SADDLEBACK TIMBER RESERVE

BAUXITE PIT REHABILITATION

1995 APPENDED PRESCRIPTION

This is the annual Appended Prescription to the document "Bauxite Pit Rehabilitation (Saddleback Timber Reserve) - Agreed Arrangements between Worsley Alumina Pty Ltd and the Department of Conservation and Land Management".

April 1995

TABLE OF CONTENTS

1. INTRODUCTION

A total of 66.6 ha of mined land in Saddleback Timber Reserve and 17.7 ha of private land are scheduled for rehabilitation by Worsley Alumina in 1995. The location of these areas are illustrated on the "Proposed 1995 Rehabilitation" plan (1:40 000).

2. REVEGETATION TREATMENT

2.1 SITE DESCRIPTION PRIOR TO CLEARING

PIT NAME SADDLEBACK RESERVE	AREA (ha)	PRE-MINING VEGETATION (APPROXIMATE PROPORTIONS)	AVERAGE OVERBURDEN DEPTH (m)	AVERAGE ORE DEPTH (m)
East 1	1.6	19JLc 100%	0.8	6.9
North 9	25.4	19JBg 40%, 19JLc 60%	0.4	8.2
North 10	19.4	19JBg 75%, 19JSd 25%	0.4	4.9
North -East 1	0.5	19JLc 100%	1.6	8.0
North-East 5	3.7	19JLc 100%	0.3	2.6
South-East 2	7.5	19JLc 100%	0.5	4.1
West 1	2.6	19JLc 100%	0.4	10.0
West 5	5.9	19JLc 100%	0.3	5.7

PRIVATE LAND	AREA (ha)			
Fawcett	13.4	19JLc 100%	0.7	4.7
North-East 2	4.3	19JLc 100%	1.2	2.4

2.2 REVEGETATION

Plant species selection criteria, tree densities, seeding rates, fertiliser treatments and establishment success assessment will be based on the "General Prescription - Saddleback Timber Reserve".

Prior to mining, three jarrah vegetation community types covered the area scheduled for rehabilitation in 1995 and these areas will receive the same general revegetation treatment.

The base understorey species mix listed in the General Prescription will be augmented with a large number of Saddleback Timber Reserve species to promote understorey species diversity.

TREE ESTABLISHMENT BY HAND PLANTING

Tree establishment of approximately 64 of the 84ha of mined land scheduled for rehabilitation is to be undertaken by using the conventional tree-planting method. The tree species, percentage of rehabilitated area and percentage planting frequency for each of the three jarrah vegetation community types to be established in 1995 is summarised below:

VEGETATION TYPE	% OF REHABILITATED AREA	% PLANTING FREQUENCY		
		E. MARGINATA	*E. CALOPHYLLA*	*A. FRASERIANA*
JSd	10	63	23	14
JBg	50	73	10	17
JLc	40	60	10	30

TREE ESTABLISHMENT BY DIRECT SEEDING

Approximately 20ha of rehabilitation is scheduled for tree establishment by direct seeding. Seeding rates will be designed to establish approximately 600 stems/ha for the total area and reflect the vegetation characteristics of the three jarrah vegetation communities by adjusting the proportions of seed from each tree species applied accordingly.

The provisional seeding rates for each of the three jarrah vegetation communities is listed below. These rates may change subject to seed viability testing.

Vegetation Type	Species	Seeding Rate g/ha	No of Trees Planned/ha at 9 months
JSd	*E. marginata*	142	380
	E. calophylla	38	140
	A. fraseriana	2.1	80
			TOTAL 600
JBg	*E. marginata*	169	450
	E. calophylla	14	50
	A. fraseriana	2.6	100
			TOTAL 600
JLc	*E. marginata*	135	360
	E. calophylla	16	60
	A. fraseriana	4.6	180
			TOTAL 600

These seeding rates are based on the monitoring results from the 1993 North 7 Direct Seeding Trial and the 1994 North 10, 3 ha Direct Seeding Trial.

BAUXITE PIT REHABILITATION
SADDLEBACK TIMBER RESERVE

AGREED ARRANGEMENTS BETWEEN

WORSLEY ALUMINA PTY LTD

AND

THE DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

April 1995

TABLE OF CONTENTS

1. PREAMBLE

The aim of this document is to outline the mechanisms by which the Department of Conservation and Land Management (CALM) and Worsley Alumina will provide for progressive mine-pit rehabilitation in Timber Reserve areas (as defined in Section 6(2) of the Conservation and Land Management Act 1984), of the Worsley Alumina Principal Mineralised Area (ie Saddleback, Quindanning and Marradong forest blocks).

