Chapter 7

REHABILITATION

by A.J.M. Hopkins[A] and N. Caporn[B]

[A]Department of Conservation and Land Management, Western Australian Wildlife Research Centre,
P.O. Box 51, Wanneroo, W.A. 6065
[B]Department of Conservation and Land Management, Environmental Protection Branch,
P.O. Box 104, Como, W.A. 6152

Abstract

Information contained in the ERMP is insufficient for assessment of the likely success of rehabilitation after mining and de-commissioning of the power station. The proponents have not detailed their rehabilitation program; instead they propose to produce a management plan prior to commencement of mining. Many of the general statements that are made in the ERMP and inconsistencies between formal commitments and stated rehabilitation objectives suggest a very superficial understanding of the complexities involved in rehabilitation. The proponents suggest that experiences gained in the Lesueur area and at Eneabba provide the basis for successful reconstruction / reclamation programs. However, this work has not yet been shown to be successful; furthermore there are significant differences between the types of disturbance at those sites and that proposed for Lesueur in the ERMP. It is concluded that reconstruction or reclamation is not achievable within a human life-time, but that revegetation with a limited range of native plant species may be.

7.1 INTRODUCTION

Having drawn attention in previous chapters to the extent to which present natural ecosystems might be destroyed, or at least seriously disturbed, by the proposed mine and power station, it is pertinent to consider the likely success of any rehabilitation program.

Allen (1988) has defined the various levels of post-mining land treatment thus:

- Reconstruction (which includes restoration) involves creation of ecosystems that are identical to those that were present prior to the disturbance.
- Reclamation involves establishing ecosystems that are similar, but not necessarily identical in terms of species composition, to the pre-disturbance ecosystems.
- Rehabilitation means that the land is made useful but that it usually has a purpose that differs from the pre-disturbance one and it is invariably composed of different species.

In Australia, the term rehabilitation is loosely used as a synonym of reconstruction and reclamation.

7.2 ASSESSMENT OF THE ERMP

In its guidelines for the preparation of the Environmental Review and Management Programme the Environmental Protection Authority (EPA) stated "It is important that sufficient information is contained in the ERMP to allow an assessment of the likely success of rehabilitation and other management proposals" (ERMP Attachment 1, p. 7). The proponents have not seriously addressed this requirement; instead they have sought to defer debate on this important issue by proposing to produce a rehabilitation management plan at some future date prior to the commencement of mining.

A little over six pages in the ERMP has been devoted to discussion of general issues associated with rehabilitation of the mined areas, overburden dumps, ash disposal areas, the evaporation pond, sedimentation ponds, the power station site, roads and other areas to be disturbed. It is a matter of concern to CALM that the statements in the ERMP indicate a very superficial understanding of the issues involved. The proponents have had the opportunity to research the topic and to conduct rehabilitation trials over the past few years; indeed it can be argued that a more pro-active approach to rehabilitation would have been prudent given the long acknowledged nature conservation values of the area proposed to be mined.

7.3 REHABILITATION OBJECTIVES AND COMMITMENTS

Commitments made by the proponents of the Hill River Project to rehabilitation are not consistent with the stated rehabilitation objectives as outlined in the ERMP. In the case of this project, the early statements in the ERMP suggest that reconstruction or at least reclamation will be undertaken, whereas the commitments are only to rehabilitation *sensu* Allen (1988). In simple terms, this is really the only option, since the proposed mining activities will lead to such a massive change in landform and substrate conditions that reconstruction and reclamation will not be achievable within a human time span (see also Hobbs and Hopkins 1990).

The stated preferred end land-use of the mine/power station area involves a return to native vegetation with a view to maximising conservation values (ERMP Section 5.2.5). Another long-term objective is to rehabilitate the full range of vegetation units disturbed during mining (and presumably by associated developments) (ERMP Section 6.8.2). However, these objectives are the subject of ongoing review and the details of how they might be achieved are not provided in the ERMP. The document merely commits the proponents to, amongst other things:

- preparation of a detailed rehabilitation management plan prior to mining (ERMP Section 6.8.2),
- conducting rehabilitation trials (ERMP Section 6.8.2), and
- progressive rehabilitation to local native species: (ERMP Section 10.16).

