas field development found all of the following risks to be "probable" .

- Increased risk of bushfires
- Reduced habitat availability for State listed threatened species, populations or communities resulting from vegetation clearance
- Loss and/or fragmentation of native vegetation resulting from clearing for wells, gas plant and water infrastructure
- Drawdown of surface aquifers resulting from dewatering of coproduced water during gas extraction
- Contamination of surface waters resulting from storage of saline coproduced water or brine
- Reduced opportunity for recreation in areas of Pilliga East State Forest
- Potential contamination of land resulting from brine storage or disposal
- Erosion and deposition of exposed soils and release of sediment laden runoff into creeks and rivers

Already, the coal seam gas exploration drilling in the Pilliga Forest has caused massive environmental damage. Santos now plans to drill 50 more exploration wells in the region. Over 20 environmental incidents have been reported including a large spill of untreated coal seam gas water: a toxic cocktail of heavy metals (arsenic, lead and chromium), salts and petrochemicals.

Activities to date have also caused ecological problems and directly destroyed at least 150 hectares of habitat. 1,700 hectares of native vegetation has been heavily fragmented, impacting sensitive plant and animal populations and causing weed invasions. Chemical and diesel pollution events have occurred, killing many further hectares of forest. Native wildlife has been found dead at saline drill ponds[6].



Ready to raze - NSW Government gives green light to coal seam gas

In September 2012, the NSW Government put 22 exploration licences up for renewal, including PEL 238 in the Pilliga Forest. This green light to exploration was given despite a record in NSW of toxic coal seam gas spills and community opposition. These exploration renewals were released the same day as the NSW Government released their Strategic Regional Land Use Policy - a policy that does not protect one square inch of land in NSW from mining. This means that food producing land, water catchments and important ecological areas like the Pilliga Forest are still under threat.

Lessons from QLD – gas leaks likely

The QLD government recently conducted gas well inspections of 2719 wells, resulting in the identification of gas leaks relating to the well casing, the well head and related well head equipment.

Five leaks were found to be risking the safety of workers and the community. A further 29 leaks were above a level where best practice dictates that action should be taken[7].

The full impacts of leaking methane gas wells in the highly bushfire prone Pilliga Forest are untested. The flammable methane gas, coupled with the drop in groundwater levels from the gas mines' dewatering process, could lead to disaster for the threatened species and ecological communities of the Pilliga Forest.

Locals to the area know the bushfire risks of the Pilliga, as there is a long history of fire to the forest. An extremely dry winter and spring in 2006 saw a number of large fires develop, including a fire which burned out 740 square kilometers on just its first day.

Threatened species at risk

Eastern Star Gas described the importance of the Pilliga as follows, "The remnant has national, state and regional conservation significance for the protection of biodiversity and threatened species"[8]. In fact, there are 24 matters of national environmental significance, as defined by the Environment Protection and Biodiversity Conservation Act 1999 that occur within the gas license areas of the Pilliga Forest[9].

Sadly, human impacts to this iconic natural area have already taken their toll. More than 14 mammal species are already believed to be extinct in the region–one of the highest extinction rates in Australia. Those species now lost from the area include the Bilby, Brush-tailed Bettong, Western Barred Bandicoot, Bridled Nailtail Wallaby and the Eastern Chestnut Mouse[10].

The future of the fragile native species left surviving in the region is now very much in the hands of those deciding the actions allowed within the iconic Pilliga Forest.

The habitat loss, increase in fragmentation and predation as a result of the gas development is likely to severely impact the Squirrel Glider, Koala and Eastern Pygmy Possum. Declining woodland birds such as the Diamond Firetail, Hooded Robin and Speckled Warbler will also be impacted, as the Pilliga represents a major refuge area. Migratory species to be impacted include the Regent Honeyeater, Swift Parrot, Great Egret and the Rainbow Bee-eater.

The Pilliga provides habitat for the only known population of the endemic Pilliga Mouse, the largest Koala population in NSW west of the Great Divide (due to the occurrence of some of the Koala's favourite tree species[11]) and one of only two known Black-striped Wallaby populations in NSW. It is also recognised as the national stronghold for the south-eastern Long-eared Bat.

Rainbow Bee-eater

The gas project referral failed to identify the migratory Rainbow Bee-eaters which are known to occur in the area[12].

Barking Owl

Photo: Robin Ducker

The Pilliga area is recognised as a major stronghold for the Barking Owl in NSW[13].

Photo: Justin McDowell

Pilliga Mouse

The vulnerable Pilliga Mouse lives only in the Pilliga Forest. The 2011 Narrabri Coal Seam Gas Project referral concluded that, "given the population of Pilliga Mouse in the project area is considered an important population and the potential for impacts described above, the development may have a significant impact on the species"[14].

Black-striped Wallaby

The Black-striped Wallaby is endangered in NSW and the northern Pilliga is the only known location of this species in western NSW. Requiring dense vegetation, it is extremely vulnerable to clearing, fragmentation and increased predation.

Malleefowl

The endangered Malleefowl is now possibly extinct in the Pilliga, although the species could be revived through captive breeding and release programs if predation and fire risks decrease.

"Coal seam gas mining and iconic high conservation value areas like the Pilliga are mutually exclusive. It is either one or the other." Jane Judd, Coonabarabran resident.

Recommendations

This proposed gas field development will cause species fragmentation, weed invasion, habitat and heritage loss, noise and increased fire risk. As such, decision makers are strongly encouraged to:

- Reject this gas field proposal, as it is dangerous in nature, poses significant threats to endemic and threatened species and would destroy a key natural icon of NSW.
- Ensure this national icon is safe from future developments which pose such risks to its natural systems and declare the Pilliga a mining free area.
- Resolve the uncertainties and establish scientifically credible measures to avoid or mitigate the high impacts and fire risk of this gas field proposal.
- Publicly release all information regarding the spills, breaches and environmental failures in the Pilliga and prosecute the coal seam gas companies accordingly.

WARKWORTH SANDS WOODLAND

Why is it special?

Warkworth Sands Woodland is an important drought refuge for migratory bird species and wildlife corridor linkage across the Hunter Valley. With unique ancient sand beds and blooming banksias, it is home to a range of threatened species and provides significant tree hollows and habitat amongst a heavily cleared landscape.

Warkworth Sands Woodland is listed as an Endangered Ecological Community under the NSW Threatened Species Conservation Act 1995 and is extremely rare, confined to a small area around Warkworth, about 15 km south east of Singleton near the town of Bulga in the mid Hunter Valley[1]. According to recent detailed vegetation surveys, only 464.8 hectares of Warkworth Sands Woodland remain in existence. This figure is down 40% from what the NSW Scientific Committee had previously estimated, prompting recommendations for it to now receive a Critically Endangered status[2].

In 1992, the NSW government identified the need to protect Warkworth Sands Woodland in a Nature Reserve due to its extremely confined distribution and the encroaching threats to its survival. However, despite the ecological significance, there is currently no representation of this endangered ecological community within a dedicated conservation reserve[3]. Unless key ongoing threats such as open-cut coalmining, sandmining and the construction of mining infrastructure cease, Warkworth Sands Woodland is likely to become extinct in New South Wales[4].

Warkworth Sands Woodland presents a choice for elected leaders: protect what's left of this important endangered ecosystem... or be responsible for its extinction.

What's the threat?

Coal and Allied (Rio Tinto) plan to extend their current Warkworth open cut coal mine to the west to extract up to 18 million tonnes of coal every year for an additional 21 years past their current mine closure date[5]. This proposed extension will destroy 22% of the only remaining stand of Warkworth Sand Woodland left in Australia[6], altogether clearing 765 hectares of woodland and open forest containing four endangered ecological communities and numerous threatened species.

The mine would destroy Non Disturbance Area 1 habitat, which had been given a Ministerial guarantee to be a Non Open Cut Mining Area, supposed to be set aside for conservation forever. Groundwater dependent ecosystems along the eastern bank of the Wollombi Brook would also be impacted[7].

113 Aboriginal heritage sites, including scarred trees, artifact scatter sites and grinding groove site will be impacted if the proposal goes ahead[8]. Aboriginal people consulted expressed that all sites are sacred and they would rather not have them disturbed[9].

The project is not supported by the local Singleton Council and there is strong community concern about the proposal's impacts on biodiversity, air quality, visual amenity and the impacts along Wallaby Scrub Road, which is to be consumed by the open cut pit[10]. Council unanimously rejected the sale and destruction of the road due to the road's utilitarian and historic importance, nearby Aboriginal heritage sites and the habitat that was understood to be protected by the state State Government Ministerial Guarantee[11].

Guinea flower (Hibbertia linearis)

Photo: Nathan Hurst

Threatened species at risk

This proposed mining expansion will lead to a significant loss to biodiversity on the floor of the Hunter Valley and will destroy habitat for 17 threatened animal species listed under the NSW Threatened Species Conservation Act 1995, two endangered and one critically endangered species listed under the Federal Environment Protection and Biodiversity Conservation (EPBC) Act.

Threatened species to be impacted include the Speckled Warbler, Large-eared Pied Bat, Brown Treecreeper and Grey-crowned Babbler[12]. The vulnerable Squirell Glider, Turquoise Parrot and the Glossy Black Cockatoo are also present on the site[13].

In times of drought in northern breeding and feeding areas, this Warkworth habitat is a critical drought refuge for the Swift Parrot (nationally endangered) and the Regent Honeyeater. The Regent Honeyeater has recently been updated to be a "critically endangered species", facing an extremely high risk of extinction in New South Wales in the immediate future[14].

The project will clear four endangered ecological communities, including the Warkworth Sands Woodland, Central Hunter Grey Box- Ironbark Woodland, Central Hunter Ironbark-Spotted Gum- Grey Box Forest, and Hunter Lowlands Red Gum Forest. The tree hollows in these forests take up to 200 years to develop and are critical to the survival of many threatened animal species for breeding and sanctuary from prey.

"There were serious concerns raised by Aboriginal groups about the destruction of heritage that were not addressed by Rio Tinto, and many other local people are still troubled by the loss." Stewart Mitchell, Bulga resident

Photo: www.listeningearth.com.au

Swift Parrot. Endangered

Photo: Tim Williams

Regent Honeyeater. Critically Endangered

Biodiversity Offsets give green light to habitat destruction

Mining companies have been getting the go ahead to destroy nationally and state significant threatened species habitat if they buy a bush block elsewhere as an 'offset'.

In offset areas, activities such as clearing, grazing and moving fallen timber are often prohibited. However, mining activities have proven to override protection agreements. The proposed Warkworth open cut extension will destroy a conservation offset guaranteed by a Deed of Agreement by the Planning Minister in 2003, which at the time allowed for the destruction of endangered Warkworth Sands Woodland habitat for another mining extension.

This would not be the first time a conservation agreement was broken. At Mt Owen Mine, the destruction of nearly 50% of Ravensworth State Forest was approved because the company committed to protect the remaining forest as an offset, only for more of this offset area to be approved for destruction ten years later.

For the Warkworth extension, Coal and Allied propose to set up a biodiversity conservation area on the Goulburn River near Merriwa. This protection will not compensate for the destruction of the specific Endangered Ecological Communities at Warkworth and the threatened species they support.