To achieve this aim, the document sets out the responsibilities of each party and develops a set of policies, objectives, strategies and review mechanisms for rehabilitation planning. These provide a framework from which a rehabilitation prescription will be prepared annually. The framework ensures that full advantage can be taken of the resources and experiences of both organisations and that the prescription is responsive to new information from trials, research and operational experience. It is also anticipated that the regular process of review built into the mechanism will identify aspects of rehabilitation requiring trial and experimentation.

2. RESPONSIBILITIES

Under the provisions of the Conservation and Land Management Act 1984 (as amended), CALM is charged with the responsibility for management of State Forest and Timber Reserves. In fulfilling this responsibility, CALM ensures that forest resources are managed to give the maximum long-term social and economic benefit. To this end, CALM's Central Forest Region Management Plan promotes the principle of multiple use on State Forest and Timber Reserves. The details of multiple use zones needs to be further defined but based on historical priority use, zoning, recreation, scientific study, water protection and timber production are considered the most likely priority uses for Saddleback Forest Block. Rehabilitation following bauxite mining will have the objective of maximising the long-term potential of the forest for these priority uses. Rehabilitation prescriptions for forest blocks such as Quindanning and Marradong will be amended as appropriate to land use, when these areas come within a five year mining plan.

Worsley Alumina is bound by the provisions of the Alumina Refinery (Worsley) Agreement (1973-1982) (the Worsley Agreement) and the approved ERMP (October 1979). With specific reference to rehabilitation, the following obligations and undertakings are important:

(i) Clause 16)8) of the Worsley Agreement states:

"As may reasonably be required by the Executive Director, the Joint Venturers shall from time to time and at their expense take adequate measures -

(i) for the progressive restoration and re-afforestation of the forest destroyed;

(ii) for the prevention of soil erosion;

(iii) for the prevention of the formation of deep water pools and other dangers to persons who may use the forest areas.

PROVIDED THAT the Joint Venturers shall not be obliged to restore to its original contour land on which forest has been destroyed.".

(ii) Clause 16(10) of the Worsley Agreement states:

"The Joint Venturers after consultation with the Executive Director of CALM will prepare and submit to the State not later than two years after 31st October, 1978, a plan in reasonable detail of their proposed mining operations upon areas of State

forest and Crown land during the succeeding ten years and such plan after like consultation shall be reviewed and resubmitted thereafter at yearly intervals".

(iii) The approved ERMP contains undertakings in several technical areas:

- surface water control;
- disease management;
- topsoil/overburden handling;
- pit-floor ripping;
- revegetation;
- fertilising;
- maintenance of rehabilitation;
- rehabilitation research (including the Trial Rehabilitation Exercise (TRE-1).

(iv) The approved ERMP also contains a commitment to carry-out biological studies, which have been and will be designed to provide data directly applicable to rehabilitation planning.

3. POLICIES AND OBJECTIVES

3.1 LAND USE PLANS IN THE PRINCIPAL MINERALISED AREA

There is a small area within Saddleback Block set aside for scientific study. This area encompasses an hydrology research area designed to study the hydrologic impact of mining and rehabilitation. Worsley Alumina has made a specific commitment to support this study in terms of liaison with the appropriate authorities regarding the timing of mining operations in the research area.

Other uses for the area include conservation of flora and fauna and protection of forest values.

Current recreational use of the area is minimal and only broad scale planning has been undertaken to develop its potential. This is outlined in the Northern Region Forest Recreation Framework Plan (Forests Department, 1982). In this plan, the area falls within the Monadnock Management Unit (grouped with other monadnocks in the eastern forest). Since these areas are best suited to non-motorised, low-intensity recreational activities, the following management strategies are relevant:

(i) where practical, avoid road construction within the immediate vicinity of monadnocks to discourage vehicle use and to minimise problems of erosion and disease;

(ii) facilitate access by foot by providing facilities at the base of hills; and

(iii) provide written guides to flora, fauna and landscape characteristics.

In the above mentioned Recreation Plan, it is proposed that a long-term development plan be written for the Saddleback Block. This plan can form the basis for developing recreation guidelines for rehabilitation prescriptions.

3.2 REHABILITATION OBJECTIVES

The broad objective is to regenerate a stable forest ecosystem planned to maintain recreation, conservation and other nominated forest values.

