Appendix 3
Anvil Hill Coal Project
Independent Hearing and Assessment Panel
*Flora & Fauna*

# CONTENTS

# INTRODUCTION

The Minister for Planning appointed an Independent Hearing and Assessment Panel, under section 75G(1)(a) of the *Environmental Planning and Assessment Act 1979*, to advise on impacts of the proposed construction and operation of a new open cut coal mine and associated facilities at Anvil Hill and to consider issues raised in submissions.

The proposed establishment by Centennial Hunter Pty Limited of this new open cut coal mining operation at Anvil Hill, approximately 20 km west of Muswellbrook and 10 km north of Denman in the Upper Hunter Valley, is classified as a major project under the *State Environmental Planning Policy (Major Projects) 2005*, Schedule 1.The Proponent submitted an EA for the project in June 2006. This EA was placed on public exhibition by the Department of Planning from Friday 25 August 2006 until Friday 6 October 2006.

The project proposed by Centennial Hunter Pty Limited (known as the Anvil Hill Coal Project) involves a Project Area of approximately 3763 ha with a Proposed Disturbance Area, or footprint, of approximately 2238 ha. The Anvil Hill Coal Project, if granted a mining lease, will have a 21 year project life. Open cut mining will be carried out in stages throughout the life of the project. Part of the Proposed Disturbance Area will be used for coal handling and a preparation plant. The Project will include a rail spur and rail loop off the Muswellbrook-Ulan railway line and associated rail and train loading infrastructure.

**Purpose**

This report reviews the ecological impacts and biodiversity offset strategy of the proposed Anvil Hill Coal Mine as described in the report entitled 'Anvil Hill Project Environmental Assessment' prepared by Umwelt Environmental Consultants for Centennial Hunter Pty Limited (August 2006) and referred to hereafter as the EA for the proposal. Ecological issues raised in submissions to the Panel are also reviewed and the adequacy of the Proponent's responses to these is assessed. Comment is made concerning the issues raised and recommendations are put forward.
Note that although the focus of this report is primarily ecological, the Panel members heard submissions that were raised about a suite of other environmental issues. These included ground water, archaeology, erosion and other matters that are outside the expertise of Cumberland Ecology and outside the scope of this report.

**Terms of Reference**

The Terms of Reference, as set out by the Minister for Planning, require the Panel to:

Consider and advise on the:

a) Following impacts of the project

   - Noise and blasting;
   - Air quality, in particular dust impacts; and
   - Flora and fauna, in particular vegetation offsets;

b) Relevant issues raised in submissions in regards to these impacts; and

c) Adequacy of the proponent's response to the issues raised in submissions and identify and comment on any other significant issues raised in submissions or during panel hearings.

In accordance with the Panel's Terms of Reference, this report has assessed and considered the EA of Anvil Hill Coal Project, written and oral submissions and the proponent's response to submissions.

**Literature Review**

A literature review was made of relevant literature, including all of the submissions that dealt with flora and fauna. Summaries were made of the major issues raised by any organisation or individual that provided a submission to the Panel. The list of issues was later used to help evaluate the ecological impacts of the proposed coal mine.
The following key documents, among other relevant literature, were read for the purposes of assessing ecological aspects of the proposed Anvil Hill Coal Project:

- Abel Ecology (2005) Flora and Fauna Report for 168 Bells Lane, Denman in the Upper Hunter Valley New South Wales Prepared for Anvil Hill Project Watch Association by Abel Ecology.
- HLA Envirosciences Pty Limited (2002) Great Northern Coal Mine Project Flora and Fauna Investigations for Proposed Bulk Sample Pit at Anvil Hill Prepared for Powercoal Pty Limited.
- Umwelt (2006) Anvil Hill Project Environmental Assessment Prepared for Centennial Hunter Pty Limited by Umwelt Environmental Consultants, NSW.
- Umwelt (2006) Anvil Hill Project Environmental Assessment Response to Submissions Part B Prepared for Centennial Hunter Pty Limited by Umwelt Environmental Consultants, NSW.
- Umwelt (2006) Anvil Hill Project Environmental Assessment Response to Submissions Part C Prepared for Centennial Hunter Pty Limited by Umwelt Environmental Consultants, NSW.

Also reviewed were written and oral submissions made to the Panel by the Proponent, various Government agencies, Council, Environmental groups, Community/Public Interest groups and local land owners/residents and relevant material referred to within these submissions.

**Site Inspections**

During the Panel Hearings on the 18th of October 2006, and later on the 23rd of November, Dr David Robertson of Cumberland Ecology conducted inspections of Anvil Hill and the proposed offsets area in the company of Umwelt and Centennial staff. During the site visits, Dr Robertson made observations of the nature and extent of flora and fauna habitats and their current condition. He also made note of the context for the site in relation to other habitats in the upper Hunter Valley.

**Analysis of Potential Endangered Ecological Communities**

Some issues were raised during the Panel hearings about the identity of plant communities and whether or not some vegetation communities that were described by consultants acting for the proponent were endangered ecological communities (EECs) that are listed by either the TSC Act or the EPBC Act. Some submissions suggested that several of the plant communities found within the proposed mining area were particular types of EECs. Where such suggestions were made, Cumberland Ecology obtained the original flora survey data from Mr Travis Peake, senior ecologist at Umwelt, and independently compared the vegetation data to information published in the Final Determinations of various EECs that were published by the Scientific Committees of the TSC Act and EPBC Act.

# REVIEW OF ANVIL HILL PROJECT ENVIRONMENTAL ASSESSMENT

This chapter provides a summary of the proponent's evaluation of the flora and fauna of the subject land at Anvil Hill and of the likely impacts to flora and fauna that would arise as a result of the proposed coal mine. The chapter also summarises the mitigation and compensation that has been put forward to offset the impacts of the project upon flora and fauna.

## FLORA AND FAUNA

### Findings Made by Umwelt for the EA

Flora and fauna aspects of the project have been addressed within Section 4 and Appendices 9A and 9B of the EA. According to the assessment within the EA approximately 1300 ha of treed vegetation communities will be directly impacted by the project. Analysis of aerial photographs dating back to the 1930s indicates that most of the area has been cleared at some time in the past 75 years.

Two vegetation communities (Ironbark Woodland Complex and Slaty Box Woodland) were found to cover most of the study area. These two communities are regarded as being of regional significance as they are comparable to central Hunter Valley communities regarded as being likely to meet DEH criteria for listing as an endangered ecological community of national environmental significance according to Peake (2006).

Most other vegetation communities occur in specific landscape positions such as riparian areas, rocky ridges or steep sheltered slopes which are small, restricted locations. Other communities considered likely to meet DEH listing criteria by Peake (2006) include: Weeping Myall Woodland, Swamp Oak Riparian Forest, River Oak Riparian Forest, Rough-barked Apple Woodland, Forest Red Gum Riparian Woodland, and Paperbark Woodland. Other communities recorded from the study area include: Bulloak Woodland, Sheltered Grey Gum Woodland, Red Ash Sheltered Forest, Drooping She-oak Woodland, Exotic Rushland, Tall Mixed Shrubland Complex, Coast Myall Exposed Woodland, and Disturbed Grassland.

Six threatened bird species were recorded in both the proposed disturbance area and the proposed offset area: Diamond Firetail (*Stagonopleura guttata*), Speckled Warbler (*Pyrrholaemus sagittata*), Brown Treecreeper (*Climacteris picumnus victoriae*) Glossy Black-cockatoo (*Calyptorhynchus lathami*), Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) and Hooded Robin (*Melanodryas cucullata cucullata*). The Turquoise Parrot (*Neophema pulchella*) was recorded solely from the proposed disturbance area. The Masked Owl was the only species recorded solely from the Proposed Offset area.

Six threatened species of mammal were recorded within the proposed disturbance area: the Squirrel Glider (*Petauris nofolcensis*), Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Large-footed Myotis (*Vespadelus troughtoni*). The proposed offset areas have records of the Koala (*Phascolarctos cinereus*), Squirrel Glider, Brush-tailed Rock Wallaby (*Petrogale penicillata*), Eastern Freetail Bat (*Mormopterus norfolkensis*), Eastern Bent-wing Bat, Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Large-eared Pied Bat, Large-footed Myotis and the Eastern Cave Bat.

Threatened flora species recorded from the study area include: *Bothriochloa biloba*; *Commersonia rosea*; Painted Diuris (*Diuris tricolor*); Narrow Goodenia (*Goodenia macbarronii*); *Grevillea montana; Pomaderris queenslandica; Lasiopetalum longistameneum;* and *Pomaderris reperta*. Three of these species occur within the proposed disturbance area: *Cymbidium canaliculatum*; *Goodenia macbarronii*; and *Pomaderris queenslandica*. Two endangered flora populations were recorded from within the study area; *Cymbidium canaliculatum* and *Acacia pendula*. One EEC that is listed by the TSC Act, Weeping Myall Woodland, was recorded as occurring in the study area. However it does not occur in the proposed disturbance area.

Painted Diuris and Narrow Goodenia are listed under the EPBC Act and assessments of significance were conducted for both species. These found that the records of Painted diuris and Narrow Goodenia within the study area are likely to be at or approaching the eastern limit of the known range for these species, and therefore it is likely that an important population of these species is present. The records of Narrow Goodenia within the proposed disturbance area represent the largest area of known habitat for this species within the Hunter region. All of this known habitat will be lost as a result of the proposal. It is considered possible by Umwelt that the proposal will lead to a significant impact on important populations of Painted Diuris and Narrow Goodenia due to the probability of:

- A long term decrease in the size of the populations;
- A reduction in the area of their occupancy;
- Likely disruption to their breeding cycle;
- Fragmentation of populations; and
- The likely interference with the recovery of these species at a local level.

**Other Flora and Fauna Investigations of the Study Area**

HLA Envirosciences (2002), Great Northern Coal Mine Project, Flora and Fauna Investigations for Proposed Bulk Sample Pit at Anvil Hill

HLA Envirosciences conducted flora and fauna investigations at Anvil Hill prior to the investigations by Umwelt. The findings of the HLA investigations have been incorporated into the EA report.
The only threatened flora species recorded by HLA was *Goodenia macbarronii*; no additional threatened flora species were recorded to the Umwelt report.

Threatened fauna found in this report include: Speckled Warbler (*Pyrrholaemus sagittata*); Diamond firetail (*Stagonopleura guttata*); and Brown Treecreeper (*Climacteris picumnus victoriae),* however no additional threatened fauna species were recorded to the Umwelt report.

The authors of the HLA report considered that the Slaty Box Woodland of the study area shares many similarities with the final determination for the White Box Yellow Box Blakely's Red Gum Woodland EEC and should be considered as such. This is in contrast to the Umwelt EA which reported the occurrence of Slaty Box Woodland over much of the study area, however they did not consider that it comprised an EEC.