Warkworth Sands Woodland cannot be adequately protected elsewhere to compensate, as there is not sufficient woodland left remaining. The Chair of the NSW Scientific Committee has stated that the ecosystem removal of Warkworth Sands Woodland for open cut coal mining will likely lead to the irreversible extinction of the ecological community[15].

Recommendations

- Reject the Warkworth Extension proposal and place the remaining Warkworth Sand Woodland area into a Nature Reserve, protecting the threatened native vegetation types in perpetuity and the threatened species that depend upon this ecological community for survival.
- Uphold the 2003 Deed of Agreement to protect the Warkworth Sands Woodland offset as approved under that assessment.
- Conduct a full inquiry into the success or otherwise of mining offsets and mining rehabilitation in protecting biodiversity in NSW. Include a full listing of offsets and mining consent conditions and rehabilitation outcome for all mines in NSW, and examine the government's ability to enforce offset arrangements, rehabilitation commitments and conditions of approval for open cut mining to date.
- Undertake integrated modelling and cumulative assessment of the dust, habitat clearing and groundwater impacts across the areas of Bulga, Jerrys Plains, Broke and Warkworth.
- Complete a full and independent health study for the Singleton Shire before any further large scale mines are approved.
- Maintain Wallaby Scrub Road in its present location for its historical and heritage value and protect the road from any development which may seek to degrade, destroy or relocate it in future.

LEARD STATE FOREST

Why is it special?

Leard State Forest includes the most extensive and intact stands of the nationally–listed and critically endangered Box-Gum Woodland remaining on the Australian continent. The thousands of hectares of Australian native forest within Leard are teeming with life - representing the most significant forest for conservation of the entire Wheat-Sheep Belt[1].

Surveys show Leard State Forest is home to 396 native species of plants and animals, and includes habitat for 34 threatened species and several endangered ecological communities[2]. It has an extraordinarily high density of tree hollows, provides a major drought and climate change refuge, and creates the rare environmental conditions where population numbers of unique species can actually increase.

Leard State Forest is located approximately 80km NW of Tamworth within the Liverpool Plains province of the Brigalow Belt South bioregion, a nationally recognised biodiversity hotspot. Only 2.9% of this bioregion within NSW is included in secure protected areas, well short of the 15% protection target considered necessary by both national and international standards[3].

What's the threat?

The integrity of this significant forest safe haven is now at risk of collapse. There are plans for three large open cut coal mines to plough through the heart of the forest. This will heavily impact a diverse range of native species, already threatened and vulnerable to fragmentation.

Together, the three mines will span across one full length of the forest, clearing an estimated 3,500 hectares of Leard State Forest and approximately 5,500 hectares of native vegetation in total[4], much of which is highly intact and Critically Endangered Box-Gum Woodland.

The three coal mines are set to mine coal 24 hours per day, seven days a week, clear vast amounts of critical forest habitat and lead to significant light and noise disturbance. The coal mine pits will be hundreds of metres deep, significantly impacting surface water flows, depressurising the water table across kilometers of surrounding forest and agricultural land and impacting unique groundwater dependent ecosystems[5].

Cutting through the heart of Leard State Forest

Boggabri Coal is currently operating within Leard Forest and plan to expand their opencut coal mine to be approximately 5km wide and 5km long, clearing 1,900 hectares of native vegetation[7].

The Maules Creek proposal involves an open cut coal mine about the size of Boggabri, clearing a further 1,500 hectares of Leard State Forest, digging pits 320m metres deep and selling 10.8 million tonnes of coal every year for over 30 years[8].

Tarrawonga plans to increase open cut disturbance area by three times to expand into Leard State Forest and completely adjoin the Boggabri open cut pit. The mine life will increase from eight to 23 years and Goonbri Creek will be moved[9].

Swapping sanctuary for predation zone

The coal mines propose to protect a number of surrounding scattered and degraded areas to 'offset' the destruction of this high quality forest[10], leaving only fragmented edges. These proposed 'offset' areas do not nearly compensate for the loss of what is one of the most significant and intact remnants of a critically endangered ecosystem known to exist nationally. The current offset sites occur on highly disturbed freehold land containing bird species that lead to the decline of threatened woodland birds through nest predation and competition[11].

Forest management responsibilities sold out

Leard State Forest is public land and should not be destroyed for private gain. Clear felling and open cut mining massive expanses of state forest and endangered ecological communities is inconsistent with the objects of the Forestry Commission under the NSW Forestry Act 1916. It does not "conserve and utilise the timber", or lead to "the preservation of the native flora" or "conserve birds and animals" or "provide natural resource environmental services"[12].

If the three mines go ahead, more of Leard Forest will be disturbance zone than critical habitat.

Box-Gum Woodland

Box-Gum Woodland is extremely rare, occurring on the fertile plains usually cleared for agriculture. More ample resources of water and nutrients mean Box-Gum Woodland trees often grow very large and develop hollows. These hollows are extremely important for a huge range of threatened animal species of parrots, owls and bats. Box-Gum Woodland trees also have reliable nectar flows and foliage growth, making them essential for nectar-feeding and insectivorous woodland birds and bats[6].

Diamond Firetail

Photo: Marj Kibby

Koala

Photo: Frank Maurer

Masked Owl

Photo: Ian Thomas

Threatened species at risk

The proposed clearing of Leard State Forest for open cut coal mines will impact negatively on the life-cycles of rare and threatened native species. It will lead to a substantial reduction in foraging and roosting habitat, fragmentation, edge effects, increased threats from invasive species, disruption of breeding cycles and will ultimately cause a long-term decrease in the size of the populations.

The clear felling needed for the coal mining process will interfere with recovery action and cause enormous negative impacts on up to 34 unique threatened species and their habitats, particularly hollow-dependent species and declining woodland birds.

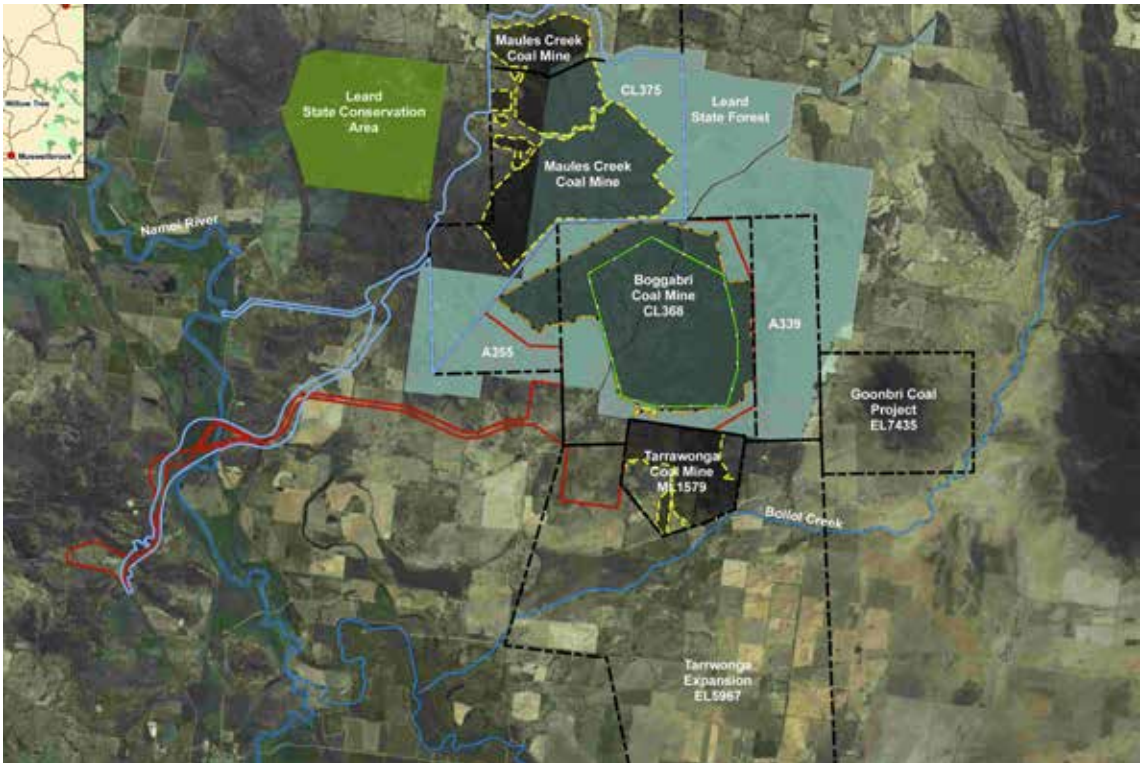
Leard State Forest is one of only three known occurrences on public land of the Feathertail Glider in the Brigalow Belt South Bioregion and is one of only three core areas for the vulnerable Diamond Firetail[13]. The list of significant threatened and vulnerable species to be impacted includes: Box-Gum Woodland, Weeping Myall Woodland, Swift Parrrot, Turquoise Parrot, Regent Honeyeater, South-eastern Long-eared Bat, Spotted-tailed Quoll, Masked Owl, Border Thick-tailed Gecko, Spotted Harrier the Wallaroo and the Koala.

Photo: Joyce Webster

Massive carbon impact on community and climate

The Boggabri mine will produce up to 7 million tonnes of coal every year, with the combined production at more than 22 million tonnes per year.[14] This is larger than any existing Hunter Valley mine, and will cause major impacts on local communities, their health, their way of life and their livelihoods.

The Boggabri mine alone will destroy the existing forest carbon sink and produce 16.9 million tonnes of greenhouse gases each year. This is equivalent to 10% of all greenhouse gases polluted every year throughout the whole of NSW.[15] The cumulative impacts of all the mines are even greater and should be properly considered by the Minister and Department of Planning.