Specific goals are:

- **Recreation** - where practicable, to provide or maintain recreational values in accordance with approved CALM plans.
- **Conservation** - to regenerate, in the long term, floral and faunal characteristics compatible with the Eastern Jarrah Forest.
- **Landscape** - to create a rehabilitated landscape compatible with the general landform and physiography.
- **Hydrology** - to restore the hydrological balance through the establishment of deep-rooted vegetation in rehabilitated areas.
- **Protection** - to minimise impacts on non-mined areas, to conserve the residual soils, to minimise dieback spread, and ensure that unacceptable fire hazards do not accumulate.

In seeking to meet these goals, the desired end result is a multiple-use forest in which rehabilitated and undisturbed stands are integrated to the maximum practical extent.

4. STRATEGIES AND PLANNING

4.1 REHABILITATION OBJECTIVES

The following measures will be adopted to achieve the objectives:

- the development of prescriptions for rehabilitation procedures for each mined area, in accordance with the designated land use priority and land use management plans;
- the conduct of trial and monitoring programmes into means of improving rehabilitation procedures;
- the monitoring of regenerated areas for their capacity to sustain long-term production of the forest values listed in the objectives; and
- the development of remedial treatments should monitoring reveal that rehabilitation objectives are not being fulfilled.

4.2 REHABILITATION PLANNING

Rehabilitation planning occurs at two levels; the first is broad-scale regional minesite planning on a 10-year time scale. The second is the detailed operational annual planning on a pit-by-pit basis.

For broad-scale regional planning, Worsley Alumina consults with CALM to produce an annually-updated 10-year Mining Plan for submission to the State. In the preparation of these plans, the following aspects of rehabilitation are considered:

- the sequence of mining and rehabilitation;
- access for mining and future management;
- location of mine facilities;

- dieback hygiene;
- water management systems and water-course protection;
- land use priorities; and
- buffer zones for fire protection.

On a broad scale, CALM will advise on perceived recreational values, so that Worsley Alumina may take these values into account in developing rehabilitation proposals.

In terms of recreation, the draft proposal will address:

- impacts on natural and cultural (ie man-made) landscape attractions and recreational features - large rock outcrops, prominent view points, historical sites, and existing recreation development which are considered important to the existing or potential recreational use of the area;
- types of vegetation to be cleared for mining: this information will also be used in selecting species mixes for re-seeding following mining, in selecting treatments to provide faunal habitats, and in determining stocking rates and selecting vegetation structures and types for particular areas of rehabilitation;
- assessment of the mining envelope and environs in terms of its existing significance for recreation at a regional and local level. The assessment will identify the opportunities which exist for recreation activities taking into account both the likely demand for such activities and the capability of the area to service those demands;
- proposed action to re-establish or enhance recreational potential;
- post-mining access requirements for recreational use of the area, for incorporation into planning and decommissioning of the mien road network;
- the scheduling of mining and rehabilitation in areas of high visibility, so that visual impacts are minimised to the extent that is practicable.

4.3 PRESCRIPTION DEVELOPMENT

Detailed operational planning will consist of two steps.

Firstly, after completion of each year's rehabilitation plantings, an updated generalised prescription for the next year's rehabilitation works will be jointly prepared. This will specify rehabilitation works common to all pits and identify where options to vary particular rehabilitation treatments exist. It will address:

- preparation of pits for planting, including landscaping, topsoil/overburden management, treatment of "islands" of unmined ore and ripping;
- water management options;
- planting - species selection and layout, fertiliser application rates and success evaluation.

Secondly, Worsley Alumina will prepare a detailed rehabilitation proposal for each pit based on the generalised prescription. This will include:

- pit identity and location;
- detailed drawings;
- particular options for rehabilitation chosen to suit particular locations;
- any proposed deviations from the general prescription.

Each proposal will be jointly assessed prior to submission seeking formal affirmation from the Executive Director. Departures from the agreed plan may sometimes be necessary, but will only take place after consultation and endorsement by both organisations.

4.4 DOCUMENTATION

Worsley Alumina will assume responsibility for the progressive graphic and descriptive documentation of rehabilitation efforts. The Department of CALM will advise of its particular requirements for its internal recording; where practical, these requirements will be incorporated into the documentation programme.