The proponents have not clearly identified an end land-use or rehabilitation objectives for the mined-out pits which will be left at the conclusion of the project. These pits will be very extensive, have steep batters at or approaching the angle of repose and will contain saline and most likely acidic waters (ERMP Section 5.13.1). The concept of leaving such large areas open is not consistent with the stated end land use for the project area as outlined in the ERMP.

7.4 POTENTIAL TO ACHIEVE REHABILITATION OBJECTIVES

The proponents suggest that the experiences already gained in the Lesueur area and at Eneabba provide the basis for successful reconstruction / reclamation programs. Work in the Hill River Project area to date is very limited and mainly involves revegetating drill pads. These are areas that have been scraped and compacted by vehicles. As a disturbance, this fits within the description of "utilization" as defined by Hobbs and Hopkins (1990): there is no major change in the chemical or nutritional states of the substrate, nor is there a major loss of the biotic component of the ecosystem. In contrast, mining involves complete removal of vegetation and soil and complete disruption of ecosystem processes and is categorised as "removal". Thus, the value of the experiences gained in the Lesueur area is very limited.

Mining for heavy mineral sands at Eneabba is more analogous to the proposed coal mining, although there are still major differences. It is, however, worthwhile to look at the Eneabba experience for insight into what might be undertaken within the project area at Lesueur.

Mining at Eneabba occurs on alluvial and colluvial deposits immediately to the west of the Gingin escarpment. The sands and clays are excavated in an open cut mining operation, the heavy minerals are removed in a wet, gravity separation process and the tailings are returned to the pits as a wet slurry that is left to dry and is then revegetated. Prior to mining, the native vegetation is harvested as brush. Topsoil is removed in a two-cut operation, sometimes stockpiled for short periods, and then relaid on dried tailings as the first part of the rehabilitation procedure. Areas are seeded with native plant species and sparse cereal crops for short-term stabilization and then covered with harvested brush. Small amounts of fertilizer (around 100 Kg/ha) are added and seedlings of selected species are planted out.

Results of the rehabilitation are assessed by the Mineral Sands Rehabilitation Co-ordinating Committee (MSRCC). The Committee has established a set of quantitative criteria to provide a framework for this assessment. Criteria relate to:

- **Species richness:**

  Numbers of species of native plants per unit area. Data on species are recorded in individual quadrats and in large rehabilitated blocks.

- **Plant density:**

  Numbers of individual plants (native species only) recorded in quadrats.

- **Canopy cover:**

  Cover of native plants, not including short-lived species.

Taken together it is believed that the criteria will provide useful insight into the long-term viability of the reconstructed plant communities. The data used to set the values for the criteria were derived from studies of the pristine native vegetation in the area. Values set for rehabilitation are between 40 and 50% of those recorded for pristine vegetation.

Full scale mining commenced in 1976. So far the company mining at Eneabba has not approached the

MSRCC with a view to having areas assessed as completely rehabilitated. It is believed that some of the recently treated areas approach the rehabilitation criteria values, but most of the areas treated before about 1986 will require ongoing treatment. Many species, particularly those in the Cyperaceae, Restionaceae, Orchidaceae, Epacridaceae and Rutaceae have failed to regenerate at all in mining-affected areas at Eneabba (K. Dixon[1] personal communication).

From the rehabilitation perspective, mining for coal in the Lesueur area will pose much greater problems than the sand mining at Eneabba. Two aspects are important:

1. Within the Lesueur area, the post-mining substrates (overburden dumps) will be quite different from the present environments. The area proposed to be mined includes a wide range of sedimentary rock types; these have been faulted, weathered and eroded to produce a complex mosaic of substrates which support the rich flora and vegetation for which the area is renowned (Griffin and Hopkins 1990; Griffin *et al.* 1990). The mining process will lead to a significant re-ordering of the geological sequence with fresh rock being brought to the surface. Overburden dumps will also be much less compacted than present substrates. Reconstruction after mining of the complex soil profiles and soil mosaics will be extremely difficult if not impossible.