Abel Ecology (2005), Flora and Fauna Report for Lot 168 Bells Lane, Denman in the Upper Hunter Valley of New South Wales

Abel Ecology recorded three threatened flora species *Diuris tricolor, Grevillea montana,* and *Pomaderris reperta.* These three threatened flora species were also recorded by Umwelt. Two other orchid species that are unique to the area and which have only recently been named were recorded by Abel Ecology within grassland areas of the proposed offset area. Danny Wotherspoon of Abel Ecology expressed the view that the grasslands were therefore significant and had been undervalued by the Umwelt investigation for the EA, which does not rate grasslands as having significant conservation values.

Threatened flora species recorded by Abel Ecology were: Brown Treecreeper (*Climacteris picumnus victoriae*), Hooded Robin (*Melanodryas cucullata cucullata*), Diamond Firetail (*Stagonopleura guttata*), Speckled Warbler (*Pyrrholaemus sagittata*), Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), Glossy Black -cockatoo (*Calyptorhynchus lathami*), Turquoise Parrot (*Neophema pulchella*), and the Eastern Cave Bat (*Vespadelus troughtoni*).

One threatened fauna species, the Square tailed kite (*Lophoictinia isura*), was recorded by Abel Ecology but not by Umwelt. No EEC was recorded as occurring in the study area. However, during the their submission to the Panel Hearing, Danny Wotherspoon, the director of Abel Ecology questioned whether several of the plant communities in the study area actually fitted within the definitions of EECs that are described by the TSC Act including White Box-

Yellow Box-Blakely's Red Gum Grassy Woodlands and some of the recently listed floodplain EECs (particularly River-Flat Eucalypt Forest on Coastal Floodplains).

This report concluded that due to the high abundance and diversity of habitat resources, as well as high levels of biodiversity recorded from the site, that the ecological communities on the site have high conservation value. These values are enhanced by the adjacent extensive areas of high conservation value.

## BIODIVERSITY OFFSETS

The applicant has addressed impact mitigation of the project in section 9.0 of the EA. This consists of two main components: those standard mitigation strategies that are commonly included within projects of this kind and a Biodiversity Offset Strategy to supplement the Standard Impact Mitigation strategy.

The Standard Impact Mitigation Strategy includes the rehabilitation, revegetation and regeneration of the post mining landscape as general management strategies for fencing, weed control, feral animal control and bushfire.
The Biodiversity Offset strategy consists of several additional mitigation strategies designed to address the effect on key threatened species, identified within the EA. These include:

- Establishment and protection of Proposed Offset Areas to allow for the conservation of existing vegetation within the Study Area;
- Revegetation and regeneration Strategy
- Conceptual Corridor Strategy, including augmentation of existing corridor vegetation to improve existing corridor function;
- Augmentation of existing vegetation to increase habitat quality, including provision of nest boxes, fallen timber and specific foraging features for target key threatened species; and
- Development of a detailed Ecological Monitoring Program for the life of the mine.

### Proposed Offset Area

As part of the Project, 1304 ha of treed vegetation and 934 ha of grassland is proposed for removal, making a total of 2238 ha.
The Proponent describes a Proposed Offset Area of 1707 ha, of which 1034 ha is currently covered in treed vegetation. This treed area of 1034 ha of the Proposed Offset Area is to be protected and managed as a Conservation Area, while 471 ha of Habitat Enhancement Area will be subject to extensive regeneration and revegetation. A further 202 ha of grassland habitat will also be retained as offset. Subsequent to a request from DEC for more land to be set aside for offsets, Centennial have agreed to provide a further 600 ha for this purpose. The applicant contends that the Proposed Offset Areas will facilitate the protection of most of the vegetation community types that will be removed from the Proposed Disturbance Area.

Note that the total area for proposed offsets in Table 1 and as presented in the EA (1904 ha) is not consistent with the figure (1707 ha) presented in the more recent document produced for Centennial, the Response to Submissions (Umwelt 2006b, p. 2.2). This figure of 1707 ha does not include the additional 600 ha of land for offsets that Centennial have agreed to provide in accordance with DEC's requirements. Table 1 is derived from the EA rather than more recent documents because the proposed disturbance area for each vegetation community is provided in the EA. However, later in this report, the updated proposal for compensatory habitat including the additional hectares is assessed and discussed by this report.

| Vegetation Community | Proposed disturbance area (ha) | Proposed Offset Areas (ha) |
|---|---|---|
| Woodland | 1251 | 874 |
| Slaty Box woodland | 245 | 282 |
| Ironbark Woodland Complex | 886 | 507 |
| Bulloak Woodland | 100 | 0.4 |
| Sheltered Grey Gum Woodland | 0 | 79 |
| Red Ash Sheltered Forest | 0 | 0.7 |
| Drooping she-oak Woodland | 0.8 | 1 |
| Mixed spp Regeneration Replanting | 0 | 0.8 |
| Paperbark Woodland | 19 | 3 |
| **Riparian and Floodplain** | **52** | **31** |
| Exotic Rushland | 0 | 0.2 |
| Swamp Oak Riparian Forest | 1 | 20 |
| River Oak Riparian Forest | 0 | 0.6 |
| Rough Barked Apple Woodland | 0.3 | 11 |
| Forest Red Gum Riparian Woodland | 51 | 0 |
| **Shrubland** | **0.2** | **127** |
| Tall Mixed Shrubland Complex | 0 | 52 |
| Weeping Myall Woodland | 0.1 | 0.9 |
| Coast Myall Exposed Woodland | 0.2 | 74 |

| Vegetation Community | Proposed disturbance area (ha) | Proposed Offset Areas (ha) |
|---|---|---|
| **Grassland** | **934** | **872** |
| Disturbed grassland | 934 | 872 |
| **Total** | **2238** | **1904** |

***Table 1: Area of vegetation communities to be removed and area of corresponding communities present in offsets (not including dec's requirement for an additional 600 ha of offsets) as presented in the EA***

**Revegetation and Regeneration Strategy**

Regeneration and revegetation form a major element of the biodiversity offset strategy for the project. This is designed to contribute towards the rehabilitation of previously mined areas, provision of corridors, habitat augmentation. This is designed to replace habitat loss from the proposed disturbance area and to establish habitat within the proposed offset areas and corridor areas.

It is proposed to revegetate approximately 515 ha of vegetation, consisting of 386 ha of Woodland, 101 ha of Riparian/Floodplain, and 29 ha of Shrubland. In addition to this area, the majority of the proposed disturbance area, including the open cut mining areas and overburden emplacement areas will be progressively revegetated and regenerated to self-sustaining indigenous vegetation communities.

**The Conceptual Corridor Strategy**

This strategy was developed in order to address the reduction in movement opportunities for native fauna. The landscape within and adjoining the Study area consists of a large number of vegetated fragments of varying sizes and degree of connectivity. Therefore, another part of the Biodiversity Offset Strategy includes regeneration and revegetation to increase the functioning of existing corridors. Eight corridor options have been identified which allow for movement within and outside of the study area. These include two options each to allow for northern and western connectivity and movement opportunities.

**Habitat Augmentation Strategy**

Augmentation strategies will be aimed at increasing the quality of habitat for threatened species in the area. These strategies will be applied to the proposed offset areas, corridors and other areas of revegetation. This will include provision of nest boxes, salvage and re-erection of hollows in timber, replacement of habitat features such as hollow logs, fallen timber and boulders, and planting of specific habitat resources and foraging features to increase quality of habitat for target key threatened species.

**Ecological Monitoring Program**

The applicant proposes to implement an ecological monitoring program to asses the adequacy of the Standard Impact Management Strategy and the Biodiversity Offsets Strategy. This program, yet to be designed, will include monitoring of:

- Retained vegetation;
- Revegetation and regeneration areas;
- Fauna;
- Nest Boxes;
- Threatened species;

- Aquatic monitoring; and
- Landscape function analysis.

**Land Management Strategy**

Centennial also proposes to establish a land management strategy to contribute towards its corporate sustainability goals. The Strategy "Wybong Uplands Land Management Strategy" will target sustainable land management across the broader landscape of the Wybong area. This will include Sustainable agriculture, demonstration farms and Riparian zone management and ecological corridors. Centennial will commit $100,000 per year to the strategy for five years.

The proponent concludes that despite the more restricted area of fauna habitat available in the POAs, there is a generally higher quality of habitat present for most of the key threatened fauna species, except in the Riparian / Floodplain formation, where the relative quality of the habitat is substantially poorer. Centennial claim that their contribution to riparian enhancement in the general area as part of the Wybong Uplands Land Management Strategy will contribute to the offsetting of these impacts (p. 9.12 of the EA).

**Completion Criteria**

Completion Criteria identify when land has reached a condition that allow a company to relinquish responsibility for a rehabilitated site. The Department of Primary Industries (DPI) recommended that the proponent establish a Rehabilitation Research and Development Committee including community and academics representation and DPI within two months of obtaining project approval.

The proponent has developed a set of conceptual completion criteria that broadly follows the principles recommended for rehabilitation completion criteria for Native Ecosystem Establishment by the Australian Centre for Minerals Extension and Research (ACMER). They indicate that completion criteria will be developed after the project has been approved. The criteria are not very specific about what the criteria will constitute but they indicate that they will incorporate key elements of the ACMER recommendations including:

- Stakeholder consultation;
- Cost effective best practice;
- Principles of continuous improvement and review of criteria;
- Completion criteria for all stages of the mining operation;
- Development of completion criteria being an iterative process; and
- Target standards being used to trigger actions if not met.

**Ecology Risk Assessment**

Project activities that may affect ecology, as outlined in the EA, include vegetation clearing, topsoil removal, overburden removal and placement, and reject/tailings disposal. The potential impacts of these activities on ecology include loss of threatened flora species, endangered populations and endangered ecological communities, and loss of threatened fauna species and their habitats.

Rating of the consequences of these impacts in the EA is 'Major'. Taking into account the likelihood of occurrence of these impacts, risk of the impacts is estimated as extreme. It is further stated that with implementation of the proposed controls for each of these possible impacts, their risk will drop to "Moderate".