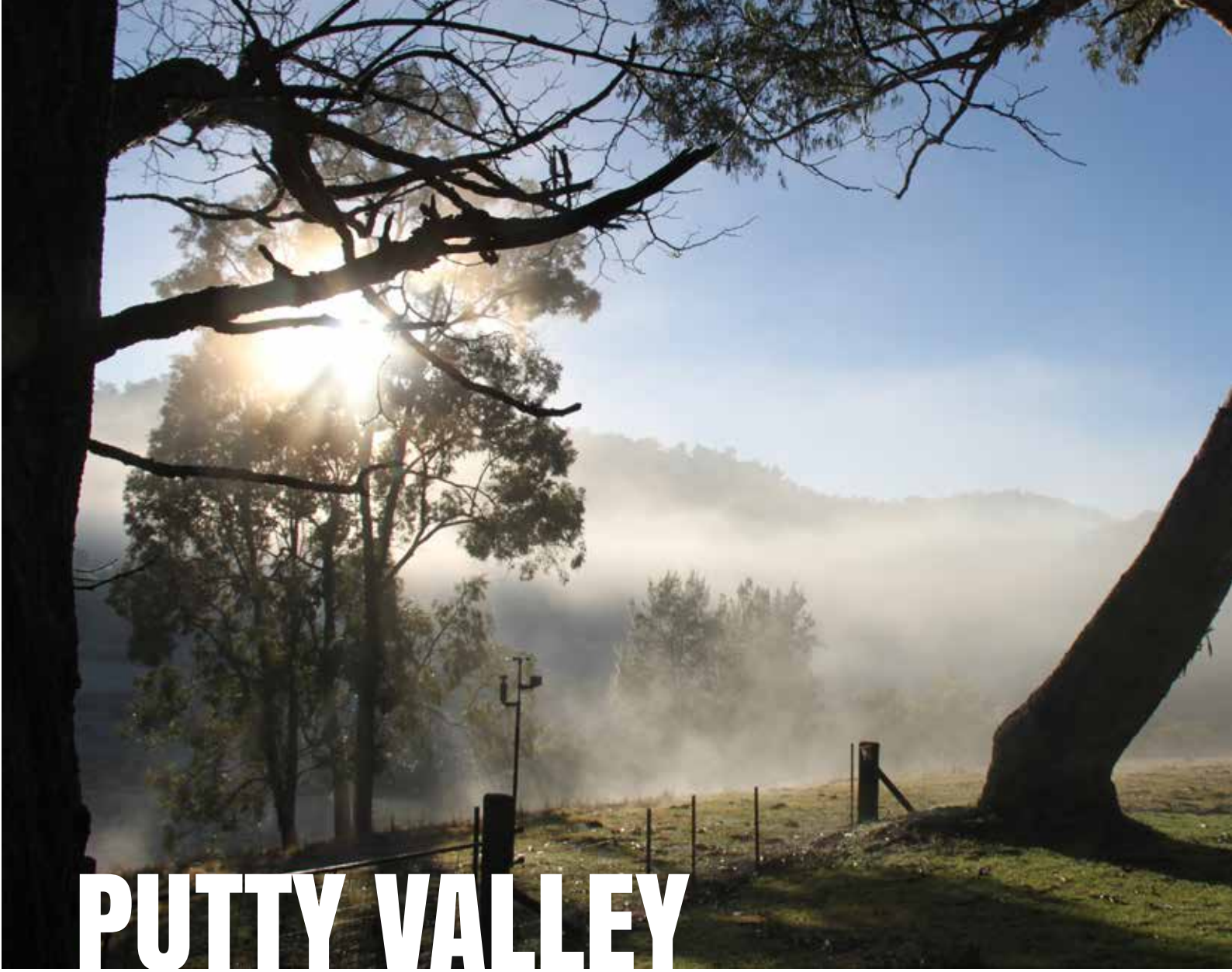


The footprint of the multiple open cut coal mines over Leard State Forest will devastate the region.

Recommendations

Clearing Leard State Forest for these three planned open cut coal mines will have an enormous impact on the fragile forest ecosystem and the native species it supports. It would also create a massive dust bowl and disrupt the local hydrology of the region, threatening the viability of local communities. The NSW Government and/or Federal Environment Minister Tony Burke must:

- Insist mining companies reapply and re-submit their Environmental Assessments with full consideration of the cumulative impacts of all three mining proposals on the ecological integrity of the forest, considering options for underground mining.
- Manage Leard State Forest in accordance with the objects of the NSW Forestry Commission.
- Meet state, national and international targets for threatened species conservation and biological representation.
- Reject Leard State Forest coal mines due to their impact on the Critically Endangered Box Gum Ecological Community, one of the most extensive and intact stands on the continent.
- Disallow any further open cut coal mining in this significant ecological safe haven.
- Mandate minimum wildlife corridor distances between coal mines of at least 1km across the state in line with the needs for effective glider corridors.
- Place a moratorium on coal approvals in Leard Forest until a Health Impact Assessment has been completed and its results analysed by Government.



PUTTY VALLEY

Why is it special?

The Putty Valley is home to a vibrant local community nestled between Yengo and Wollemi National Parks. Wollemi National Park is known for its wild rivers and spectacular landscapes, canyons, cliffs and undisturbed forest containing the world-famous Wollemi Pines. It is the largest wilderness area in NSW and forms part of the Greater Blue Mountains World Heritage Area[1].

Water from the Putty Valley catchment area flows into the Colo River, declared a 'Wild River' in 2008 and protected under the National Parks and Wildlife Act 1974 due to its near-pristine condition of water flow and its animal and plant life[2]. The Colo then joins the iconic Hawkesbury River.

Rich in heritage values, the Putty Valley and the Wollemi National Park contain sacred sites and Aboriginal cave paintings[3]. The Putty community is also considered a living connection to some of the earliest European settlement in Australia, preserving old buildings and sections of Bulga Road, the first road built north of Sydney, opened in 1823[4].

Putty Valley industries include cattle and horse breeding, and commercial crops of pine trees, olives, nuts and fruit trees. Committed to sustainable catchment management, landowners are increasingly fencing off Wollemi and Putty Creeks to stock, using rotational grazing, rehabilitating river banks and tree planting. The community has also been developing plans for ecotourism and local bush regeneration, so the area retains its ecological, social and historical value for future generations[5].

What's the threat?

This Putty Valley rural environment is now threatened by potential coal seam gas industrialisation. Macquarie Energy Pty Ltd (a fully owned subsidiary of Dart Energy Australia) holds an Exploration Licence and has drilled a core hole just south of Putty to investigate the potential Coal Seam Gas resource[6]. They plan to drill another core hole in the area in early 2012.

Only 500m from the World Heritage Wollemi National Park, the core hole site has a high bushfire and flash flooding risk. It is located 40 metres from Long Wheeney Creek, which flows into Wollemi Creek then into the pristine and protected Colo River and further downstream to where the export quality $8 million Hawkesbury River oyster industry is located.

At the drill site, drilling fluid and contaminated waters were stored in lined pits. Macquarie Energy identified the risks of potential soil contamination as a result of oil, chemical, grease or fuel spillages or leaks associated with operation of machinery, and sediment runoff from disturbed areas adjacent to the site.

Underground, the company makes no guarantees, stating 'Macquarie Energy may intercept the groundwater resource, although due to the casing of the core hole, it is considered unlikely that the proposed activity will impact on the groundwater resource'[7].

Coal Seam Gas versus Water

How might the Putty Valley be impacted if commercially viable quantities of gas are identified during exploration? According to the Australian Government National Water Commission's Position Statement on coal seam gas and water[8], coal seam gas development could cause significant social, land use and local environment impacts. It would also involve the following potential risks to sustainable water management:

- Extracting large volumes of low-quality water will impact on connected surface and groundwater systems.
- Impacts on other water users and the environment may occur due to the dramatic depressurisation of the coal seam, including:
    - changes in pressures of adjacent aquifers with consequential changes in water availability.
    - reductions in surface water flows in connected systems.
    - land subsidence over large areas, affecting surface water systems, ecosystems, irrigation and grazing lands.
- The production of large volumes of treated waste water, if released to surface water systems, could alter natural flow patterns and have significant impacts on water quality, and river and wetland health.
- The practice of hydraulic fracturing, or fraccing, to increase gas output, has the potential to induce connection and cross-contamination between aquifers, with impacts on groundwater quality.
- The reinjection of treated waste water into other aquifers has the potential to change the beneficial use characteristics of those aquifers.

The high likelihood of aquifer impacts was acknowledged by a spokesperson from Australian Petroleum Production and Exploration Association (APPEA). "Drilling will, to varying degrees, impact on adjoining aquifers. The extent of impact and whether the impact can be managed is the question."[9]

Threatened species at risk

Most Putty Valley residents and landowners are committed to protecting the surrounding parks and threatened species and are concerned by the risks of water contamination to the Blue Mountains World Heritage Area and Colo River[10]. To date, there has been no way of assuring the negative impacts of coal seam gas extraction are limited to the areas outside the National Parks.

Within just 2km of the proposed drill site, 25 federally listed threatened species and 14 migratory species have been recorded. These include Littlejohn's Tree Frog, Regent Honeyeater, Little Lorikeet, Powerful Owl, Yellow-bellied Glider, Diamond Firetail, Large-eared Pied Bat and the Koala[11].

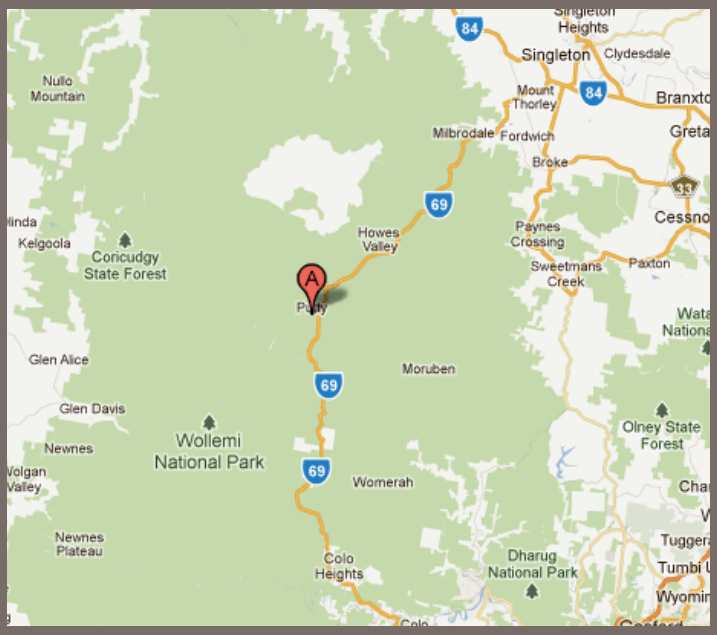
The nearby Wollemi National Park, most famous for hosting the critically endangered Wollemi Pine, is also home to around 55 species of butterfly, 235 recorded species of birds, 58 reptiles and 32 recorded amphibians. Many species are threatened in NSW, including the Masked Owl, Spotted-tailed Quoll and the Eastern Pygmy Possum. The Stuttering Frog and Brush-tailed Rock-wallaby in particular are of extremely high conservation concern due to their continued recent decline in numbers[12]. The Platypus is found in the Colo River[13] and the park's waterways include about 20 different native fish species[14].

Photo: ACT Parks and Conservation Service

Spotted-tailed Quoll

Photo: animals.nationalgeographic.com

Platypus



Putty Valley is completely surrounded by National Park – in the heart of significant World Heritage Listed forests.

Photo: Velella

The Wollemi pine is classified as Critically Endangered on the International Union for Conservation of Nature's Red List[15] .

"Putty is surrounded by World Heritage National Parks and any extraction of coal seam gas in the area poses contamination risks. There is no way of assuring us that wells will not be extracting water and gas from under the park." Putty resident Kathy McKenzie.

Recommendations

Currently in NSW, only National Parks are legally protected from mining and extractive industries. However, with coal and gas expanding rapidly across the state, new legislation must be enacted to provide mining exclusion zones over sensitive areas such as the Putty Valley, to protect nearby National Parks, local communities, agricultural and heritage values, and downstream aquaculture and fisheries.

The NSW Liberal & National Coalition's Strategic Regional Land Use Policy document released prior to the 2011 election states that they "believe that agricultural land and other sensitive areas exist in NSW where mining and coal seam gas extraction should not occur". As such, the Putty c ommunity seeks appropriate planning protection for this unique locality and calls on the NSW Government to:

- Create a 10km mining free buffer zone around National Parks to avoid contamination of connected ecosystems and ground water systems.
- Declare Putty Valley as a 'sensitive area' to exclude mining and extractive industries and to protect its significant environmental, heritage, tourism, and nature based industry values.
- Put on hold all licence renewals, exploration and production approvals in NSW until Strategic Regional Land Use Plans are developed and in place and detailed aquifer information is known.
- Support a precautionary approach to coal seam gas mining.

Colo River: this declared and protected 'Wild River' is now at risk of Coal Seam Gas related pollution. Photo: Wabbaly

WORONORA

Why is it special?