5. REVIEW MECHANISMS

The annual reviews of rehabilitation, foreshadowed in Section 4.3, together with regular liaison between Worsley Alumina and CALM, will demonstrate the results of continuing trials and monitoring. Findings for inclusion in operational practice will then be incorporated into planning and into the agreed prescription of operations. Priorities for experimentation will also be evaluated, and work programmes developed as appropriate.

6. PRESCRIPTIONS

6.1 GENERAL PRESCRIPTION - SADDLEBACK TIMBER RESERVE

This prescription is considered to be a dynamic document which will evolve as more information from research into the biological and hydrological nature of the area becomes available, as future recreational planning progresses, and when the results of on-going trail rehabilitation treatments identify change requirements. The development of new or improved rehabilitation implements may also affect the methods employed to achieve the rehabilitation objective.

The following general prescription will be supplemented annually with specific and detailed pit-by-pit plans which will take into account the unique nature of each site to be rehabilitated.

6.1.1 PREPARATION OF AREAS FOR REHABILITATION

As part of the mining operation, and after ore removal, rehabilitation earthworks will be carried-out in the following sequence:

- The pit floor will normally be deep ripped on contour to a depth of 1.5 m at 1 m intervals. However, localised areas such as borrow pits may be programmed for heath development where this is compatible with local landforms and vegetation, and consequently might not be ripped.

- Pit sides will be battered down and the entire area landscaped to enhance aesthetic and recreational land use values. Where bauxite mineralisation necessitates the clearing of narrow forest strips, which in turn may result in apparent long straight batter runs following mining of deep ore horizons, the slopes of the landscaped batters will be varied along strike to soften the visual impact of the final rehabilitation surface. Large boulders derived from deep ripping, or residual from the mining operation, may either be buried or utilised for fauna habitats.

- Where required, pit drainage and water management structures will be designed to promote retention and infiltration, and to prevent prolonged surface or sub-surface ponding. This may be achieved by:

(i) infiltration and silt trapping in the contoured rip lines; and

(ii) collection of overland flow either in a series of mid-slope contour banks and a pit bottom sump, or by a system of grade discharge banks directing flows to predetermined sump areas within the pit. Criteria for designing these drainage structures include:

- each sump will have the capacity to cope with the run-off from a 10-day 15-year storm event (170 mm, derived by Worsley Alumina from Marradong rainfall data, Station 009575, 1907-1980) as calculated from meteorological records and mine-pit characteristics;
- contour interceptor banks, where constructed, will be established at vertical intervals of up to 10 m. Such banks will not exceed 1 m in height or have steep sides which present an obstacle to future access;
- where used, contour interception banks will be provided with suitable constructed overflows and non-erodable spillways - construction of these devices will be completed before the first autumn rains;
- grade discharge banks, where used, will comprise stabilised waterways which direct water to detention sumps within the pit - sump and drain locations will be indicated on the rehabilitation plans;
- if the design of banks conflicts with landscape considerations, alternative systems of drainage may be examined.

- Overburden will be replaced.
- Topsoil, including forest litter and trash remaining after clearing, will be re-spread and the entire area lightly scarified on contour.
- Where pits exceed 5 hectares, temporary internal access tracks will be provided for the revegetation programme, on-going biological monitoring and general forest management operations.
- Hollow logs, rocks, gravel and vegetation debris may be collected to construct artificial fauna habitats that will help to expedite the recolonisation of fauna into mine-pit rehabilitation areas.

6.1.2 REVEGETATION

Vegetation Community Types

Tree and understorey species mixes will be applied to produce vegetation communities which are consistent with the post-mining landscape and with adjacent remnant vegetation, and which reflect the pre-mining vegetation communities. As Worsley's bauxite mining operations typically involve the clearing of mid-slope "jarrah community" vegetation, this will be the predominant revegetation community type. However, areas which are low in the post-mining profile, and which are potentially water-gaining, may be revegetated with "wandoo community" species.

Heath community vegetation may be returned to localised areas (eg borrow pits) which have not been ripped during rehabilitation earthworks, where this is consistent with adjacent community types. In addition, small areas (up to 0.25 ha) of heath community vegetation may be included within large (>5 ha) pit areas. These will add to the structural and floristic diversity, and help promote the recolonisation of rehabilitated mine-pit areas by fauna.

TREE SEEDLING ESTABLISHMENT BY TREE PLANTING

(i) **Planting Layout and Design**

- Generally, tree species are to be established as mixtures, but pure stands may be planted in localised portions of the landscape.