## ISSUES RAISED IN SUBMISSIONS

This chapter reviews and provides an overview of the submissions received about the ecological aspects of the EA and the ecological implications of the proposed coal mine. Ecological submissions about the proposal generally expressed concern about the level of impact likely from the mining and the low probability that rehabilitation and compensation would successfully offset the scale of the impact. Some of the key points raised in submissions included:

- Approval is inconsistent with the objects of Threatened Species Conservation Act 1997; Environmental Planning and Assessment Act 1979; Natural Resources Commission Act 2003; Catchment Management Authorities Act 2003; and Protection of the Environment Operations Act 1997;
- The area of the proposed mine site has been recommended as a high priority-urgent action area for conservation due to its biodiversity significance and it has been recommended for inclusion in conservation reserves (Peake 2006);
- There are no reserves on the Hunter valley floor that protect similar vegetation to that on the Anvil Hill site;
- The proposal will impact on significant remnant native vegetation, the habitat of threatened species, and water and catchment values;
- There is no justification for the reduction in grassland habitat;
- The remnant woodlands of the Anvil Hill Project area were identified as irreplaceable for the maintenance of flora and fauna species in the 1998 NSW State Government Comprehensive Regional Assessment of the Lower North East Region;
- The proposed development is located within two Mitchell landscapes which are regionally significant. There is no opportunity for offsets for these landscapes and they should therefore not be cleared;
- The Western Hunter Narrabeen Footslopes Ironbark-Cypress Pine Woodland is a restricted and poorly reserved community and the proposal will result in the removal of over half of the largest remnant of the community (loss of 740 ha);
- The proposed Anvil Hill mine site forms part of a recognised biodiversity corridor and is critical for connectivity across the Hunter Valley floor between Manobalai Nature Reserve to the north and the Wollemi National Park and Goulburn River National Park to the south;
- The corridor strategy is not detailed enough and there is no indication about the basis on which it has been developed;
- Claims in the EA that rehabilitation of the mine site and replanting in the offset areas will improve connectivity in the medium to long term are spurious because they fail to acknowledge that connectivity will be lost in the short to medium term and that it will be some time (if ever) before any of the replanted vegetation will reach the size or maturity to provide adequate habitat resources;
- The Proponent fails to comprehensively examine the potential cumulative impacts of the combined operation of the project together with other approved and existing mines in the Region;
- The proposed Anvil Hill mine site occurs at the intersection of three Biogeographic Regions and four Botanical Provinces and includes a number of species which are at the limit of their distribution;
- The EA deliberately obscures facts and figures and deliberately understates the conservation status of vegetation communities at the site, for example, the EA discounts the presence of three EEC's;
- The study area contains large areas of woodland that potentially meet DEH listing criteria (e.g. 527 ha of Slaty Box Woodland, 577 ha of Central Hunter Ironbark Woodland) but are not acknowledged as such in the EA;
- Rehabilitation practices are not likely to endeavour, let alone succeed, in replacing the rich ecosystem of Anvil Hill;
- Rehabilitation is likely to be poor on overburden piles due to the contamination of the soil structure. There has been a historically poor success rate in rehabilitation of mines;
- Compensatory re-vegetation is not ecologically sustainable in the medium term and cannot ensure the long-term persistence of populations, communities and processes;
- Rehabilitated mine sites do not replicate remnant communities that have been destroyed and attempts to re-establish natural communities have not been shown to be successful;

- Proposed offset ratios are inadequate and the offsets are not like-for-like;
- There is no long term commitment to offset areas;
- The mitigation strategy fails to acknowledge that more than half of the Proposed Disturbance Area is very poorly represented in the Proposed Offset Area;
- Due to lack of data, the relative importance of the Proposed Disturbance Area and the Proposed Offset Area cannot be compared;
- The Director General's Requirements are not satisfied because the requirement for no net loss of flora and fauna values in the area in the medium to long term has not been satisfied by the offset strategy;
- There has been insufficient survey for some species, including terrestrial orchids, some mammals (eg Brush-tailed Rock Wallaby) and some birds;
- A number of threatened species, including a viable population of Squirrel Gliders, are expected to become locally extinct in the area as a result of the proposed mine;
- Of the fauna species likely to be significantly impacted by the proposed mine, 13 have been assessed in the 1998 NSW State Government Comprehensive Regional Assessment (CRA) of the Lower North East Region. It was found that these species failed to meet population reservation targets in the Lower North East CRA Region. The implication that the recognised significant impact of the proposal on 13 threatened fauna species a 2 threatened flora species will be offset by the Proposed Offset Area is false and misleading;
- The EA provides misleading definitions and information in some cases and contains contradictions and inconsistencies; and
- The EA does not consider the impacts of the proposal far enough into the future to be able to assess sustainability adequately. Approval of the proposed project would not be consistent with the principles of Ecologically Sustainable Development.

# ADEQUACY OF IMPACT ASSESSMENT, MITIGATION MEASURES AND PROPONENT'S RESPONSE TO ECOLOGICAL ISSUES

This chapter examines the adequacy of the proponent's impact assessment and responses to ecological issues raised during the Panel hearings and within written submissions. The chapter focuses upon the adequacy of description of the existing flora and fauna, impact assessment, mitigation and compensation proposed by the proponent.

## ADEQUACY OF FLORA AND FAUNA SURVEYS

The alleged inadequacy of the survey effort for flora and fauna was a common theme for the submissions to the Panel, with many respondents expressing concern about the level of survey effort undertaken for the EA. However, when the measures of survey effort are compared with the latest DEC guidelines for survey (DEC 2004), the proponent has generally complied with or exceeded the guidelines for survey effort (Table 2). This was acknowledged by the submission to the Panel by DEC.

There are some gaps in the survey effort. For example, with respect to the amount of trapping prescribed using cage traps and "Elliot" traps, the surveys do not comply fully with the guidelines. However, this is compensated for by the use of hair tubes, the numbers of which greatly exceeded the guidelines. Extensive effort has been devoted to flora survey and to the mapping of vegetation communities on the subject land and in the offset area. The plant species inventory is detailed and this provides a substantial body of information to use for examining the current values of the vegetation.

One criticism that was levelled at the flora survey related to the survey effort for rare herbaceous plants, particularly orchid species. Some groups have found threatened orchids – *Diurus tricolour* - within some areas where they have not been found by the Umwelt survey. Moreover, these locations were within semi-natural grassland areas that are alleged by some opponents of the project to have been undervalued and under surveyed by the proponent. However, the Umwelt surveys located specimens of the orchid and the authors of the study have assessed the impacts of the project upon this plant species.

Similarly, two species of orchid that are thought to be endemic to the upper Hunter Valley - (*Prasophyllum sp. aff. petilum*) and *Oligochaetochilus sp. aff. praetermissus*) - have been found within grassland areas in the proposed offset area and have potential to occur in the proposed mining area. They have not been found by the Umwelt surveys and Umwelt responded to criticisms by stating that the species are not listed currently either by the EPBC Act or by the TSC Act. There is potential for these plant species to occur on the proposed mining area. Moreover, their presence in grassland areas does indeed suggest that the grassland areas may not have been regarded as having sufficiently high enough conservation values by the Umwelt flora and fauna investigations. Moreover, it is not valid to assume that because rare species have not been listed on either the EPBC Act or the TSC Act that they should not be treated as such. Based upon their current distribution and abundance, both of these species are likely to be listed if nominated for the TSC Act and may also be listed on the Commonwealth EPBC Act.

The Umwelt fauna survey has also been thorough and has detected the majority of threatened species known or thought likely to occur in the habitats of the Hunter Valley. Although in some aspects the Umwelt surveys did not meet the DEC guidelines, in some respects they detected more than other surveys on the same land that were conducted by HLA Envirosciences and Abel Ecology. They also described the habitats available on the site in detail. DEC notes that the *"EA provides a comprehensive and detailed examination and comparison of the biodiversity of the area to be directly affected by the mine and of surrounding areas that have been proposed as offsets"*. DEC stated that they are satisfied with the rigour of the assessment and considered the results and survey methods to be adequate. Overall, with the exception of the grassland areas (see Section 5.2), the Panel is satisfied that there has been enough survey effort to provide adequate baseline data to understand the ecological values of the subject land and those of the proposed offset area (Table 2).

| DEC guidelines | Survey effort by Umwelt | Comment |
|---|---|---|
| **Vegetation survey** | | |
| The study area must be initially stratified and each stratification unit surveyed | 70, 10 hr days of flora survey by Umwelt and HLA staff, + 6, 10 hr days by HCRCMA | This survey effort is likely to be sufficient to characterise the plant communities of the study area and the proposed offset area. Survey effort per stratification units was indicated by the numbers of quadrats placed per vegetation unit. |
| **Quadrats for Vegetation Survey** | | |
| 10 quadrats per 501-1000 hectares of stratification unit,<br><br>plus one additional quadrat for each extra 100 hectares<br><br>thereof. | 141 20 x 20m quadrats | Sufficient - DEC requirements are for approximately 37 quadrats for the size of the site (3763 ha).<br><br>Most vegetation types mapped within the study area for the EA were covered by adequate numbers of quadrats. Exceptions to this are within the native grassland areas that occur on the site (see Section 5.2). |
| **Targeted Searches for Threatened Plant Species** | | |
| 10x100m traverses per 501-1000 hectares of stratification<br><br>unit, plus one additional 100m traverse for each extra 100<br><br>hectares thereof | 73 km of threatened flora search transects | Sufficient - DEC requirements are for 3.7 km of transects for the size of the site (3763 ha). A high level of detail was provided about threatened flora of the study area. However sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Pitfall traps** | | |

| DEC guidelines | Survey effort by Umwelt | Comment |
|---|---|---|
| 24 trap nights over 3-4 consecutive nights for an area up to 50 ha of stratification<br><br>unit and then an additional 24 trap nights for each additional 100 ha. | 40 trap nights | Insufficient – for the size of the study area (3763 ha) DEC requirements are for 912 trap nights. Sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Arboreal Hair tubes** | | |
| 3 tubes in each of 10 habitat trees for at least 4 days and 4 nights, in up to 100 ha of stratification<br><br>unit plus an additional effort for each additional 100 ha | 6492 nights, 3 seasons and 2 years | Sufficient - for the size of the study area (3763 ha) DEC requirements are for 4440 nights for this area. Sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Terrestrial Hair tubes** | | |
| 10 large and 10 small tubes in pairs for at least 4 days and nights, in up to 50 ha of stratification<br><br>unit plus an additional effort for each additional 100 ha | 7629 nights, 4 seasons and 2 years | Sufficient – for the size of the study area (3763 ha) DEC requirements are for 3040 nights for this area. Sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Cage traps** | | |
| 24 trap nights over 3-4 consecutive nights in up to 50 ha of stratification<br><br>unit plus an additional effort for each additional 100 ha | 253 cage traps across 3 seasons and 2 years | Insufficient – for the size of the study area (3763 ha) DEC requirements are for 912 trap nights. However, this is compensated for by the extensive use of hair tubes. Sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Elliott A traps (small)** | | |

| DEC guidelines | Survey effort by Umwelt | Comment |
|---|---|---|
| 100 trap nights over 3-4 consecutive nights in up to 50 ha of stratification<br><br>unit plus an additional effort for each additional 100 ha | 976 trap nights | Insufficient – for the size of the study area (3763 ha) DEC requirements are for 3800 nights. However, this is compensated for by the extensive use of hair tubes. Sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Elliott B traps (large)** | | |
| 100 trap nights over 3-4 consecutive nights in up to 50 ha of stratification<br><br>unit plus an additional effort for each additional 100 ha | 364 trap nights | Insufficient – for the size of the study area (3763 ha) DEC requirements are for 3800 nights. However, this is compensated for by the extensive use of hair tubes. Sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Arboreal Elliott Traps** | | |
| 24 trap nights over 3-4 consecutive nights in up to 50 ha of stratification<br><br>unit plus an additional effort for each additional 100 ha | 532 trap nights over 3 seasons and 2 years | Insufficient – for the size of the study area (3763 ha) DEC requirements are for 912 trap nights. Sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Spotlighting on foot** | | |
| minimum of 2 searches on 2 nights for 1 hr for at least 1 km for up to 200 ha of stratification<br><br>unit and an additional effort for each additional 100 ha | 23 walking person hours | Insufficient – for the size of the study area (3763 ha) DEC requirements are for 37 person hours. Sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |
| **Spotlighting from vehicle** | | |
| 2x1 km of track up to 200 ha of | 19 driving person | Insufficient – for the size of the study |

| DEC guidelines | Survey effort by Umwelt | Comment |
|---|---|---|
| stratification<br><br>unit on 2 separate nights | hours | area (3763 ha) DEC requirements are for 37 person hours. It is not indicated how many kms were driven and sampling effort per stratification units was not indicated and therefore the survey effort required is likely to be higher |

***Table 2 Evaluation of survey effort by Umwelt (2006)***

### Recommendations

There is no recommendation for further broad scale/general surveys. However, additional surveys are recommended for selected species (see below).