The Woronora Special Area forms part of a series of conservation areas that play a vital water purification role for one of the largest freshwater reservoir supplies in the Sydney catchment system. The area cradles significant rainforest and tall old growth forests, open treeless heaths and fragile upland swamps[1].

These upland swamps are key habitats for many unique threatened species[2]. The Giant Burrowing Frog and the Beautiful Firetail rely on the Woronora Special Area as an intermediate stopover point for migration between known habitats in Royal National Park and Dharawal State Conservation Area and Nature Reserve[3].

Not only an ecological hotspot; the area also includes hundreds of sacred Aboriginal heritage sites. The beautiful sandstone overhangs in particular contain art, artifacts, deposits, grinding grooves and engravings[4].

Public access to the Woronora Special Area is prohibited, and the Sydney Catchment Authority is required to ensure that any development in the Special Areas is of "neutral or beneficial" impact, due to the critical function this area plays in providing safe clean drinking water to thousands of homes in the greater Sydney region.

What's the threat?

Beneath the surface, mining activities are threatening the critical role of Sydney's Special Areas. The Sydney Catchment Authority has estimated that under current industry plans 91% of Sydney's southern supply catchment will be undermined.

For example, Metropolitan Colliery has operated under the Woronora Special Area since the mid-1990s. Its river, the Waratah Rivulet, now passes over collapsed mine shafts, the riverbed is cracked, runs dry and appears to have tilted to the east as a result of the subsidence from the underground mining[5]. The collapse of two wet overhangs (one a significant Aboriginal heritage site) has also been observed above Metropolitan's longwalls[6].

Despite these impacts, in 2009 the NSW State government granted approval for the Metropoliatan Colliery (owned by US company Peabody Energy–the world's largest private sector coal company[7]) to extract a further 27 longwall panels, some directly beneath the Woronora Reservoir[8].

Why is longwall mining our water catchments a problem?

Longwall mining takes place underground, cutting out a coal seam panel using powerful machines. A panel may be three or four metres high, up to 350 metres wide, and several kilometres long. During mining, the land above is propped up to protect machinery. As the machines move forward, the immensely heavy overlying rock is left to collapse into the cavern created by the removal of the coal seam.

This collapse causes subsidence, cracking river beds and causing irreversible long-term damage to water dependant ecosystems. Longwall mining has been shown to lead to the potential for[9]:

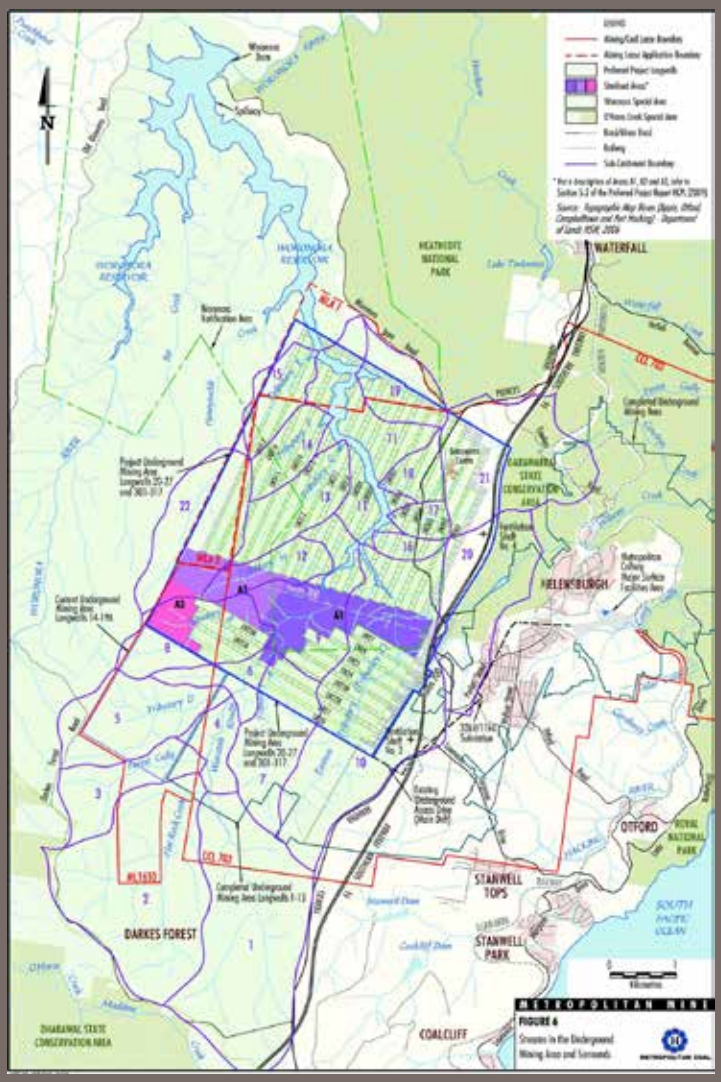
- the complete loss of water-based habitats, wetlands and refuge pools.
- habitat fragmentation (drying up the connection between water pools.)
- loss of water quality (increased iron, aluminium, manganese and changes in pH.)
- the release of methane gas from coal seams into streams.
- localised extinctions of water dependent species .

Subsidence can also cause hill slopes to collapse, increased erosion and eco-toxic stream pollution[10], and escarpments to topple–reducing shelter and roost sites for bats, birds and reptiles[11].

Longwall mining is listed as a Key Threatening Process in Schedule 3 of the Threatened Species Conservation Act[12] and the Sydney Catchment Authority has identified "Habitat alteration due to land subsidence from longwall mining is currently impacting on the Special Areas and will be very destructive in the future unless measures are taken to protect sensitive habitats. In particular, Upland Swamp fauna are threatened by this process as it can destroy the Upland Swamps themselves."[13]

Photo: C. Jonkers

Damaged Aboriginal hand art as a result of longwall mining.



Longwall mining panels are directly underneath the Woronora Reservior – threatening Sydney's drinking water.

Threatened species at risk

The Wononora Special Area alone is home to 40 threatened animals and 26 threatened plants including the Spotted-tail Quoll, Thick-leaf Star-hair, Prickly Bush-pea[18] and the largest Koala population south of Sydney. The unique Temperate Highland Peat Swamps are listed federally as an Endangered Ecological Community[19] and support highly endangered animals such as the Green and Golden Bell Frog and Stuttering Frog.

These upland swamps are significant to the Ground Parrot, where it had been thought to be extinct before the rediscovery of the population in the Woronora Special Area[20]. For a number of other species, the area provides a critical proportion of their habitat in the region, including the Littlejohn's Tree Frog, Broad-headed Snake, Koala, Beautiful Firetail, Southern Emu-wren, Tawnycrowned Honeyeater, Rosenberg's Goanna, Giant Burrowing Frog, Red-crowned Toadlet, and the Eastern Pygmy-possum[21]. The Platypus of the Woronora River and Waratah Rivulet is potentially impacted by subsidence and rock falls[22] .

Photo: Rainforest Harley

Green Tree Frog

The Green Tree frog has a high regional conservation priority for the Woronora Special Area and surrounding catchments[23].

Photo: Bruce Thomson

Spiny Crayfish

Freshwater spiny crayfish are found in few places on the Woronora Plateau and are losing critical surface water through cracked streambeds as a result of longwall mining[24].

Green and Golden Bell Frog

Once common, Green and Golden Bell Frogs are now one of the most threatened frogs in NSW.

Photo: Mark Jekabsons

Eastern Pygmy Possum

The Woronora Plateau is a refuge for the vulnerable Eastern Pygmy Possum.

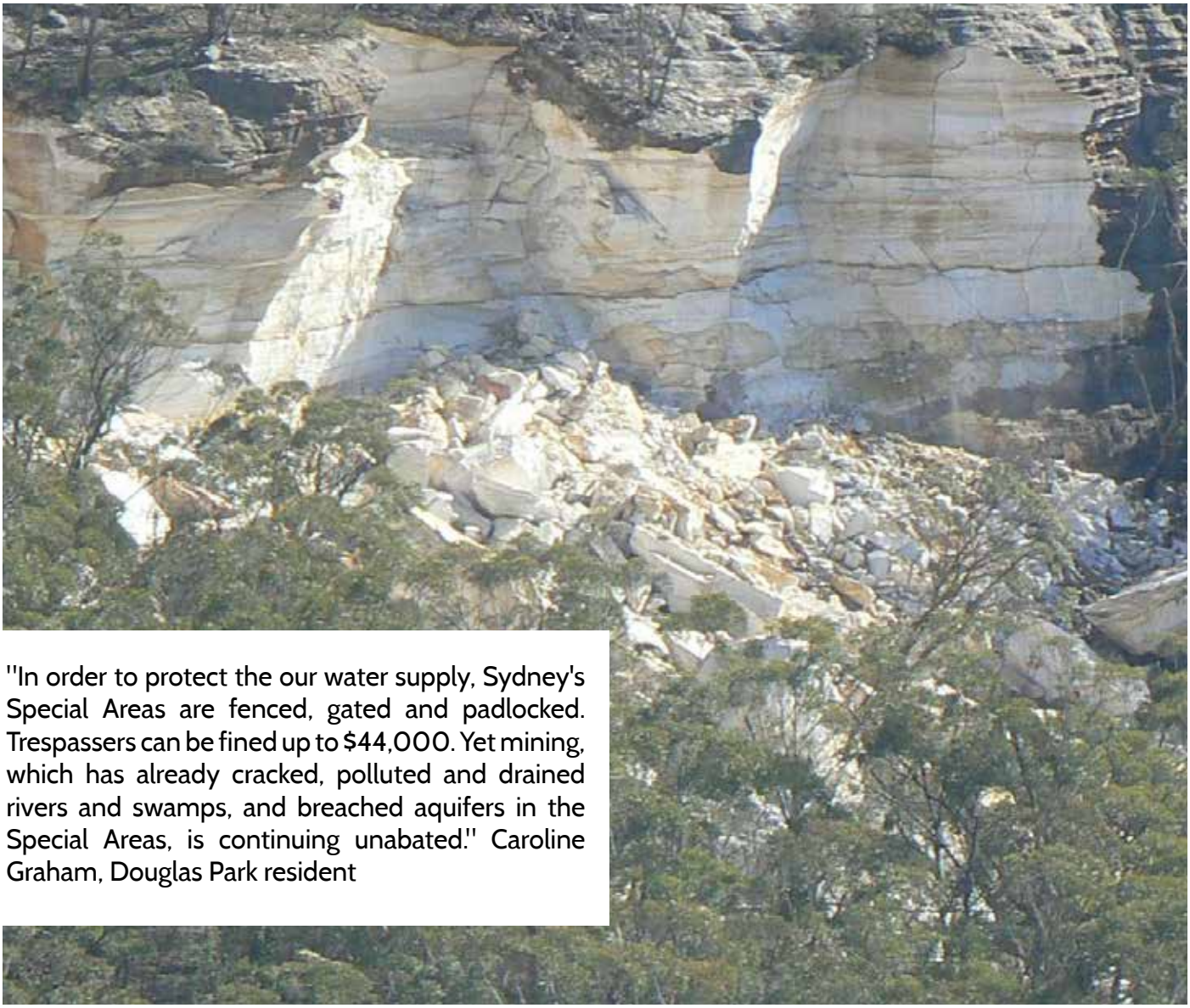
Water is disappearing, 'remedial action' not working

In early 2011, it was discovered that despite significant rainfall, the water levels in Woronora Reservoir were dropping, while other Sydney dam water levels were increasing[14].