   In contrast, it is possible to recreate a soil profile that is physically and chemically (but not biologically) similar to the pre-mined profile in the process of disposal of tailings after mineral sands mining at Eneabba. Hydraulic back-filling allows for blending of sand and clay fractions in a predetermined fashion and ensures that the sediments compact to a degree approaching that achieved under natural deposition.

2. The overburden is likely to be toxic to plant growth. Oxidation of minerals, particularly pyrite, in sediments following exposure through excavation generally causes major pH changes in the resultant soils. For example pH values of 2.5 to 3 are not uncommon in overburden dumps at Collie (Koch 1984). Release of heavy metals can also inhibit plant growth on tailings. Finally, activation of salts (NaCl and soluble Aluminium salts) in sediments of marine origin may cause problems for rehabilitation.

   Some of these problems may be addressed by special amendment programs such as liming and deep burial to ensure that the toxic materials are maintained under anaerobic conditions. Whether these techniques will be sufficient to permit successful establishment of local native plant species in the project area can only be conjectured at this stage.

   In contrast, tailings at Eneabba are relatively benign.

It is instructive to review progress in rehabilitation of coal mine overburden elsewhere in Australia. Hannon (1984) provides a general summary but notes that, at least up to 1983, there was limited experience in returning native vegetation. Some work has been done in recent years at Collie but detailed results are not available. Studies by Koch, Fox and others (e.g. Koch 1984; Koch and Bell 1985; Fox *et al.* 1985, 1987) have addressed some local problems particularly growth of native plant species in chemically hostile substrates. As a generalization, few native species establish naturally while a limited number will establish if planted in soils which have been treated to raise their pH and nutrient status.

Koch (1984) has also summarised the range of problems that arise in rehabilitation programs as a consequence of changes to physical and chemical properties of coal mine substrates. However, it is not possible at this stage to predict how these relate to the Lesueur situation: data provided in the ERMP are inadequate for assessment and the rehabilitation program has yet to be designed in detail.

A major problem for rehabilitation after mining that is only now coming to light at Eneabba is that associated with infection by species of *Phytophthora*. Hill (1990) discusses the potential of these fungi to seriously degrade native plant communities in the Lesueur area. Likewise, if *Phytophthora* becomes established in areas to be rehabilitated, it will seriously impede efforts to re-establish native plant species and vegetation communities.

Other issues which have not been adequately addressed or which are not consistent with the proponents rehabilitation objectives relate to the re-introduction of rare species and the rehabilitation of the mined out pits on decommissioning of the project. The proponents intend to re-introduce rare plants onto rehabilitated dumps (ERMP 5.12.3). However, the long-term success of such an operation in a synthetic community is extremely doubtful because so many other ecosystem components will be missing. Rare species by their very nature generally occupy specific and unusual niches in the environment. The potential for long-term survival of such species in an unrestored ecosystem is doubtful.

1 Dr K.W. Dixon, Kings Park and Botanic Garden, West Perth.

Similarly, the proponents claims that rehabilitated areas are likely to survive better than undisturbed bushland is unsubstantiated (ERMP 6.8.1).

The proponents themselves have identified that ecosystem restoration will be difficult by stating that rehabilitation will be "near natural" (ERMP Section 5.13). "Near natural" state is a dubious description for an ecological measure for rehabilitation. Further, the use of "near natural" as a measure of rehabilitation success is questionable given that the project impinges on a proposed conservation reserve, especially one that has been clearly documented to have high conservation, landscape and recreational values (Burbidge *et al.* 1990)

7.5 CONCLUSIONS

The proponents have not produced a compelling case to justify access to the conservation reserve proposed for the Lesueur area on the basis of their ability to return the area's nature conservation values after mining. Available information suggests that it will not be possible to reconstruct or reclaim the ecosystems presently represented in the area. Revegetation of overburden with a very limited range of native plant species (i.e. rehabilitation *sensu* Allen 1988) is achievable, although even this will be difficult because of changes to the substrates' physical and chemical properties.