## ADEQUACY OF IMPACT ASSESSMENT

As the proponent has provided detailed and accurate maps of flora and fauna habitat within the study area, the net losses of treed habitat can be and have been accurately measured for woodland and forest habitats. The EA acknowledges that the area is of high ecological significance because it is part of a large patch of native vegetation and is one of the largest patches remaining in the upper Hunter Valley. Anvil Hill is located within the Wybong Uplands, the second largest intact remnant of vegetation (2067 ha) on the Central Hunter Valley floor. The largest remnant is Myambat Military Area (2251 ha).

As stated in Centennial's response to submissions (Umwelt 2006b), the Wybong Uplands includes most of the contiguous stand of remnant vegetation that is present in the Proposed Disturbance Area and the Proposed Offset Area but also includes some vegetation outside the Anvil Hill Study Area. In general, approximately half of the Wybong Uplands would be disturbed by the Project.

Moreover, the upper Hunter Valley is an area of biogeographical interest being located in an area that receives species from west of the Great Dividing Ranges, from coastal areas, and from northern and southern NSW. The area is also topographically varied and includes riparian areas, flat areas, hillsides and rocky slopes. Consequently, the large patch of forest, woodland, grassland habitats support a high diversity of native flora and fauna including a substantial array of flora and fauna that are listed on the TSC Act and/or the EPBC Act.

The EA concluded that the proposed development, without any mitigation measures, would result in a significant impact to a wide range of fauna and flora species. However, with the mitigation measures proposed, such as the provision of compensatory habitat and extensive revegetation and rehabilitation, no significant impact was expected on any of these species.

### Impact Assessment for Grassland Habitats

Various forms of grassland are widespread within the impact area and the proposed offset areas. The impact assessment for flora and fauna within the EA determined that:

> *"Approximately 1300 hectares of treed vegetation communities will be directly impacted by the Project. Analysis of historical aerial photographs dating back to the 1930s has demonstrated that the majority of this area has been cleared at some time in, or prior to, the last 75 years. Approximately 42% of the Proposed Disturbance Area is grassland that was derived from the previous clearing of woodland."*

Although the EA states that grassland habitats have some ecological values, it seems that these may have been understated in the impact assessment and also, subsequently within the mitigation and compensation measures. The EA notes that disturbed grassland is a widespread unnatural vegetation community that occurs as a result of extensive human modification of the natural woodland and open forest environments in the general locality. The structure and floristic composition of the community is highly variable, being largely dependent upon previous and current land use.

Although formed by clearing, much of the grassland appears to be dominated by native species, including the following (from page 4.16 of volume 4, the EA):

> *The following species include the most frequent natives that are encountered: three awned spear grass (Aristida vegans), wiregrass (Aristida ramosa), wallaby grass (Austrodanthonia fulva), couch (Cynodon dactylon), corkscrew grass (Austrostipa scabra), paddock lovegrass (Eragrostis leptostachya), kidney weed (Dichondra repens), winter amulla (Eremophilla debilis), climbing saltbush (Einadia nutans), eastern cottonbush (Maireana microphylla), hyssop loosestrife (Lythrum hyssopifolia), galvanised burr (Sclerolaena birchii), twining glycine (Glycine clandestina), variable glycine (Glycine tabacina) and star cudweed (Euchiton involucratus).*

Additionally, it seems that some of the grassland mapped may actually be a form of very open woodland (ie it contains scattered trees), as indicated by the following passage from the description of grassland in the EA (from page 4.16 of the EA):

> *In many areas widely spaced trees are present; the most common species are slaty box (Eucalyptus dawsonii), narrow-leaved ironbark (Eucalyptus crebra), grey box (Eucalyptus moluccana) and Blakely's red gum (Eucalyptus blakelyi).*

The EA (page 4.16 of volume 4) states that threatened species can and do occur within grassland habitats, as indicated by the following passage from Volume 4, page 4.16:

> *While the presence of this vegetation community has resulted from clearing of forests and woodlands, it still has some conservation value for native flora and fauna. Rare or threatened plants such as tricolour donkey orchid (Diuris tricolour), lobed blue grass (Bothriochloa biloba), narrow goodenia (Goodenia macbarroni) and tiger orchid (Cymbidium canaliculatum) can still be present where suitable conditions exist. Despite this, the vegetation community is not, in itself, of conservation significance.*

Danny Wotherspoon of Abel Ecology pointed out that two species of orchid that are thought to be endemic to the upper Hunter Valley (*Prasophyllum sp. aff. petilum* and *Oligochaetochilus sp. aff. praetermissus*) have been found within grassland areas in the proposed offset area and have potential to occur in the proposed mining area. From the description in the EA, it appears as though several types of grassland community may be recognisable and that much of the grassland in the proposed impact area may be dominated by native species. More detailed categorisation of grassland areas is warranted and this should be taken into consideration when considering offsets for the project.

**Recommendations**

If approval is to be given for the project, soils from native grassland areas should be salvaged and translocated to assist with rehabilitation of other areas outside the mining area, or within revegetation areas. This will retain some of the seed bank and also improve prospects for regenerating/revegetating some areas.

## IMPACTS UPON THREATENED AND REGIONALLY SIGNIFICANT FLORA AND FAUNA

Plant Communities

The Permian sediments of the Hunter Valley floor support many vegetation communities that have either been listed as endangered or meet the criteria for listing as endangered under both State and Commonwealth legislation. Many

rare plant species and a number of plant populations identified as regionally endangered or listed under the NSW TSC Act also occur on the floor of the Hunter Valley. There are no reserves that protect vegetation similar to that occurring on the Permian sediments of the Hunter Valley floor and very few of the communities are adequately conserved in the National Parks and Nature Reserves on the surrounding steep sandstone escarpments or plateaus (p. 24 Coast and Wetlands Society Incorporated submission).

The EA concluded the following with respect to threatened flora:

> *Six threatened flora species, two endangered populations and one endangered ecological community (EEC) were recorded within the Study Area. Three threatened plants, Narrow Goodenia (Goodenia macbarronii), Pomaderris queenslandica and Cymbidium canaliculatum, were recorded in the Proposed Disturbance Area, while five were recorded in the Potential Offset Area. Two threatened flora populations and one EEC were found within the Study Area, of which none are proposed to be disturbed by the Project.*

Table 3 below provides a listing of plant communities that are mapped for the study area and indicates the status or potential status of plant communities according to the EA. It is notable that only one of these – Weeping Myall Woodland - is listed as an EEC by the TSC Act and that this will only be marginally impacted by the project. However, according to the EA, seven of the plant communities are distinctive enough and rare enough to fit DEH criteria for listing as nationally endangered plant communities (DEH 2004). Such communities include three of the eight woodland communities and all of the four native floodplain communities described in the EA.

As indicated in Table 2, even with the proposed offsets, there will be sizeable net impacts to Ironbark Woodland Complex, Bulloak Woodland, Paperbark Woodland and Forest Redgum Riparian Woodland. Of these communities, Forest Redgum Riparian Woodland contains a number of key species from, and is at least broadly comparable to, Floodplain Eucalypt Forest on Coastal Floodplains (NPWS 2004b). An analysis of the species that are contained within quadrats taken from this woodland type for the EA, compared with the list of characteristic species from the Final Determination is provided in Appendix C of this report. This shows that the quadrats contain trees, shrubs and herbaceous plants listed in the Final Determination and that overall 30% of the species listed are present in the habitat of the study area.

It is notable that the Final Determinations for floodplain forest types clearly state that they cover a wide area and so only a portion of the species need be present. The plant community occurs on a floodplain and so the habitat fits the Final Description. However, the floodplain is at the western end of the Hunter Valley (at a considerable distance from the coast) and the creek is ephemeral. Hence it doesn't precisely fit the description in the Final Determination as being from a coastal floodplain. Nevertheless, the Final Determination states that all intermediate communities are covered by the listing.

It is significant that 51 hectares of the Forest Redgum Riparian Woodland occurs within the proposed disturbance area and that none of this plant community occurs in the offset areas presented in the EA.
It is also significant that the proposed mining will impact upon seven woodland types that have potential to be listed as nationally endangered ecological communities. Some of the other plant communities described on site do have floristic and structural similarities with plant communities listed on the TSC Act and/or EBPC Act. These plant communities include:

- Slaty Box Woodland and Rough Barked Apple Woodland, which contain plant species from the White Box Grassy Woodland EEC, and
- Swamp Oak Riparian Forest, which contains some species in common with the listed Swamp Oak Floodplain EEC.

Table 3 is derived from figures presented in the EA because the EA provides area measurements for individual vegetation communities. However, it should be noted that the total area for proposed offsets in Table 5.2 and as presented in the EA (1904 ha) is not consistent with the figure (1707 ha) presented in the more recent document produced for Centennial, the Response to Submissions (Umwelt 2006b, p. 2.2). This figure of 1707 ha does not

include the additional 600 ha of land for offsets that Centennial have agreed to provide in accordance with DEC's requirements.