According to the Sydney Catchment Authority, the Waratah Rivulet is losing several thousand litres of water every day, despite attempts by the miners to repair the longwall damage.

Peabody's attempted remediation to deal with the cracks, lost water and drying up of threatened swampland habitat has involved cement grouting, sand or cotton trash and mulch. These unsuccessful repair attempts have caused pollution of these pristine areas, as the grout had been found to simply wash out of the cracks along the Waratah Rivulet[15].

Peabody has also claimed the water disappearing from fractured streambeds may reemerge further downstream[16]. However, there is no published evidence that supports re-emergence of lost stream flows. Further, such re-emergent surface water could be heavily contaminated with groundwater polluted with salt and metals - potentially ecotoxic groundwater effluent[17].



"In order to protect the our water supply, Sydney's Special Areas are fenced, gated and padlocked. Trespassers can be fined up to $44,000. Yet mining, which has already cracked, polluted and drained rivers and swamps, and breached aquifers in the Special Areas, is continuing unabated." Caroline Graham, Douglas Park resident

Photo: C. Jonkers

Cliff Collapse

Recommendations

In 2010, the Bulli Planning Assessment Commission found that "it is no longer a viable proposition for mining to cause more than negligible damage to pristine or near-pristine waterways in drinking water catchments". The NSW State government must safeguard Sydney's water supplies and:

- Prevent longwall mining at sensitive sites by mandating 1km subsidence protection zones around rivers and significant geological, ecological and cultural features.
- Commission an inquiry into damage done to river systems and water resources across NSW by coal mining. Investigate longwall mining in supply catchments and the Special Areas as a separate term of reference.
- Reject pending approvals across the East Bargo coal exploration area.
- Tighten approval conditions to make subsidence damage trigger a cessation of mining activity.
- Devise new policies that reject claims that remediation adequately addresses mining damage to water catchments and natural areas.
- Regulate underground mine layouts through the NSW Department of Planning.
- Establish and enact a threat abatement plan for longwall mining to respond to its role as a listed key threatening process.

THE GREAT DRIPPING GORGE

Why is it special?

The Drip and Corner Gorges of the Goulburn River form part of an ancient, visually dramatic landscape. Many visit this iconic and culturally significant place to experience its natural beauty and extensive Aboriginal heritage, walking along the Goulburn River or picnicking under soaring sandstone cliffs. Clear spring water drips and seeps through sculptural rock formations laden with ferns, bottlebrushes and weeping grasses[1].

The Drip Gorge sits on the western most lip of the Sydney sandstone basin and on the lowest point of the Great Dividing Range. It is only a short walk from an access road and is widely used by the community, tourists and schools for recreational, educational and cultural purposes[2]. It allows families to have a 'wilderness experience' similar to walks in the Blue Mountains Heritage Area or Northern Territory gorges.

There is also a recent coal mining history amongst these beautiful cliffs and river gorges. A small coal mine using pit ponies operated in the region before 1980. In the 1980s, Ulan Coal developed their open cut mine and longwall operation, diverting kilometers of the Goulburn River around their open cut coal mine in 1981[3].

What's the threat?

Since 1981, the unstable water channels, bank erosion, mine tailings and poor downstream water quality, particularly after significant rain events, have created a legacy of coal mining impacts in the region. There is no evidence of successful rehabilitation. Now, the headway of the Goulburn River is under threat from increasing coal production and proposed mega coal mines.

In 2007, coal company Felix Resources (now owned by Yancoal), was granted approval to construct and operate three open cut coal mines within the Moolarben Creek valley and one underground mine - directly threatening the integrity of the Drip Gorge through cliff collapse and loss of groundwater. After being granted approval for eight separate modifications within 'Stage 1', the company is now seeking approval for 'Stage 2', increasing production by creating a fourth open cut mega mine of approximately 1270 hectares.

The proposed 'Stage 2' Moolarben mine will result in[4]:

- The removal of a total of 851 hectares of remnant native vegetation, including 157 hectares of Critically Endangered Ecological Communities.
- The diversion and relocation of two creeks in the headwaters of the Goulburn River, with some sections of the final creek alignment to be located through mine spoil.
- Additional coal mined at a rate of up to 12 million tonnes of coal per year for the next 24 years, operating 24 hours per day, 7 days per week.
- Two underground longwall mines producing a maximum combined coal rate of 4 million tonnes of coal per year and mining within 100 metres from the bed of the Goulburn River.
- Multiple new coal stockpiles, a dump station, crushing and sizing plant, overhead trippers, and reclaim tunnels.
- A large extraction of groundwater and interference to aquifer and river system due to mine subsidence, dewatering and on site water use, in the order of 18 million litres of water per day.
- Removal of 21 significant Aboriginal heritage sites and the disturbance of a further nine sites.
- Likely longwall mine damage and instability along a 100 metre high cliff line and gorges containing numerous artworks - hand stencils, animal tracks and animal motifs.

The company's own assessment of this 'Stage 2' coal project admits there is a high probability of impacting on ground water supply for humans and the environment, high risk of subsidence, and a high risk of loss of flora and fauna, impacts on places of national significance, and loss of wildlife corridors to nearby National Parks[5].

Dewatering aquifers

Since the approval for Stage One of Moolarben Coal Project, the company has made eight separate applications to modify the Minister's approval for the project, each with impacts on the local environment and community.

Modification 7 was approved in February 2011, one month before a change of NSW Government. This modification approval involves dewatering the Ulan coal seam in preparation for the assumed approval of increased mining in future years[6]. This dewatering process within the headwaters of the Goulburn River is likely to impact on the base flow of the Goulburn River and interfere with surrounding aquifers, surrounding agricultural bores and groundwater dependant ecosystems[7].

The Environmental Assessment predicts a Ulan aquifer draw down of 100 meters inside the Goulburn River National Park after the Moolarben Coal mining process, with a 15 metre drawdown over ten kilometres from the mine site[8]. This modeling did not take into account the dewatering impacts from the adjoining Wilpinjong Mine or the Ulan Coal mine.

Photo: Rivers SOS

The cliffs of the Goulburn River's Corner Gorge - now under threat from longwall mining and increased water pollution and discharge from nearby mega coal mines.

Threatened species at risk

The development of the Moolarben Coal open cut and underground operations will negatively impact unique and threatened species and their habitat. It will result in impacts to 226 hectares of the Critically Endangered White Box/ Yellow Box/Blakely's Redgum Ecological Community and loss of threatened species habitat for woodland birds, bats, owls and iconic native mammals[11].

The critical woodlands to be destroyed provide habitat for nationally listed endangered animal species including the Swift Parrot, Squirrel Glider, Painted Honeyeater, Hooded Robin, Diamond Firetail and the now Critically Endangered Regent Honeyeater. Studies have also identified the occurrence of habitat for the threatened Brown Treecreeper, Speckled Warbler, Gilbert's Whistler, Glossy Black Cockatoo, Powerful Owl, Large Bentwing Bat, Large-eared Pied Bat and Greater Long-eared Bat. Foraging and breeding sites will be lost, especially from areas where there is a high density of tree hollows[12].

Impacts will also be felt from the removal of several kilometers of creek habitat and significant cultural landscapes along the Murragamba Creek and Eastern Creek valleys, including two groundwater dependant ecosystems.

Photo: Julia Robinson

Powerful Owl

The vulnerable Powerful Owl is the largest owl species in Australia, nesting in large hollows of eucalypt trees at least 150 years old[13].

Photo: Bruce Thomson

Greater Long-eared Bat

This tiny micro-bat is vulnerable in NSW.

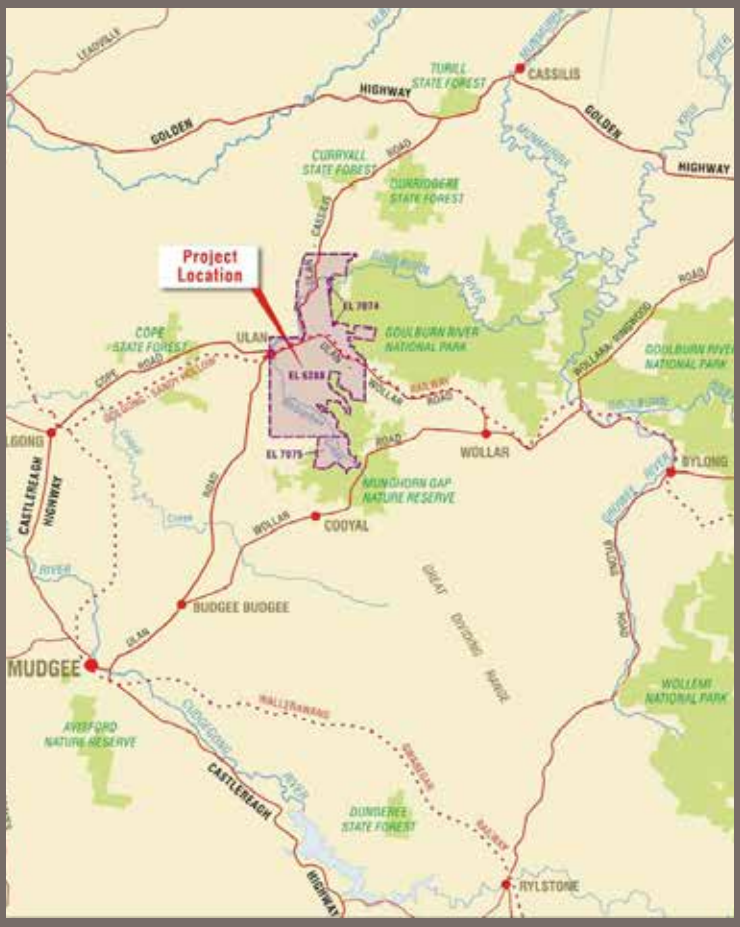
The cumulative impacts of coal mines

The Moolarben Coal Project is set to operate alongside the 28 square kilometre Wilpinjong open cut mine, while neighbouring Ulan Coal has been granted permission to expand its open cut and longwall operations to include a 400m wide longwall – the largest in Australia[9].

The impact of these three large and expanding coal mines in the Ulan Wollar area raises many questions about interference to regional groundwater and long term viability and integrity of the Goulburn River, a major tributary of the Hunter River. The combined total water being removed from the groundwater system by mining is set to be in excess of 30 million litres per day.

The local community has also expressed their concerns with the risks to surface water, damage to the Drip and Corner Gorges, impacts to groundwater dependant ecosystems, fears of local tourism industry decline, dust, noise and an overall inadequate assessment of cumulative and regional impacts associated with these three mining operations[10].

Photo: Rivers SOS



The Moolarben mega mine site sits right next to the iconic Drip and Corner Gorges, on the headwaters of the Goulburn River National Park, bounded by the Goulburn River to the north and west, and Goulburn River National Park to the east.

Bush stone Curlew

The grassy woodland loving Bush stone Curlew is endangered in NSW, and numbers continue to decline[16].

Photo: Jym McPhee

Many groups advocate for the The Drip and Corner Gorge to be included as part of the bordering Goulburn River National Park.