- Plant spacing will be varied to reduce uniform tree densities in rehabilitated pits, and increase the structural diversity of revegetated areas. In certain situations, such as prominent view points and along selected roads, some areas may be left unplanted.

- Initial average stocking of upper tree layer species (ie *Eucalyptus marginata, E. calophylla, E. wandoo, Allocasuarina fraseriana*) of 500 trees/hectare for "jarrah community" areas, 500 trees/hectare for "wandoo community" areas, and 100 trees/hectare for "heath community" areas. Additional numbers of second storey species (eg *Eucalyptus drummondii, Melaleuca preissiana, Persoonia longifolia*) may also be planted.

- Planting will preferably commence when the soil is wet to a depth exceeding 1 m, but no later than mid-June. Planting will be completed by 1 August.

(ii) **Species Selection**

- In every mixture, species indigenous to the Saddleback area will be included. Species mixes will be determined in advance and confirmed in the agreed Annual Rehabilitation Plan with the Department of Conservation and Land Management.

- Seedling specifications: plants in jiffy-pots or paper-pots, approximately 12 cm in height with a minimum of 2 pairs of leaves; pots and soil mix sterile.

- In addition to seedlings planted, "jarrah community mix" rehabilitated pits will be sown with *E. marginata, E. calophylla and A. fraseriana* at a rate of 1 000 viable seeds per hectare; "wandoo community mix" rehabilitated pits will be sown with *E. wandoo* and *E. calophylla* and *E. patens* at a rate of 1 000 viable seeds per hectare.

(iii) **Fertiliser Application**

- Each tree seedling will receive one (1) 200 g Di-ammonium Phosphate fertiliser tablet at planting. The tablets will be speared in below the soil surface up-slope and between 200 mm and 300 mm from each seedling.

(iv) **Success Criteria**

- 80% survival of planted species, at 9 months after planting, as determined by a systematic sample.

TREE SEEDLING ESTABLISHMENT BY DIRECT SEEDING

(i) **Seeding Rates and Design**

- Seed will be broadcasted at a rate which produces on average, 600 trees/hectare for the minesite revegetation of that year nine (9) months after seeding.

- For each mine-pit area seed will be broadcast at a rate that aims to establish a minimum of 400 trees per hectare and a maximum of 1 000 trees per hectare nine (9) months after seeding.

- Tree species seed mixes will be applied to the post-mining rehabilitated surface to produce vegetation communities that reflect the pre-mining vegetation characteristics of that area.

(ii) **Success Criteria**

- Establishment of 600 stems per hectare for the revegetated area of that year at nine (9) months after seeding as determined by systematic sampling.
- Establishment of 400 stems per hectare in a mine-pit area, at nine (9) months after seeding as determined by systematic sampling.

UNDERSTOREY ESTABLISHMENT

(i) **Species Selection and Establishment**

- Species for understorey and groundcover seeding will be selected from those known to be "indicator" or "associated" species of the vegetation communities representative of the type of community being re-established (Worsley Alumina Pty Ltd, 1985), from experience gained on the Trial Rehabilitation Exercise One (TRE-1) site, and to facilitate erosion control and soil nutrition-building. Detailed provenance data will be recorded for all seed/seedlings used in rehabilitation.

- The base species for the seeding mix will include the major Saddleback Timber Reserve legume species, together with species identified as having high "relative importance values" in the majority of plant community types represented within the area (Worsley Alumina Pty Ltd, 1985). The base mix will comprise about 75% of the total understorey seed mix and will generally include the following species:

Acacia alata
A. drummondii
A. pulchella
Bossiaea ornata
Daviesia decurrens
D. rhombifolia
Dryandra nivea
Hakea lissocarpha
Kennedia coccinea
K. prostrata
Macrozamia riedlei
Xanthorrhoea preissii.

- In order to promote species diversity, a large number of minor Saddleback Timber Reserve species will generally make up the balance of seed in the base mix, including other nitrogen fixing species (eg *Allocasuarina spp).* Importantly, plants which are "indicator" or "associated" species for particular sites, eg heathland, etc, may be selected in advance and confirmed in the agreed annual rehabilitation plan with CALM.

- Mixed seed will be sown at the rate of 1.0 kg/hectare.

(ii) **Fertiliser Application**

- All areas will be broadcast with Superphosphate No1 at a rate of 450 kg/hectare.

(iii) **Success Criteria**

- One native plant established per square metre, nine (9) months after sowing, as determined by a sample quadrat survey of each pit.