**Recommendations**

Plant communities that are described in the EA as being eligible for listing as nationally endangered plant communities should all be included in the compensatory habitat package. In particular, the loss of 51 ha of Forest Redgum Riparian Woodland should be specifically covered within the compensatory habitat package.

| Vegetation Community | Status or Potential DEH Status | Proposed disturbance area (ha) | Proposed Offset Areas (ha) | Difference (ha) (Offset minus Disturbance) |
|---|---|---|---|---|
| **Woodland** | | 1251 | 874 | -377.0 |
| Ironbark Woodland Complex | P | 886 | 507 | -379.0 |
| Bulloak Woodland | P | 100 | 0.4 | -99.6 |
| Paperbark Woodland | P | 19 | 3 | -16.0 |
| Drooping she-oak Woodland | | 0.8 | 1 | 0.2 |
| Red Ash Sheltered Forest | | 0 | 0.7 | 0.7 |
| Mixed spp Regeneration Replanting | | 0 | 0.8 | 0.8 |
| Slaty Box woodland | P | 245 | 282 | 37.0 |
| Sheltered Grey Gum Woodland | | 0 | 79 | 79.0 |
| **Riparian and Floodplain** | | 52 | 31 | -21.0 |
| Forest Red Gum Riparian Woodland | P; E | 51 | 0 | -51.0 |
| Exotic Rushland | | 0 | 0.2 | 0.2 |
| River Oak Riparian Forest | P | 0 | 0.6 | 0.6 |
| Rough Barked Apple Woodland | P | 0.3 | 11 | 10.7 |
| Swamp Oak Riparian Forest | P | 1 | 20 | 19.0 |
| **Shrubland** | | 0.2 | 127 | 126.8 |
| Weeping Myall Woodland | E (TSC Act) | 0.1 | 0.9 | 0.8 |
| Tall Mixed Shrubland Complex | | 0 | 52 | 52.0 |
| Coast Myall Exposed Woodland | | 0.2 | 74 | 73.8 |
| **Grassland** | | 934 | 872 | -62.0 |
| Disturbed grassland | | 934 | 872 | -62.0 |
| **Total** | | 2238 | 1904 | -334.0 |

P = potential EEC that fits the criteria to be listed under DEH criteria as a nationally listed community according to the EA; E = listed as vulnerable.

***Table 3: Status of vegetation communities versus impacts (based on figures provided in the EA)***

Plant Species

Plant species – particularly trees and shrubs – have been well surveyed for within the proposed disturbance area and within the offsets area and this has been acknowledged by the DEC submission. It is also indicated by comparing the survey effort for plants in the EA with the minimum standards recommended by DEC.

As stated above, some ground orchids may have been underestimated, including two species of orchid that are thought to be endemic to the upper Hunter Valley; *Prasophyllum sp. aff. petilum* and *Oligochaetochilus sp. aff. praetermissus* have been found within grassland areas in the proposed offset area and have potential to occur in the proposed mining area. The orchid *Diurus tricolour* has been detected and is accounted for within the impact assessment, but may be more widespread within the impact area that was previously stated in the EA as it also occurs within some grassland areas.

**Recommendations**

Further surveys are warranted for such herbaceous threatened species in future. If found, such all such species should be specifically incorporated into the compensatory habitat package. Also, experimentation should be conducted to translocate or propagate and plant such orchids within conservation and revegetation areas.

Animal Species

The Panel is satisfied that animal species – particularly vertebrates – have been well surveyed for within the proposed disturbance area and within the offsets area. This has been acknowledged by the DEC submission. It is also indicated by comparing the survey effort for fauna in the EA with the minimum standards recommended by DEC. This has allowed the potential impacts to threatened fauna to have been predicted by the EA for most species.
The impact assessment concluded that a wide variety of threatened fauna occur or potentially occur within the proposed disturbance area as indicated by the following statement:

> *Nineteen threatened fauna species were recorded within the Study Area which included two parrots, two owls, five woodland birds, two arboreal mammals, one terrestrial mammal and seven microbats. Four listed migratory bird species were also recorded. Of these, 13 species were recorded in the Proposed Disturbance Area, while 17 species occurred in the Potential Offset Area. Several threatened woodland bird species are widespread across the Study Area, while signs of the koala (Phascolarctos cinereus) were found only in the southeast of the Potential Offset Areas. Based on assessment without mitigating measures, 13 of these threatened fauna species are likely to be significantly impacted by the Project."*

Conservation groups opposing the mine allege that the potential impacts of the project upon some species are uncertain and that some populations of species such as the Squirrel Glider will be made locally extinct by the proposed mining development (Abel Ecology 2006). However, experience with revegetation of mine sites such as Mt Owen in the Hunter Valley indicates that a wide variety of fauna is capable of using regrowth and even revegetation in time. Such fauna include Squirrel Gliders, bats, owls, and small passerine birds.

The time taken for fauna to recolonise revegetation is unclear but is likely to occur only in the medium to long term as replanted woodland species mature.Traces of two threatened species of animals were found in the study area. These include the Brush-tailed Rock Wallaby, droppings of which were found in rock shelters in the study area and also the Koala, droppings of which were found in the southern offset area. Neither of these species were considered likely to make significant use of the study area by the EA.

The EA (and the proponent's response to submissions) also made the point that the habitat for such species will be conserved in any case within the proposed offset area. Feral animals, particularly foxes, are a major threat to both species and the proponent proposes to implement controls for feral animals if the project is approved. Such control measures would have potential to benefit both species.

Koalas feed on selected eucalypt species including Forest Redgum (*Eucalyptus tereticornis*). As stated above, there is to be a net loss of 51 hectares of Forest Redgum Riparian Woodland from the proposed disturbance area.

**Recommendations**

If approved, the project should entail extensive replanting of this species as a precautionary measure to ensure that potential habitat is restored within the mining area in the long term.

## IMPACTS UPON PROTECTED SPECIES

The focus for the impact assessment was upon threatened fauna species, particularly vertebrate fauna. Impacts to protected fauna or to faunal assemblages generally have been considered by the EA and detailed lists of fauna species containing the majority of species predicted for the western Hunter Valley have been provided in the EA. The relative size and diversity of habitat types present in the study area for fauna are discussed and considered and measures are put forward to mitigate impacts upon fauna in general, including purchase of land for offset habitats, purchase and/or restoration of fauna corridors and management of feral animals. Such measures are appropriate and are discussed further below in this chapter.

Terrestrial invertebrate fauna have not been considered in detail in the EA. However, the habitats of such fauna have been indirectly considered within the EA because when assessing the impacts to vegetation communities, because plant communities play such a major role in determining habitat for terrestrial invertebrates. One submission raised the issue of a land snail taxon of conservation significance within the study area and that data is lacking about the distribution and abundance of such molluscs, and the likely impacts to them if the project is approved.

**Recommendations**

If the project is approved surveys should be conducted to elucidate the distribution and abundance of native molluscan fauna of conservation significance in the impact and conservation areas. If native molluscs are detected, the pattern of occurrence should be analysed and if required, (ie if additional measures are warranted to protect molluscan habitat) then such measures should be incorporated into mitigation measures.

## IMPACTS UPON HABITATS OTHER THAN VEGETATION

The EA does consider the potential impacts of the project for habitats other than simply vegetation habitats, as it considers aquatic habitat along creeks within the study area and also habitat associated with rock outcrops on Anvil Hill itself. One of the major mitigation measures has entailed protection of Anvil Hill and its associated rock outcrop habitat.

There will be a net loss of ephemeral stream habitat within the study area as has been indicated by the EA. The mine will completely remove both Clarks Gully and Anvil Creek and come within 50 metres of the bank of Big Flat Creek. The aquatic fauna within these habitats, including fish and macroinvertebrate fauna has been considered within the EA.

There will be a net loss of ephemeral stream habitat from the study area. Such stream habitats are associated with Forest Redgum Riparian Woodland and, if the mine is approved, there should be provision made to recreate stream habitat within the rehabilitated mine landscapes.

**Recommendations**

There should be provision made to recreate stream habitat within the rehabilitated mine landscapes.

**Key Threatening Processes**

In general the EA has considered the formally listed Key Threatening Processes that are listed by the TSC Act and EPBC Act as threats to native flora and fauna. The EA deals adequately in its discussion of such threats. However, one potential threatening process requires further investigation. This is the listing of infection by the root-rot fungus *Phythophora cinnamomi*. *Phythophora cinnamomi* is believed to be an introduced fungal pathogen. It colonises the roots of all vascular plant species and can indirectly cause the deaths of plants during dry conditions because it damages root systems and impairs the abilities of plants to uptake water. In some parts of Australia, particularly southern Australia, this plant pathogen can devastate the understorey of native vegetation. It was originally believed that the pathogen was relatively benign in NSW vegetation, but studies in recent years have shown that it can severely impact upon some forest, woodland and heathland communities in NSW and Queensland. This is why it is listed both nationally and in NSW.

Some plants and plant communities are tolerant of the pathogen, including ironbarks and redgum species. However, other plant taxa are highly susceptible and the relative susceptibility of many native plant species is poorly known. *Phytophthora cinnamomi* is spread by earthmoving equipment and alterations to surface drainage, because motile (mobile) spores called zoospores are spread within soil water. If present the pathogen has potential to negatively impact upon revegetation and in a worst case scenario could prevent regeneration of some species. It could also potentially have relevance to the viability vegetation of the proposed offset area.

**Recommendations**

Sampling for this pathogen should be undertaken across a range of plant communities in the study area. If present in the study area, a risk analysis should be conducted to help assess the implications of this fungus for future revegetation and regeneration work.

## CUMULATIVE ECOLOGICAL IMPACTS

Over 520 square kilometres of the Hunter Valley floor is subject to open-cut coal mining (Connor *et al.* 2004 p. 48)) and the overall size of the valley floor spans approximately 2750 sq km. The EA fails to address the potential cumulative impacts that may arise from the combined operation of the project, together with the other approved and existing mines in the region. Land use patterns in the Hunter have left it seriously denuded of native vegetation.

The cumulative impacts of the mining industry in the Hunter give rise to changed landscapes including loss of remnant vegetation and biodiversity, over-use of Hunter River water and an increasing production of rehabilitated landscapes. Anvil Hill forms part of one of the largest remaining blocks of native vegetation on the floor of the Hunter Valley.

**Recommendations**

In order to counter the cumulative impacts of mining, the proposed mitigation and compensation measure should be implemented at the earliest possible stages of mining (to the maximum extent feasible). Measures to reinstate/create wildlife corridors that are proposed by the EA should be commenced in Year 1 of the project.

**MITIGATION MEASURES**

DEC has a general premise for dealing with ecological impacts that can be summarised as follows:

- Avoid – design a development to avoid impacts to flora and fauna whenever possible;

- Mitigate – where impacts cannot be avoided, design and implement mitigation measures to ameliorate the impacts of the proposed project or activity; and
- Compensate – where there will be a net loss of flora and fauna compensate for the impacts to biodiversity by providing offsets or some other compensatory mechanisms (such as making contributions to recovery planning of threatened species, etc).

The proposed open cut mining cannot readily avoid an impact to flora and fauna in the Anvil Hill area. This is because the most feasible method of mining is open cut and the deposits of coal underlay significant flora and fauna habitat. Similarly, although mitigation measures can be implemented, these cannot fully ameliorate the substantial impacts that will arise from open cut mining on the scale proposed at Anvil Hill. For this reason, compensation for impacts to flora and fauna is the only means by which the ecological impacts of the project can be dealt with.
The ecological management strategy presented in the EA has been designed to address potentially significant impacts to threatened flora and fauna species from the proposed mine. The identified impacts are addressed through:

- Biodiversity management of mining operations (including standard impact mitigation strategies); and
- Biodiversity offset strategy.