"The Moolarben Coal Mine should do the right thing by the community and the environment and allow The Drip and Corner Gorges to be included in the bordering Goulburn River National park". Julia Imrie, local resident

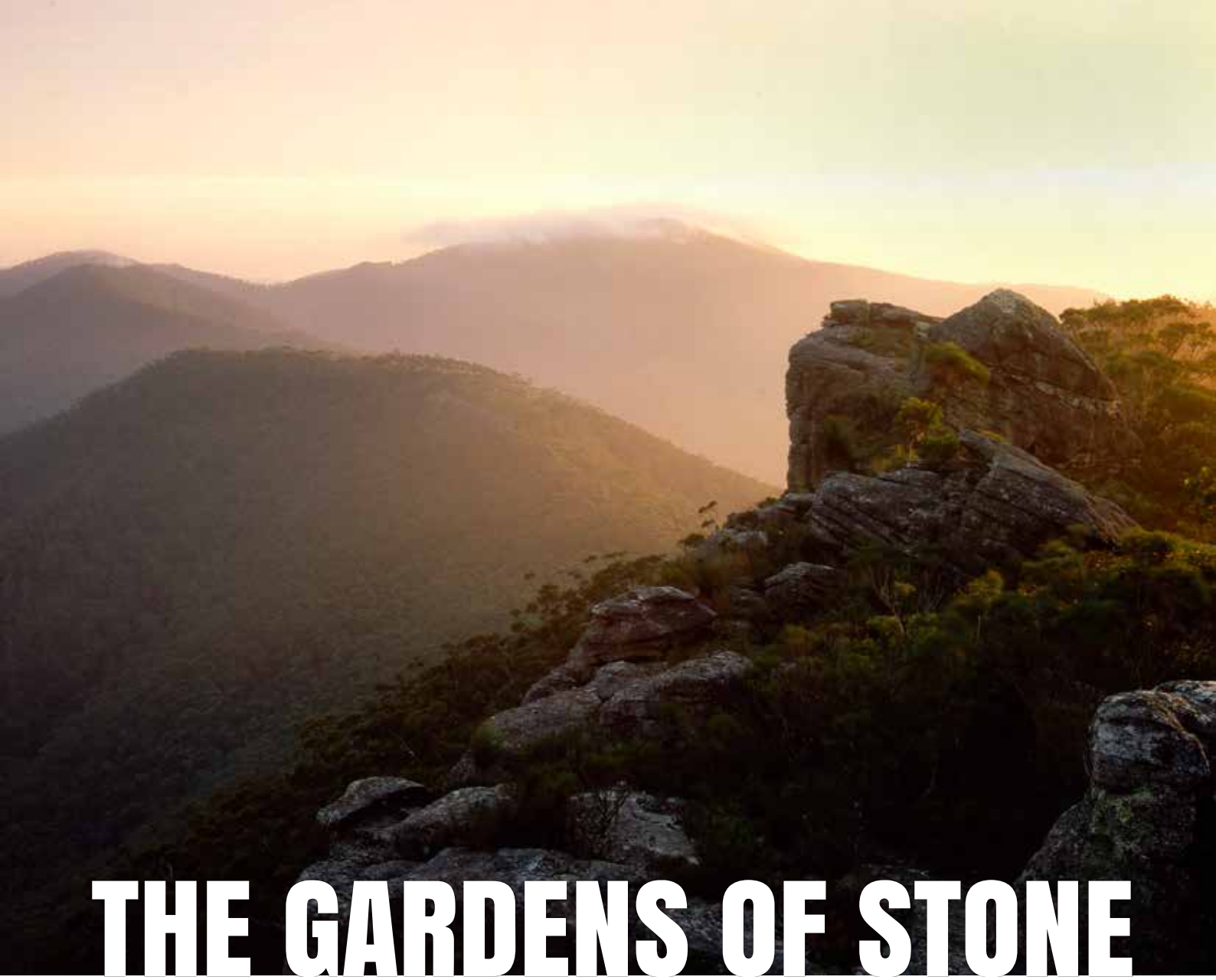
Recommendations

There is broad and enduring community and agency support for the protection of the highly valued and regionally significant Drip Gorge riparian area and adjacent escarpments by incorporating them into the Goulburn River National Park[14]. The panel for the independent planning assessment hearing concluded that the significant cultural, spiritual, historical, educational, tourism and recreational values associated with The Drip and the Corner Gorge should lead to their protection[15].

Moolarben Coal Mine should relinquish this area of crown lease for its inclusion into the national estate for the people of NSW.

The Government must take action to:

- Protect the Drip Gorge by adding it to the Goulburn River National Park.
- Commission an Independent Regional Water Survey and cumulative impact study to determine the full environmental impacts of all three mines on the groundwater and river systems of the Upper Goulburn River catchment.
- Reject the proposed Moolarben Stage 2 opencut and longwall coal mines.



THE GARDENS OF STONE

Why is it special?

An outstanding diversity of flowering native plants, huge eye catching cliff lines and sandstone 'pagoda' rock formations, gentle grassy woodlands and glimpses of rare native animals are some of the features to be enjoyed when exploring the unique Gardens of Stone area. In addition, there is a wealth of both European and Aboriginal cultural heritage.

The area which is proposed in the 'Gardens of Stone Stage 2 Proposal' is located on the western edge of the Blue Mountains on the Sydney Basin's highest sandstone plateau. It encompasses more than 40,000 hectares of pristine bush land adjoining the Greater Blue Mountains World Heritage Area. Its ecosystems provide a safe haven for threatened and endangered native flora and fauna; while the area's water flows into its diverse upland swamps and the headwaters of rivers within the Warragamba Dam catchment.

What's the threat?

The wonderland of coloured escarpments, narrow canyons, endangered upland shrub swamps, rock arches, cave overhangs, lonely sandstone peninsulas and pagoda complexes of the Ben Bullen State Forest are now at risk of destruction from open cut coal mining[1].

Coal mining company Coalpac Pty. Ltd. is seeking approval to significantly extend its open cut coal mining by consolidating its Cullen Valley Mine and Invincible Colliery operations. This 'Coalpac Consolidation Project' will produce up to a total of 3.5 millions tonnes of product coal every year for an additional 21 years[2] .

If approved, this open cut coal mine will clear fell 843 hectares of publicly reserved forest. This will impact a range of threatened species and ecological communities. It will result in the removal of 196 hectares of forest containing 19,200 vulnerable Eucalyptus cannonii. A number of hectares of Box Gum Woodland would be also destroyed, a Critically Endangered Ecological Community under the Federal Environment Protection and Biodiversity Conservation (EPBC) Act[3].

Water management and pollution impacts over such a large open-cut are also of great concern. The Turon River is within the highly stressed Murray-Darling Basin and flows just a short distance from the mine.

The ugly perimeter of the Coalpac open-cut areas will be about 40 kilometres long.

The stability of the iconic and unique sandstone 'pagoda' features may be threatened by partial or total collapse from mining activities, compromising the region's tourism.

Coalpac profits from breaking the law

It is often more profitable for mining companies to break the conditions of their approval than to remain within the law. For example, in 2008, Coalpac was fined for producing more coal than allowed by their lease. The legal case resulted in Coalpac paying $255,000[4]. However, Coalpac made many hundreds of thousands of dollars from their violation and hence still profited greatly from their illegal actions.

Threatened species at risk

A significant number of endangered plants and animals prefer growing in unique pagoda habitats. Coalpac's project has been declared a "Controlled Action" under the EPBC Act due to the impacts it will have on threatened species of national significance.

The area to be clear-felled is known habitat for 27 native animals six listed as threatened under the EPBC Act. The coal mine will result in significant habitat destruction for the critically endangered Regent Honeyeater, Spotted-tailed Quoll, Bathurst Copper Butterfly, Brush-tailed Rock-wallaby and the Powerful Owl[5].

There are over 500 plant species existing within the proposed area to be cleared of which six are listed as rare or threatened.

Photo: Ian Montgomery

Superb Lyrebird

Mining will completely remove the protective pathways between nesting sites for foraging adult lyrebirds and will destroy their food habitats within the more fertile valley floors of the Ben Bullen State Forest.

Threatened species missed in mine assessment

Mining project assessment reports always seem to conclude the project is environmentally responsible, despite the impacts to flora and fauna, water, air quality and lost natural assets. Are these mining company commissioned reports accurate?

It was shown that ecological surveys commissioned by Coalpac for its 'Coalpac Consolidation Project' proposal understated the native flora diversity of the area to become an open cut coal mine. Coalpac missed identifying over 100 native plant species in its flora assessment and failed to table an indigenous cave site.

Local environment groups are now wondering what else is being missed within Coalpac's surveys and have called for an independent flora assessment.

The OEH wrote in its submission on the Coalpac proposal that the entire Ben Bullen State Forest is suitable for future reservation under the National Parks and Wildlife Act.

Photo: Alan Wolf

Brush-tailed Rock-wallaby

Endangered in NSW.

Photo: Julian Robinson

Gang-gang Cockatoo

Vulnerable in NSW

Environment groups propose areas for new State Conservation Areas and National Park extensions across the Garden's of Stone.

Photo: Rob Baigent

People from across NSW feel passionately about protecting this unique natural icon from open cut coal mining.

Photo: Bob van Reyswoud

"My bushwalking friends and I are totally opposed to open cut coal mining in the Gardens of Stone. This is of World Heritage value to us; we love the enormous diversity of unique plants and animals and the spectacular pagoda top views - it will always be a favourite place." Meredith Brownhill

Recommendations

Environment and community groups across the state are calling on the NSW government to:

- Reject the 'Coalpac Consolidation Project' Cullen Bullen NSW and act to protect the region within a State Conservation Area.
- Add the Ben Bullen State Forest to the conservation reserve system as a matter of priority.
- Ensure the most beautiful parts of the Blue Mountains and the headwaters of Sydney's drinking water catchment are not degraded for mining industry profit targets.
- Cease issuing further mining leases within the Gardens of Stone unless the industry agrees to adequately protect all heritage values of the area and dramatically improve the environmental performance of existing collieries.
- Ensure mining applicant's bottom lines do not determine Government policy. Only approve extraction of relatively low impact (i.e. bord and pillar underground methods) or, where this is not practicable, keep coal in the ground.

References

The Pilliga

[1]RACD (2002). Summary of Scoping of Wilderness Values: NSW Western Regional Assessments – BBS Stage 2. (Prepared for the Resource and Conservation Assessment Council.)

[2]Birdlife International (2011). Pilliga. <http://www.birdlife.org/datazone/sitefactsheet.php ?id=23856> (accessed 5/09/2011).

[3]Office of Environment and Heritage (2011). Pilliga Natural Reserve. <http://www.environment. nsw.gov.au/NationalParks/parkWildlife.aspx?id=N0464> (accessed 5/09/2011).

[4] RACD (2002). Vertebrate Fauna Survey, Analysis and Modelling Projects; NSW Western Regional Assessments, Brigalow Belt South Stage 2. (Draft report to RACAC by the NSW NPWS.)

[5]Australian Government Department of Sustainability, Environment, Water, Population and Communities (2009). Australia's 15 National Biodiversity Hotspots. <http://www.environment. gov.au/biodiversity/hotspots/national-hotspots.html> (accessed 5/09/2011).