A detailed ecological monitoring program is proposed to track the impacts of construction and operation of the mine, as well as the efficacy of site mitigation strategies. The site mitigation strategies include:

- Implementation of a detailed tree felling procedure to minimise potential impacts on native fauna species as a result of clearing hollow-bearing trees;
- Fencing;
- Weed management;
- Feral fauna management;
- Bushfire management;
- Adaptive management;
- Aquatic habitat management; and
- Implementation of a mine revegetation plan which will include progressive revegetation works, use of species of local provenance, re-establishment of a variety of vegetation types and formations, and will provide a suitable degree of heterogeneity within the vegetation of the post-mining landscape.

The ecological monitoring strategy to monitor the success of the mitigation measures will include:

- Collection of systematic floristics data from permanent plots;
- Photo monitoring at permanent plots;
- Assessment of flora and fauna diversity and abundance;
- Assessments of habitat loss or gain;
- Assessments of incidence of weeds and feral animals;
- Assessments of the security of protected areas;
- Assessments of ongoing revegetation and regeneration of vegetation communities;
- Assessments of the resilience of ecosystems; and
- Analysis of biogeochemical functioning of the landscape.

Such measures are practical and feasible to achieve and constitute standard practice for large projects such as coal mines. The array of mitigation measures proposed is generally appropriate to help mitigate some of the impacts of mining.

**Biodiversity Offset Strategy**

In 2002 the Environmental Protection Authority (EPA) published a concept paper on offsets, providing guidelines on how offsets should function. The mine offsets are basically an example of what are referred to as "green offsets" in the EPA concept paper. According to this concept paper, a green offset scheme ensures that there is a net environmental improvement as a result of development. In order to achieve this, offsets must be:

- Enduring;
- Quantifiable (the impacts and benefits must be reliably estimated);
- Targeted (they must offset the impacts on a 'like-for-like' basis);
- Located appropriately;
- Supplementary; and
- Enforceable (through development consent conditions, licence conditions, covenants or a contract).

The applicant proposes to develop a large area of land – over 2,000 ha. Of this, 1304 ha contains treed native vegetation which supports a high level of biodiversity. According to Abel Ecology (2005) the site is at the junction of a number of bioregions and botanical divisions, and contains both flora and fauna species from east and west of the Great Dividing Range. A number of species found in this area are at the limit of their ranges. As a result of the high biodiversity of the area, the mature age of the vegetation, habitat diversity and corridor connectivity, the area has been recommended by the Hunter-Central Rivers Catchment Management Authority for immediate action to conserve through conservation agreements, wildlife refuge or as a managed trust.

As part of the Anvil Hill Project, offsets are proposed to address the net loss of vegetation and other habitats from the proposed disturbance area. Tables 5.3 to 5.5 below summarise the latest figures put forward by the Proponent (in their Response to Submissions Part B, Umwelt 2006b) for an offset package. Note that DEC has recommended that the offset package be increased by 600 ha, which the Proponent has agreed to. Consequently, the summary tables below indicate the current proposed offset including the additional 600 ha.

The offsets fall into three categories that are defined and discussed in Tables 4-6. These include in situ conservation of existing vegetation, assisted natural regeneration of existing natural vegetation and complete rehabilitation/revegetation. Of these three, the first two options are most effective at conserving biodiversity (DEH 2005). In terms of the area proposed for revegetation, there appears to be inconsistency in the figures provided in the EA (Volume 4, Section 9.5.2), the Executive Summary of the EA, and the Response to Submissions Part B (p. 2.1).

**Evaluation of Mitigation and Offset Measures**

This section critically examines the mitigation and compensatory package that has been proposed in the EA.

Methodology for Evaluation of Offsets

The proposed offsets were examined by the Panel by reviewing relevant literature about offsetting and rehabilitation, including:

- DEC (NSW) (2005) Biobanking – A Biodiversity Offsets and Banking Scheme; Conserving and restoring biodiversity in NSW, Working Paper Department of Environment and Conservation NSW, Sydney.
- DEC (2005b) Recovering Bushland on the Cumberland Plain. Best practice guidelines for the management and restoration of bushland. Department of Environment and Conservation (NSW).
- Department of Mineral Resources (1999) Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of NSW I.
- Environmental Protection Authority (2002) Green Offsets for Sustainable Development Concept Paper Environmental Protection Authority, Sydney.

Additionally, the proposed compensatory land package was compared with other offset packages for projects of a similar scale, with particular emphasis upon mines within the Hunter Valley.

## Biodiversity Values

The Panel also considered the biodiversity values that would be lost as a result of mining compared with the gains that are likely to be made as a result of offsetting. The original proposal for offsetting of various plant communities is provided in Table 3.1 and this shows that although many of the native vegetation communities that will be cleared from the impact area are present in the offset area, not all plant communities are represented. Several such as Bulloak Woodland (100ha) and Forest Redgum Riparian Woodland (51ha) are not represented within the proposed compensatory habitat areas. Under the current proposal there would be a net loss of such habitats and the biodiversity associated with them unless rehabilitation and revegetation can replicate such communities in the long term.

As explained below, current revegetation practices within the Hunter Valley and elsewhere for mining projects have not been able to reproduce or replicate all components of the original vegetation – revegetation, though useful and desirable – has not been able to restore the full complement of species.

The proposal does make provision to revegetate the majority of the impact area using local native plant species, with the intention of at least partly restoring the original vegetation. Unless such revegetation work improves upon current revegetation practices and is stringently conditioned to ensure that all strata of vegetation are covered adequately in revegetation processes, a net loss of plant species may result. Recommendations are provided in sections below to address this issue.

Native faunal assemblages that eventually recolonise revegetated areas are likely to be simplified and less diverse than the existing faunal assemblages for decades until revegetation matures. However, in the long term the proposal will create a larger area of treed habitat (including offset and vegetation areas) than occurs at present. Moreover, the proponent proposes to actively manage such vegetation, for example by controlling erosion, weeds and feral animals. If the final treed area is conserved in perpetuity and actively managed for conservation, then it is likely that the existing faunal assemblages will be retained.

## Offset Ratios

Centennial have agreed to provide 600 ha of additional land in accordance with DEC's requirements but have not provided details of the vegetation in this area due to continuing negotiations with land owners. They estimate that approximately 370 ha of the additional 600 ha offset area will comprise treed vegetation and 230 ha will comprise grasslands (Umwelt 2006b, p. 2.3). The following analysis of the proposed offset package assumes that the 600 ha forms part of the proposal.

The applicant proposes to conserve a 2307 ha area in total for offsets, including the 600 ha additional offset requested by DEC. In addition, the applicant proposes to rehabilitate a further 1947 ha including the Proposed Disturbance Area. Therefore, together with the area of offsets offered, the applicant claims that the total area to be conserved at the end of the mine life will be 4254 ha. This is a significant increase, but the end of mine life is over 20 years away and there will be a loss of approximately 2238 ha in the short term that needs to be offset appropriately. The ratio of offset to disturbance area (excluding rehabilitation) is very low (approximately 1:1, see Tables 5 and 6), considering the high ecological value of the study area.

A minimum offset ratio of at least 2:1 is a common requirement for development and considering the very high ecological value of Anvil Hill, the degree of compensation is likely to be inadequate. Offsets are usually greater than the amount removed, however this scale of offset is not being offered by the current proposal. The Environmental Defenders Office (EDO) recommends that there should be a minimum ratio of 2:1 offset ratio requirement, with a far higher ratio where threatened species or ecological communities are involved. They also recommend that offsets must not apply for critically endangered ecological communities. Other similar proposals (e.g. Mt Owen Mine) have

offered areas of offsets significantly larger than the areas to be developed as an immediate offset and ratios greater than 2:1 (excluding final mine rehabilitation are not uncommon).

| | Existing Treed Land | Cleared Land | Total |
|---|---|---|---|
| Proposed Impact Area (ha) | 1304 | 934 | 2238 |
| Proposed Offsets (ha) including DEC requirement for an additional 600 ha | 1404 | 903 | 2307 |
| Difference Between Impacts and Offsets (ha) | 100 | 31 | 69 |
| Offsets as a % of Impacts | 108 | 97 | 103 |

***Table 4 Comparison of offsets proposed at Anvil Hill excluding rehabilitation***

| Offset Ratios (Including 600 ha) | Treed Areas (ha) | Offset to Impact Area Ratio |
|---|---|---|
| Proposed Impacted Area | 1304 | |
| | | |
| Proposed Offset including DEC requirement for an additional 600 ha | 1404 | 1.07 |
| Rehabilitation | 1947 | 1.49 |
| Offset & Rehabilitation | 3351 | 2.57 |

***Table 5 Offset ratios based upon the loss of treed areas only***

| Offset Ratios (Including 600 ha) | Treed Areas and Grassland (ha) | Offset to Impact Area Ratio |
|---|---|---|
| Proposed Impacted Area | 2238 | |
| | | |
| Proposed Offset including DEC requirement for an additional 600 ha | 2307 | 1.03 |
| Rehabilitation | 1947 | 0.87 |
| Offset & Rehabilitation | 4254 | 1.90 |

***Table 6 Offset ratios based upon the loss of treed and grassland areas***

**Recommendations**

The proposed offset (excluding revegetation proposed within the disturbance area) should be increased in area to provide a ratio of 2 hectares of offset for every 1 hectare of native vegetation to be cleared for the project (native vegetation should include treed vegetation and native grassland dominated by native grasses and herbs).

Role of Rehabilitation

The Director General's requirements for the EA include "a detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape; and the measures which would be put in place for the long-term management of the site (including biodiversity offset areas) following cessation of mining operations." The requirements for impact mitigation of mine sites usually include goals such as "no net loss of biodiversity" or "maintain or improve biodiversity".

The Department of Mineral Resources have developed a plan entitled "*Synoptic Plan: Integrated Landscapes for Coal Mine Rehabilitation in the Hunter Valley of NSW, 1999*". This plan provides a basis for the development of long term integrated strategy for the rehabilitation of mines. The plan recognises that:

*Mine site rehabilitation can make a significant contribution to the establishment of new areas of forest through the linking of remnant native vegetation of mine holdings. Increased connectivity through linking remnants is anticipated to result in increases in richness and diversity of both flora and fauna. The planting of locally occurring native flora species will enhance the viability of existing isolated patches of vegetation. Movement of wildlife increases gene flow between fragmented populations, increasing the likelihood that populations will be viable. Corridors also provide native animals with shelter and protection from feral predators as they move between habitat remnants.*

DEC published a guide to the restoration of the Cumberland Plain vegetation that essentially agreed with the Department of Mineral Resources summary above. The DEC guide (DEC 2005) stated *"revegetation measures should only be considered when:*

- *The regeneration potential of a site has been wholly or severely depleted;*
- *Attempts to trigger regeneration of soil-stored seed by a range of techniques have failed; and*
- *Key missing species can not be naturally recruited to an area."*

Mine rehabilitation and management practices can contribute towards positive catchment management objectives. Coordination of the protection of remnant native vegetation, site drainage design, erosion and sediment control and water quality management offers the potential of enhancing the sustainability of remnant vegetation. For these outcomes to be successful however, a detailed and thorough revegetation strategy needs to be implemented.

Conventional mine rehabilitation strategies typically involve planting of a limited range of species, typically canopy species. These efforts have been shown to be inadequate in terms of replacing original natural ecosystems. Numerous studies have shown that while appearing to progress toward their original states, community composition can differ substantially. A long term study of the rehabilitation of forests on mine sites in Western Australia showed, despite efforts, vegetation did not develop toward the original vegetation composition or structure (Norman et al. 2006). Furthermore, it was found the native species returning following revegetation comprised a different suite of species to those in remnant habitat (Nichols 2006).

There does not appear to be any short term net environmental improvement in the offset strategy put forward by the applicant. The applicant submits that the majority of the proposed disturbance area, including the open cut mining areas and overburden emplacement areas will be progressively revegetated and regenerated to self-sustaining indigenous vegetation communities. However, restoration ecology is a new and immature branch of ecology. The underpinning science is undeveloped and subject to much uncertainty. It is very difficult and may not always be possible to recreate habitats to support viable populations.

Stringent appraisal of ecological criteria is required if restored systems are to conserve biodiversity and deliver ecosystem services to the extent mining industry ecologists believe is possible. However, the limited success and the extended rates of ecosystem restoration observed in Wilkins *et al*. (2003) supports recommendations for regulatory approaches that seek to prevent damages to ecosystems where ever possible rather than rely too heavily upon restoration.

**Recommendations**

- Revegetation work should prescribe replanting of canopy, subcanopy (if relevant), understorey and ground strata to be replanted;

- Revegetation work should focus on the re-creation of an understorey and ground stratum for each recreated vegetation community where native species dominate and where a grassy understorey is to be rehabilitated or recreated, key performance objectives should be developed to provide a target for the minimum percentage cover to be achieved prior to mine closure;

- The areas of native grassland within the proposed disturbance area should be reinvestigated and where possible "salvaged" by means of topsoil transfer. By this, it is meant that the layer of topsoil containing grassland dominated by native species should be stripped and placed on pre-prepared recipient sites to make use of the seed bank within areas to be rehabilitated or revegetated;

- Plans should be developed for replanting and all known species of threatened plant species within the proposed rehabilitation and recreation areas.

- Where information is lacking to enable replanting and revegetation with threatened species, as may be the case with orchid species for example, the proponent must fund research to develop techniques to enable such work to proceed successfully;

Connectivity

The site provides a wildlife corridor connecting the Manobalai Nature Reserve to the north and the Wollemi National Park and Goulburn River National Park to the south. DEC have recognised this area as a biodiversity corridor. The proposal will result in the removal of large amount of habitat that will in the short and medium term impact upon connectivity between tracts of habitat in the wider locality. This could impact upon a variety of fauna and also possibly upon flora, as propagules for many plants are spread by animal vectors. No detailed analysis has been made of the species that could be impacted most by such impacts upon connectivity.

To address this, the EA indicates that the applicant has committed to provide one external corridor to the north and one corridor to the west. DEC raised concern over the security of the proposed corridor areas and recommended that the applicant seek to secure two more corridors (5 and 7) as well as the ones already secured. The applicant has already acquired additional land within these corridor areas since lodgement of the DA.

It is important to note that no areas set aside for corridors currently function as ecological corridors. All of them comprise substantial areas of grassland and require revegetation and regeneration before they could function as ecological corridors. It is estimated to take between 10 and 20 years for vegetation to develop sufficiently to allow some native fauna to utilise these corridors. Consequently there will be a reduction in connectivity in the short to medium term until such vegetation can develop.

**Recommendation**

- Measures to reinstate/create wildlife corridors that are proposed by the EA should be commenced in Year 1 of the project.

Long-term Security of Offsets

The Proponent is committed to the long-term protection of offset areas and is considering the following mechanisms by which to achieve this:

- Project Approval Conditions;
- Voluntary Planning Agreement;
- Voluntary Conservation Agreement;
- Property Vegetation Plans;
- Zoning of the land – Environment Planning Instrument; and
- Covenants on the land title.

**Recommendation**

The offset area and revegetation areas should be protected by a permanent conservation zoning.

Completion Criteria

Completion Criteria identify when land has reached a condition that allow a company to relinquish responsibility for a rehabilitated site. The proponent has developed a set of conceptual completion criteria that broadly follows the principles recommended for rehabilitation completion criteria for Native Ecosystem Establishment by the Australian Centre for Minerals Extension and Research (ACMER) Nichols 2005 – Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on Coal Mines in the Hunter Valley.

The proponent states that completion criteria will be developed after the project has been approved. They are rather vague about what the criteria will constitute but they indicate that they will incorporate key elements of the ACMER recommendations including:

- Stakeholder consultation;
- Cost effective best practice;
- Principles of continuous improvement and review of criteria;
- Completion criteria for all stages of the mining operation;
- Development of completion criteria being an iterative process; and
- Target standards being used to trigger actions if not met.

The Department of Primary Industries (DPI) recommended that the proponent establish a Rehabilitation Research and Development Committee including community and academics representation and DPI within two months of obtaining project approval.

**Recommendations**

- The completion criteria should be stringent and should commit the proponent to reestablishment of all strata within the various plant communities that are to be replanted. This should extend beyond trees and shrubs to include native grasses and herbs. Completion criteria should also include demonstrable establishment of threatened plant species, and the habitat for threatened fauna species.

Monitoring and Reporting

The proponent proposes to monitor conservation and revegetation work but no plan has been formulated at present. Frequent monitoring and independent auditing is required to ensure that conservation management and revegetation work is best practice. Monitoring should be designed to ensure that flora and fauna management, and revegetation are proceeding adequately and that completion criteria are able to be met. If problems with conservation or revegetation are detected, they monitoring should trigger prompt remedial action.

There has been a high number of submissions about the flora and fauna of the Anvil Hill area and many submissions opposed the impacts of mining to flora and fauna. For this reason, monitoring reports and any provisions for remedial action for conservation should be made publicly available.

**Recommendations**

- Monitoring should be carefully designed to ensure that flora and fauna management, and revegetation are proceeding adequately and that completion criteria are able to be met.

- Monitoring reports and any provisions for remedial action for conservation should be made publicly available.

Risks

The proposed compensatory package will entail purchase and conservation of high conservation value land centred on the Limb of Addy which has been demonstrated to contain many of the flora and fauna values of the impact area. Such an area is large enough to be managed sustainably for conservation purposes and of high enough quality to warrant placing the land into permanent conservation tenure. However, this land is part of the larger block of woodland that will be impacted by the mining. The mining will essentially halve the patch in question during the mining period. The result will be that for the short and medium term, there will be a net loss of mature or semi-mature woodland habitat and less habitat available for native biota.

The proposal as it currently stands relies upon the proposed revegetation program to result in a long term increase in woodland area when the Limb of Addy parcel is considered together with the revegetation land. There is a risk that there could be a decline in biodiversity within the larger woodland patch if revegetation is unsuccessful or if the reduction in size of the overall "undisturbed" woodland area (Limb of Addy and proposed disturbance area combined) significantly reduces population sizes and viability of plants and animals in the remaining woodland areas.

Revegetation work in the Hunter Valley, and also on the Cumberland Plain in Sydney, has not been undertaken for long and some of the revegetation work has been of mixed quality. Earlier revegetation work undertaken in the 1980s and early 1990s in some sites in the Hunter Valley has produced simplified stands of trees and shrubs above a largely exotic understorey. More recent revegetation work, such as that done at Mt Owen, has produced more diverse vegetation. However, such revegetation is still under 20 years old and it is unknown what type of biodiversity can be achieved in the longer term. Clearly the lack of mature examples of revegetation on Hunter Valley mine sites constitutes a risk in that it cannot be safely assumed that revegetation will produce healthy vegetation for a wide variety of species.

Climate change constitutes another risk to woodland biota and presents a threat to the long term diversity of revegetation and native vegetation alike. Climate change could increase the aridity of the study area, increase bush fire frequency and intensity and threaten the viability of some species.

The risks associated with revegetation provide a reason for a greater degree of caution for projects such as the Anvil Hill project which will impact upon a sizeable patch of woodland habitat. Such risks are a key reason why, if the project proceeds, a greater reliance should be placed upon conservation of existing vegetation to provide offsets rather than relying to a high degree on revegetation. Notwithstanding this, revegetation can provide habitat for native flora and fauna and if the project is approved, stringent criteria should be applied to ensure that revegetation is best practice.

**Recommendations**

- The proponent should develop contingency plans for dealing with problems and failures associated with the proposed compensatory and revegetation works. Plans should include provision for watering revegetation during dry periods under extended drought conditions.

| Category of Offset | Description | Feasibility |
|---|---|---|
| | | |
| *In situ* conservation | Proponent purchase land that is already naturally vegetated and designates land for conservation in perpetuity or for a specified period. | Feasible provided that suitable naturally vegetated land is available for purchase in the correct location and in appropriate sized and shaped parcels to allow for conservation. |
| Assisted Natural Regeneration | Proponent purchase land that is already partially naturally vegetated and designates land for conservation in perpetuity or for a specified period. The proponent must provide a mechanism for assisting with the regeneration of the vegetation. This can involve direct seeding, replanting and/or protection from grazing. | This approach is feasible provided that suitable land is available, as described above for *in situ* conservation. However, in addition, the feasibility will depend upon the extent to which the vegetation has been degraded. The greater the extent of existing degradation, the more difficult assisted natural regeneration may be. |
| Rehabilitation (Revegetation) | Proponent must have land available to use for rehabilitation and must also be able to rehabilitate the landscape. This may entail recontouring, replacing or remediating soil, restoring drainage, ect. | This approach is difficult and requires extensive reseeding or replanting. The rehabilitated community is unlikely to be identical to the original community. For woodland and forest communities, many years must elapse before regeneration matures to the extent that it can function appropriately and to an equivalent level of the original community. |

**Table 7** ***Comparison of broad categories of offset for mining impacts***

# CONCLUSIONS AND RECOMMENDATIONS

## CONCLUSION

The Anvil Hill area contains flora and fauna of high ecological significance, being part of a large area of native vegetation that is one of the largest patches remaining in the upper Hunter Valley. The extensive expanses of forest, woodland, grassland habitats within the proposed mining area support a high diversity of native flora and fauna including a substantial array of flora and fauna that are listed on the TSC Act and/or the EPBC Act.

The proposal will remove 2238 ha of vegetation of which 1304 ha (58%) is forest, woodland and shrubland. Approximately 934 ha (42%) of the vegetation to be removed is grassland, that has been produced by clearing of the original native vegetation. Much of the grassland appears to be dominated by native grasses and other native herbaceous plants. It is also significant that the proposed mining will impact upon seven woodland types that, according to the EA, have potential to be listed as nationally endangered ecological communities.

At least some of the grassland areas appear to have been undervalued in the assessment by the EA. Grassland supports habitat for threatened orchid species and possibly other threatened species. Moreover, due to the dominance of native grasses and the presence of scattered trees, at least some of it would have the potential to regenerate to woodland if grazing pressure from livestock is removed.