[6] Jordan, W., Clarke, P. and Flint, C. (2011). Under the Radar - HOW COAL SEAM GAS MINING IN THE PILLIGA IS IMPACTING MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE. The Wilderness Society and the Northern Inland Council for the Environment. (Prepared for The Nature Conservation Council of NSW)

[7]The State of Queensland, Department of Employment, Economic Development and Innovation (2011). Final Report on the Coal Seam Gas Well Head Safety Program April 2011, <http://www.industry.qld.gov.au/documents/LNG/Coal-Seam-Gas-Well-Head-Safety-Program-Inspection-Report-2011.pdf> (accessed 1 September 2011).

[8]Eastern Star Gas (2009). Review of Environmental Factors: 2009 Narrabri Coal Seam Gas Program Dewhurst 8 Lateral Production Pilot.

[9]AECOM Australia Pty Ltd (2010). Narrabri Coal Seam Gas Project - Gas Field Development Preliminary Environmental Assessment. (Prepared for Eastern Star Gas, Sydney)

[10]RACD (2002). Vertebrate Fauna Survey, Analysis and Modelling Projects; NSW Western Regional Assessments, Brigalow Belt South Stage 2. (Draft report to RACAC by the NSW NPWS)

[11]Office of Environment and Heritage (2011). Discover the Unique Landscapes and Wildlife of NSW. <http://www.environment.nsw.gov.au/parks/GetIntoNature.htm> (accessed 5 September 2011).

[12]Coonabarabran Local Environment Group (2011). Submission to Eastern Star Gat Ltd. Referral, Reference Number: 2011/5914

[13] Milledge, D.R. (2002). A survey of large owls in the Cypress Pine - Ironbark forests and woodlands of central western NSW Consultants report to the NSW National Parks and Wildlife Service, Hurstville.

[14] Tolley (2011). Referral of proposed action, Narrabri Gas Field Development, April 2011, Ecological Australia

Warkworth Sands Woodland

[1]Office of Environment and Heritage. Warkworth Sands Woodland in the Sydney Basin Bioregion - Determination to Make a Minor Amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act. <http://www.environment.nsw.gov.au /determinations/warkworthsands36a.htm> (accessed 31 October 2011).

[2]Umwelt (2011). Review of Ecological Assessments for Warkworth Extension EA and HVO South Modification Projects (August 2011). Prepared for the Department of Planning and Infrastructure. <https://majorprojects.affinitylive.com/public/aa3323d066ba29f559baba3dc3d0d06f/Final_Ecological%20Technical%20Report%20Aug%202011.pdf> (accessed 9 Nov 2011).

[3]Pavich, C. (1992).Warkworth Sands Reference Statement. (Unpublished.) Rep. Muswellbrook: NSW National Parks and Wildlife Service.

[4]Office of Environment and Heritage. Warkworth Sands Woodland in the Sydney Basin Bioregion - Determination to Make a Minor Amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act. <http://www.environment.nsw.gov.au /determinations/warkworthsands36a.htm> (accessed 31 October 2011).

[5]Coal and Allied (2010). Proposed Warkworth Extension, Environmental Assessment Volume 1, Chapter 5, The Proposal. <http://www.coalandallied.com.au/documents/ Volume_1_Chapter_5_The_Proposal.pdf> (accessed 31 October 2011).

[6]Umwelt (2011). Review of Ecological Assessments for Warkworth Extension EA and HVO South Modification Projects (August 2011). Prepared for the Department of Planning and Infrastructure. <https://majorprojects.affinitylive.com/public/aa3323d066ba29f559baba3dc3d0d06f/Final_Ecological%20Technical%20Report%20Aug%202011.pdf> (accessed 9 Nov 2011).

[7]Coal and Allied (2010). Proposed Warkworth Extension, Environmental Assessment Volume 1, Chapter 5, The Proposal. <http://www.coalandallied.com.au/documents/ Volume_1_Chapter_5_The_Proposal.pdf> (accessed 31 October 2011).

[8]Umwelt (2011). Review of Ecological Assessments for Warkworth Extension EA and HVO South Modification Projects. <https://majorprojects.affinitylive.com/public/581b8c9f14e3e9803f7bf1daeb2562e7/Director-Generals%20Assessment%20Report.pdf> (accessed 9 Nov 2011).

[9]Coal and Allied (2010). Proposed Warkworth Extension, Environmental Assessment Volume 1, Chapter 9 Aboriginal Heritage. <http://www.coalandallied.com.au/documents /Volume_1_-_Chapter_9_Aboriginal_Heritage.pdf> (accessed 31 October 2011).

[10]NSW Government (21 June 2012). Singleton Shire Council. <http://www.singleton. nsw.gov.au/agenda/Open/2010/CM_21062010_MIN_WEB.HTM>. (accessed 24 October 2011).

[11]Maguire, Paul. Wallaby Scrub in Conflict. Singleton Argus. <http://www.singletonargus.com.au/news/local/news/general/wallaby-scrub-in-conflict/2324131.aspx?storypage=1>. (accessed 24 October 2011).

[12]Environmental Resource Management (2002). Extension of Warkworth Mine Background Paper. (Prepared for Warkworth Mining Limited)

[13]Peake, T., Bell, S., Tame, T., Simpson, J., and Curran, T. (2002). Warkworth Sands Woodland - An Endangered Ecological Community Distribution, Ecological Significance and Conservation Status. <http://www.huntergardens.org.au/warkworth1.htm>. (accessed 27 November 2011).

[14]Office of Environment and Heritage. Regent Honeyeater Anthochaera Phrygia - Critically Endangered Species Listing. <http://www.environment.nsw.gov.au /determinations/regenthoneyeaterFD.htm> (accessed 31 October 2011).

[15]Office of Environment and Heritage. Regent Honeyeater Anthochaera Phrygia - Critically Endangered Species Listing. <http://www.environment.nsw.gov.au /determinations/regenthoneyeaterFD.htm> (accessed 31 October 2011).

Leard State Forest

[1]Western Conservation Alliance (2002). Saving What's Left in the Brigalow Belt South. (Unpublished.)

[2]Bailey, J. (2010).Continuation of Boggabri Coal Mine – Environmental Assessment. (Prepared for Boggabri Coal Pty Ltd.)

[3]Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). Australia's 15 National Biodiversity Hotspots - Biodiversity Hotspots. <http://www.environment.gov.au/biodiversity/hotspots/national-hotspots.html> (accessed 29 Sept 2011).

[4]Hansen Bailey (2010). Continuation of Boggabri Coal Mine Environmental Assessment. Chapter 11 Worst Case Cumulative Impact Scenario. [plus the 500ha clearing already conducted or planned for this project]

[5]Bailey, J. (2011). Maules Creek Coal Project Environmental Assessment. (Prepared for Ashton Coal 2 Pty Ltd.)

[6]NSW National Parks and Wildlife Service (2002). Fact Sheet, Endangered Ecological Community: Box-Gum Woodland Information.

[7]Bailey, J. (2010).Continuation of Boggabri Coal Mine – Environmental Assessment. (Prepared for Boggabri Coal Pty Ltd.)

[8]Aston Resources (2011). Maules Creek Project. <http://astonresources.com/maules-creek/project/maules-creek-project/> (accessed 29 Sept. 2011).

[9]National Parks Association NSW. http://www.npansw.org.au/index.php/campaigns-parentmenu-434/npa-west-parentmenu-461/coal-mining.html (accessed 21 Sept 2012)

[10]National Parks Association NSW. http://www.npansw.org.au/index.php/campaigns-parentmenu-434/npa-west-parentmenu-461/coal-mining.html (accessed 21 Sept 2012)
[11]NSW National Parks and Wildlife Service (2002). Vertebrate survey, analysis and modeling projects: NSW Western Regional Assessments. Projects undertaken for the Resource and Conservation Assessment Council. Project numbers WRA 23 & 27.
[12]NSW Government (2009). NSW Forestry Act 1916, Section 8A: Objects of the Commission. <http://www.legislation.nsw.gov.au/inforcepdf/1916-55.pdf?id=96ab6391-3742-cdf4-8694-d77ea5a1f58c> (accessed 28 Sept. 2011).
[13]Western Conservation Alliance (2002). Saving What's Left in the Brigalow Belt South. (Unpublished).
[14]. National Parks Association NSW. http://www.npansw.org.au/index.php/campaigns-parentmenu-434/npa-west-parentmenu-461/coal-mining.html (accessed 21 Sept 2012)
[15]. National Parks Association NSW. http://www.npansw.org.au/index.php/campaigns-parentmenu-434/npa-west-parentmenu-461/coal-mining.html (accessed 21 Sept 2012)

Putty Valley

[1]NSW Government Office of Environment and Heritage. Wollemi National Park. <http://www. environment.nsw.gov.au/nationalparks/parkhome.aspx?id=N0051> (accessed 3 November 2011).
[2]NSW Government Office of Environment and Heritage (2011). Wild Rivers. <http://www.environment.nsw.gov.au/parktypes/wildrivers.htm>.
[3]Australia For Everyone (2010). Aboriginal Sites: Wollemi National Park. <http://www.australiaforeveryone.com.au/aborsites_wollemi.htm> (accessed 4 November 2011).
[4]Putty Road Truck Drivers Memorial. History of the Putty Road. <http://www.puttyroadmemorial. com.au/history-of-the-putty-road> (accessed 8 November 2011).
[5]Putty Community Association CSG Subcommittee (2011) <http://putty.nsw.au/assets/document/1314598998-csg_submission.pdf> (accessed 8 Nov 2011).
[6]Environment Planning Services Pty Ltd (2010). PEL 460 Review of Environmental Factors Drilling Operations (for Macquarie Energy)<http://www.dpi.nsw.gov.au/__data/assets/pdf_file/ 0004/370435/20101216-REF-PEL-460-Putty-Core-Hole_Drilling-Operations.pdf> (accessed 31 October 2011).
[7]Environment Planning Services Pty Ltd (2010). PEL 460 Review of Environmental Factors Drilling Operations, for Macquarie Energy <http://www.dpi.nsw.gov.au/__data/assets/pdf_file/ 0004/370435/20101216-REF-PEL-460-Putty-Core-Hole_Drilling-Operations.pdf> (accessed 3 November 2011).
[8]National Water Commission (2010). Position Statement on Coal Seam Gas and water, presented as part of the Inquiry into Coal Seam Gas on 31 August 2011. <http://www.parliament.nsw. gov.au/Prod/parlment/committee.nsf/0/18e571052de084b6ca25790d000ad4ed/$FILE/Submission%200100.pdf> (accessed 4 November 2011).
[9]Dunn, R pers. comm. (1 August 2011) public meeting, Leichhardt Town Hall
[10].Putty Community Association CSG Subcommittee (2011) <http://putty.nsw.au/assets/document/1314598998-csg_submission.pdf> (accessed 8 Nov 2011).
[11]Environment Planning Services Pty Ltd (2010). PEL 460 Review of Environmental Factors Drilling Operations, for Macquarie Energy <http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/370435/20101216-REF-PEL-460-Putty-Core-Hole_Drilling-Operations.pdf>(accessed3 November 2011).
[12]NSW Government Office of Environment and Heritage (2011). The Vertebrate Fauna of North Western Wollemi National Park. <http://www.environment.nsw.gov.au/surveys/WollemiNpNwVertebrateFauna.htm> (accessed 31 October 2011).
[13]NSW Government. Wollemi Threatened Species. <http://www.google.com.au/url?sa=t&rct=j&q=wollemi%20national%20park%20nsw%20threatened%20fauna%20species&source=web&cd=1&ved=0CBsQFjAA&url=http%3A%2F%2Fwww.environment.nsw.gov.au%2Fresources%2Fnature%2FVertebrateFaunaNEWollemi.pdf&ei=oOuuToWHAsy5iAeY8vDGDw&usg=AFQjCNH_Azc0LesMan2HftyI5J2bXOOiGg&sig2=YeUOBLK0q_LFdzKuN2ppIA,> (accessed 31 October 2011).
[14]NSW Government Office of Environment and Heritage (2011). Wollemi NationalPark.<http://www.environment.nsw.gov.au/nationalparks/parkhome.aspx?id=N0051> (accessed 3 October 2011).
[15] IUCN (2011). IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org> (accessed 12 Nov. 2011)