The clearance of native vegetation for the proposal is largely unavoidable if the coal reserve is to be mined. Without compensatory offsets, the impacts resulting from the scale of clearance proposed, in the context of the extensively cleared Hunter Valley, would have a significant impact upon native flora and fauna generally, and threatened species in particular. The scale of impact needs to be recognised and, for the project to proceed, it must provide substantial offsets to compensate for the short, medium and possibly long term impacts of the proposal on biodiversity.

If the development is to be approved the following recommendations should be adopted as conditions of consent:

The scale of impact proposed at Anvil Hill needs to be recognised and, for the project to proceed, it must provide substantial offsets to compensate for the short, medium and possibly long term impacts of the proposal on biodiversity. Additionally, the conditions of consent should be directed towards ensuring high quality rehabilitation by requiring more stringent completion criteria for:

- in the diversity of native plant species and plant strata aimed for in the rehabilitation;
- in feral animal and weed control; and
- in the way in which threatened species are provided for within rehabilitation.

Conditions of consent should also be aimed at ensuring that the proponent uses best practice techniques for rehabilitation and revegetation.

## RECOMMENDATIONS

The following recommendations are made for the Anvil Hill project if it is to be approved:

- All mitigation measures and compensation measures that are currently proposed by Centennial should be adopted and implemented;
- The proposed offset (excluding revegetation proposed within the disturbance area) should be increased in area to provide a ratio of 2 hectares of offset for every 1 hectare of native vegetation to be cleared for the project (native vegetation should include treed vegetation and native grassland dominated by native grasses and herbs – see recommendation below);
- Revegetation work should prescribe replanting of canopy, subcanopy (if relevant), understorey and ground strata to be replanted;
- The offset package should contain Forest Redgum Riparian Woodland at least equivalent to that which is to be cleared within the proposed disturbance area.

- Forest Redgum (Eucalyptus tereticornis) and other koala food trees should be replanted extensively within offset area to maintain potential habitat for the Koala in the study area;
- Surveys should be conducted to elucidate the distribution of native terrestrial molluscs of conservation significance and, where relevant, habitat requirements should be provided for within the offset package;
- Revegetation work should focus on the re-creation of an understorey and ground stratum for each recreated vegetation community where native species dominate and where a grassy understorey is to be rehabilitated or recreated, key performance objectives should be developed to provide a target for the minimum percentage cover to be achieved prior to mine closure;
- More detailed examination and categorisation of grassland areas is warranted and this should be taken into consideration when considering offsets for the project;
- Conduct further surveys to elucidate the distribution and abundance of threatened herbaceous species such as terrestrial orchids across the proposed disturbance area and particularly within grassland areas;
- The areas of native grassland within the proposed disturbance area should be reinvestigated and where possible "salvaged" by means of topsoil transfer. By this, it is meant that the layer of topsoil containing grassland dominated by native species should be stripped and placed on pre-prepared recipient sites to make use of the seed bank within areas to be rehabilitated or revegetated;
- Plans should be developed for replanting and all known species of threatened plant species within the proposed rehabilitation and recreation areas.
- Where information is lacking to enable replanting and revegetation with threatened species, as may be the case with orchid species for example, the proponent must fund research to develop techniques to enable such work to proceed successfully;
- Feral goats and other species that are currently impacting the hilltop areas of the Limb of Addy (in the offset area) and Anvil Hill itself should be controlled prior to commencement of mining work. Control measures should be maintained throughout the life of the mine and beyond; and
- Soil testing should be conducted to determine whether the plant pathogen Phytophthora cinnamomi occurs in the proposed disturbance area or the proposed offset area. If the pathogen is present, a risk assessment should be made and incorporated into management plans for conservation areas and revegetation areas.

**Annex A**

**Glossary**

The following terminology and abbreviations are used in this report:

- Assisted Natural Regeneration = assisting the natural regenerative capacity of native vegetation by measures such as grazing management, manipulation of fire regime and limited replanting and reseeding;
- Compensation Package = a package of measures provided to offset the impacts of a proposed development upon flora and fauna;
- DEC = NSW Department of Environment and Conservation;
- DEH = Commonwealth Department of Environment and Heritage;
- DoP = NSW Department of Planning;
- DPI = NSW Department of Primary Industries;
- EA = Anvil Hill Project Environmental Assessment report prepared by Umwelt (2006);
- EEC = endangered ecological community listed either for the EBPB Act or the TSC Act;
- EPBC Act = Environment Protection and Biodiversity Conservation Act 1999;
- In situ conservation = conservation of flora and fauna on site
- Mitigation measures= measures that are implemented to minimise or ameliorate the impacts of a development upon flora and fauna (such as weeding, fencing, road signage to slow vehicles and avoid impacts to fauna, etc).
- Offset = an offset is part of a compensation package used to compensate for the net loss of flora and/or fauna habitat resulting from a development;
- Rehabilitation = complete reshaping and revegetation of a mined landscape;
- Revegetation = complete replanting of an altered landscape that has been denuded of its original vegetation cover, as occurs for mine site rehabilitation.
- TSC Act = Threatened Species Conservation Act 1995.

**Annex B**

Comparison of EA Vegetation Data to the Final Determination of Eucalypt Floodplain Forest

| **COMPARISON OF FOREST REDGUM RIPARIAN WOODLAND WITH RIVER FLAT EUCALYPT FOREST** | |
|---|---|
| **CHARACTERISTIC SPECIES LISTED IN THE FINAL DETERMINATION FOR RIVER FLAT EUCALYPT FOREST, AN EEC LISTED BY THE TSC ACT.** | **SPECIES THAT ARE PRESENT IN FOREST RED GUM RIPARIAN WOODLAND (FROM EA)** |
| ***Trees*** | |
| *Angophora floribunda* | Present |
| *Angophora subvelutina* | |
| *Casuarina cunninghamiana* subsp. *cunninghamiana* | |
| *Casuarina glauca* | |
| *Eucalyptus amplifolia* | |
| *Eucalyptus baueriana* | |
| *Eucalyptus benthamii* | |
| *Eucalyptus botryoides* | |
| *Eucalyptus elata* | |
| *Eucalyptus grandis* | |
| *Eucalyptus longifolia* | |
| *Eucalyptus moluccana* | |
| *Eucalyptus ovata* | |
| *Eucalyptus saligna* | Present |
| *Eucalyptus tereticornis* | |
| *Eucalyptus viminalis* | |
| *Livistona australis* | |
| *Melaleuca decora* | Present |
| *Melaleuca linariifolia* | |
| *Melaleuca styphelioides* | |
| *Melia azedarach* | |
| *Small Trees* | |
| *Acmena smithii* | |
| *Trema aspera* | |
| ***Shrubs*** | |
| *Acacia floribunda* | |

| COMPARISON OF FOREST REDGUM RIPARIAN WOODLAND WITH RIVER FLAT EUCALYPT FOREST | |
|---|---|
| **CHARACTERISTIC SPECIES LISTED IN THE FINAL DETERMINATION FOR RIVER FLAT EUCALYPT FOREST, AN EEC LISTED BY THE TSC ACT.** | **SPECIES THAT ARE PRESENT IN FOREST RED GUM RIPARIAN WOODLAND (FROM EA)** |
| *Acacia parramattensis* | |
| *Backhousia myrtifolia* | |
| *Bursaria spinosa* | Present |
| *Ozothamnus diosmifolius* | |
| *Tristaniopsis laurina* | |
| ***Herbs*** | |
| *Adiantum aethiopicum* | |
| *Austrostipa ramosissima* | |
| *Breynia oblongifolia* | |
| *Cayratia clematidea* | |
| *Centella asiatica* | |
| *Cheilanthes sieberi* subsp. *sieberi* | Present |
| *Commelina cyanea* | Present |
| *Cymbopogon refractus* | Present |
| *Dichelachne micrantha* | |
| *Dichondra repens* | Present |
| *Digitaria parviflora* | |
| *Doodia aspera* | |
| *Echinopogon caespitosus* var. *caespitosus* | Present |
| *Echinopogon ovatus* | Present |
| *Einadia hastata* | |
| *Einadia trigonos* | |
| *Entolasia marginata* | |
| *Entolasia stricta* | |
| *Eragrostis leptostachya* | Present |
| *Euchiton sphaericus* | |
| *Eustrephus latifolius* | |
| *Galium propinquum* | Present |
| *Geitonoplesium cymosum* | |
| *Geranium solanderi* | Present |
| *Glycine clandestina* | Present |

| COMPARISON OF FOREST REDGUM RIPARIAN WOODLAND WITH RIVER FLAT EUCALYPT FOREST | |
|---|---|
| **CHARACTERISTIC SPECIES LISTED IN THE FINAL DETERMINATION FOR RIVER FLAT EUCALYPT FOREST, AN EEC LISTED BY THE TSC ACT.** | **SPECIES THAT ARE PRESENT IN FOREST RED GUM RIPARIAN WOODLAND (FROM EA)** |
| *Glycine microphylla* | |
| *Glycine tabacina* | Present |
| *Hardenbergia violacea* | Present |
| *Hydrocotyle peduncularis* | |
| *Hymenanthera dentata* | |
| *Hypolepis muelleri* | |
| *Imperata cylindrica* var. *major* | Present |
| *Lomandra filiformis* | Present |
| *Lomandra longifolia* | Present |
| *Lomandra multiflora* subsp. *multiflora* | Present |
| *Microlaena stipoides* var. *stipoides* | Present |
| *Opercularia diphylla* | Present |
| *Oplismenus aemulus* | |
| *Oxalis perennans* | |
| *Paspalidium distans* | |
| *Persicaria decipiens* | |
| *Phyllanthus gunnii* | |
| *Plectranthus parviflorus* | |
| *Poranthera microphylla* | |
| *Pratia purpurascens* | |
| *Pteridium esculentum* | |
| *Sigesbeckia orientalis* subsp. *orientalis* | |
| *Solanum prinophyllum* | |
| *Themeda australis* | Present |
| *Vernonia cinerea* | Present |
| *Veronica plebeia* | Present |
| *Viola hederacea* | Present |
| *Wahlenbergia gracilis* | |
| ***Climbers*** | |
| *Clematis aristata* | |
| *Clematis glycinoides* | |

| **COMPARISON OF FOREST REDGUM RIPARIAN WOODLAND WITH RIVER FLAT EUCALYPT FOREST** | |
|---|---|
| **CHARACTERISTIC SPECIES LISTED IN THE FINAL DETERMINATION FOR RIVER FLAT EUCALYPT FOREST, AN EEC LISTED BY THE TSC ACT.** | **SPECIES THAT ARE PRESENT IN FOREST RED GUM RIPARIAN WOODLAND (FROM EA)** |
| *Desmodium varians* | Present |
| *Pandorea pandorana* | |
| *Rubus parvifolius* | |
| *Stephania japonica* var. *discolor* | |
| **TOTAL SPECIES** | **27 SPECIES PRESENT** |