Woronora

[1]. Muir, K. (2010). The Impact of Coal Mining on the Gardens of Stone. Colong Foundation for Wilderness Ltd.
[2]Sydney Catchment Authority (SCA) (2007). Special Areas Strategic Plan of Management 2007 (SASPoM).
[3]Department of Environment and Climate Change (2007). Threatened and Pest Animals of Greater Southern Sydney.
[4]Metropolitan Coal Project Environmental Assessment. Resource Strategies and Helensburg Coal. <http://www.peabodyenergy.com.au/images/stories/pdfs/metropolitan/enviro/Sec%204.pdf> (accessed 30 September 2011).
[5]Total Environment Centre (2007). What Happened to the Waratah Rivulet?
[6]Metropolitan Coal Project Environmental Assessment. Resource Strategies and Helensburg Coal. <http://www.peabodyenergy.com.au/images/stories/pdfs/metropolitan/enviro/Sec%204.pdf> (accessed 30 September 2011).
[7]Association, Major. Peabody Energy. <http://www.peabodyenergy.com/> (accessed 30 Sept. 2011).
[8]Metropolitan Coal Project Environmental Assessment. Resource Strategies and Helensburg Coal. <http://www.peabodyenergy.com.au/images/stories/pdfs/metropolitan/enviro/Sec%204.pdf> (accessed 29 September 2011).
[9]Sydney: Department of Infrastructure, Planning, and Natural Resources (DIPNR) (2004). Water and Sydney's Future. Balancing the Values of Our Rivers and Economy.
[10]Young, ARM. (1982). Upland Swamps (dells) on the Woronora Plateau. (Thesis.) University of Wollongong.
[11]Metropolitan Coal Project Environmental Assessment. Resource Strategies and Helensburg Coal. <http://www.peabodyenergy.com.au/images/stories/pdfs /metropolitan/enviro/Sec%204.pdf> (accessed 29 September 2011).
[12]Office of Environment and Heritage (2011). Alteration of Habitat following Subsidence Due to Longwall Mining - Key Threatening Process Listing. <http://www.environment.nsw.gov.au/determinations/LongwallMiningKtp.htm> (accessed 29 September 2011).
[13]Sydney Catchment Authority and Parks and Wildlife Group of the Department of Environment and Climate Change (2007). The Fauna of the Metropolitan, O'Hares Creek and Woronora Special Areas: Summary of Findings and Recommendations.
[14]Silmalis, L., and T. Vermeer. (20 January 2011) Underground Mine Cracks Drain Dam Water, The Sunday Telegraph. <http://www.dailytelegraph.com.au/property/underground-mine-cracks-drain-dam-water/story-e6freztr-1225996743162> (accessed 30 September 2011).
[15]Colong Foundation for Wilderness. Support the Save Sydney's Water Campaign.<http://www.colongwilderness.org.au/CatchmentMining/CampaignSupport.htm>.
[16]Metropolitan Coal Project Environmental Assessment. Resource Strategies and Helensburg Coal. <http://www.peabodyenergy.com.au/images/stories/pdfs/ metropolitan/enviro/Sec%204.pdf> (accessed 30 September 2011).
[17]Muir, K. (2010). The Impact of Coal Mining on the Gardens of Stone. Colong Foundation for Wilderness Ltd.
[18]Metropolitan Coal Project Environmental Assessment. Resource Strategies and Helensburg Coal. <http://www.peabodyenergy.com.au/images/stories/pdfs/ metropolitan/enviro/Sec%204.pdf> (accessed 30 Sept. 2011).
[19]DECC Scientific Services (12 September 2011). <http://www.planning.nsw.gov.au/ planningsystem/pdf/wyonginquiry_submissions_deccattach2.pdf> (accessed 29 September 2011).
[20]Metropolitan Coal Project Environmental Assessment. Resource Strategies and Helensburg Coal. <http://www.peabodyenergy.com.au/images/stories/pdfs /metropolitan/enviro/Sec%204.pdf> (accessed 30 September 2011).
[21]Sydney Catchment Authority (SCA) (2007). Special Areas Strategic Plan of Management 2007 (SASPoM).
[22]Metropolitan Coal Project Environmental Assessment. Resource Strategies and Helensburg Coal. <http://www.peabodyenergy.com.au/images/stories/pdfs /metropolitan/enviro/Sec%204.pdf>.
[23]Sydney Catchment Authority (SCA) (2007). Special Areas Strategic Plan of Management 2007 (SASPoM).
[24]Baker, A. M., Hughes J. M., and Dean, J. C. (2004). Mitochondrial DNA Reveals Phylogenetic Structuring and Cryptic Diversity in Australian Freshwater Macroinvertebrate Assemblages. Marine and Freshwater Research, p 55, 629–640.

The Great Dripping Gorge

[1]Harwood, Helen. (10 June 2011). <http://fairviewartspace.wordpress.com/page/3/>.
[2]Galvin, J., Mackie, C., and Karantonis, P. (2007). REPORT OF THE INDEPENDENT HEARING AND ASSESSMENT PANEL for the MOOLARBEN COAL PROJECT. (Prepared for: Director General Department of Planning New South Wales.)
[3]Ulan Coal - History of Development (10 June 2011). <http://www.ulancoal.com.au/EN/ABOUTUS /Pages/HistoryofDevelopment.aspx>.
[4]Wells Environmental Services and Coffey Natural Systems, Moolarben Coal Project Environmental Assessment Report, Stage 2 (2010). <http://www.moolarbencoal.com.au/licences-approvals/major-project-approvals/environmental-assessment-part-2> (accessed 6 September 2011).
[5]Wells Environmental Services and Coffey Natural Systems, Moolarben Coal Project Environmental Assessment Report, Stage 2 (2010). <http://www.moolarbencoal.com.au/licences-approvals/major-project-approvals/environmental-assessment-part-2> (accessed 6 September 2011).
[6]Coffey Natural Systems Pty Ltd (2010). ENVIRONMENTAL ASSESSMENT Section 75W Modification Application, Moolarben Coal Project – Stage 1 MOD 7. <http://www.moolarbencoal.com.au/__documents/major-project-approvals/s1m7/environmental-assessment---part-a.pdf> (accessed 7 October 2011).
[7]Total Environment Centre (2007). IMPACTS OF LONGWALL COAL MINING ON THE ENVIRONMENT IN NEW SOUTH WALES. <http://www.tec.org.au/component /docman/doc_view/201-longwall-rep07> (accessed 12 September 2011).
[8]Pegasus Technical (2010). Moolarben Coal Stage 2 Environmental Assessment Plan 33. <http://www.moolarbencoal.com.au/__documents/major-project-approvals/environmental-assessment-report/environmental-assessment-part-2/volume-2/plan-33.pdf> (accessed 6 October 2010).
[9]Total Environment Centre (2007). IMPACTS OF LONGWALL COAL MINING ON THE ENVIRONMENT IN NEW SOUTH WALES. <http://www.tec.org.au/component /docman/doc_view/201-longwall-rep07> (accessed 12 September 2011).
[10]Galvin, J., Mackie, C., and Karantonis, P. (2007). REPORT OF THE INDEPENDENT HEARING AND ASSESSMENT PANEL for the MOOLARBEN COAL PROJECT. (Prepared for: Director General Department of Planning New South Wales.)
[11]Wells Environmental Services and Coffey Natural Systems, Moolarben Coal Project Environmental Assessment Report, Stage 2 (2010). <http://www.moolarbencoal.com.au/licences-approvals/major-project-approvals/environmental-assessment-part-2> (accessed 6 September 2011).
[12]Coffey Natural Systems Pty Ltd (2010). ENVIRONMENTAL ASSESSMENT Section 75W Modification Application, Moolarben Coal Project – Stage 1 MOD 7. <http://www.moolarbencoal.com.au/__documents/major-project-approvals/s1m7/environmental-assessment---part-a.pdf> (accessed 7 October 2011).
[13]NSW Government Department of Environment and Conservation (2011). Threatened Species Profile: Powerful Owl. <http://www.threatenedspecies.environment. nsw.gov.au/tsprofile/profile.aspx?id=10562> (accessed 07 November 2011).
[14]Mudgee District Environment Group (2011). Goulburn River National Park Briefing Note. MDEG., <http://www.savethedrip.com/> (accessed 6 October 2011).
[15]Galvin, J., Mackie, C., and Karantonis, P. (2007). REPORT OF THE INDEPENDENT HEARING AND ASSESSMENT PANEL for the MOOLARBEN COAL PROJECT. (Prepared for: Director General Department of Planning New South Wales.)
[16]Threatened Species Network. Bush Stone Curlew. <http://www.environment.gov.au/ biodiversity/threatened/publications/pubs/tsd05bush-stone-curlew.pdf> (accessed 6 October 2011).

The Gardens of Stone

[1]Muir, K. (2010) The impact of coal mining on the Gardens of Stone, The Colong Foundation for Wilderness Ltd.
[2]Hanrahan, T. (2011). Coalpac Consolidation Project - Newsletter Number 2, May 2011, (Prepared for Coalpac Pty. Ltd.) <http://www.cetresources.com/images/stories/files/newsletters /may11.pdf>.
[3]Hansen Bailey, 2010, Coalpac Consolidation Project - Preliminary Environmental Assessment, (Prepared for Coalpac Pty Ltd.)
[4]Minister for Planning v Coalpac Pty Limited (2008) NSWLEC 271. <http://www.lawlink.nsw.gov.au/lecjudgments/2008nswlec.nsf/000000000000000000000000000000/3c45cd3f286f9d66ca2574c9000773d9?opendocument> (accessed 30 Oct. 2011)
[5]Hansen Bailey, 2010, Coalpac Consolidation Project - Preliminary Environmental Assessment, (Prepared for Coalpac Pty Ltd.)

Photo Credits for Cover Pages

Cover Page Photo: Shannon Plummer shannonplummer.com and Joyce Webster
Back Cover Page Photo: istockphoto and Jeremy Buckingham
Introduction Page Photo: Anne Miehs
Pilliga Cover Photo: Tony Pickard
Warkworth Sands Woodland Cover Photo: Shannon Plummer shannonplummer.com
Putty Valley Cover Photo: Kathy McKenzie
Leard State Forest Cover Photo: Don White
Woronora Cover Photo: Henry Gold
The Great Dripping Gorge Cover Photo: Julia Imrie
Gardens of Stone Cover Photo: Henry Gold

Nature Conservation Council of NSW

HUNTER COMMUNITY ENVIRONMENT CENTRE

THE WILDERNESS SOCIETY

Printed on 100% recycled paper

ICONS UNDER THREAT

Natural areas and threatened species at risk from mining and gas in NSW